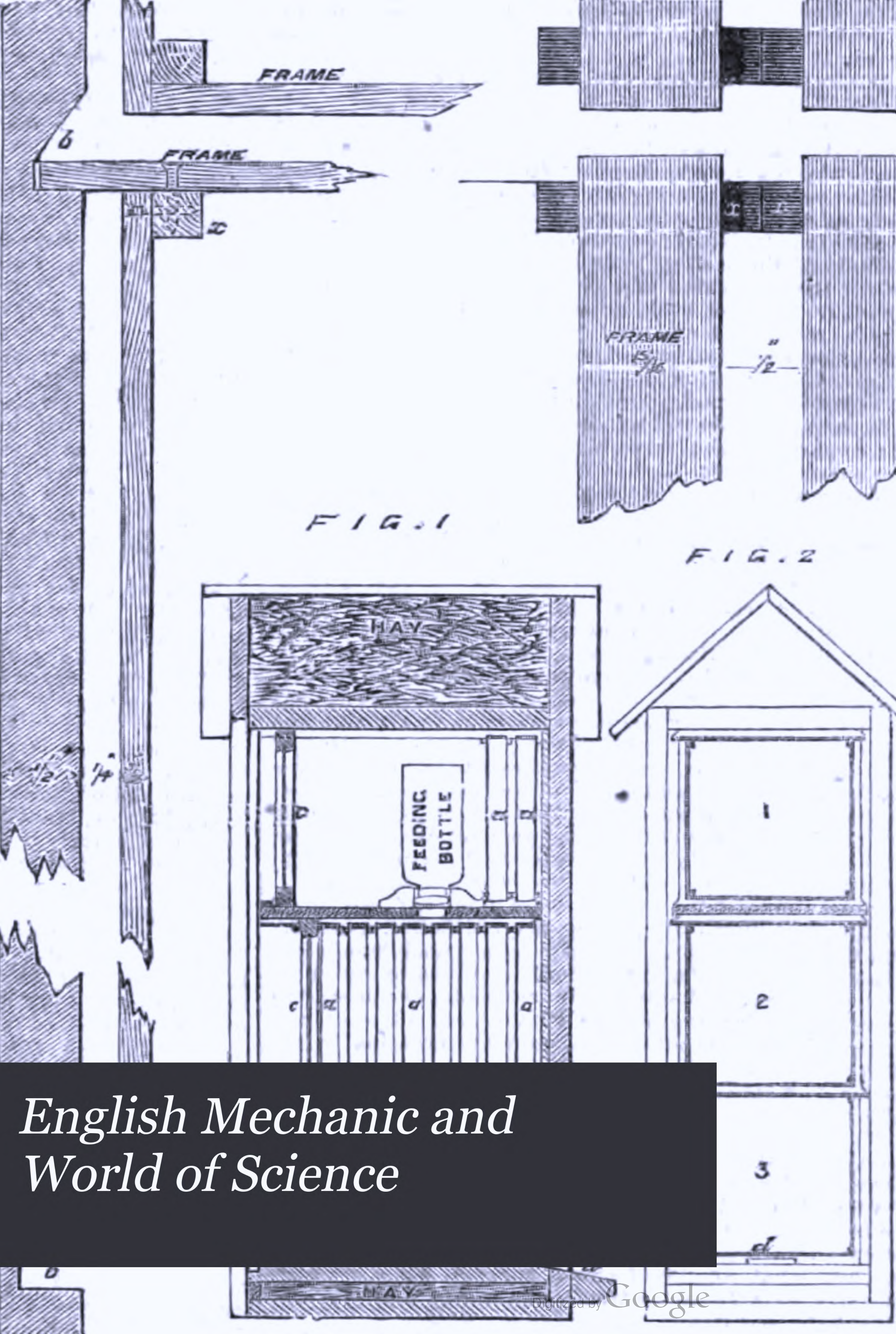

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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

ARTICLES.

THE PRESERVATION AND DESICCATION OF WOOD.

THE preservation of timber is a subject that has occupied the attention of scientific inquirers for years, and notwithstanding that iron has supplanted it for many purposes, wood is still used to an extent which makes its duration a consideration not to be lightly passed over. On p. 324 of our last volume we gave an account of the results of some experiments tried with various antiseptic preparations on green oak, by Herr Muller, from which it appeared that the best method of preserving wood from the effects of moisture is to force into it two mineral antiseptic salts, which mutually decompose each other in the pores of the wood, and by coagulating the albumen, and excluding the water, prevent decay. The two salts found to give the best results were phosphate of soda and chloride of barium, in solutions of which the timber was steeped; but a combination of soda, soap, and sulphate of copper is probably equally efficient, and this latter process is to be preferred for timber likely to be subjected to the attacks of worms, which under certain circumstances necessitate the exercise of as much precaution as the decay known by the generic name of rot. The best known processes, however, are those which employ creosote, corrosive sublimate (Kyanising), chloride of zinc, and sulphate of copper, all of which have been used with fair success. Kyan's process, patented in 1832 and 1836, was highly thought of at the time of its introduction, but it is now seldom used. Payne's method consisted in first forcing a solution of sulphate of iron into the wood, and subsequently introducing carbonate of soda, an insoluble substance being thus formed in the cellular structure of the wood, the process when properly and effectually carried out having yielded satisfactory results. Chloride of zinc has been used in several of the Government dockyards in preserving wood for the interior fittings of vessels, which are frequently liable to the attacks of insects. But probably the most successful process hitherto adopted is that known as creosoting, in which the wood is completely impregnated with oil of tar, the bituminous portion of which enters the capillary tubes of the material, closing the pores and preventing the access of air and moisture, while the albumen is coagulated and the attacks of worms and insects generally warded off by the noxious properties of the creosote. But even this method fails to preserve timber from the ravages of the *Limnoria terebrans* for any length of time, as piles under water, such as those of jetties, have been found to be eaten through after about four years, although thoroughly creosoted, the preserving process appearing to be effective only so long as the external coating of the oil endured. The process, as patented by Mr. Bethell, consists in drying the wood in a chamber through which the smoke and the products of combustion of the fuel, which also heats the oil, are passed; the wood while still warm is then immersed in a bath of heated creosote, or placed in strong wrought-iron cylinders, and the preserving fluid forced into it at a high pressure. With soft woods, such as pine, but little difficulty is experienced in thoroughly impregnating the timber, but with oak and other woods a pressure of 170lb. or 180lb. on the square inch is not sufficient to creosote more than the outer inch or so.

One of the simplest methods of preserving wood is that introduced by M. Boucherie, which has been found effectual with elm, poplar, alder, beech, birch, and other porous-grained timber when newly felled. He employs a solution of sulphate of copper (1 to 100 of water), and a water-tight cap being fitted on one end of the log to be preserved and connected by a tube with the tank containing the solution, which is elevated about 40ft. from the ground, the sap runs out at one end as the preserving fluid enters at the other, the weight of the liquid in the tank furnishing the very moderate pressure required by this system.

Some interesting particulars of the various plans hitherto adopted for the desiccation of wood, have been recently published by M. Payen in the *Annales de Conservatoire*. From these we find that the methods heretofore employed in the desiccation of wood may be referred to one of the following classes:—1. Coatings applied to the surface of wood in order to prevent the access of air and moisture. 2. Simple immersion in an antiseptic fluid. 3. Vital suction or filtration, of which the Boucherie process mentioned above is the type. 4. Injection of antiseptic fluids, in a closed vessel, by alternation of vacuum and pressure. 5. Artificial desiccation, followed by injection in closed vessels.

The presence of water and air in wood is one of the principal causes of the fermentation of its organic matter, and of its consequent alteration and destruction. These changes often remove an appreciable part of organic matter containing combustible carbon and hydrogen, while the hygroscopic water contained in the wood, in its volatilisation absorbs a part of the heat developed in combustion, thus diminishing its calorific powers.

To give a precise notion of the utility of the desiccation of wood fuel, it is necessary to compare the quantity of useful heat obtained from dried and from green wood. This comparison is easily made by taking for standard the mean elementary composition of some wood, say oak, and the equivalent of carbon given under the two conditions. 100 parts of dry oak contain 50 of carbon, 6·20 of hydrogen, and 43·80 of oxygen. To the calorific power of the carbon (50) should be added, the equivalent representing the excess of hydrogen (somewhat variable in different kinds of wood) above the quantity necessary to unite with the oxygen so as to form water. In oak, this excess is 0·630; equivalent to at least 1·89 of carbon. 100 parts of dry oak are, therefore, equivalent to $50 + 1{\cdot}89 = 51{\cdot}89$ of pure carbon.

But in order to determine the quantity of useful heat, it is proper to deduct that which, in the process of combustion, transforms into vapour the hydrogen and oxygen. This water of composition is fifty-hundredths of the total weight, absorbing in transformation into vapour at the temperature of combustion a quantity of heat equivalent to 5 of carbon, which is to be deducted from 51·89; giving a remainder of 46·89 of useful carbon, which represents the calorific power of 100 parts of dry oak.

Now suppose that moist oak contains 45 per cent. of water: As 100 parts of desiccated wood represent 46·89 of carbon, 55 would give 25·79 of carbon; from which is to be deducted 4·50 used in vaporising the 45 parts of water; giving 21·29. It follows that 225 parts of green wood must be burned to give as much useful heat as 100 of dry. But besides this loss, it happens that in certain cases, as in the melting of glass and of zinc, it is impossible to attain the desired end by the use of green wood. Hence, desiccation, almost always useful, becomes an absolute necessity in the manufacture of glass and in metallurgy where wood is the fuel employed.

In the injection of wood under pressure the elimination of the water of moisture permits the antiseptic liquid to take its place. Hence the more or less complete expulsion of the water would be useful in various ways, and would fulfil one of the conditions most favourable to its conservation.

There are two methods of desiccation: the natural, by long exposure to air, under cover; and the artificial, by means of stoves or ovens. The natural process is insufficient for preservation; for however great the pains and long the exposure, there always remains a residuum of water, amounting to from 10 to 20 per cent., sufficient to cause fermentation, to invite insects, and to favour cryptogamic growths. This sort of drying is suited only to wood for carpentry or furniture; being sufficient to prevent change of dimensions or warping when removed from the action of humidity. The artificial process secures a more complete preservation, since it drives from the wood all the contained moisture; this condition cannot be maintained against the influence of the atmosphere, except by some coating impervious to moisture. On the other hand, the preparation of the wood, or its injection with antiseptic fluids in closed vessels cannot be successful unless the wood has been sufficiently dried, so as to allow the withdrawal of the air from the tissues. When moist wood is subjected to this process, the liquids cannot escape; and of course their place cannot be taken by antiseptic fluids.

Experience has shown that injection in closed vessels is practicable only with woods sufficiently dried, and this explains the invention of so many apparatus for desiccation. It is only within a few years that this preliminary desiccation has become successful; a success mainly due to the apparatus described further on.

Attempts to desiccate wood have been frequently made. Wollaston and Fourcroy recommended the process; and Newmann employed steam for the purpose. Placing the wood in a large wooden box, he admitted steam from a boiler and drew off the condensed vapour charged with albumen and sap. The progress was tested by the colour of the liquid drawn off; when this became colourless the wood was taken out. This method would have given favourable results if superheated steam had been employed so as thoroughly to permeate the wood; but the expense would have been too great. In 1837 M. de Mecquenem invented a process which consisted in subjecting the wood to a current of heated air in a closed vessel; the current being impelled by a blower. The air entered at the bottom and escaped at the top. In 1839 M. Carpentier patented an invention in which he made use of a hermetically closed chamber, in which the wood was exposed to the action of air heated by passing over metallic plates, and introduced through four longitudinal tubes disposed upon the floor of the furnace, from which it was discharged into the heating chamber. The vapours and the moist air escaped by four longitudinal pipes placed in the upper part of the furnace and communicating with the chimney.

In 1848—1853 Bethell, who gave much attention to the preservation of wood and vegetable substances, took out a number of patents in England and France. One of these consisted of a rectangular brick chamber, with hollow walls filled with cinders to prevent radiation; the arched roof being constructed in the same way. One end was left free to admit a carriage on rails, and a double iron door closed this entrance when the chamber was filled. At the other end was a furnace provided with a grate for the burning of coke, oil, wood, or tar, according to the end in view, whether simple desiccation, or *smoking;* that is, impregnating with antiseptic gases proceeding from the incomplete combustion of tarry substances. The products of combustion passed through a central flue at the bottom, which divided near the entrance; the branches carried the smoke to the bottom of the chamber, from which it passed over the wood. The smoke, gases, and moisture escaped at one end by a pipe at the top, and at the other by a sort of ventilating chimney. The temperature was about 210° Fahr., and the time varied from eight to twelve hours. This rapidity was obtained at considerable expense of fuel; for the rapid movement of the heated gases did not permit the complete utilisation of their caloric, and it is doubtful whether large pieces of wood, as railway ties, can be thoroughly desiccated in so short a time. This, indeed, was shown by numerous experiments made at London in 1853 by the "Desiccating Company." The wood was placed in a close chamber of a capacity of about 1,300 cubic yards. The air was heated in Taylor's apparatus, as in the metallurgy of iron, and was driven over the wood by a ventilator; but slowly, and in such quantity that the atmosphere of the chamber was entirely changed in three or four minutes. Nearly twenty-four bushels of coal were consumed in twenty-four hours. It was found that an average of fifteen days was required for complete desiccation at a temperature of from 113° to 140°. This low temperature and protracted time seem to be better for woods that are to be used in carpentry, cabinet work, and the like.

The furnace of M. Guibert, of Tourlaville, invented in 1861, was in essential points similar to that of Bethell, patented in England in 1848. Reuther's invention (1860) was intended for the desiccation of ties and their injection with creosote. The products of combustion are introduced by means of canals at the bottom of either side of the chamber. These are covered with iron plates which heat the air within the chamber. At the extremities near the door are two vertical pipes which enter the hollow space in the walls and the vault. A chimney surmounts the vault at either end. Before the wood is put in, the two orifices at the end of the canals are opened so that the smoke and heated gas may enter the chamber and raise its temperature. At the beginning of the operation, one chimney is closed so that the products of combustion may pass directly to the other chimney by the vertical pipes. When the vault is warm enough, the second chimney, that near the entrance, is closed. The time of desiccation is twenty-four hours, the temperature being gradually raised to 210°.

In all the apparatus described, the gas, smoke, and heat are introduced at the bottom, while the discharge is from the top. This disposition is defective, because the heated air rises directly to the top of the chamber, and escapes without having had time to become saturated with the moisture of the wood.

Peclet in his treatise on "Heat" noticed this defect, and recommended a reversal of the direction of the heated currents. He states that in 1822 M. Ternaux effected this in a vermicelli desiccator at Saint Ouen, and that the operation was much more rapid. He says: "We thus find a condition of great importance; that the issue of vapours should always be effected at the bottom of the drying-chamber. This prevents stagnation, and is at the same time very favourable to the saturation of the heated air; for hot air moves rapidly while rising in a denser medium, but moves slowly and distributes itself uniformly when it circulates downward."

Peclet proposed the following process for drying wood and peat: Two parallel galleries with a furnace at the bottom of each, and horizontal pipes under the bottom, through which the smoke is to pass uniformly and in succession, so as to distribute the heat as uniformly as possible. Each gallery is to be closed at both ends by double doors, and is to be provided with rails for iron waggons, upon which the wood is to be piled so as nearly to fill the chamber. The smoke of the two furnaces passes into a common chimney of large section, having a draught-regulator at its top. The adjacent walls of the galleries form a closed space; in the middle of this is a chimney which communicates below with each of the galleries by means of orifices provided with registers. On each side of the chimney, at the bottom, are the furnaces. This process was applied some years ago at Graffenstaden. The apparatus was of trapezoidal form; there were six chambers heated by seven furnaces, disposed in two sections separated by a passage. The vapours escaped by lateral orifices at the bottom, opening into the chimney. Each furnace was connected with a horizontal brick chamber, hermetically closed at the end, which divided and returned upon itself to open into a vertical chimney near the furnace. The desiccation lasted night and day for from ten to twenty days. Experience fixed the temperature for oak at 100° and for pine at 120°. The action of this apparatus is very slow, and, therefore, not fitted for the desiccation of railroad ties.

In 1851 M. Imbert took out a patent for an oven for drying wood intended as fuel in metal or glass works. The chamber was long, and its bottom was covered with metallic plates forming three longitudinal tubes, which terminated at one end in the chimney of a small furnace set several yards below, in a vault. The carriages entered at one end and were removed at the other, near which the products from the fire entered by orifices in the plates. The gases escaped by an orifice in the lower part of the oven. When the wood on the carriage nearest the discharging door was dry enough, it was shoved out by another introduced at the entrance. The temperature was lower nearer the entrance, so that the wood advanced in a contrary direction to that of the motion of the gases, and passed into successively higher temperatures.

This device of making the wood advance in a direction contrary to the motion of the heated gas was afterwards recommended by Lechatelier in 1853. He proposed for the desiccation of ties which were to be injected, an apparatus like the kiln employed in annealing glass. The wood was to be put in a long gallery, on waggons, and to be slowly moved in a direction contrary to that of the heated gas, towards the maximum point of temperature, the introduction and removal being effected as in the last case.

In 1863 Mr. Blythe, an English manufacturer who was engaged at Bordeaux and Landes in the injection of wood with sulphate of copper, invented the apparatus which has now come into most general use. This is a double oven, composed of two rectangular chambers about 10½ft. wide, 8ft. high, and 10½ft. long. The outer and partition walls are of brick, resting on a foundation of masonry. Two brick vaults roof the chamber. The side and partition walls are hollow, the space being 3in. wide, and extending the entire length and height of the wall. These hollow spaces communicate with the lower part of the chambers by small openings, and with small chimneys at the top. At either end of each chamber is a double gate of iron. In each chamber, at a little distance from the side walls, are set two walls of masonry for the rails. Between and below these walls is a long arched passage, communicating with a furnace. The furnaces are covered by a fire-brick vault, which projects over the fire-grate far enough into the chamber to cover the flame. Along the whole length of the walls of the passage just described, and inside the rails, run two small flues or passages; and between these is another flue, so connected with the furnaces as to form a separate passage for each, so as to prevent the mixture of the products of combustion.

The action of the apparatus is as follows:—Four waggons of wood are introduced, and the doors shut. The products of combustion enter the passages from the furnaces; thence they enter through orifices into the two flues just inside the rails. The heated gases now rise and and pass through the wood, taking up the water that has been converted into vapour. In doing this they cool, and then pass along the walls, which are colder than the middle of the chambers. Arriving at the bottom, they escape by orifices regularly distributed in the hollow wall, and pass out by the chimneys. By this method a constant and uniform circulation is secured, and the temperature is sensibly uniform.

The great advantage of this system is that the process can be completed within twenty-four hours after the tree is felled, and even water-logged timber can be subjected to it and effectually dried.

THE ECONOMICAL USE OF STEAM.

AT the recent meeting of the Manchester Steam-Users' Association, Sir William Fairbairn made some observations concerning the most economical pressure at which it is desirable to employ steam. The subject is one of increasing importance, if not exactly in view of the exhaustion of our coal supplies, at least as an attempt to meet the largely enhanced cost of fuel which is likely to arise. It is a matter of fact that by raising the working pressure from 10lb. or 15lb. to 50lb. a saving of one half the fuel required is effected, while an equal amount of work is accomplished; and assuming that the same law holds good for pressures up to even 1,000lb. it is a subject worthy the earnest consideration of steam-users at what pressure it is safe to work boilers in order to obtain the greatest economy in fuel. From the experiments which Sir W. Fairbairn has made for some years past on the density, force, and temperature of steam, he is convinced that if a large economy in fuel is ever to be attained it must be by employing greatly increased pressure, and a more largely augmented rate of expansion than what is usual at present. The results of his experiments have convinced him that dry steam isolated from water at a high pressure gives double the work at the same expenditure of fuel—an opinion which is indorsed by the most eminent writers on the subject. Regarding the construction of boilers capable of withstanding high pressures as a matter completely under control, and having arrived by actual practice, at a knowledge that steam at 50lb. or 70lb. per square inch can be governed as easily as that at 15, he asks why pressures of 150lb. and 200lb. should not be tried on the presumption that the saving of fuel would be in proportion and follow the same law in the ratio of the increase of pressure—*i.e.*, a more complete utilisation of the heat, and consequently a greater amount of work at the same expenditure of fuel. All attempts to effect changes of this description are, of course, limited by the amount of strength it is found possible to impart to the boiler, and by the conditions essential to the safety of its working. On this, the most important part of the question, however, he has no misgivings, for from experiments he has been making recently, he is convinced that the steam-user would be as safe, if not safer, in working at 150lb. as he is at present with 50lb. per square inch. Sir William did not explain the principle on which these boilers are to be constructed, but mentioned that he had one of 80 horse-power at work, which had been tested by hydraulic pressure to 400lb. on the square inch, this being the limit to which the pumps and gauges employed were capable of working. He is convinced that it would have withstood double that pressure (*i.e.*, 800lb.) if the testing apparatus had been equal to the task. A suitable engine is also undergoing a series of trials, and while all parties are satisfied with the boiler, he hopes that the same may before long be said of the engine. Sir William was very naturally reticent as to the construction of his experimental apparatus, but the introduction of the matter before the Association is an earnest that full particulars will shortly be given. The engineer of the Association points out that no higher charge is made for boilers working at 100lb. than for those at as low as 10lb. per square inch, provided they are constructed in a manner suitable to the higher pressure. Locomotives are worked at from 120lb. to 200lb. on the square inch, and we see no reason why similar pressures should not become the fashion in stationary boilers; for, as Sir William said, "there are no secrets in boiler explosions; they are entirely owing either to neglect on the part of the engineer or on the part of his employer."

LESSONS ON CHEMISTRY.*

BY SELIMO R. BOTTONE.

(*Late of the Istituto Bellino, Novara, Italy.*)

(*Continued from p. 597, Vol. XIV.*)

SECTION 6B. — COMPOUNDS OF OXYGEN WITH CHLORINE.

98.—OXYGEN combines with chlorine in five[1] different proportions, but of the resulting compounds only *three* are known in the free state.

1 Many chemists admit only *three* of these as being definite compounds; but they are not agreed as to which of the five are to come under this designation. While Miller, Roscoe, and most English chemists hold the bodies marked A, B, and C to be the true oxides of chlorine, Millon, and others who have devoted much study to the subject, incline to the belief that A, B, and E are the only ones worthy of that name, and that the others are either mixtures of chlorine gas with one or other of these oxides, or else compounds of these oxides with each other. A brief notice of these doubtfully-constituted bodies will be found at the end of this section (6B).

A. CHLORINE MONOXIDE.[2]—*Synonym: Hypochlorous anhydride. Symbol:* $Cl_2'O''$. *Molecular weight:* 87.

99. PROPERTIES.—At ordinary temperatures this body exists as a pale reddish yellow gas[3] of the specific gravity of 3·01. Its odour is very powerful, resembling that of chlorine. It dissolves freely in water, furnishing a solution of yellow colour, which possesses powerful bleaching properties. At a temperature of about 0° Fahr., chlorine monoxide becomes liquid. In the fluid state it is of a red colour, and is heavier than water. Thrown into water, liquid chlorine monoxide sinks to the bottom, and then, provided there be sufficient water, dissolves. When once reduced to the liquid form chlorine monoxide does not boil, or even appear to volatilise, until the temperature reaches 70° Fahr. It is, however, a very dangerous body to handle, as it sometimes explodes spontaneously even when surrounded with a freezing mixture. The solution of chlorine monoxide in water bleaches with much greater power than the solution of chlorine. We can easily understand the reason of this greater energy when we call to mind that chlorine bleaches by virtue of its power of seizing the hydrogen contained in the water, and liberating its oxygen; for the quantity of oxygen liberated by the chlorine monoxide solution is exactly double that liberated by an equal amount of chlorine solution. This is illustrated by the following equations:—

For Chlorine $\qquad Cl_2' + H_2'O'' = Cl_2'H_2' + O''$

For Chlorine Monoxide $\qquad Cl_2'O'' + H_2'O'' = Cl_2'H_2' + O_2''$

The oxygen thus liberated, being in the *nascent state*,[4] rapidly enters into combination with the elements of the colouring matter, producing thereby colourless compounds.

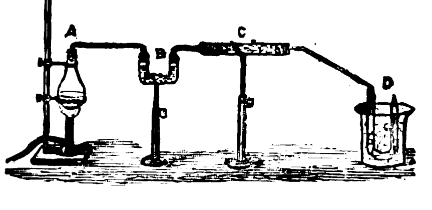
100.—As we shall return to the subject of chlorine monoxide when dealing of the correct application of the word "acid," we would impress on the reader's mind *that the solution of chlorine monoxide in water is yellow.*

101.—PREPARATION.—By passing *dry* chlorine over mercury oxide, when part of the chlorine combines with the mercury to form mercury chloride, and part with the oxygen to form chlorine monoxide. The following equation exemplifies the changes which take place:—

$$Hg''O'' + Cl_4' = Hg''Cl_2' + Cl_2'O''.$$

Fig. 9 represents the apparatus required. A is the flask for generating chlorine, B tube containing calcium chloride, which absorbs[5] any moisture the gas may carry with it; C tube containing mercury oxide, D tube in which the

FIG. 9



chlorine monoxide may be condensed by a freezing mixture.

A (2). HYPOCHLOROUS ACID.—*Synonym: Hydrogen Hypochlorite.*[6] *Symbol:* $H'A'O''$. *Molecular and combining weight:* 52·5.

102.—PROPERTIES. — Hypochlorous acid is a colourless fluid, of a very peculiar smell and powerful bleaching properties. It combines with metals to form a class of bodies called *hypochlorites.* It appears to be formed from chlorine monoxide by the union of one molecule of water with one of chlorine monoxide (hence called hypochlorous anhydride, or hypochlorous acid without water.) By this union a substitution takes place, and two molecules of hypochlorous acid result. The following graphic equation will facilitate comprehension:—

1 Molecule of Chlorine Monoxide. $\quad$ 1 Molecule of Water. $\quad$ 2 Molecules of Hypochlorous Acid.

$$\left.\begin{array}{l}Cl'\\Cl'\end{array}\right\rangle O'' + \left.\begin{array}{l}H'\\H'\end{array}\right\rangle O'' = \overbrace{\left.\begin{array}{l}Cl'\\H'\end{array}\right\rangle O'' + \left.\begin{array}{l}Cl'\\H'\end{array}\right\rangle O''}$$

When hypochlorous acid acts on metallic bodies, the hydrogen contained in the molecule is expelled, and the metal takes its place thus:—

$$M' + H'Cl'O'' = M'Cl'O'' + H.$$

(See paragraph 53.) Acted on by metallic oxides, water is formed, while the metal unites with the oxide of chlorine, thus:—

$$M_2'O'' + 2H'Cl'O'' = 2M'Cl'O'' + H_2'O''.$$

The resulting compound in either case is a hypochlorite of the metal employed. This property of acting on metallic oxides, with the production of water, is common to all acids.[7]

103.—PREPARATION. — When chlorine gas is passed through a cold solution of soda ($Na'H'O''$), a mixture of sodium hypochlorite, along with sodium chloride, is formed, as may be seen below:

$$2Na'H'O'' + Cl_2' = Na'Cl'O'' + Na'Cl' + H_2'O''.$$

If, instead of soda, we use slaked lime ($Ca''H_2'O_2''$), a similar interchange takes place, and we obtain a calcium hypochlorite in mixture with a calcium chloride, thus:—

$$2Ca''H_2'O_2'' + 2Cl_2' = Ca''Cl_2'O_2'' + Ca''Cl_2' + 2H_2'O''.$$

By acting on either of these substances with dilute nitric, or acetic acid, the hypochlorous acid is liberated, and may be obtained by distillation; while the calcium chloride (or sodium chloride, as the case may be) is left unchanged. The following equation elucidates this:—

$$Ca''Cl_2'O_2'', Ca''Cl_2' + 2H'N'''O_3'' = Ca''2N'''O_3'' + Ca''Cl_2 + H_2'Cl_2'O_2''.$$

104.—The hypochlorites are much used in the arts as bleaching and disinfectant agents; the ones most in use are the impure calcium, sodium, and potassium hypochlorites. The first is known commercially under the names of *bleaching powder*, or *chloride of lime;* the second is known as *bleaching liquor*, or *chloride of soda;* and the last goes by the name of *Eau de Javelle.* The use of the hypochlorites of magnesium, aluminium, and zinc, as bleaching agents, has also been proposed. Chloride of lime, for the use of the arts, is prepared on a large scale by the following process:—A chamber, built of lead or Yorkshire flagstone, and containing a number of perforated shelves, is provided. Into this, on the shelves, are placed thin layers of well-slaked lime. Chlorine[8] is then introduced, which, acting on the lime, produces the compound in question. The richness of the resulting substance in hypochlorite depends—(1) on the goodness of the lime; (2) on the amount of water it has absorbed during the slaking; and (3) on not allowing the chlorine to enter the chamber too rapidly, as in this latter case heat is generated, and a new compound, possessing no bleaching properties, is formed. The quantity of chlorine absorbed, even under the most favourable circumstances, always falls short of that indicated by theory. When acted on by hydrochloric acid, hypochlorous acid is resolved into water and chlorine, as the following equation illustrates:—

$$\left.\begin{array}{l}Cl'\\H'\end{array}\right\rangle O'' + H'Cl' = \left.\begin{array}{l}H'\\H'\end{array}\right\rangle O'' + Cl'Cl'.$$

All acids which are sufficiently powerful to set free hydrochloric acid from calcium chloride, produce this effect when added to bleaching powder.

105.—We have seen (paragraph 87) that manganese binoxide facilitates the production of oxygen from potassium chlorate without undergoing any *apparent* change; a somewhat similar effect is produced when the oxide of copper, or of cobalt, is heated with the solution of a hypochlorite. No change is visible in the oxide used, but the oxygen of the hypochlorite is gradually eliminated, and a metallic chloride is formed, thus:—

$$M'Cl'O'' = M'Cl' + O''.$$

"This decomposition depends on the fact, that higher oxides of the metal are at first formed; but these decompose under the influence of heat, and give off oxygen, regenerating the lower oxide, which again attacks another portion of hypochlorite, and thus the process becomes continuous. It is not improbable that the action of manganese binoxide, in facilitating the evolution of oxygen from potassium chlorate, may depend upon a similar action."[9] It is also probable that the effect noticed above (of copper sulphate on air and hydrochloric acid) is due to the same cause. Owing to the above reaction, oxygen may be easily prepared from a hypochlorite.

106.—By attentive examination of the mode in which hypochlorous acid comports itself with regard to metals and metallic oxides, we are led to the conclusion that the rational graphic formula of this body is

$$\begin{array}{l}Cl'\\ \updownarrow\\ O''\leftrightarrow H'\end{array}$$

Here we see that the bivalency of the oxygen enables it to hold the two atoms (each monovalent) of hydrogen and chlorine, and this gives also the key to the interchanges which may be effected by substituting a metal for the hydrogen. Not only can the hydrogen be replaced by another monovalent body, but the chlorine also is capable of being replaced in like manner. Hence, as we have seen (104), by acting on this body with hydrochloric acid, we actually bring about this substitution. It is worthy of remark, that both monoxide of chlorine and hypochlorous anhydride may be conveniently referred to the type, *water.*

Water. Chlorine Monoxide. Hypochlorous Acid.

$$\left.\begin{array}{l}H'\\H'\end{array}\right\rangle O'' \qquad \left.\begin{array}{l}Cl'\\Cl'\end{array}\right\rangle O'' \qquad \left.\begin{array}{l}H'\\Cl'\end{array}\right\rangle O''$$

But water itself may be referred to the type *oxygen*, for the oxygen molecule is built up of two bivalent atoms of oxygen,[10]

Oxygen. $\qquad$ Water.

$$O'' \rightleftarrows O'' \qquad \left.\begin{array}{l}H'\\H'\end{array}\right\rangle O''$$

while in water two monovalent atoms of hydrogen replace one bivalent atom of oxygen.

[2] Owing to the different views held by various chemists as to the molecular constitution of bodies, and the relations which these hold to one another, our chemical nomenclature is in a state of transition and fearful disorder. Hardly two chemists agree as to the most appropriate name for any compound. Hence, at the London University Matriculation Examinations, the name given to the compounds and expected to be used by the candidates varies with each examiner, and at nearly every examination. It would only confuse the reader were we to put in the text *all* the names by which any substance may be designated; but in footnote will be found most of the received names. All theoretical considerations regarding the adaptability, propriety, and scientific accuracy of the names will be deferred until a sufficient number of facts has been placed under the reader's notice to enable him to judge for himself. The synonyms of chlorine monoxide are protoxide of chlorine and hypochlorous acid. This last is the name *now* used (1872) by the examiners.

[3] Of all modern autherities Roscoe is the only one who states this gas to be colourless.

[4] Nascent (from *nascere*, to be born), being born. An element is said to be nascent when just set free from a compound containing it. Elements are found to be gifted with much greater chemical energy when in the nascent state than in their ordinary condition. The reason is obvious. We have seen (17) that elements in their free state consist of an aggregation of molecules, each of which is built up of two or more atoms of the self-same element. Now, in these molecules the valencies of the element are, to a certain extent, satisfied reciprocally. Let us take, for the sake of example, the molecule of ordinary oxygen, consisting, as we have reason to believe, of one atom of oxygen, united to another atom of oxygen, by virtue of the two valencies inherent to each atom, thus:—

$$O'' \rightleftarrows O''$$

But on liberating an element (say oxygen) from its compounds, the individual atoms are, *pro tempore*, free, and hence act with their full power, thus:—

$$\leftarrow O'' \rightarrow$$

But, of course, if no other element be present with which they can combine by preference, these atoms instantly unite to form the molecules of ordinary oxygen.

[5] Many substances are used for drying gases. Pumice stone soaked in oil of vitriol is very useful. Potash, lime, &c., are sometimes employed.

[6] Hydric hypochlorite. Barff., 1871.

[7] We use the term "acid" in preference to "hydrogen salt," for reasons which will be hereafter adduced.

[8] The chlorine for this purpose is prepared by a new and most interesting process. It has been found that by causing a mixture of hydrochloric acid gas and common air to pass over heated copper sulphate, the oxygen contained in the air combines with the hydrogen of the hydrochloric acid, forming water, and liberating the chlorine, thus:—

$$O_2'' + H_4'Cl_4' = H_4'O_2'' + Cl_4'.$$

The copper sulphate *apparently* undergoes no change, hence it may be used an indefinite number of times; but it is probable that a series of rapid oxidations and deoxidations take place in it. We shall return to this point shortly when treating of the action of some metallic oxides on hypochlorites.

[9] Roscoe.

[10] See paragraph 26 in farther elucidation of this view.

B. CHLORINE TRIOXIDE.—*Synonym: Chlorous anhydride.*[11] *Symbol:* $Cl_2'O_3''$. *Combining weight:* 119.

107.—PROPERTIES.—A gas of a deep greenish-yellow colour, with a specific gravity of about 2·745.[12] It has a very strong, pungent smell. In the presence of water it bleaches powerfully. Heated to 135° Fahr. it explodes with moderate force, resolving itself into his constituents.

108.—PREPARATION.—When a mixture of potassium chlorate, nitric acid, and a deoxidising body[13] is heated to a temperature somewhat under 135° Fahr., chlorine trioxide is evolved, and may be collected by downward displacement, as shown at Fig. 3 (see paragraph 51). Care must be taken not to reach 135°, as explosion would ensue.

B (2). CHLOROUS ACID.—*Synonym: Hydrogen Chlorite.*[14] *Symbol:* $H'Cl'O_2''$. *Combining weight:* 68·5.

109.—This body has been but little studied. It is known to be a most active bleaching agent. It is formed by the union of chlorous anhydride with the elements of water, thus:—

$$Cl_2'O_3'' + H_2'O'' = H'Cl'O_2'' + H'Cl'O_2''.$$

In presence of metallic oxides, it gives rise to a *chlorite* of the metal employed with the reproduction of water, thus:—

$$M''O'' + 2H'Cl'O_2'' = M''2Cl'O_2'' + H_2'O''.$$

The graphic formula of this body may be expressed as

$$H' \rightarrow \leftarrow O'' \rightarrow \leftarrow O'' \rightarrow \leftarrow Cl'$$

REVIEWS.

The Deviation of the Compass in Iron Ships considered practically. By W. H. ROSSER. London: J. Imray and Son.

A VERY practical manual on an important subject, and when we consider the immense amount of property afloat and the vast number of lives exposed to danger, if not to death, on our ocean highways, the appearance of a concise series of directions for ascertaining the *deviation* of the compass in iron ships by the ordinary method of swinging, for the construction of steering cards, for the determination of deviation at sea by time azimuths of the sun or a star, for finding the errors of adjusted compasses, and also of the heeling error, with the method of adjusting the standard compass, and other matters appertaining to the general subject, written in an easy style, which we are certain will commend itself to the class for which the work is principally intended, is a sign that no ordinary interest is manifested in the welfare of our sea-going population.

It is to be regretted that undue dependence is often placed on the adjustment of the compasses by professional adjusters, the officers of a ship in many cases being quite satisfied that the compasses are adjusted, and they are furnished with a steering card. On this head the author's prefatory remarks are exceedingly pertinent. Speaking of the treatment of the subject as distinct from its connection with the science of magnetism, and its mathematical investigation, he says:—

"The majority of seamen (fully to the extent of ninety-nine out of every hundred) are unscientific and non-mathematical, yet not so ignorant, but that if told *why* they are to do a thing they will do it better than by blindly following a rule without a reason assigned, as is the case when they add together certain logarithms to obtain particular results in the various problems of navigation.

"An intercourse for upwards of twenty years with the officers of the Merchant Service—as teacher, adjuster of compasses, and author—has given me ample means of making myself acquainted with their weak points; and to appreciate how weak they are in the matter of the deviation of the compass one has only to attend an inquiry into the loss of an iron ship, when the crude questions asked, and equally crude answers given fully testify that nautical assessors, masters, mates, and pilots are all in the same category."

On the extent of deviation and the importance of having the steering compass adjusted, especially for short voyages, the author says:—

"It can well be supposed that when the maximum deviation of the steering compass in vessels employed on short voyages exceeds a point, it would be preferable to adjust it by the use of magnets, for if left uncorrected the man at the wheel could not but be perfectly bewildered."

We were somewhat surprised to find from the author's twenty years' experience, that "it must be said with regret that in the Merchant Service comparatively few iron ships and steamers carry a standard compass; at least, an instrument entitled to that name. In the large majority of instances all the compasses are, as regards the cardinal points, adjusted by the use of bar magnets, while the quadrantal deviation, which ought to be compensated by chain boxes or by cylindrical iron is too generally neglected, so that after all such compasses are but *partially* adjusted." If this really be the case we, as members of the press, and feeling the importance of the public safety, must say *emphatically* "such things ought not to be."

The sections on "heeling error" are written with much judgment. Bearing in mind that an iron ship is itself a magnet affected differently in every position she may be in by the earth's magnetism, and that her compasses are adjusted on an even beam, a competent knowledge on the part of the master of the error of deviation produced by heeling is indispensable, especially as this error is perpetually changing with the latitude, and is more or less dependent upon the lay of the ship when building. It is during this process she takes up her magnetism, but not permanently so. The author's observations on this head are important:

"It is useless to offer any remarks on the direction in which an iron ship should be built; it must be built in the builder's yard, be the lay of it what it may; but it would be well if there were a better understanding between builder, owner, optician, and adjuster than there seems to be at present. Vessels would then be better equipped as regards compasses than they are now. Further, no vessel should be turned off the stocks and immediately afterwards adjusted or swung for the errors of the compasses, subsequently loaded, and then sent to sea; such a mode of proceeding is nothing more or less than wicked in the extreme, for by the time the ship is ready for sea the errors have changed and the given deviation cards are of no use. After launching, the vessel while fitting and loading should lie in the opposite direction to that in which it was built, and be swung for the errors of the compasses just before going to sea.

"Vessels lose a large part of their magnetism within a short time of their launching. * * * As a rule they cannot be said to have settled to their normal condition under two to two and a half years; after that no change of any significance occurs except under a considerable change of geographical position, which is equivalent to saying that the deviation changes with a change of the magnetic elements within the range of which they are brought by voyaging from one region to another."

As regards the compasses generally supplied, our author says, "A walk through the portion of any town where these instruments are exposed in the windows is not very encouraging, and the general impression derived from an examination of them, taking one with the other, is that they are far from being instruments of precision." On the idea of cutting off the ship's magnetism from the compass, he says:—

"Never set your wits to work to devise a method of cutting off from the compass the magnetism of the ship, such a thing being an impossibility; it would only show you are witless. None but quacks in science talk of demagnetising and depolarising a ship, of cutting off a ship's magnetism, or of inventing a compass to be unaffected with deviation; but you may, if you have a spare compass, try it in different parts of the ship to find out the spot of least deviation; you thereby show your judgment."

This book, which is illustrated with Napier's diagram of the curve of deviation, is one of which every page contains valuable information. Its rules are concise and its directions so plain that a master could readily ascertain the deviation of the compasses of his own ship and readily adjust them. In a word, it contains all that is necessary to become acquainted with for the safety of his vessel, so far as magnetism is concerned.

Observations of Comets from B.C. 611 to A.D. 1640. Extracted from the Chinese Annals. By JOHN WILLIAMS, F.S.A., Assistant Secretary of the Royal Astronomical Society. London: 1871.

THE award of the Gold Medal of the Royal Astronomical Society to Sig. Schiaparelli has tended to invest Cometary Astronomy with a new interest. Although we have the orbits of but two comets identified with those of meteors it is not improbable that as science advances other indentifications will be made, and catalogues of comets will be in greater request than heretofore. The catalogue now before us of 373 comets recorded by the Chinese, contains 149 instances not included in Biot's "Catalogue of Comets observed in China," published in the supplement to the "Connaissance des Temps" for 1846, and may be regarded as the most complete collection of notices of these phenomena from those ancient annals. The well-known Sinological attainments of the translator, and his perfect acquaintance with the Chinese language, particularly fit him for rendering into English the notices of Cometary phenomena contained in the work. In each case the year and day in our reckoning of the appearance of the comet is given, also the year of the Chinese epoch; the moon and day of the same phenomenon are given with all the astronomical particulars, such as its place amongst the stars, the character and length of its tail, and the direction which this appendage assumed. Accompanying the catalogue is an atlas of 32 maps, including the 28 stellar divisions most in use by the Chinese astronomers, and continually referred to by them in their observations. This atlas is not only curious and interesting as giving an idea of Chinese astronomy so far as regards the stars, but Mr. Williams has, by giving reduced tracings of Flamsteed's figures, furnished the means—by laying down upon them the corresponding Chinese asterisms—of identifying the stars in both systems, the Chinese and European. It is this feature which renders the work so valuable in an astronomical point of view, nor is it less valuable as a guide to Chinese chronology. The mode of reckoning by cycles of 60 years, which has been in use in China since the year 2637 B.C.; the lunar cycle of 19 years; the arrangements of the months, &c., are all fully explained and illustrated by appropriate tables, so that the work, having a much higher value than being a mere catalogue of comets, will greatly assist students of Chinese history. The introductory remarks also contain a very interesting account of the early astronomy of the Chinese. The following extract shows the great care and amount of labour that has been bestowed on the translation of the catalogue.

"From the preceding remarks it must be evident that the production of this work has been attended with no ordinary amount of labour. Many thousands of Chinese characters required to be carefully copied and accurately translated, the whole of the dates ascertained by computation, and numerous works, both Chinese and European, had to be examined or collated. In addition to these, the construction of the tables for computing the dates of their chronology, and of the atlas, both of which have been found not merely useful but indispensable to the carrying on of the work, required a great amount of research and attention. How far the results may be worthy of the time and labour bestowed on them must be left for those who are better qualified than myself to form an opinion on such subjects to determine. Errors may doubtless be found to exist, although every care has been taken to avoid them; and it is hoped that none seriously affecting the character of any part of the work may be found. It must, however, be remembered, that this is strictly a work of reference, and as such may at some future period be of service in investigations respecting the former appearance of any particular comet that may then pay us a visit."

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11 Chlorous acid, 1820-56; chlorous acid, 1871. Barff, &c.

12 Air 1·00. Its density is, therefore, *anomalous*—that is to say, does not agree with the received view of the constitution of a molecule. We have seen (17) that the weight of a molecule is usually the weight of 2 vols. Now 2 vols. of hydrogen weigh 2; but 2 vols. of chlorine trioxide, instead of weighing 119 (as the formula given above would lead me to infer) weigh only 79·4. This peculiarity points to one of two things:—(1) Either the generally-received formula is incorrect; (2) or contraction has taken place to a lesser extent than indicated by theory. This latter is probably the true cause of the discrepancy in question, for we find that 3 vols. of oxygen and 2 of chlorine have coalesced to form 3 vols. of the compound, instead of 2 only; hence 3 vols. weigh 119, which is the theoretical weight of one molecule of this body.

13 A deoxodising body is one which absorbs oxygen readily, hence takes oxygen from or deoxodises any substance with which it may be placed in contact. Deoxodising bodies are also called reducing agents.

14 Hydric chlorite. Barff, 1871.

ELECTRIC CLOCKS.

AT a recent meeting of the Society of Arts connected with the Technological Institute of Massachusetts, Mr. J. Hamblett read a paper on electric clocks, of which the following is an abstract:—

One of the first attempts to propel clocks by electricity was made by Alexander Bain about 1812. His battery consisted of a plate of copper and a plate of zinc buried in the earth. The pendulum rod was of wood, with a large coil of copper wire for a bob; the ends of the wire were carried up the pendulum rod to its point of suspension, and were there connected with wires from the buried plates; two brackets, about half way up the rod, supported a sliding breakpiece, which was so situated that it would be pushed a little at every vibration of the pendulum, and by this means an electric circuit was made and broken. The operation of these clocks was not satisfactory, as they were liable to error from fluctuations of the battery power.

Batteries have always been a source of trouble to electric clock makers, for upon their constancy the accuracy of the clocks in a great measure depends. Mr. Hamblett uses the Smee battery; the elements are pure zinc and platinum; the solution consists of pure water and chemically pure sulphuric acid. He uses no screw cups, as they are liable to become loose, and are frequently the source of much annoyance. The wires connecting the elements of his battery are soldered together. An electric clock invented by Mr. Charles Shepard has been much used in England. In these clocks the impulse is given to the pendulum by the falling of a lever, which is raised at each vibration of the pendulum by an electro-magnet. As the weight of the lever and the distance which it falls are constant quantities, the impulse imparted to the pendulum will be constant, and the accuracy of the clocks will not be affected by fluctuations of the battery power.

The mechanism of these clocks is such that an electric circuit is established and broken once every second, which operates dials at distant places. Electric contacts are usually made of platinum or of an alloy of platinum and iridium. When the circuit is broken, an electric spark passes between the contact points, which causes a slight oxidation of the platinum, and, where an electric current is established every second, this oxide may accumulate and become a cause of error. In Mr. Hamblett's clocks, this difficulty is obviated to a great extent by establishing the circuit, which moves the dials only once in a minute. The dials are made very simple and tick once in each minute; and all the dials controlled by one clock will move together, indicating exactly the beginning of each minute.

Clocks cannot only be propelled, but may be controlled and corrected by electricity. Clocks controlled by electricity have two small magnets, placed at the lower end of the pendulum, which are so arranged in relation to two stationary coils of wire that at each vibration of the pendulum one of the magnets will pass into the opening in one of the coils. Once each second an electric current is sent through the coils from the controlling clock, and if the controlled clock be inclined to go slow, the current from the controlling clock, acting upon the magnets, will tend to accelerate it, and *vice versa*. Mr. Hamblett believes this to be the best method yet devised for distributing time. One standard clock may control many other clocks at different points, and if an accident happens to the wires the controlled clocks will not stop, but will go on at their own rates. Methods similar to this have been adopted in Edinburgh, Glasgow, and St. Petersburg. A clock, erected by Mr. Hamblett in the observatory at Alleghany City, Pa., controls all the clocks of the Pennsylvania Central Railroad, and those of connecting lines westward to St. Louis. This is the longest line of time distribution in the world. He made brief mention of the various time signals and time balls used in different countries, and explained at length the distribution of time and the operation of time signals in England by the mean time clock in the observatory at Greenwich.

WHAT IS GUANO?

THIS question has recently attracted a good deal of attention from several naturalists, especially from Professor A. M. Edwards, of the Lyceum of Natural History of New York. Professor Edwards says that in California there is a deposit of "Infusoria," improperly so-called, accompanied by bitumen, which bitumen the gentlemen of the State Survey believe has been derived from those "Infusoria," and that contiguous thereto we have guano deposits. At Payta, in Peru, Dr. C. F. Winslow discovered an "Infusorial" deposit, almost identical in character with the Californian one; near by are bitumen springs, and lying off the coast are the guano islands of Lobos, Chincha, Guanape, and others. At Natanai, Japan, we have extensive "Infusorial" strata and bitumen; it is not recorded whether guano occurs in that quarter. In the island of Barbadoes we have "Infusorial" strata, bitumen, and near by the guano islands of the Caribbean Sea; and he is informed guano is abundant on the small islands and rocks nearly throughout the West Indian Archipelago. In the island of Trinidad we have "Infusorial" strata and bitumen, and, of course, adjacent guano. At all of these localities volcanic action is evident, but we have some localities of guano without "Infusorial" strata or bitumen as yet recorded, while we have the celebrated "Infusorial" strata of Virginia, which, by a little stretch of the imagination, may be supposed to be related in some way to the petroleum of West Virginia and Pennsylvania. In Algeria we have "Infusorial" strata and bitumen, but he never heard of guano having been found near by. However, now that attention is called to this fact it is to be hoped that more careful observations will be made connected with the subject, and he hereby calls on all sciencists and travellers to do all they can to assist in the elucidation of this interesting and important matter. From all of these facts, and others that he has collected of no less importance, derived from chemical and microscopical characters, he has come to the conclusion that guano is not the excreta of birds deposited upon the islands and mainland after its upheaval, but that it is the result of the accumulation of the bodies of animals and plants, for the most part minute, and belonging to the group which Haeckel has included in a new kingdom, separate from the animal as well as the vegetable, under the name of Protista, and subsequently upheaved from the bottom of the ocean. Subsequent chemical changes have transformed it into guano, or heat and pressure have so acted upon it that the organic matter has been transformed into bitumen, while the mineral constituents are preserved in the beautiful *atomies* that make up the mass of the extensive "Infusorial" strata found in various parts of the world.—*Monthly Microscopical Journal*.

ATMOSPHERIC DUST.*

(*Concluded from page* 658, Vol. XIV.)

HAVING demonstrated that the ordinary atmosphere is filled with organic dust, it will be necessary to show you that the quantity and quality may vary considerably according to the locality. It is self-evident as regards the quantity, that, in spite of the extreme lightness of these particles, they will gradually subside and settle down, and a pure atmosphere, as regards motes, is attainable. Even in the country, however, we find these motes. There may, besides, be organic particles even too fine for the highest powers of our microscope, or the analysis of a beam of sunlight. It, however, requires the constant regurgitation of the waves of air, from the movements of a busy city or shifting winds, to keep this dust suspended. I have here a flask which has been placed all night in the vaults of St. Michan's Church. The vaults are so dry, and absorb moisture so rapidly, that all the bodies that are placed in them are converted into natural mummies. There are specimens, centuries old, that are as perfect as the day they were placed there, except that the flesh is converted into parchment. In these subterranean vaults there is a long passage, closed by an iron door; and when this passage is closed, there is nothing but the stillness of death. What could be more appropriate for an experiment? This flask which we have here was first exhausted, and then opened in an inverted position in the vaults. After some time it was removed, taking the precaution, however, to close it before it was removed. On placing this across the course of the light, it is found to be optically empty; it contains no dust, although it had been in a place where everything was dry and dusty; but the air was perfectly still, and all the motes had subsided; thus we see that, by merely placing a flask that has been opened in a certain locality across the beam of light, we can optically analyse it. Again, as we ascend, there is less and less of this dust. On the high mountains, such as the Alps, the air is found to be nearly pure.

We now come to a very important part—namely, the composition of this dust. The composition will differ much according to the locality; but large cities interest us most, both from the fact that the dust abounds in such localities, and because it comes in contact with more lungs. In such cities the dust contains larger quantities of matter out of place (dirt) than other localities. It mainly or almost entirely consists of stable manure, in a finely comminuted condition, with germs and other products arising from the fermentation connected therewith. In 1866, the cholera year, I published analyses of the street dusts of Dublin, taken from Grafton and other streets, and drew particular attention to the importance of this subject, as bearing upon sanitary matters. Next year Dr. Letheby wrote upon the same subject, in connection with the mud and dust of London, and also gave analyses of them. I now place before you the results of some analyses recently made for this lecture:—

Grafton-street, dust dried at 212° Fahr. contained organic matter, 31; carbon, 43·7; nitrogen, 1·07; per cent. Cab stand, Nassau-street, contained organic matter, 45; carbon, 57·5; nitrogen, 2·1 per cent., nitrates and ammonia a trace.

These dusts, if left in a damp condition, after some days become alkaline, and evolve ammonia; when first produced, they are faintly acid, and contain little or no ammonia; this, however, does not always apply to cab stands, the mud and dirt of which is generally in a progressing state of composition; they are most mischievous spots, and require a great deal of supervision. This disagreeable matter is all well ground down by the wheels of the cabs on the paving stones. If we take into consideration the fact that, over Carlisle Bridge alone we have a milling power that would grind many barrels of corn *per diem*, we see how well this organic matter is prepared to work mischief, if it is capable of doing so. The street dust becomes the pabulum, or stock in trade, of the atmospheric dust; and when we consider the large amount of animal matter of the worst description that is spread out for the play of the breezes, the quality of the organic matter of our atmosphere can be well appreciated. That the great supply of this organic matter is gotten from the street dust, is borne out by the microscopic and other researches of Dr. Angus Smith. These floating particles may be viewed as the carriers of zymotic diseases, or those started by ferments.

Disease is simply a matter of chemical change produced, in many cases, by the direct action of a ferment. M. Pasteur, proved, many years since, that if a flask of putrescible matter were closed after being filled with air that had passed through red-hot tubes, we get no fermentation. Why? Professor Tyndall's experiments explain this phenomenon; the germs of fermentation contained in the air have been destroyed. M. Pasteur had done to the air entering the flask what was done some short time since to the air entering the tube. The germs were burnt up. Here are specimens of soup and milk some two months old, and yet, when opened to-day, quite fresh and good; but the most curious part of this is the fact that they were simply closed with prepared cotton wool. Each specimen was boiled in its respective flask, to destroy any germs that might be in them, and closed whilst boiling, but now they have been once opened fermentation would set in, for the atmospheric dust would enter with the air.

One of the practical applications of these and similar experiments has been wonderfully developed by Professor Lister, of Edinburgh. To use his own words, it is a system of treatment which consists of such management of surgical cases as shall effectually prevent the occurrence of putrefaction in the parts concerned. Space will not permit me to go into Professor Lister's line of investigation at present; but, in conclusion, I may remark that by a careful and well-considered system of antiseptic treatment, which is based upon the scientific consideration of the germ theory, hospital gangrene, and such like diseases are said to be almost unknown in the institution with which he is connected.

As regards the dust eliminated during the different processes of trades, I have only one or two remarks to make. In most cases they act chemically, but many cases are known where they shorten life merely by the mechanical entrance of particles into the lungs. Where we find coarse and heavy particles, such as iron, and such glutinous particles as flour, passing through the protective passages into the lungs there is nothing wonderful in spores passing, 250,000 of which have been seen in one drop of water, particularly when such motes are found to pass and bubble through vessels containing sulphuric acid without being stopped.

There is a great deal of grinding in the manufacture of edge tools, and polished iron work of every description; and there are two kinds of grinders—the wet and the dry grinders; the first suffer, but not nearly so much as the latter, who "buff" or polish their goods with emery, which you know is a very hard mineral. It is also curious to find that the polishing of cast iron is said to be much more injurious than wrought, or even steel. The sleeves of these men's shirts are a mass of iron mould from wiping the perspiration off their faces.

One intellectual man said that workmen could not afford respirators, which soon became filthy, and were very hot and uncomfortable to wear, and made them feel faint. When told that he did not look so bad, he said that at one time he was very ill, but was much better now (aged 32). His doctor had told him he might live to about 46; his fellow-workers died about 40. He took an emetic every week. Dr. Sigerson also states that scutch mills, from the character of their spiky dust, are human slaughter houses. Dr. Mapother has described an excellent respirator for working men. Although the workman is sometimes an inconsiderate being, what does he not suffer in the cause of commerce? and how careful we should be in legislating justly and considerately for this being who offers up as a sacrifice so many precious days of his life on the altar of mammon.

As regards the difficulty in intercepting this floating matter, Tyndall, in mentioning the subject, gives cotton wool as being the best intercepter; therefore it will be the best mechanical purifier. You must remember that when there are no par-

* By C. R. C. TICHBORNE, F.C.S., &c. An abstract of a lecture delivered before the Royal Dublin Society.

ticles of dust, there is no continuity of the light. The following experiment of Tyndall will illustrate this in another manner. I have here an ordinary glass shade, and I will place it in the track of the beam mouth downwards. The track can be observed passing through the shade; but if I let pure hydrogen gas enter the shade from the top downwards, this gas being much lighter than ordinary air, it gradually displaces it. Hydrogen is a metal in a gaseous state, and is the lightest substance known. As soon as it occupies the space crossed by the beam the luminous space is obliterated. Here we have the same results, or darkness, produced as when we burnt up the motes.

Having thus reminded you of the optical appearance that is produced by placing pure gas or air in the track of the beam, you will understand the experiments which illustrate the effects of cotton-wool as a fitting medium, as detailed by Professor Tyndall:—"I fill my lungs with ordinary air, and breathe through a glass tube across the electric beam. The condensation of the aqueous vapour of the breath is shown by the formation of a luminous white cloud of delicate texture. It is necessary to abolish this cloud by heating the tube: when this is done, the luminous track of the beam is uninterrupted, the dust from the lungs makes good the particles displaced. But after a time an obscure disc appears upon the beam, the darkness of which increases, until finally towards the end of the expiration, the beam is, as it were, pierced by an intense black hole, in which no particles whatever can be discovered. The air, in fact, has so lodged its motes within the passages of the lungs as to render the last portions of the expired air absolutely free from suspended matter. I now empty my lungs as perfectly as possible, and, placing a handful of cotton wool against my mouth and nostrils, inhale through it. On expiring the air through the glass tube, its freedom from floating matter is at once manifested. From the beginning of the expiration the beam is pierced by a black aperture."

Before concluding this rather meagre account of so important a subject, I would wish to add a few words as regards the merit and bearing of the question generally. Because we have had it strikingly placed before us that we are constantly inhaling dust, we are not necessarily to work ourselves into a dust mania; but, on the other hand, we should not be callous to the danger that may arise from such a quarter.

You know, perhaps, Voltaire's remarks when he was told that coffee was a slow poison—"You are right, my friend; it is slow, and horribly slow. I have been drinking it more than seventy years, and it has not killed me yet." Well, Voltaire was a sceptical kind of man, but we must not be too sceptical, for dust may be harmless, very slow poison, and sometimes such a poison that no human efforts could stay its power. I remember a very clever article appearing in one of the papers some years since upon the change of matter, in which the author showed that the number of persons who had existed upon our globe would, on calculation, be five persons to every square foot of earth; so that the earth was one vast cemetery, the whole surface of the globe having been dug over 128 times to bury its dead—that

"There's not a dust that floats on air
But once was living man."

Now, such a notion would not be pleasant; and, however clever such writing may be, it is but the hyperbole of science—simply a poetical license. We are not breathing the dust of our forefathers; it is changed, and is constantly changing. We are consuming oxygen, hydrogen, carbon, and other substances; but the oxygen, when it enters into my system, and combines with the products it already finds there, is no longer oxygen; its entity is destroyed, and it exists as another compound. In fact, our bodily existence on earth may be viewed as typical of the interchange of chemical molecules generally; and, whilst we are tied to these chemical atoms, let us hope that we may use them to our own honour, and to the advantage of our fellow-creatures.

GAS AND WATER PIPES AS LIGHTNING CONDUCTORS.

THE influence of gas and water pipes in determining the direction of a discharge of lightning formed the subject of a paper recently read by Mr. Henry Wilde, before the Manchester Literary and Philosophical Society. The author said:—

Although the utility of the lightning-conductor has been established in all parts of the world by the experience of more than a century, yet a sufficient number of instances are recorded of damage done by lightning to buildings armed with conductors to produce, in the minds of some, an impression that the protective influence of lightning-conductors is of but questionable value. The destruction by fire of the church at Crumpsall during a thunderstorm has induced me to bring before the society some facts connected with the electric discharge, which have guided me for some years in the recommendation of means by which disasters of this kind may be averted.

For the proper consideration of this subject, it is necessary to make a distinction between the mechanical damage, which is the direct effect of the lightning stroke, and the damage caused indirectly by the firing of inflammable materials which happen to be in the line of discharge.

Instances of mechanical injury to buildings not provided with conductors are still sufficiently numerous to illustrate the terrific force of the lightning stroke. Wherever lofty buildings are furnished with conductors from the summit to the base, and thence into the earth, damage of the mechanical kind is now unknown; and even in those cases where lightning conductors have not extended continuously through the whole height of a building, or where the lower extremity of the conductor has terminated abruptly at the base of the building, the severity of the stroke has been greatly mitigated, the damage being limited, in many cases, to the loosening of a few stones or bricks.

The ever extending introduction of gas and water pipes into the interior of buildings armed with lightning-conductors has, however, greatly altered the character of the protection which they formerly afforded, and the conviction has been long forced upon me that while buildings so armed are effectually protected from injury of the mechanical kind, they are more subject to damage by fire. The proximity of lightning-conductors to gas and water mains as an element of danger has not yet, so far as I know, engaged the attention of electricians, and it was first brought under my notice at Oldham, in 1861, by witnessing the effects of a lightning discharge from the end of a length of iron wire rope, which had been fixed near to the top of a tall factory chimney, for the purpose of supporting a long length of telegraph wire. The chimney was provided with a copper lightning-conductor terminating in the ground in the usual manner. In close proximity to the conductor, and parallel with it, the wire rope descended from near the top of the chimney for a distance of 100ft., and was finally secured to an iron bolt inserted in the chimney about 10ft. from the ground. During a thunderstorm which occurred soon after the telegraph wire was fixed the lightning descended the wire rope, and instead of discharging itself upon the neighbouring lightning-conductor, darted through the air for a distance of 16ft. to a gas-meter in the cellar of an adjoining cotton warehouse, where it fused the lead pipe connections and ignited the gas. That the discharge had really passed between the end of the wire rope and the lead pipe connections, was abundantly evident from the marks made on the chimney by the fusion and volatilisation of the end of the wire rope, and by the fusion the lead pipe. As the accident occurred in the day-time, the fire was soon detected and promptly extinguished.

Another and equally instructive instance of the influence of gas-pipes in determining the direction of the lightning discharge occurred in the summer of 1863 at St. Paul's Church, Kersal Moor, during divine service. To the outside of the spire and tower of this church a copper conductor was fixed, the lower extremity of which was extended under the soil for a distance of about 20ft. The lightning descended this conductor, but instead of passing into the earth by the path provided for it, struck through the side of the tower to a small gas-pipe fixed to the inner wall. The point at which the lightning left the conductor was about 5ft. above the level of the ground, and the thickness of the wall pierced was about 4ft.; but beyond the fracture of one of the outer stones of the wall, and the shattering of the plaster near the gas-pipe, the building sustained no injury. That the direction of the electric discharge had, in this case, been determined by the gas-pipes which passed under the floor of the church was evident from the fact that the watches of several members of the congregation who were seated in the vicinity of the gas mains were so strongly magnetised as to be rendered unserviceable.

The church at Crumpsall is about a mile distant from that at Kersal Moor, and the ignition of the gas by lightning, which undoubtedly caused its destruction, is not so distinctly traceable as it is in other cases which have come under my observation, because the evidences of the passage of the electric discharge have been obliterated by the fire. From information, however, communicated to me by the clerk in charge of the building as to the arrangement of the gas-pipes, the most probable course of the electric discharge was ultimately found. The church is provided with a copper conductor, which descends outside the spire and tower as far as the level of the roof. The conductor then enters a large iron down-spout, and from thence is carried into the same drain as that in which the spout discharges itself. Immediately under the roof of the nave, and against the wall, a line of iron gas-pipe extended parallel with the horizontal lead gutter which conveyed the water from the roof to the iron spout in which the conductor was inclosed. This line of gas-piping, though not in use for some time previous to the fire, was in contact with the pipes connected with the meter in the vestry where the fire originated, and was not more than 3ft. distant from the lead gutter on the roof. As no indications of the electric discharge having taken place through the masonry were found, as in the case of the church at Kersal Moor, it seems highly probable that the lightning left the conductor at the point where the latter entered the iron spout, and by traversing the space between the leaden gutter and the line of gas-piping in the roof found a more easy path to the earth by the gas mains than was provided for it in the drain.

In my experiments on the electrical condition of the terrestrial globe, I have already directed attention to the powerful influence which lines of metal, extended in contact with moist ground, exercise in promoting the discharge of electric currents of comparatively low tension into the earth's substance, and also that the amount of the discharge from an electro-motor into the earth increases conjointly with the tension of the current and the length of the conductor extended in contact with the earth. It is not, therefore, surprising that atmospheric electricity, of a tension sufficient to strike through a stratum of air several hundred yards thick, should find a easier path to the earth by leaping from a lightning conductor through a few feet of air or stone to a great system of gas and water mains, extending in large towns for miles, than by the short line of metal extending in the ground which forms the usual termination of a lightning conductor.

It deserves to be noticed that in the cases of lightning discharge which I have cited the lightning conductors acted efficiently in protecting the buildings from damage of a mechanical nature—the trifling injury to the church tower at Kersal Moor being directly attributable to the presence of the gas-pipe in proximity to the conductor. Nor would there have been any danger from fire by the ignition of the gas if all the pipes used in the interior of the buildings had been made of iron or brass instead of lead; for all the cases of the ignition of gas by lightning which have come under my observation have been brought about by the fusion of lead pipes in the line of discharge. The substitution of brass and iron, wherever lead is used in the construction of gas apparatus, would, however, be attended with great inconvenience and expense, and moreover would not avert other dangers incident to the disruptive discharge from the conductor to the gas and water pipes within a building. I have, therefore, recommended that in all cases where lightning conductors are attached to buildings, fitted up with gas and water pipes, the lower extremity of the lightning conductor should be bound in good metallic contact with one or other of such pipes outside the building. By attending to this precaution the disruptive discharge between the lightning conductor and the gas and water pipes is prevented, and the fusible metal pipes in the interior of the building are placed out of the influence of the lightning discharge.

Objections have been raised by some corporations to the establishment of metallic connection between lightning conductors and gas mains, on the ground that damage might arise from ignition and explosion. These objections are most irrational, as gas will not ignite and explode unless mixed with atmospheric air, and the passage of lightning along continuous metallic conductors will not ignite gas, even when mixed with air. Moreover, in every case of the ignition of gas by lightning the discharge is actually transmitted along the mains, such objections notwithstanding. A grave responsibility, therefore, rests upon those who, after introducing a source of danger into a building, raise obstacles to the adoption of measures for averting this danger.

WATER-PRESSURE ENGINE.

ENGRAVINGS of a very simple form of water-pressure engine designed by Mr. A. Schmid, of Zurich, and which is now being manufactured in this country by Messrs. Fielding and Platt, of the Atlas Iron Works, Gloucester, will be found at page 12. The engine shown in our illustration has a 7in. cylinder with 9in. stroke, and is calculated to develop 5 effective horse-power for each 100ft. of head of water with which it is worked. Referring to the engraving, it will be seen that the cylinder is oscillating and that the face to which the passages from each end of the cylinder open, is curved to an arc of a circle struck from the centre line of the trunnions. This face is beneath the cylinder, and bears upon a correspondingly formed concave face, having in it three ports, of which that in the centre communicates with the supply pipe, and the two outer ones with the escape or exhaust. It will be readily understood, from an inspection of the section, how, as the cylinder oscillates, the water is alternately admitted to, and exhausted from, each end of the cylinder.

Referring to Fig. 3 it will be seen that the trunnions on the cylinder work in bearings formed in a pair of levers having their fulcra at one end on the engine frame, and connected at the other end by a cross piece, as shown. A bolt—connected at its lower end to the engine frame—passes up through this cross piece, and exerts a downward pull upon it through the intervention of an indiarubber washer. By means of the nuts on this bolt the pressure can be regulated to just the amount sufficient to keep what we may call the valve faces in water-tight contact. The trunnion bearings are also adjustable for wear, as shown in Figs. 2 and 4.

An air-vessel is provided on the supply pipe to take up any shocks which would otherwise be caused by variations in the speed of flow through that pipe, and it is found that in practice these engines run with great smoothness. An engine of this class, with 5in. stroke, has been run most satisfactorily at 200 revolutions per minute. As regards the duty obtained, we quote the following extract from a report made by Professor Kronauer, of the Polytechnic School at Zurich. He says:—"As a member of the jury charged with the trial of twelve water motors (five cylinder engines and seven turbines) of different constructions, I can state that the engine of Mr. Schmid has surpassed all the others in regard of the percentage of duty and of simplicity of construction, the trials, which have been made with the greatest care and accuracy, having given a useful effect of 89 per cent." The engine is, as the Professor justly remarks, of very simple construction, and the proportions and general design are excellent. No doubt these engines will prove very useful motors in a large number of cases.

LAMPLIGHTING BY ELECTRICITY.

A PLAN for lighting street and other lamps by electricity has been "invented" by a resident of San Francisco. Dr. Van Zandt not only lights the gas, but also turns it on or off by electricity. The lamps are connected by underground wires with a central station, where the apparatus is situated, consisting of a galvanic battery, an induction coil, and a switch to throw the current on or off the wires in any portion of the city, so that all or any part of the lamps may be lighted or extinguished as required. Two independent circuits are necessary, one for operating an automatic apparatus in each lamp by which the gas is turned on and off; the other for conveying the current which lights the gas. The wire for the last circuit passes across the slit in the burner, where it is broken, so that the passage of the electric current produces a spark which ignites the gas. The wire near the burner cannot be insulated by caoutchouc or cloth, as these are destroyed by the heat; it is insulated by winding it around non-conducting trunnions on the burner. Above these insulators, the wires are of German silver tipped with platinum. Trials of this apparatus, using thirty-seven burners and over a mile of wire, have been made in one of the towns of the States, with results which show that the invention is applicable to the purpose for which it is intended.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE monthly meeting of this Society was held on Friday, March 8, Professor Cayley, President, in the chair.

The Late Solar Eclipse.

We were greatly disappointed on finding that only *one* communication had been received by the Society on this subject. We well remember the absorbing interest manifested on the occasion of the return of the members of the different expeditions which went out to observe the eclipse of December, 1870, and we felt it a decided blank when the only communication read was that from Mr. Russell, the Government Astronomer at Sydney, detailing the arrangements that had been made for observing the late eclipse, which were rendered nugatory by the presence of clouds. A question was asked by Captain Noble as to whether any other communications had been received, which he supplemented by another—viz., If not, why not? In reply it was stated that no *original* communications had been made to the Society. The notices contained in the report of the council presented at the annual meeting were obtained from various sources. This introduced some remarks on the proposed publication of the results by the Society (see ENGLISH MECHANIC, No. 357, January 26, 1872, p. 479), among which it was stated that the Government having been applied to to print the results, and having announced that no funds were available for the purpose, the council of the Royal Astronomical Society had volunteered to defray the expenses, an understanding having been entered into with the council of the British Association, through whose instrumentality the funds for the expedition had been obtained, that all observed facts should be published and none suppressed, although some might appear to be irrelevant.

Solar Activity.

Messrs. De La Rue, Stewart, and Lowey, communicated the usual annual summary of photographic solar observations at Kew, from which it appeared that the intensity of the spot-producing energy is diminishing, also that groups of sun-spots have of late been developed in the higher latitudes. In connection with this subject we find from the annual report that 381 photograms of the sun were taken during the past year on 226 days, but we regret to learn that the continuous photographic record of the sun's disk will shortly draw to a close. During the past ten years 2,778 solar photograms have been taken, and about twenty papers communicated to the Royal and Royal Astronomical Societies embodying the results.

Source of Solar Heat.

A communication on this subject by Maxwell Hall was read. The author considered that the slow contraction of the sun contributed to the development of solar heat.

Approaching Transit of Venus.

An interesting communication from Otto Struve on the preparations by the Russian Government for observing the forthcoming transit was read. The number of stations to take part in the observations within the territories of the Russian Empire is twenty-four. They will be fully equipped for the purpose.

Aurora Borealis.

A communication, by Mr. Finlayson, on the Aurora of February 4, 1872, was read. We did not remark any peculiarity in the observations.

Diffraction Phenomena in a Telescope.

Captain Noble having noticed some remarkable phenomena of diffraction while observing was induced to search for the cause, and found it to arise from the labours of a busy spider, having effected an entrance within the tube and constructed a complete network or grating across. These little creatures are often annoying to the astronomer, although he is so greatly indebted to them for the means of measurement. It was mentioned that on one occasion a spider had found its way into a micrometer and had availed itself of the lines already there.

Optical Power as Affecting the Perception of Colours.

Col. Strange communicated a note on certain observations on the effect of optical power in producing a difference in the perception of certain colours. It appeared that the Colonel and some ladies of his family were at the theatre, and that the ladies directed his attention to a dress which they described as *pink*. On using his opera glass he at once pronounced it to be *yellow*, and requested the ladies to view it through the same medium, when they too agreed that it was *yellow*. Subsequently it was ascertained that the dress in question was really white trimmed with yellow. The colonel said that nothing was more untrustworthy than descriptions of colour, and as much attention had of late been given to the colours of heavenly bodies, he considered the fact above narrated worthy of record, and that in observations of colour the effects of various powers should be ascertained and recorded.

Chronographic Determination of Longitude.

A determination of the longitude of Teheran, in Persia, as connected with the Great Indian Survey, was communicated by Col. Walker. We understood that this determination connects the arc between Greenwich and Madras with that previously determined between Greenwich and San Francisco, by the intermediate station Cambridge, Massachusetts. The retardation on the Indian line of 3,870 miles was less than 0·5 second. In the American determination the time of transmission of the galvanic current was 0·8 second. In the determination of the difference of longitude of Neufchâtel and Zurich, the velocity of the galvanic current was found to be about 7,300 miles in a second.

Double Image Micrometer.

Mr. Browning called attention to a double image micrometer which he had constructed by employing a divided Barlow lens. The instrument which was exhibited gave occasion to numerous remarks on the various contrivances that had been adopted for the purpose from Dollond's divided object-glass, 1750, which was mentioned by Captain Noble, to a plan of the Astronomer Royal, which Dr. De La Rue considered to be similar to the one before the meeting. Col. Strange considered that an advantage is gained by dividing an intermediate lens.

Spectroscope Adjustable for Dispersive Power.

Mr. Browning exhibited and explained the construction of a spectroscope, with especial reference to effecting a change in the dispersive power, as readily as altering the magnifying power of a telescope. The instrument, which possesses the ordinary automatic movement, is furnished with an extra prism, to be inserted in the battery of prisms, so as to reduce or vary the dispersion as the observer may desire.

In addition to the above, papers were read by the President on the "Variation of the Position of the Orbit in the Planetary Theory," and on a "Pair of Differential Equations in the Lunar Theory;" by Mr. Knott on the "Measures of the Binary Star ξ Ursa Majoris;" by Captain Noble on "Uniformity in the Measurement of Position Angles with the Telescope;" by Mr. Russell, "An Explanatory Note on η Argûs;" and by M. Stephan "Observations of the Minor Planet (117) Loomia, and Nebulæ discovered and observed at Marseilles."

THE INSTITUTION OF CIVIL ENGINEERS.

AT the last meeting of the Institution of Civil Engineers, held on March 5, 1872, Thomas Hawksley, Esq., President, in the chair, the paper read was "On the Kind-Chaudron System of Sinking Shafts through Water-Bearing Strata, without the use of Pumping Machinery," by Mr. Emerson Bainbridge, Assoc.-Inst. C.E.

Of the total expenditure necessary to open out a coal field, one of the chief items of cost was caused by the heavy expenses incurred in sinking the shafts, and when such sinking happened to pass through water-bearing strata, the proportion due to this head, of the total cost, was much increased. When a shaft exceeded 200 or 300 yards in depth, and when the water occurred near the surface, it was usual to keep the water back by the insertion of cylindrical metal "tubbing," placed upon a hard bed of rock at a point immediately below the lowest feeder. Where pits were less than 100 or 200 yards in depth, the application of tubbing was not of much service, as the movement and dislocation of the strata, consequent upon the removal of the coal, generally caused the water to find its way into the underground workings. The sinkings in which there was the largest quantity of water had been carried in Belgium through the chalk, and in England through the Permian series; these rocks usually being sufficiently porous to contain large volumes of water. Without exception, in England, all such sinkings had been made by the use of pumping machinery of sufficient power to keep the pit, during the process of sinking, comparatively dry.

It was stated that the question of dealing with wet sinkings in the most economical manner would, before long, become of much greater importance than heretofore. In the Report of the Royal Coal Commission an estimate was given of the coal remaining in the British Islands, as follows:—

	Million Tons.
Coal yet remaining which is or will have to be reached by sinkings through the coal-measures	90,527
Coal yet remaining which is or will have to be got by sinkings through the Permian and other formations overlying the coal-measures.. ..	104,418
Total	194,945

It thus appeared that 104,418 millions of tons, or 54 per cent. of the remaining resources of the British coal-fields would have to be reached by pits sunk through the Permian and other formations more recent than the coal-measures; and, as a rule, more likely to be saturated with large volumes of water. With such important evidence bearing on the future of coal-mining, it had been considered that the present was an opportune moment to bring under the notice of the Institution a description of a mode of sinking shafts through water-bearing rocks, which had proved successful in many cases on the Continent.

The plan of sinking pits hitherto practised in this country consisted in dealing with the water by means of large pumping engines, in leaving the bottoms of the pits dry enough to allow the sinkers to block the well, and in keeping back the water in the upper strata by metal rings, cast in segments about 4ft. long, and connected by wooden joints, which were wedged tight, when all the tubbing was fixed. The evils of this system were: 1. The heavy first cost of the plant, when special pumping machinery was used. 2. The expense of the wedging tubs, and the cost of fixing them. 3. The delay caused by the sinkers being compelled to work always in water. 4. The high first cost of the tubbing and of fixing it in the shaft, and the liability of the tubbing leaking in consequence of the numerous joints.

In the application of the Kind-Chaudron system these evils were to a great extent avoided. This system consisted of a combination of Mr. Kind's well-known apparatus for boring wells, with an ingenious device, invented by M. Chaudron, for fixing cylindrical tubbing under water in such a manner as to make it quite secure and water-tight. In the latter part of 1871 the author, accompanied by Mr. W. Cochrane, visited the Maurage pits, near Mons, where two shafts were being sunk by this process. These shafts, though having a depth respectively of 373ft. and 593ft. at the date of that visit, had been bored that depth under water with a diameter of 13ft. 6in., the water having been constantly standing at a depth of 37ft. from the surface. The Chaudron system consisted of the following distinct processes:—1. The erection of the machinery on the surface. 2. The boring of the pits to the lowest part of the water-bearing strata. 3. The placing of the tubbing. 4. The introduction of cement behind the tubbing to complete its solidity. 5. The extraction of the water from the pits, and the erection of wedged cribs to secure the moss-box. The machinery on the surface consisted of a capstan engine, which raised the *débris* from the pits, and a vertical engine, by means of which the boring tools were lifted at each stroke; the speed of the latter engine varying from fifteen to eighteen strokes per minute. The first tool applied was the small trepan, which weighed 8 tons, and bored a hole 4ft. 8⅔in. in diameter, the depth of the boring being increased at the rate of from 6ft. to 10ft. per day. The pit was enlarged by a trepan weighing 16½ tons, which increased the size to 13ft. 6in., and was kept from 10 to 30 yards behind the pit made by the smaller trepan. The larger boring tool had 28 teeth, and the smaller tool 14 teeth, each tooth weighing 72lb. The boring by the larger trepan did not progress faster than about 3ft. per day of 24 hours. The boring was generally carried on in the day, the remaining twelve hours being employed in raising the *débris* from the pits. When the bottom of the water-bearing strata was reached, the tubbing, which consisted of metal cylinders cast in complete rings of an internal diameter of 12ft., and a length of 4ft. 9in., was placed in the shaft, the rings of tubbing being connected by bolts. The tubbing was tested by hydraulic apparatus to one-half more pressure than it was expected to be subjected to. The rings of tubbing were let down into the shaft by means of the capstan; the moss-box at the bottom of the tubbing being placed in the pit first. The moss-box consisted of two cylinders, one sliding inside the other, and each having a flange broad enough to form a chamber to hold a quantity of ordinary moss. When the moss-box reached the bed which was prepared for it at the bottom of the pit, the weight of the super-incumbent tubbing pressed upon the moss, and formed a water-tight barrier. The tubbing being thus fixed, the annular space between it and the sides of the shaft was filled with cement, thus insuring the solidity of the tubbing; after this was finished, the standing water in the shaft was drawn out, and the joint below the moss-box was made permanently safe, by the fixing of several rings of tubbing resting on two strong wedging cribs.

The comparative cost of sinking by the processes referred to was shown by two tables, one of which exhibited the complete cost of sinking, and the time occupied by the ordinary system, at eighteen different collieries, whilst the other gave the same information for ten collieries put down by M. Chaudron's process. The results showed that, whilst with the system of sinking by the aid of pumping machinery, the average cost per foot had amounted to £114·7, and the rate of sinking to 8·9ft. per month, with the Chaudron process the average cost of all the pits was equal to £22·9 per foot, and the speed of sinking to 15·8ft. per month. This striking result, which was so much in favour of the Chaudron system, evinced the importance which this mode of dealing with water-bearing strata was likely to have.

It was remarked that, where a large quantity of water occurred in shallow sinkings, tubbing would be of no avail, and the economy of boring by the "Niveau plein" system would probably be considerable. On the other hand, where the strata were hard, and where the feeders of water were so well separated by beds of rock as to allow them to be dealt with separately, the ordinary system of sinking might prove as economical as the Chaudron process. The boring of the shaft by the Chaudron process could not be said to be advisable below the water-bearing strata, as with an increased depth the time which could be utilised in boring would become less, and further, the small particles into which the rock was broken by the tool hindered the sinking, so that it progressed more slowly than when the shafts were sunk by the ordinary mode.

BRISTOL NATURALISTS' SOCIETY.

THE usual general meeting of this society was held at the New Institute, on Thursday evening last. The president, Mr. W. Sanders, F.R.S., was in the chair, and a paper was read by Mr. W. W. Stoddart, F.G.S., on the Cotswold-hills, especially part of the range near the town of Wotton-under-Edge, or Wotton-under-Ridge, which was visited by the members of the society in one of their general excursions during the past season. During the excursion an observation was made, which gave the height of Tyndal's monument, near Nibley, as 626ft. above the sea level. In time not geologically distant, and during an age when the land stood considerably lower than now, the sea, there is every reason to believe, flowed far up the vale of Tewkesbury, and met the deep inlet projecting southward from the basin of the Ribble. This, which was first pointed out by Sir R. I. Murchison, was called by him the Ancient Straits of Malvern. The early geological history of Great Britain was then sketched, showing how, in very distant days, it consisted of patches of the igneous rocks exposed to the wearing action of the Western Sea, which gradually wore them down and deposited the detritus on the eastern side, forming continually newer and newer beds of sand and clay, &c. The various and distinct populations of those ancient seas were described, and specimens shown, such as the Trilobites of Siluria and the armour-plated fish of the old red sandstone and carboniferous series, with others more minute but not less interesting. The abundant, but perhaps monotonous, vegetation of the coal-measures succeeded, indicating estuarine conditions of growth and deposit. The thick deposit of new red sandstone succeeds, nearly unfossiliferous in this locality, but showing a rich fauna in the Austrian Alps. Next is the Rhætic series, with its rich fossil treasures, of which Aust Cliff and Westbury-on-Severn afford abundant supplies. The various beds of the lias and oolite were dwelt on, and more in detail, as the district in question is mainly composed of these. Particular attention was drawn to the constant occurrence of one particular fossil in many of these beds, not, of course, alone, but in company with others not peculiar to it. Thus, certain beds of the trias are characterised by ammonites peculiar to them, and found neither in the beds above nor in those below. In the same way, some of the beds of the oolite are distinguished by the presence in them of a shell called, from its shape, Terebratula fimbria, and so on. The advantage of this means of readily distinguishing strata was shown, and the alternatives between which geologists have to choose pointed out. They must admit either that these creatures were called into being, endured but a short time, and then became extinct, or that the beds in which their remains occur, though often only a few feet in thickness, required for their deposition a long series of ages. For many reasons which could not be set forth at length, geologists had unanimously chosen the latter alternative, and hence the great age they were compelled to assign to the crust of the earth and the animal and vegetable tribes upon it. The resemblance and difference between the Cotswolds and Dundry-hill were dwelt on, and the variation in thickness of the same bed in different localities explained. A sketch map was exhibited, showing the contour of the country if sunk to a depth of 500ft. The Ancient Straits of Malvern would be restored, and the counties of Gloucester, Worcester, Somerset, and Hereford reduced to an archipelago, consisting of the Cotswold and of Malvern, &c., separated by deep ocean creeks and channels. The speaker concluded by an allusion to the connection of agriculture with the geology of a district, mentioning the single fact that the common damson will not come to perfection off the fuller's earth, and therefore grows nowhere so well as in the districts where the subsoil consists of this formation. Natives of those districts regard damsons grown on other soil as worthless, however good they may appear to those who are not familiar with the fruit in its favourite habitat. Several questions were asked, and some discussion followed the reading of the paper.

USEFUL AND SCIENTIFIC NOTES.

Phosphorus in Iron.—The presence of the least trace of phosphorus and sulphur in iron will destroy it for many purposes, and a correct and easy way of detecting these substances is therefore important. K. Meineke dissolves the finely pulverised iron in chloride of copper, separates the reduced copper by treatment with an excess of chloride of copper and common salt, filters through a layer of asbestos, brings the insoluble portions adhering to the abestos into a beaker-glass, and oxidises by strong nitric acid and chlorate of potash; then he evaporates with hydrochloric acid and determines the sulphur by baryta as sulphate, and the phosphorus by molybdic acid in the usual way.

Government Scientific Expedition.—It is said that the *Challenger* will be commissioned early in the summer for a voyage of exploration and research. Some scientific gentlemen will be accommodated on board the vessel, and it is probable that Captain George S. Nares, now serving in the surveying vessel *Shearwater*, in the Red Sea, will be placed in command. The actual places which will be visited have not yet been determined, but it is anticipated that the groups of islands in the Pacific will have special attention bestowed upon them. This movement on the part of the Admiralty is in encouraging contrast to the fact that Arctic voyages have been abandoned to other nations, and to the late refusal of the Lords of the Treasury to grant any assistance whatever to the Livingstone search expedition.

Sir Roderick I. Murchison.—In the Geological Museum, Jermyn street, have recently been placed some objects of interest in connection with the late Sir R. I. Murchison. In the hall is a marble bust of him, executed by H. Weekes, R.A., and on the principal floor are two objects connected with his labours in the geology of Russia. It will be remembered that by those labours he established the right of the Permian to rank as a separate formation. The Emperor Nicholas I. presented to him a beautiful large vase in avanturine quartz on a square pedestal of gray porphyry from the Kourgon Mountains, in the province of Tomsk, Siberia, and this he bequeathed to the museum. The other object is a fine metal salver, having a worked border of illustrations of various mineralogical and metallurgical arts. There is an inscription in Russian, the translation of which is, "To the geologist Murchison, in testimony of their highest esteem, the Russian Administration of Mines, Zlata, Ust, 1843." Professor Ramsay has been appointed Director-General of the Geological Survey of the United Kingdom, in the room of Sir R. I. Murchison.

MICROSCOPICAL NOTES.

Sponge Spicules. — There are two common sponges which deserve attention as furnishing interesting spicules. The one is the common fresh-water sponge, *Spongilla fluviatilis*, containing spicules of two forms,—one with two discs like serrated wheels united by an axle, the other slightly curved, pointed at each end, and rough on the surface. These are siliceous spicules, and may be obtained by the use of nitric acid. The other is a marine sponge, but the spicules which are also of two forms are calcareous. In this case liquor potassæ must be employed to obtain the spicules. One form is tri-radiate and the other club-shaped at one end and pointed at the other. The sponge is very small and white, and may be found attached to sea-weeds. It is called *Grantia compressa*. These spicules should have a place in every cabinet.

The White Corpuscles of the Blood.—Dr. Rodenstein, in a paper on Tuberculosis in the *New York Medical Journal*, calls attention to the action of the white corpuscles of the blood, as seen under the microscope. He says that in making experiments with blood corpuscles he has lately noticed that if a drop of blood, freshly drawn, be placed in an alkaline solution of carmine, the red corpuscles lose their power of forming rouleaux, and the white corpuscles absorb the carmine, seek each other, congregate in little masses, and seem to become agglutinated to each other. In a drop of blood prepared for microscopic inspection, by careful focussing there can be seen the whole field covered by fine little rings, which seem to form a delicate network, looking somewhat like the cornea of a fly seen with a low power; this is nothing but the red corpuscles of the blood which touch each other by their edges. Scattered over this delicate, pale network, there can be seen, here and there, little, bright red, cellular masses; these are the white corpuscles of the blood tinged with carmine.

Action of Quinine on the White Corpuscles of the Blood.—This subject, in which Binz and Stricker held somewhat different views, has recently, says the *Lancet*, been taken up by Herr Kerner, who contributes a paper on this subject to the last part of Pflüger's "Archiv," being incited by the observations of Mosler on the cure of certain cases of leucæmia by the administration of quinine. Kerner remarks that it is quite possible to obtain a neutral salt of quinine, and in his experiments he used the chloride and the carbonate. He drew small quantities of blood from cats and dogs, and applied a one-tenth solution of this salt in proportion to the blood of 1 part to 4000, upon a microscopic stage maintained at blood heat. The result was striking. The white corpuscles became round and darkly granular, and the movements were very speedily completely arrested. It of course became interesting to compare these effects with those produced by other neutral salts, and in pursuing this investigation to some extent he found that salicin, caffein, atropine, and arseniate of potash were all either wholly indifferent or possessed only the slightest influence. Quinine, therefore, exerts a remarkable action on the white corpuscles of the blood, independent of its antiseptic properties.

Prizes for Amateur Microscopists.—We wish to remind our microscopical readers of the prizes offered by the Countess of Ducie through the Early Closing Association, viz.:—(1) Two Prizes for the best lists of the ponds and other aquatic resorts for collecting purposes, within 20 miles of Charing-cross. 1st Prize, Three guineas: 2nd, Two guineas. Rules:—1. The exact locality of the pond must be given, in order that it may be identified, and the name of the railway station nearest to it. 2. Each competitor to send in his lists sealed in a cover bearing a motto, and accompanied by an envelope sealed, in which is inclosed the real name, address, and occupation of the competitor. (2) A Prize for the best list of the ponds and other aquatic resorts for collecting purposes, within 20 miles of Charing-cross, with a list of the microscopical animals and plants found in them during each month of the year, commencing March 1, 1872. Five guineas. Rules:—1. The exact locality of the pond must be given, and the name of the nearest railway station. 2. The date of the visit must be specified. 3. When any rare or supposed new objects are found, specimens should be immediately forwarded to Walter W. Reeves, Esq., Royal Microscopical Society, King's College, Strand (Somerset House), for examination. 4. Each competitor to send in his lists and other information sealed in a cover bearing a motto, and accompanied by an envelope sealed, in which is inclosed the real name, address, and occupation of the competitor. The lists are to be delivered not later than March 31, 1873, addressed Secretary, Natural History Prizes, 100, Fleet-street, E.C. The adjudicators are Mr. H. J. Slack and Mr. W. W. Reeves, the Secretary and Assistant-Secretary of the Royal Microscopical Society, and they will attach importance to notes and records of pond life made in each month with reference to the local distribution, development, or hybernation of the species

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *81, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

THE *NAUTICAL ALMANAC*—STAR MAPS—THE MOON'S AXIS—THE TRANSIT OF VENUS—JUPITER'S SATELLITES — SEMIDIURNAL ARCS—AND ABERRATION (OF INTELLECT).

[3795.]—PERHAPS the most immediate answer to Mr. John Andrews (query 11186, p. 649) is that the *Nautical Almanac* takes no cognisance whatever of the wants and requirements of amateur observers (as such), but is wholly given up to data having navigational value. I would, however, further remind my querist that a long series of observations of a system of satellites is requisite before trustworthy tables can be computed from them; and that as the Uranian and Neptunean moons are only discernible in our largest instruments, we can scarcely expect such observations to accumulate very rapidly. The little difficulty attendant on the employment of an 11in. or 12in. achromatic on board of a ship lurching through an angle of some 35° is scarcely worth alluding to.

"M. D. D." (query 11182, p. 650), will find some difficulty in obtaining "*a* chart of the stars, with the figures of the constellations marked on." Perhaps the index plates of Proctor's "Gnomonic Atlas" would be the likeliest thing to suit him. In answer to his second question, I may say that Hannay's "Almanack" is *not* to be had; and that probably the "Illustrated London Almanack" contains as much popular astronomy as any of them.

Will Mr. Birt (letter 3753, p. 660) forgive me for pointing out that it is the inclination of the moon's axis to the plane of the orbit which she describes *about the earth* which determines the amount of libration in latitude, as visible to us? The inclination of that axis to the ecliptic is very ancillary to this; for it must be borne in mind that it is from the earth, and not from the sun, that we view her.

Now that I know that it is the transit of Venus in 1761 with reference to which Mr. Lowdon put query 10871, page 572, I may tell him that it was observed at Greenwich by the Savilian Professor of Geometry, Mr. Bliss (Dr. Bradley, the Astronomer Royal, whom he succeeded, being unfortunately ill at the time), and by a Mr. Green, the then first assistant. Bliss employed an old 15-ft. (non-achromatic) refractor; Green, a 2ft. Gregorian reflector by Short, with a divided convex lens before its aperture, as a micrometer. The weather was very indifferent, though, and they only had glimpses of the transit by fits and starts for a short time, until towards the end of it, when the sky cleared, and they, in company with Bird the optician, observed the egress. Internal contact took place on June 5, 20h. 19m. (*i.e.*, 8h. 19m. a.m. on June 6th, mean civil time), and the final egress at 20h. 37m. 9s. A Mr. Hornsby and a Mr. Phelps also seem to have made some indifferent observations at Shirburn Castle, Lord Macclesfield's seat. There was a grand party, too, assembled at Saville House (in those days standing in the fields, but now a blackened ruin in Leicester-square). The gazers here were the Duke of York, Princes William, Henry, and Frederick, and the Princess Augusta; the observers, Short, the famous optician, Dr. Blair, and Dr. Bevis. The last internal contact, as determined at this station, occurred at 8h. 18m. 21½s. a.m., as seen by Short; while the final egress seemed to Dr. Blair to happen at 8h. 36m 12½s.; and to Short at 8h. 37m. 5½s. The fact of the latter observing with a larger telescope will probably account for part of this discrepancy; and the masterly researches of the present Astronomer-Royal at the Cape of Good Hope, Mr. E. J. Stone, afford an easy solution of the rest of it. I may add that the transit was also observed in London, or its neighbourhood, by Mr. Canton and Mr. Dunn; at St. Helena, by Dr. Maskelyne (the successor to Bliss as Astronomer Royal); in Sweden, in Paris, in Constantinople, in Siberia, in Madras, and in other localities, by various observers. It only remains to add that at the time of transit the geocentric longitude of the sun and Venus was 75° 36′ 31″; that the duration of the transit was about 6h. 16m., and that was the second transit ever witnessed by the human eye.

I have no idea that any such photometrical experiments as those inquired for by "E. T. S." in query 11310, p. 676, have ever been made. The late Sir John Herschel did investigate the relative brightness of some of the heavenly bodies, while he was at the Cape; but I never heard of any comparison having been made, mediately, or immediately, of the difference in the amount of light emitted by the sun here and in the tropics.

In reply to "Vega" (query 11225, p. 676), I can only say that the time given on p. 576, as that of the reappearance of Jupiter's first satellite on January 12, 1871, is quite correctly printed; and that it rests on the authority of Mr. W. M. Christie, the first-assistant at the Royal Observatory. My querist says nothing, by the way, about his own longitude. His recorded observation would place him a long way to the west of Greenwich.

I have, on a former occasion, given somewhere in these columns the method of calculating semi-diurnal arcs; but, in the interest of Mr. Cramer (query 11232, p. 676), will once more repeat it. "The simplest known formula," then, may be thus expressed:—To the log. tan. of the latitude add the log. tan. of the declination of the star. The result, suppressing 10, will be the log. sin. of an arc, which, turned into time, must be added to, or subtracted from, six hours (according as the declination has the same name as, or a different name from, the latitude). The result will be the semi-diurnal arc required. A single example must suffice, by way of illustration. What is the semi-diurnal arc of Fomalhaut, at Melbourne?

Lat. of Melbourne, S.—37° 50′; log. tan.—9·8902040.
Fomalhaut, Dec. S.—30° 18′; log. tan.—9·7666751.

Log. sin. of 26° 59′ 19″. 9·6568791.

Then 26° 59′ 19″ = 1h. 47m. 57s., and *adding* this to six hours (because the declination and latitude are both *south*, we finally get 7h. 47m. 57s. as the semi-diurnal arc of Fomalhaut, at Melbourne. Of course, had it been a star with north declination, the quantity whose log. sin. we obtained must have been subtracted. Mr. Cramer must, though, see that we proceed on the assumption that the body whose apparition above the horizon we are investigating retains its declination invariable from its rising to its setting. It is just because the moon changes hers so rapidly that a table of semi-diurnal arcs is to a great extent useless with her. My querist will of course observe that the formula given above takes no account of refraction.

I think that some one must have been poking fun at Mr. Clements (query 11248, p. 677), as it is almost impossible to conceive that any such paper as he inquires for can ever have been published. I have not the pleasure of knowing "Captain William Noble, of Uckfield," and must most emphatically disclaim the smallest intention of saying anything personally discourteous or offensive to that gentleman; but I cannot refrain from observing that if he really does fancy that he observed "187 occultations of Uranus . . . . in the years 1867-68." I would suggest to his friends that Dr. Forbes Winslow would be a proper and likely man to deal with *his* Constant of Aberration; and that a temporary change of air from Uckfield to, say, Hanwell—or perhaps Colney Hatch—might ultimately result in the suppression or destruction of such astounding observations and calculations as Mr. Clements mentions, altogether.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

DUST IN THE SPECTROSCOPE.

[3796.]—MAY I be allowed to suggest to that eminent optician, Mr. John Browning, F.R.A.S., who appears as an occasional contributor to our MECHANIC, that he would be adding one more to the very numerous favours he has already conferred on the scientific world if he would publish in these columns his method of freeing the jaws of the slit of a spectroscope from those minute and impalpable particles of dust which, when the slit is very much narrowed, annoy the observer by striping the spectrum with longitudinal lines? I have tried a clean camel's-hair pencil and a freshly cut splinter of dogwood as means of removing them, but with by no means absolute success.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

"PHILO" AND VENTILATION.

[3797.]—"PHILO" (letter 3725, p. 637) disclaims the notion I imputed to him (because it was a common one at present), that constructing self-ventilative buildings was a matter of refined science; and he shows, in a column of the most misleading and mischievous fallacies that he has not the faintest idea of what self-ventilation (the only thing I deemed it worth while to write about) means! He describes how he admits fresh air to a murderously misconstructed room as a slight palliative to its non-ventilation—a very slight one, if there be no exit of foul air, and he describes none—and then asks me whether I consider such palliative "very elaborately scientific." He would appear to suppose that by this miserable shift he has "cured" his room, or made a murderous structure an innocent one. He may well object to my bird test, because he must be aware its trial in his room would kill any number of birds before half the minimum of fuel could be burnt, however "quickly," or however "slowly."

But there is not a single sentence in his letter that is not a mischievous fallacy, unless the single clause in which he adopts my dictum that building ventilation is as simple as and "closely similar to the ventilating of lanterns." He has plainly never constructed either a room or a lantern rightly, that is to say, either a lantern that would be saleable in a shop, or a room wherein a bird would live through my experiment. Birds would so live in any lighthouse lantern, or any enlarged model of a saleable lantern of any kind, through the burning of as many tons of fuel as you choose, as quickly or as slowly as you choose. If "Philo" denies this, let him give his name, and let us have a wager like the Hampden-Wallace-Bedford-level wager. It is an incomparably more important question than the flatness or roundness of an earth on which we pass (as the *Pall Mall Gazette* said) so few years. We, or Mr. Hampden, had infinitely better die in the error that the earth is round (or flat) when it is the contrary, than hold "Philo's" views of ventilation. Let me construct a model chamber of one cubic yard, the openings both for inlet and outlet not to exceed two square inches, and hang one or two caged canaries, with food and water to last them, say, a week. "Philo" is to burn therein, at as many points as he will, not directly under their cages, all the gas or other hydrocarbon fuel that he chooses, and kill the birds thereby if he can. If he can kill any before consuming their provisions, I lose the wager; if he cannot kill any (without other combustibles than hydrogen and carbon) I win it.

It is utterly untrue that "the sole difficulty is to change the air of a room often enough to keep it fresh and sweet, without having it uncomfortably cold, &c." A room has no business to require its air "changed," by external act, either often or at all. In a lantern, and in any rightly-designed room, it will change itself by the breathed air instantly leaving and fresh replacing it—the breathed air and no other, whether it be much or little, from one child or a wedged roomful of men—exactly that air, and neither more nor less, leaving and being replaced. "Philo" has not the remotest conception why this is the case in a lantern, and less perfectly in the present House of Commons, but not at all, probably in any other modern room in England. He probably knows (or has the means of knowing if he will use them instead of scribbling about it), that in all these the breathed air, instead of leaving at once, mixes inseparably with all the rest, and though none but fresh air may enter, what manner of air it shall drive out, whether the worst or the best in the room, is all utter chance-medley; or rather the structure is about the best that could be devised for mixing up all foul air with the fresh as rapidly and inextricably as possible! The main problem (it can hardly be called "difficulty") is to prevent this mixture, as every lantern does prevent it, and let out the used and poisoned particles of air instantly—for external (not internal) diffusion—and waste none of their power in moving other air than themselves. But though this is as simple as laying a pavement that shall not be flooded, "Philo" has no more conception of it than of the chemistry of Sirius.

A room that has, as he describes, a "longest period intended" for people to breathe in it, is simply a murderous room; and if it be any architect's theory that rooms are to have this "longest period intended," where is such period marked? or why is it not conspicuously engraved on them? What he says is "simply impossible," is simply the condition of Moorish rooms built ten centuries ago, and still in use, and of the lantern of every lighthouse in England! The reason lies in a difference between every right and every wrong room, that I have often described in three lines. Now let "Philo" describe it.

Mr. Saunders (letter 3726) is more likely to do this, because he does not scribble about "laws of pneumatics," and "the simplest thing conceivable," and so may have time to think a simple thing out, perhaps.

E. L. G.

TOBACCO AND DISEASE.

[3798.]—YOUR correspondent, a "Fellow of the Statistical Society," having finished his argument against the use of tobacco, permit me to reply. I shall not occupy six columns (see lets. 3347, 3448, 3777, pp. 431, 484, 666) in so doing, as there are but few points calling for any extended notice. First, I disclaim all intentional "dogmatic assertion," and all title to speak *ex cathedrâ;* but I think I am as well able to express an opinion on this question as a man who makes a selection of one-sided extracts, and who probably never smoked a pipe in his life. When Mr. Gwilt (let. 3188, p. 331) made the statement that epithelioma had been produced by smoking I knew that he had no authority for it, and coming across "Chambers's Encyclopædia" at the time, I extracted information from it which I thought might be useful, if not interesting (p. 355), and I gave the authorities for the statements made, which were by no means one-sided. Since the advent of the "F.S.S.," however, I have written to an able and well-known physician inquiring if there was any ground for the assertion that epithelioma is caused by tobacco-smoking, and he replied that the one has "no connection, direct or otherwise," with the other.

Now, with regard to M. Bouisson's statistics, what are they worth? Is there no other cause but tobacco to account for epithelioma in—above all persons—"old soldiers, rich idlers, and tavern loungers"? It seems that even M. Bouisson acknowledges the "taint;" but thinks the morbid predisposition would remain latent were it not for the local provocation of the tobacco—a view of the matter which in a modified form I pointed out in my previous letter, when I said that all tobacco could possibly do was to determine the locale of the cancer. What, may I ask, is the local provocation inducing the exhibition of epithelioma in parts where no tobacco smoke is ever applied? Why does not the morbid predisposition rest latent in these cases, and in the cases of non-smokers?

As to the second letter of the "F.S.S." what is there worth attention in it that I did not notice in my communication? I expressly mentioned Dr. Richardson's opinion on the effects of early smoking; but your correspondent makes a ludicrous mixture of tobacco and jam, quite beside the point (as he will see if he "digests" the Dr.'s remarks), and actually asks me which I would give my children, tobacco or jam—as if they were peculiar infants rejoicing in long pipes and strong ale. One does not set strong meat before babes, nor jams and lollipops before men! I cannot attempt to reconcile the statement that, *mirabile dictu*, "snuff is a mere *outward* application" with the assertion that an analytical preparation of the lungs and liver of a man (poisoned, poor fellow, by snuff at the early age of threescore and ten) "exhibited all the reactions of nicotine." Neither can I wade through the long list of statements in the third letter on p. 666 which appear to be written chiefly in the subjunctive mood, and to be utterly unsupported by *proof*. There, is one statement, however, which your correspondent appears to think very highly of, as he asks the "defenders of tobacco" to explain it. It is, that in 1838 the tobacco monopoly produced 28,000,000 francs, and there were 8,000 insane persons, but in 1862 the produce was 180,000,000 and the number of lunatics was 44,000. Of course in the interval there were no extraordinary circumstances occurring in France, but the "constant proportion in this increase" is undoubtedly due to tobacco. It will be seen that in 1838 there was one insane person for every 3,500 francs produced by the tobacco monopoly, but in 1862 there was only one for every 4,272 so obtained. But let us reduce this argument (!) to an absurdity. In 1838 there were 28,000,000 pints of cod-liver oil consumed, and 8,000 persons died of consumption; in 1862 188,000,000 pints were consumed, and 44,000 persons died of consumption; therefore, the cod-liver oil was the cause of this "constant proportion in the increase." If this had gone on without any *increase of population* for many more twenty-four years, Frenchmen would have become curiosities by their scarcity.

Your correspondent quotes from the *Doctor* the opinion of Professor Lefebre as to the influence of tobacco in causing insanity, but he does not quote from the *Doctor* the review of that very article in the *Dublin University Magazine* which appears to have bemuddled him. The *Doctor* said that if the statements contained in the article were true it was singular that the terrible effects of tobacco did not make themselves more apparent. I quote from memory.

But I am occupying space uselessly. The one great argument, and a clincher, against the tobaccophobists is, that men do smoke and yet continue to live, tolerably free from disease, and able to support those "chagrins, reverses, misfortunes," and so on, which Dr. Druhen, with a strange perversion of obstinate facts, thinks they would encounter much better without "the *depressing* action of this plant."

Even granting that tobacco may cause some latent disease to show itself in certain cases, are we all to deny ourselves the enjoyment of the weed for this? Why we should all be chronic alarmists, afraid to do anything—afraid of the rain, of the cold, of the heat, afraid of our very selves, if this argument were carried to its logical conclusion. I know that under certain circumstances I found tobacco a friend: I will place that kindness to its credit when I prove it an enemy.

But what is this I see? "There is no possible standard of 'moderation' in the use of tobacco." The old, worn out, effete argument of the teetotallers, used by a man who pretends to a right to speak on an "intricate pathological question," who has no personal experience of tobacco, and who "*cannot assent*" (*brutum fulmen*) to the opinions of Dr. Richardson, save those which harmonise with his own view of the question. The fact is, I have been speaking of the moderate use of tobacco, your correspondent of the *im*moderate—the abuse of the weed. It is more than possible that tobacco-smoking really does harm to those with whose idiocrasies it does not agree, but plain and palpable *facts* refute every argument your correspondent has brought against its use in moderation—for though he may not be able to see it, there is a distinction as well as a difference between its use and its abuse.

I may appropriately conclude with the statement that tobacco-smoke does *not* contain the bogey Nicotine. "Our" chemists may perhaps analyse it and say if I am right or wrong. The nicotine (if any remains) is in the "oil," and I pity the taste of the man who swallows that. It is pyridine, picoline, or some other *ine* that ruins the "slaves" of tobacco both morally and physically. But *satis verborum*.

Saul Rymea.

[We beg to suggest that this controversy should end with this letter.]—Ed.

VALENCIES AND ATOMICITIES.

[3799.]—"Beacon Lough" (let. 3742, p. 642) somewhat overstrains my remark as to the relative comprehensibility of the constitutional formulæ and the binary formulæ of acids and salts; no one who has read much of my communications in these pages will suppose that I would imply that the mere difficulty of an idea is any objection to its study. What I have said, and what I now repeat with any amount of emphasis required, is that the doctrine of atomicities, as debated among chemists, in the fashion illustrated by the discussion (which as usual, degenerates into a mere squabble) between "Beacon Lough" and Mr. Bottone, is a dispute about what is wholly hypothetical.

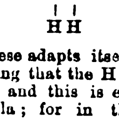
Any examiner who should venture to reject any formula attempting to define the constitution of sulphuric acid, and evidencing the possession of any ideas on the subject, because it did not agree with Frankland's guesses, would commit an act of gross tyranny, unless, of course, it was stipulated that the examination was to be governed by the guesses aforesaid.

The dispute as to whether sulphur is a dyad or a hexad, is one about words and about properties wholly hypothetical. We take up certain conceptions and fit them to a dyad or hexad atom; that is, we say the atom is hexad, *because* such and such a molecule exists, and then we say, such and such a form must be that in which the molecule exists, *because* the atom on which it is based is hexad. Some people may call this science, for my part I think it is very like the old scholastic logic, and bears a strong resemblance to the discussion as to how many thousand angels could dance together on the point of a needle, as to which no man really knew anything. Of course, in science, the great majority of men will be able to grasp only one idea, and will pin their faith to one teacher and system, just as in religion, the majority can see truth only within their own wretched little "ism." Be it so: they may be right to anchor themselves to something which appears to them fixed, and satisfies their needs. But others there are who can and must take wider views, and on their behalf I protest against any attempt to set up any standard of orthodoxy where there is not an absolute and ascertained truth in question, but merely an opinion. That is really the only point on which "Beacon Lough" and I differ.

As to the opinions themselves, sulphur and its products (both because of their practical importance and the care with which they have been examined), furnish the best illustration. "Beacon Lough" has given us the hexad formula of Frankland, and asks me to contrast it with Mr. Bottone's dyad formula of sulphuric acid, as to their adaptability to the act of electrolysis. On that head they are exactly alike, for each presents the hydrogen as forming part of two atoms of hydroxyl. Let me say here that I always use the word atom for a compound radical which cannot exist by itself, and plays the part of an elementary atom in combination. But the point I urged before was, that neither formula was so satisfactory as the simple H_2SO_4, meaning by this not the mere rational formula giving the number of elementary atoms in a lump, but the binary formula, treating the acid as composed of the chlorous radical SO_4, and the hydrogen satisfying that radical and replaceable directly by monad or dyad metals.

Here then, I contend for the broad view that each and every one of these formulæ and conceptions is one aspect of a many-sided truth, and that it is a true chemist's duty to study each of them, and recognise its value; not to sit himself down in front of one side and deny the existence of the others.

Now, I hold that if there is any such thing in reality as atomicity or valency of atoms, and if what we speak of under those names is anything more than a convenient mode of expressing ideas as to the grouping of the atoms within a molecule, then sulphur is a dyad only, and that Mr. Bottone's formula is the most probable; for in what does the difference consist? We know that S takes up two atoms of O, forming sulphurous anhydride, a closed molecule $S<\begin{matrix}O\\|\\O\end{matrix}$; again, this is converted into sulphuric acid by opening the bond between the oxygen atoms, and satisfying each of their free valencies by a monad atom of hydroxyl $-O-H$. This gives us $S<\begin{matrix}O-O-H\\O-O-H\end{matrix}$. Treating sulphur as a hexad we must suppose (it being all supposition) that two oxygen atoms fixed themselves each to two of the sulphur attractions, leaving two undeveloped, $\underset{\smile}{O=S=O}$; then the addition to these of the hydroxyl atoms gives us:—



Now, either of these adapts itself to the electrolytic reaction by assuming that the H is torn away and replaced by a metal, and this is equally explained by the binary formula; for in this the radical is $S<\begin{matrix}O-O-\\O-O-\end{matrix}$ possessing two free valencies.

But the doctrine of atomicity fails to tell us why that radical either does not exist or cannot be isolated; for if these bonds or valencies do exist and act as supposed, I, at all events, fail to see why the two free oxygen valencies do not satisfy themselves, as they are assumed to do in other cases. If "Beacon Lough" wishes me to accept his diagram (after Frankland) as an explanation, and to assume that it is a reality, and that the two hydroxyl atoms are stuck upon opposite sides of the sulphur atom, and that if the hydrogen atoms are removed the valencies set free are out of each others' range; then all I can say is, that I fail to see how a dyad atom, such as zinc, can ever manage to hook itself on to those valencies and displace the hydrogen.

This serious failure of the existing atomicity notions (for they have scarcely arrived at the dignity of a theory, let their disciples affirm them ever so vehemently) is of the same nature as "Beacon Lough's" explanations of the silico-fluorides and compound chlorides. It is nothing but a pure assertion, and not an explanation, to say that some bodies (say, binary salts) are formed in consequence of laws of valency by which satisfied molecules are formed, and that other bodies (say, compound salts) are formed by junctions of such molecules on other principles as yet unknown; for these latter bodies are just as truly built upon chemical affinities, and are as absolutely definite structures, as the others. The only true and honest course is to regard the doctrines of valency as speculations and guesses at truth; not to attempt to place the opinion of a Frankland or a Wurtz upon the footing of a decree of the ancient kings of the Medes and Persians, which altereth not; because in these revolutionary days that sort of despotism only excites rebellion.

I have hitherto used the two words valency and atomicity as synonymous, because this is commonly done; there is, however, an important distinction capable of being made if consented to. Valency may represent the power of substitution or combination as to monad atoms, hydrogen or chlorine. Here we have tangible facts alone to deal with, and in this sense the doctrines of valency are simple and important; they, however, derive their value from, and are connected to the "new notation:" thus oxygen is bivalent, so is sulphur, because in the new notation, for very sound reasons, we have doubled their own equivalent number, or ratio to hydrogen. The term valency, therefore, connects the new atomic notation with the old equivalent notation and represents facts.

Atomicity, on the other hand, represents hypothesis; it assumes a definite property of the atoms themselves, something in the actual constitution of the oxygen or sulphur atom which gives it a power of attaching to itself 2, 4, or 6 similar powers exerted either by separate monad atoms or radicals; or by 1 or more atoms possessing several similar powers themselves. Here we leave real facts, and enter upon a wilderness of guesses which may be true, but may also be false. It is in this connection we begin to dispute whether sulphur is dyad or hexad, for we know that sulphur unites to 2 atoms of hydrogen or chlorine, and calling its valency 2 expresses, therefore, this fact. We range the atoms according to our fancy, and we can develop 2, 4, or 6 imaginary links to the sulphur atom, but in calling its atomicity dyad or hexad, we only express our guess at the explanation of the facts. Sigma.

VALENCY.—To "Beacon Lough."

[3800.]—A very instructive dialogue, and one which, by the way, bears greatly on this subject, took place between two Frenchmen who were desirous of airing their English in Regent-street. A began by asking the lucid question "Did it rain to-morrow?" "Yes, it was!" was B's prompt and logical rejoinder. The pertinence and coherence of the queries and replies with which my good friend "Beacon Lough" favours me from time to time bear so strong a resemblance of qualities displayed in the above dialogue, that a suspicion has arisen in my mind that "Beacon Lough" is the identical B who framed the response to that difficult and portentous question. To render my meaning clearer I shall quote several passages in my amiable correspondent's letters, which will also serve to show the profound veneration which he has for truth, and the great care he displays in not contradicting himself. In letter 3420, page 460, "Beacon Lough" says: "Right or wrong, Dr. Frankland system of chemistry, with his atomicities, is taught in these (Government) classes. . . . . The text-book is necessarily somewhat meagre and skeleton-like, thus leaving ample room for the Mechanic to come in and fill it up, so to speak." Now I put it to the intelligent reader: What inference can be drawn from this juxtaposition of Dr. Frankland's name with "the text-book? If "Beacon Lough" constructs his sentences so as to leave the sense ambiguous (or rather that they mean the contrary to what he intends) surely I am not to be taxed with a want of verity. Acting on the self evident signification (and not the hidden meaning) of these words, I sought everywhere for a text-book emanating from Dr. Frankland, but I was assured by all to whom I applied that no such text-book existed. Consequently I denied, and still deny, that any of Dr. Frankland's works are at present text-books for the Government classes. Finding that I had taken the trouble to sift this matter, "Beacon Lough" now comes forward (letter 3742) to tell me that I am quite correct this time, and that Dr. Frankland's works are not the accepted text-books; but in order to qualify this he says my inference is quite the reverse, &c. What inference? Did it rain to-morrow, &c.? I must also call attention to the evident regard for real advancement contained in the opening words of the sentence "Right or wrong," &c. (letter 3420). In the same letter another very strong assertion is made—viz.: "these (atomicities) form the very life blood of modern chemistry," &c. But this assertion is only made to be contradicted, for at letter 3742, page 641, "Beacon Lough," with remarkable sang froid, tells me that "I must surely know" that the compounds I quoted—viz., K_2SiF_6, KBF_4, K_2PtCl_6, &c., are "all instances of molecular combination." Pray, how comes it, if "atomicities form the very life blood of modern chemistry," how comes it, I repeat, that above one thousand definite crystalline compounds exist, whose constitution is incompatible with, and inexplicable by the theory of "atomicities" (to use "Beacon Lough's" antiquated, loose, and ambiguous expression), and which require a new and distinct, though co-existent theory of "molecular combination"? I have already stated on various occasions that I placed very little reliance on the theory of valencies as it at present stands; but I must say that consequent upon thinking over the examples adduced by "Beacon Lough" I feel that the theory has even less basis than I was previously disposed to admit.

At letter 3742 we have a beautiful chain of reasoning, made, however, only to be immediately destroyed by the substance of the following sentence. I quote the passages, as it is important to keep them well in mind:—"It seems to me that if an element A combined with a monad atoms $x\ x\ x\ x$ and y, its atomicity must be equal to n, and that therefore when we find nitrogen combined with four monad atoms of H, and one monad atom of Cl, the only reasonable conclusion to which we can come is that N is a pentad." Immediately following upon this we are told that the compounds, K_2SiF_6, KBF_4, K_2PtCl_6, &c., are "all instances of molecular combination," or, in other words, not amenable to the same process of reasoning. This example alone is sufficient to show us what a tendency there is in the human mind to reject or lose sight of all that does not agree with its peculiar bent. Now, applying exactly the same reasoning as ... that my logical friend has applied to nitrogen, I also I should arrive at the conclusion that platinum is octavalent, for I might say, "It seems to me that if an element A combine with n monad atoms $x\ x\ x\ x\ x$ and $y\ y$, its atomicity must be equal to n, and that, therefore, when we find platinum combined with six monad atoms of Cl, and two monad atoms of K, the only reasonable conclusion to which we can come is that platinum is an octad."

A little farther on, another statement is made which has no foundation on fact. ... that when a chemist ... at the beginning of a series of ... adheres to them throughout. To confute this, I must give the names of a few books (I am loth to do so, for "Beacon Lough" says there are few errors that cannot be sustained by some book or other, though he quotes freely) in which exceptions are taken to the tables, &c., in the works. Beginning at W. Gregory's "Outlines of Chemistry," published 1848, where, in the table, the equivalents of phosphorus, arsenic, &c., are stated to be respectively 15·7, and 37·5, while in the body of the work the reader is requested to make the change to 31·4 and 75, &c.; coming on to Fownes, &c., until we arrive at such modern works as Odling's "Manual," Roscoe's "Elementary Chemistry," and Barff's "Chemistry," we find numerous examples of this, which is simply an acknowledgment of a recently-discovered fact, instead of a blind following of a theory. I will just point out the cases in the three last mentioned works, as they may interest the general reader. Professor Odling, in his "Manual," speaking of the elements of the chlorine group, points out their varying valency, while in the table of valency he classes them as monads.

Roscoe, in the table, puts tantalum and niobium as trivalent and pentavalent, while in the body of the work they are specified as pentavalent only. See pp. 279 and 253, edition 1871. Again, at p. 168, the elements of the nitrogen group are specially stated to be all *trivalent*, but at p. 174 their pentavalency is admitted. Barff, at pp. 210 and 211, states that oxygen, and other elements like it, are divalent; nitrogen, &c., trivalent, &c. At p. 260, he shows that nitrogen and phosphorus may be considered as pentavalent, and oxygen as tetravalent (see third edition of the above work, 1872). But the fact is, that in all these cases no contradiction is involved; it is simply a case of honestly stating the truth, whenever, or wherever found. Were I to find that a compound existed of the formula HCl_3, I should immediately call my readers' attention to the fact (even though I might have reached the middle of my lessons), and warn him not to consider hydrogen as constantly monovalent. Although, at p. 538, "Beacon Lough" says, "there are few errors which might not be accounted for by reference to some author or another," yet, at p. 641, he quotes "somebody" (not quite sure who) to prove something I have never denied; and taxes me with assigning bivalency to chloride, &c., when I have simply pointed out that the chlorine group is certainly monovalent as compared to hydrogen, although in the compounds I mentioned that such valency will not account for their existence, and would lead us to infer that they can act as triads, dyads, or pentads. This is a fact; and I truly sympathise with "Beacon Lough" when I find his pet theories must yield to facts. And now I think I am entitled to know what "Beacon Lough" requires me to do. At letter 3420 he states his object in writing to be, "not to get up an argument," &c., but to prevent that "lessons in the science which must tend to confuse the subject should be set forth in our pages." To meet this amiable proposal, as our kind Editor has not thought fit to take the hint, I would suggest that "Beacon Lough" should get up a series of lessons to replace mine. I am quite willing to withdraw, and shall much enjoy the examples of "molecular combination" to which we shall be treated. With regard to bringing my papers into conformity with the "legal system," I have already refused to do so, as I see no point of agreement betwixt legality and chemistry, except that they both terminate in y. Relative to the valencies assigned to the elements, I have distinctly stated (paragraph 21) that they *do* vary, and that my table of valencies, &c., was made out with reference to hydrogen only (see 34 at foot-note). I repeat, I have never even inferred that nitrogen, &c., does not sometimes act as a pentad. But I shall defer giving this group, pentavalency compared to hydrogen, until "Beacon Lough" or some one else has demonstrated the existence of NH_5, PH_5, AsH_5, &c. I note with pleasure that my lessons have been of some benefit to "Beacon Lough," and that he has adopted one of my ideas—viz.: that the valency of the molecule is independent of the valency of the component atoms (see 21) for his "molecular combinations" mean nothing, if not this.

In obedience to his wish, in conformity with the table given at 34 and the views held out at 21, I can represent the formula of ammonium chloride as being $\frac{1}{N'''H'_4}\ \frac{1}{H'Cl'}$, an instance, "as my learned friend must surely know of molecular combination."

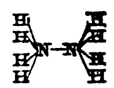
I avail myself of this occasion of correcting an erroneous statement which I made, regarding the valency assigned to sulphur by Dr. Frankland. As "Beacon Lough" did not specify which work he alluded to, I looked into a list of "atomicities" by Dr. Frankland, and there I found sulphur marked thus, = S''. I am now inclined to believe that this must be a typographic error, for on turning to my copy of the "Lecture Notes" I find that Dr. Frankland certainly does admit three different valencies. But this has no bearing on the point at issue, for, as I said before, the constitution of all known sulphur compounds can be easily explained by regarding sulphur as a dyad. Up to the present time no compounds of sulphur with hydrogen, corresponding to $S^{iv}H'_4$, or $S^{vi}H'_6$ are known to exist, and as I have taken hydrogen as the standard for valency, I feel that to be consistent I must consider it as bivalent only.

I must here take exception at the very unfair manner in which "Beacon Lough" twists "Sigma's" plain phrases into significations never intended. Now our talented friend "Sigma" stated that H_2SO_4 gave us a much better idea of the comportment of sulphuric acid in reactions in general, and electrolysis in particular than any other; but "Beacon Lough" proceeds to question him as if he ("Sigma") wished to institute a comparison between my (?) formula and Dr. Frankland's. Again, "Beacon Lough" does "Sigma" great injustice when he perverts his veritable meaning that "nothing but what is easy is to be admitted into science." "Sigma" indeed states H_2SO_4 to be easier of comprehension than $\left.\begin{matrix}SO_2\\H_2\end{matrix}\right\}O_2$ or $SO_2\left\{\begin{matrix}HO\\HO\end{matrix}\right.$, but he expressly enjoins us "to recognise the use of each, and, above all things, most carefully to avoid pinning our faith exclusively to any one idea or doctrine." Fortunately, for the progress of science, "Beacon Lough" ... he may persistently ignore them; so that until "Beacon Lough" can give us the graphic formula of the following compounds, which shall agree with Dr. Frankland's (or rather "Beacon Lough's") "atomicities," and their vapour densities, I must say that, as he prettily put it, he is "studying the shadow," instead of "getting the substance." The compounds I refer to are these:—Ammonium chloride, phosphorus pentachloride, chloric oxide, bromine pentachloride, iodine pentabromide, &c. As "Beacon Lough" finds himself unable or unwilling to give me the graphic formula of compounds referred to in my last letter, I shall, for the present, withhold them, but shall notice them in the course of my lessons. I take this opportunity of thanking "Beacon Lough" for the "amende honorable" contained in his last letter.

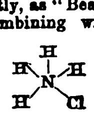
S. BOTTONE.

ATOMICITIES.

[3801.]—ALLOW me, through the medium of your paper, to call Mr. S. Bottone's attention to the atomicity of nitrogen in his letter (3470, p. 488). I cannot see, in the face of reason itself, how he can possibly make nitrogen anything else but a pentatomic element, even in his "terrible poser," Ammonium, which he states as NH_4, which is not exactly correct, the proper formulæ of which is $\left\{\begin{matrix}NH_4\\NH_4\end{matrix}\right.$, and the bonds of the nitrogen atoms consequently engaged, thus:—



four of the bonds of each being held by hydrogen, and the fifth bond of one of the nitrogen atoms is neutralised with the fifth bond of the other nitrogen atom, consequently it is a pentad. I quite agree with him, ammonium chloride is the monatomic radical ammonium united with one atom of chlorine; but he must take into consideration that the other four bonds of the nitrogen atom are engaged by the four atoms of hydrogen; consequently, as "Beacon Lough" says, it is a pentad, by combining with five monatomic elements, thus:—



The same may be said of ammonium carbonate, which is a similar example, thus:—$O = C < \begin{matrix}O - N \equiv H_4\\O - N \equiv H_4\end{matrix}$. Then, with regard to phosphorus pentachloride, I have always been led to believe that the five atoms of chlorine were united directly with the phosphorus, and I think Mr. Bottone's phospho-chloramine is merely a ruse to clear himself of a blunder. Also, allow me to call Mr. Bottone's attention to his last paper on chemistry (February 2nd, page 498), in which he states phosphorus to be a triad in phosphorus acid, when it is a pentad, thus:—P^vOHHo_2, or $H - O - \overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{P^v}} - O - H$, according to Dr. Frankland, whose views Mr. Bottone "holds in the highest respect," yet wanders so much astray from them.

MERCURIC.

AURORA BOREALIS.

[3802.]—APROPOS of Aurora borealis, I observed the last very carefully with spectroscope, and, owing to previous suspicion of the fact, observed it simultaneously with the light of a common candle, and found that the well-known green line almost, if not exactly, corresponds with a likewise green line shown (when you look down or at the end of the wick) by the spectrum of a common wax candle.

I have this moment verified the above statement. Looking at spectrum of lighted wick of common candle, you get five lines:—

180 = D, the yellow or sodium.
229·5 = D – E, one reddish-green line (seen with difficulty).
368·5 = E – b, the green line in question.
557 = F – G, a violet-blue line.
800 = G, a violet line.

In the auroral spectrum I thought I distinguished two lines, one the green, and the other too faint to fix its whereabouts, and this with a Browning's instrument of exquisite definition. The whole sky, irrespective of the auroral colour, shows this green line spectrum, which, however, is brightest on looking at the whitish-green light, and not so bright at the reddish, and is totally absent when there is no aurora.

CIRRS.

STARS.

[3803.]—I HAVE obtained, with my 8in. Alvan Clark refractor, the following observations of stars to which Mr. Burnham has called attention. The magnitude scale is one intermediate between those of Herschel and Struve, and has a light ratio of 2·512. In the case, however, of small stars near large ones, I doubt whether much weight is to be attached to magnitude estimates.

8 MONOCEROTIS.—P = 356·18°, D = 1·797". Small star, about 10 mag., and bluish.

4 MONOCEROTIS.—P = 178·60°, D = 3·385". Small star, about 10½ mag., blue. There is also a second minute companion, 11¼ mag., P = 244·1°, D = 10".

LALANDE 12936.—Near Sirius. P = 169·42°, D = 4·071". Small star, about 9½ mag.

40 ERIDANI.—The small star in the $s\ f$ quadrant mentioned by Mr. Burnham, I estimate of about 12½ mag. The Baron Dembowski mentions a star at a distance of 30" in the $n\ p$ quadrant. I fancied I glimpsed this star on March 4, but could not verify my suspicion on the following evening. There is a small star at a distance of about 100" in the same quadrant, of 12 or 12½ mag.

On March 6, I looked at the star No. 156 of the Pulkowa Catalogue, and thought it certainly oblong in a direction of 135°. I have not as yet come across any measures of it.

GEORGE KNOTT.

ASTRONOMY AND "THE ENGLISH MECHANIC" IN NEW ZEALAND.

[3804.]—YOUR useful and instructive periodical has always afforded us much pleasure and profit. We look for its arrival every month, for to it we are chiefly indebted for all the scientific news from the great centre of science. Astronomy being the principal subject of interest to us, perhaps it may interest some of your readers to hear what we have done out here. As this is but a young colony there are few persons who take much interest in scientific subjects, their time being mostly occupied with business; in fact, we do not know six persons in the province who take any interest in astronomy whatever; the consequence is that there is little demand for scientific instruments, books, &c., and we have great difficulty in getting them.

Our telescope we imported from Sydney; it is of 3in. aperture, and will divide stars 2" apart, as well as perform well on the planets, &c. We have lately been studying Orion, and can very clearly see the four stars in the trapezium, and sometimes when the atmosphere is clear have made out the fifth.

Our observatory is of our own construction, and answers very well; it is square and made of wood; the roof is divided into two parts, one of which is fixed and the other slides up and down on rollers. We find it easy to work, and was more readily constructed than any other shape might have been with our limited means and conveniences. The size of the building is 10ft. square, the highest part of the roof 6ft. 6in. high, and the lowest 6ft.; the movable portion of the roof is about 8ft. × 10ft. As the roof is covered with iron the slope is sufficient to throw off the rain. We have a 7in. transit theodolite which we use for transit purposes. The cost of the building for materials only was about £10. We have also a pretty complete assortment of meteorological instruments, an anemometer with Robinson's cups is fixed on the top of a stout post at one corner of the observatory, and two barometers are inside; the other instruments are in the garden.

In the above building we have spent many pleasant hours, and hope for many more. We hope ere long to be in a position to afford one of Browning's 8½in. reflectors; but, in the mean time, must be contented with the moderate aperture we possess.

Auckland, New Zealand. LAMBERT & TAYLOR.

THE MASTERY SYSTEM.

[3805.]—IF any one wishes to learn German, French, Spanish, or even Hebrew conversationally, let them by all means go to Longmans and procure "The Handbook to the Mastery System," price 2s. When convinced, as he will be, of the effectual way in which, by this method, languages are to be learnt, he will procure the particular volume he needs at the same price as the "Handbook." The epithet "mastery" is given to it because the language will thus be mastered in an incredibly short time.

A HARROW FELLOW.

FIG. 1.

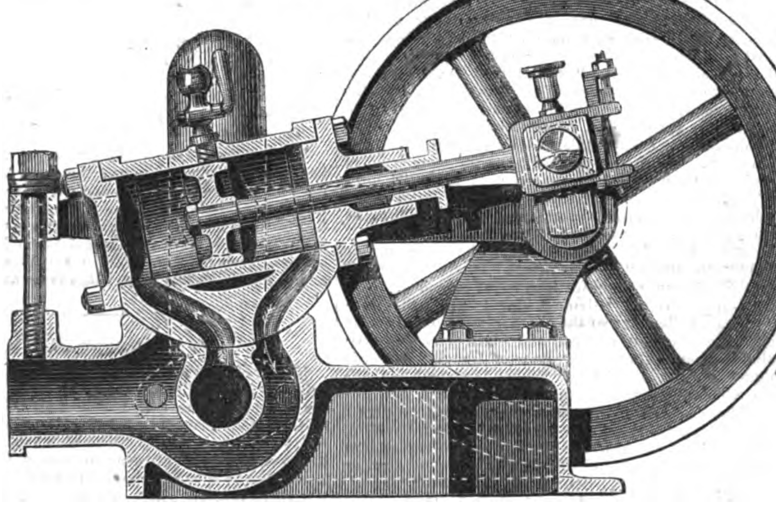


FIG. 2.

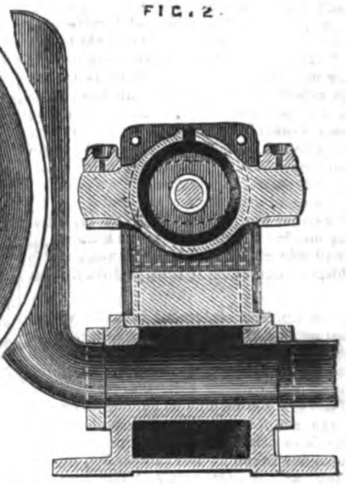


FIG. 3.

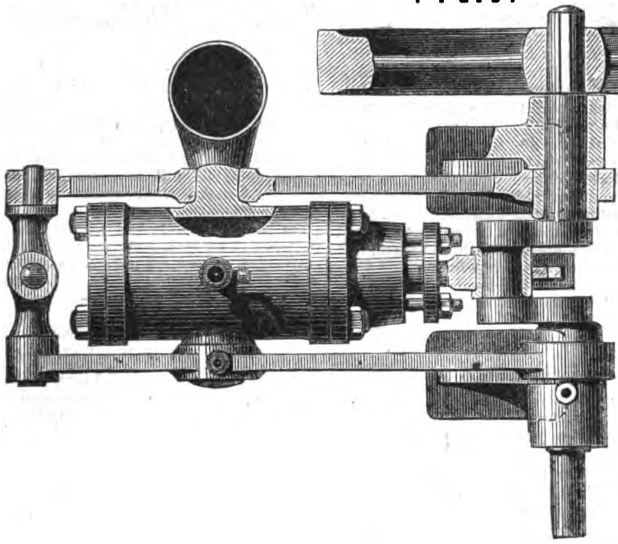
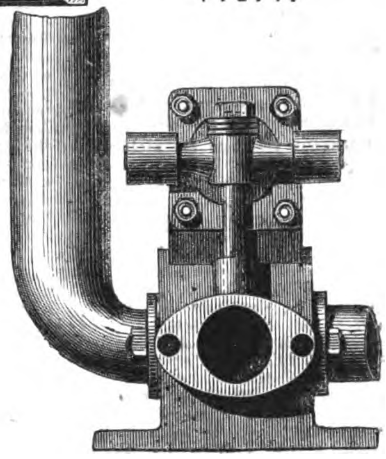


FIG. 4.



WATER-PRESSURE ENGINE.—FOR DESCRIPTION SEE PAGE 6.

THE GLORIOUS METRIC SYSTEM.

[3806.]—IT may not look well, Mr. Editor, that one who occupies so much of your space as your kindness allows me to do, should complain of another taking rather more than his share, but really it was scarcely reasonable for "E. L. G." to fill three columns in proving what nobody can think of denying, that more numbers may be divided without remainder by 6 and its multiples than by 10 and its multiplies, and that many fractions cannot be exactly expressed decimally. That is all well known, and is acknowledged to be a drawback to the metric system; but its advocates believe, notwithstanding those blemishes and the evident and serious inconveniences of change, that the advantages of the system when introduced will much preponderate, and it will need a far more forcible reasoner than "E. L. G." to shake that conviction.

It is a rule, with very few exceptions, that those who insist strongly upon a bad argument do so from conscious want of a good one, and it is another, nearly as invariable, that those who hope to conquer by argument will not descend to abuse; thus, when "E. L. G." tries to prejudice the case by talking of French Atheists and the pitiful bubble of their blowing, and asks the decimalists if it is yet quite certain that nothing but folly governed the metrical systems of all known races till the time of Marat and his Goddess of Reason, whether they were all fools to invent units divisible by 3, 4, &c., he must be very simple, or must rely very much upon the ignorance of his expected readers. To such arguments (to say nothing of their bad taste) there are two strong objections—first, the assertion is not true that no known races adopted the decimal system of coins and measures till the time of Marat; and, secondly, if true, it is nothing to the purpose. The Chinese, as everybody knows, do now use, and probably, from a time far before history, have adhered to and experienced the great advantages of, the decimal system; and, if it were a new system, that would be no more an argument against its use than it would have been against using logarithms when they were first invented.

"E. L. G." asserts (which is easier than proving) that if we decide to divide our measures of length, surface, capacity, weight, and money-value decimally, we must in consistency divide time and angles in like manner. He might as well say that those who decide to go to Uxbridge-road must, in consistency, go on to Uxbridge. I believe that the great ease with which decimally divided measures of length, surface, capacity, weight, and value may be learnt, the certainty with which they may be remembered, and the convenience with which they can be used, estimated, and compared with each other, will greatly counterbalance the trouble, cost, and inconvenience of the change, and therefore support the change; but, as I am not convinced that a decimal division of hours, and days, and years will be better than that now in use, I do not support that change, and deny that there is any inconsistency in declining to do so. We cannot divide the year of 365¼ days into equal periods of 10 days, but it can with a remainder of 1¼ day be divided into 52 weeks of 7 days each; there would, therefore, be no gain, but loss of convenience, in having 10 instead of 7 days, even if it were not the general feeling that it is right as well as expedient to leave every seventh day for rest. There is also no great advantage to be gained by dividing the day, as might be done, into 10 instead of 24 equal periods; it is not therefore worth while making the change.

The case is, however, very different with arbitrary measures for which any unit may be chosen or selected according to convenience; and it would palpably be very convenient if all nations with much intercommunication would use the same units and divisions, or, if not exactly the same, such as can be easily interchanged. For example, if our ton were made to correspond exactly, instead of very nearly, with the French Millier or million grammes, exactly instead of nearly equal to the weight of a cube metre of water; and if our sovereign were exactly equal in value to 25 francs, instead of being worth about 6 farthings more. It is true, there would be some inconvenience and cost in making the alteration, but the convenience of having our weights and moneys exactly interchangeable is far greater. If such simple changes were made, instead of two or three authorised tables of weight, avoirdupois, troy, and apothecaries, with two pounds of different weights and three systems of division, and others unauthorised, there would be one uniform weight, and one system of division; and that the simplest, most easy to add, subtract, multiply, or divide, to compare with any other, or to perceive at a glance ratios and percentages.

Of course, the full advantage will not be obtained unless all weights and measures of things to be bought or sold, as well as money, are divided decimally; but there is no reason why they should not be; and the only serious difficulty is in finding appropriate names for the new weights and measures which will not be confounded with those now in use, and easily spoken by Englishmen. With respect to money, there is no difficulty, as only one new coin, for which an old name may be revived, will be needed. If, by charging the cost of coining the sovereign, we reduce its value by 6 farthings to that of 25 francs, or divide it, as now, into 10 florins, 100 chequers, and enact that the pound shall be worth 1000 instead of 960 farthings, no other change will be needed than issuing coins (chequers) each worth 10 of those farthings, or twopence halfpenny, or one-tenth of a florin, or one-hundredth of a sovereign. The threepenny and fourpenny pieces should be called in, and no more half-crowns or sixpences coined. Shillings or half florins would be worth twelvepence halfpenny—that is, the value of the pennies would be reduced 4 per cent., and penny buns and penny newspapers would perhaps need to be made a little smaller. The cost of low-priced articles would soon be adjusted to the slightest change in the value of copper coins, and that is about all the inconvenience that would be left.

PHILO.

STELLAR AND ASTRONOMICAL NAMES.

[3807.]—WITH much humility I would ask why we should not name the stars as we do the craters in the moon? Why not deify our most distinguished lights of science after their departure to join the now sufficiently large number on the roll of fame and give each a bright particular star? Constellations might as far as possible keep together the names of those distinguished in one branch of science. Let us take Orion for example; the seven principal stars would be not α, β, γ, &c., but Ampère, Weber, Volta, Galvani, Oersted, Sturgeon, and Faraday—magnitude having no reference to eminence. By this means we should perpetuate the fame of the truly great men of the earth. Comets might be named after ballet-dancers and statesmen.

M. PARIS.

REMARKABLE ELECTRICAL PHENOMENON.

[3808.]—IN carrying out a series of experiments for the purpose of making uninsulated, or imperfectly insulated, wires available for telegraphy, I have met with a remarkable phenomenon which I do not know has been before observed.

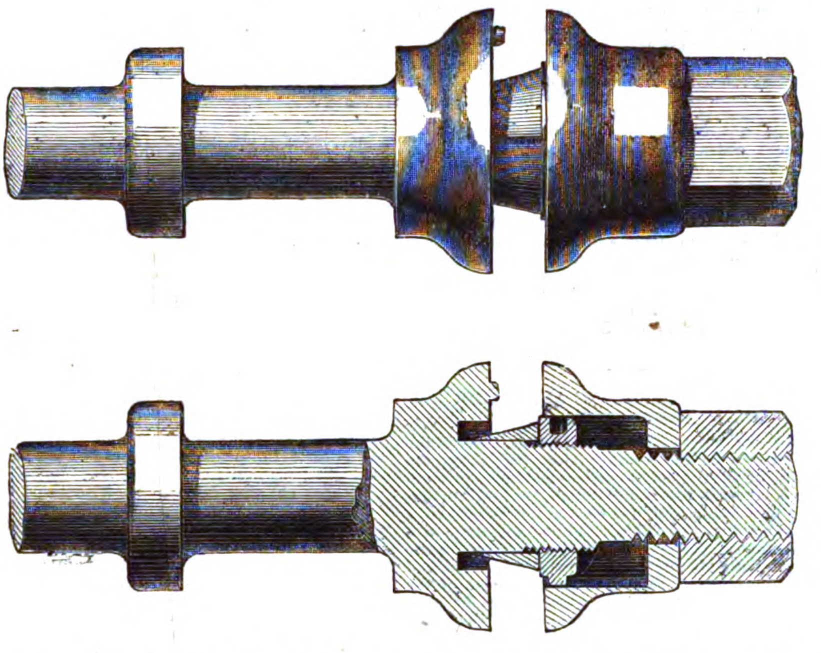
By the kind permission of the owners, I submerged a mile or two of naked wire in Wimbledon Lake, for experimental purposes; and I found that charging it with electricity of either name it retained the charge obstinately for many minutes. For instance, after attempting to discharge it at intervals of five seconds for three minutes, I found it still retained a very considerable portion of the charge, so that I have no doubt it would still have retained some portion after five or six minutes.

This may be due partly to polarisation (so called) of the wires, but I can scarcely think that this would continue for so long a time. I am inclined myself to attribute it to the electrisation of the strata of water surrounding the wires which, like the glass in a Leyden phial, require a considerable time to lose their polarity entirely. In salt water I find that the phenomenon almost disappears.

2, The Cedars, Putney. H. HIGHTON.

IMPROVED SPINDLE FOR CIRCULAR SAWS.

[3809.]—I FORWARD an illustration of Otley's patent saw spindle, which may interest those of your readers who employ circular saws. It is a simple device intended to avoid the difficulty experienced in adjusting circular saws on the ordinary spindle. A conical washer or ring, it will be seen, enters the hole in the saw to a greater or lesser depth, according to the size of the



hole. By means of the nut at the back this conical piece is forced home and makes the saw properly firm and truly centred. The illustrations explain themselves. I think the invention deserves the attention of saw-mill engineers. F. T. E.

AIR BLADDER IN FISHES.

[3810.]—I REGRET to find that the old Borellian theory relative to the use of the air-bladder in fishes still finds advocates in your valuable paper. It is upwards of twenty years ago since a paper was read at the Royal Society here on the subject, in which it was clearly shown that the air-bladder could have no influence in raising or lowering the fish in the water; in fact, no muscles exist in the fish adequate to compress the air-bladder so as to diminish its bulk, and should the fish be 34ft. below the surface, there are no muscles which could by any possibility expand it so as to take off the pressure of 15lb. on the square inch of this organ; in the latter case the air-bladder would be compressed to half its bulk. The primary use of the air-bladder would seem to be to keep the centre of gravity in the proper position, so that the whole effect of the force of the tail should operate in the progression of the fish. As the profile of the fish varies, the centre of resistance varies also, and if the centre of gravity were too high or too low, the force of the tail would cause the fish to rotate round its centre of gravity, but by having the direction of the tail force passing through these two centres, no rotation takes place. The air-bladder, then, is for regulating the position of the centre of gravity in the varying condition of the fish. In many fishes it is elongated so that the air can be located before or behind, as to produce the best effects; in the gurnard tribe and others it has lateral divisions, so that the fish can swim on its side, &c. There are other uses ascribed to the air-bladder of fishes, but the above I believe to be the most important.

Dublin. LATRATOR.

PROBLEM OF FIFTEEN SCHOOL GIRLS.

[3811.]—THE method of fulfilling the original conditions by transposing Mr. Proctor's letters occurred to me almost immediately after I had written my last letter, and I carried it still further, so as to get a more regular arrangement of the tables. I am even hoping to be able to deduce a *rule* from the tables thus transposed, which I will send if I succeed in my attempt.

L. C. E.

CONFECTIONERY, SUGAR BOILING, &c.—VI.

[3812.]—COMFITS AND PAN GOODS.—Have a comfit pan of any convenient size, suspend it from the ceiling at a convenient height to work it easy, have a charcoal fire or a stove to work it over to keep it warm, but not too hot. Have some dissolved gum not too thick. Boil some loaf sugar to 230° by the thermometer, keep it near the pan, and keep it warm; then take some coriander seed, carraway seed, or almonds, or anything you want to coat with the sugar. Put them in your pan, wet them slightly with the dissolved gum, then dust a little flour to just coat them, then add your sugar by degrees, keeping the pan well shaken all the time. To finish them boil the sugar rather less, leave what you want to colour in the pan, give them the colour in liquid, and shake them until dry, then colour the remainder separately.

I shall only give a few remarks on crystallizing, as it takes a great deal of time and trouble to crystallise goods, besides a warm room to keep the syrups in their proper degrees of heat while crystallising.

TO CRYSTALLISE COCOANUT CHIPS.—Take any quantity of cocoanuts, slice them up in thin slices, dry them in a warm stove, not so hot as to brown or shrivel them, and then place them in a tin box. Boil some sugar to 225°, pour it over the chips in the tin box so as to cover them, place them in a warm place, from 95 to 100° for 10 hours; then drain off the syrup from the chips, and place them again in the stove or warm room to dry. You can colour some red with a little colouring, but you must leave the syrup until a sort of skin forms on top before putting it on the chips.

SUGAR CANDIES.—Have tin or copper pans, with small holes opposite each other in each end of your shapes; put some twine across your boxes lengthways; then boil some loaf sugar to 230°, stand it aside until a skin forms on the top, then pour it in your pans, put it in a warm place, at about 100°, for a week; when well crystallised on the twine take it from the pans, wash it in just lukewarm water, then dry it again in the stove. You may colour it with any of the previous colours when boiling the sugar. You may make brown candies with the best raw sugar the same way as refined chocolate sweets.

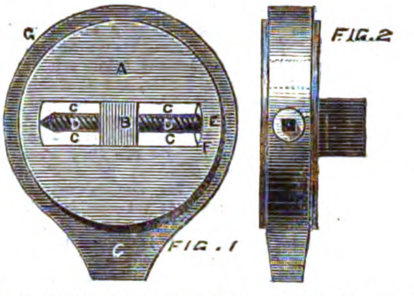
Get some pure chocolate powder, not that which is sold as prepared, but the powder without sugar being mixed with it. Boil some good raw sugar to 235°. Stand it aside to dispel the heat, then work it against the sides of the pan until it begins to grain or get creamy; then work in your chocolate powder; the quantity can be best judged by the strength of your sugar and chocolate powder.

I think by practice and perseverance in the recipes I have sent, any one having a little knowledge before will be able to make any of the plain or fancy sweets which I have named, and any difficulty the novice finds in making them I shall be most happy to clear up for him. I would give the directions for lozenges, &c.; but it would take a good space, and there must be separate rooms for making up, as it takes great cleanliness and care, but any recipes for mixing lozenges I will at any time send to subscribers through "our" journal.

L. W. D.

BOILER CONSTRUCTION AND MANAGEMENT.

[3813.]—I HAVE a great desire to arrive at a convenient two-horse motive power for my workshop. I am an amateur, and have no water-power or suitable place for windmill; have no gas for a gas-engine, and would not use one if I had; so I fancy I must look to steam. I cannot afford to keep a man to look after my steam, and so I write this hoping that some kind reader will give me his advice as to how to set to work, and his opinion on some crude ideas I shall set forth of my own. I have an engine just now, but from the bother

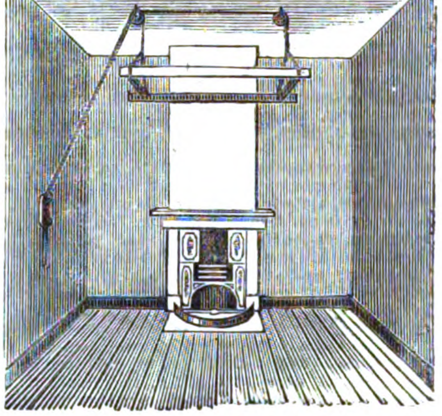


I have—first in firing, second in watching water, third in constantly regulating steam by opening or closing partially the steam-cock, and now and then blowing off some—the whole thing is almost useless. The greatest trouble is the water, and I have an idea of an adjustable eccentric which shall regulate the stroke of my pump in such a manner that after a few trials I may get the pump to throw enough to keep the water safe for at least an hour or an hour and a half. I should like an opinion on it. A is the eccentric wheel, with a slot in it, C C C. B is the end of shaft, squared to fit slot, and D D is a screw passing through B, having a collar at F, and a squared head at E. Fig. 2 shows a hole through ring G, showing square head of screw D D underneath. Now, by bringing the hole to coincide with E, and a key being applied, any amount of eccentricity can be given to A, and I imagine it might be adjusted to give the exact throw to keep the water pretty constant.

As to the boiler itself, I fancy a copper one, if the expense would not be too great. Perhaps some reader could give me an idea what a multitubular copper boiler for a two-horse engine would cost, or say how long an iron one would last with the fitful work it would have to do in the hands of an amateur (with pretty good water, however), say, four days in one week, one in the next, and perhaps nothing for the next six weeks. I fancy a damper in the flue, workable by an attachment near the lathe, would regulate the steam generation near enough, but I would like some hints; and, finally, could any of your readers do me the greatest kindness of all, by giving me good practical dimensions for a moderate running engine to suit? I fancy there is enough data given above for any one to see what I want. T. L. F.

A SUSPENDED CLOTHES HORSE.

[3814.]—I SEND you a rough sketch of what may be called "a suspended clothes horse." Its construction is both simple and cheap,—certainly no slight recommendations, though not the greatest. Everybody knows (of course I am speaking now of the working classes) how annoying and dangerous to health it is to have to dry clothes on a washing day in a house where children and grown-up people are alike exposed to the steamy atmosphere, and colds, coughs, &c., can scarcely be avoided where the old plan of drying clothes is adopted—viz., placing them on horses near the fire. The next better plan is to throw a line across the room, but even this is very inconvenient. The one I suggest



is made in the following manner:—Two scantlings of timber $1\frac{1}{2}$in. + $\frac{3}{4}$in., of such lengths as may be convenient and suitable to requirements, are fastened by two shorter pieces, say 18in. long, placed near each end as shown on sketch. A single and a double pulley are then fixed in the ceiling, the same distance from each other as the cross pieces are, and as near to the fire-place as may be convenient. A length of sash cord is then taken, the two ends of which are passed through the double pulley, one going to the single pulley through which it is passed; both ends are then secured to short loops of cord fastened to the cross pieces. The contrivance can then be raised and lowered at pleasure, and by means of a hook on the wall and knots tied in the cord, can be fixed at any height. This is no new thing, but I think it is not so generally adopted as it would be were it brought before the washing public, hence my apology for troubling you.

J. W. (Bradford.)

BEES, AND BEE-KEEPING.

[3815.]—BEES are now collecting pollen in large quantities, and, as they show great comparative activity, many bee keepers will be cheated into the belief that the dangers of wintering are over, and that this early activity denotes early swarming and a good honey crop. The Ides of March are come! Ay, Cæsar; but not gone! replied the soothsayer, who knew what was likely to happen, and ere they were gone Cæsar was no more: and although no soothsayer, I should like to warn amateur bee-keepers that although early spring has come, there is yet considerable cause for apprehension. Doubtless many bee-keepers will be glad to know what is likely to happen, but there are also many who will not heed warning or advice, and will not believe either until after the catastrophe. What is true of bees at one time is true of them at all times under similar conditions, and what has happened once will happen again when predisposing causes are similar, and as those causes vary, so will their results, and accordingly, as those predisposing causes are known and understood, so may they be governed and turned to good or evil. "Coming events cast their shadows before," and he is wise who is willing to pierce through them by the light of other people's experience. Prophesying after the event is easy enough, and hence it is not difficult for speculative bee prophets to give apparently good reasons for all sorts of failures after they have happened.

When bees are kept in straw skips, and have been deprived of their supers of honey in autumn, their ability to stand the ensuing winter could only have been judged by the weight of the hive and its contents, and taking into account the age of the comb; and although it may be ascertained whether the lower parts of the combs contain brood or not, it is almost impossible to determine what the comb actually contains, and a strong stock of bees which have stored their honey in the super, will, as they discontinue breeding, store pollen largely in the breeding cells, and consequently there may be more weight of pollen than honey in the hive, but of which fact the bee-keeper is, of course, blissfully ignorant. When early spring arrives, the hive is again judged by weight, and the bee-keeper congratulates himself on the fact of his bees having consumed so little honey. There may be plenty of bees in the hive at this time, but no brood, for the bees would be unable to commence breeding until they could gather honey; for the owner, judging by their weight, would think feeding quite uncalled for, and when the first season arrives, as it has done during the present month, the bees all go to work gathering little honey and much pollen, until they choke nearly all the cells with the latter, so that the poor queen has nowhere to deposit her eggs, and the stock dwindles during the summer from repletion of pollen, and to the surprise of its owner, perishes during the ensuing winter. This is the fate of hundreds of stocks of bees, good, sound, healthy stocks, which, if they could have begun breeding early, say in January, before pollen could be gathered, would by March be so charged with brood, which would have consumed so much of the old pollen, as to render repletion impossible. This argument is, in my opinion, one of the strongest against the use of hives with fixed combs, for if the bees were in movable comb hives, their autumn state could be correctly ascertained, and their condition in spring, as described, rendered impossible. I therefore strongly advise all persons who keep bees in hives in which the combs are fixed not to trust to weight alone as a guide to their condition, but to feed gently and continuously during all spring months.

Weak stock, such as those described by "Sixty Two," query 11046, p. 623, No. 362, should be treated in a similar way, and stimulated to their utmost. This cannot be done by giving them large quantities of food at once, but may be accomplished by patience and perseverance. To induce bees to commence breeding, it is necessary that a constant and regular supply of food should be given them, so as to induce them to think summer has come, when they will act accordingly, and when summer has come they will be fit for anything. Some writers on bees recommend honey as the best food for bees, and perhaps it is when absolutely pure, but I cannot too strongly advise bee-keepers against the practice of giving honey to bees, for it is in honey that the germs of foul brood are most likely to be contained, and to the use of it as bee-food the destruction of large apiaries is due. The mess which is sold by grocers and others as honey often contains both animal and vegetable matter—to wit, smashed brood and pollen, the result of the system which culminates in the brimstone pit, which finds a defender in Mr. Pettigrew,—and this said mess containing, as it does, all the elements of fermentation, is considered by eminent German apiarians to be the cause of that fearful disease which, in my opinion, is the only one thing which is a real obstacle in successful apiculture, and I fear nothing else, for all else is preventible.

Stimulative feeding should be performed as follows:—First, give the bees half a pint of syrup in such a way as they can get it easily; a bottle on top is best, so that they can suck it through perforated zinc, this will give them a sort of fillip and put them in good heart, then without removing the perforated zinc, procure a piece of plain zinc or tin, and punch three or four small pin holes in it, on which place your feeding bottle, and set the whole on the perforated zinc. By this means the bees will only be able to take the syrup very slowly, but the supply should continue for a long time, care being taken that the bees do not take in more than half a pint per day for the first two or three weeks, which may, of course, be regulated by the size and number of the holes in the plain zinc. There is very little trouble in this mode, and the bees do not get so excited by day after a short time, as they do when food is given them by fits and starts.

Stocks that are known to be strong and healthy require little attention at present, as they will be ready with their thousands at the right time, but the chief present difficulty lies with those above described, and it is curious to witness the apathy of bee-keepers in the matter. The chief value of a stock of bees is in having it strong in numbers when honey abounds, and to insure that, is one of the greatest arts in bee-culture, yet many never think of their bees until the fruit trees are in blossom, and it is often only then that many stocks are enabled to commence breeding at all.

The past few days have set all stocks breeding in a greater or less degree, as is evidenced by their carrying so much pollen, but it must be evident to the most superficial observer that very little honey is obtainable, and as there is a very probable chance that a spell of March weather will shortly come roaring among us, when the bees will not be able to go out at all, I wish to caution amateurs and novices against the impression which prevails, that bees have been storing honey which will help them through a spell of rough weather. Really, the very opposite is the case, for the bees have been deluded into the belief that summer is at hand, and that mild bright weather will continue, and have acted accordingly, impoverishing themselves by their instinctive desire to propagate their own species, so that if a spell of weather should imprison them, many stocks will be in considerable danger for want of continued supplies.

The same course should be adopted with them as with stocks which have been artificially induced to commence breeding; they should be fed liberally and continuously until the weather breaks and they can get abroad again.

The best food for bees is made of 5lb. of best loaf-sugar boiled in two pints of water. The addition of a wineglassful of vinegar will prevent the sugar re-crystallising.

Moist sugar or beer should not be used, as they both contain fermentative principles, and when mixed with pollen might act as the honey aforesaid.

C. N. ABBOTT.

COLLIERY EXPLOSIONS AND THEIR PREVENTION.

[3816.]—IN my last letter I said that most of the letters written on the above subject had shown the ignorance of the subject the writers had taken in hand. I did not say so as regarded "Philo's," as hitherto that was the only letter that had treated the subject in a practical manner, and I think "Philo" will agree with me that most of the suggestions put forward for the better ventilation of mines, &c., were rather absurd, and quite justified what I said as to the ignorance of the writers on the subject, and I am sorry that he calls my politeness in question, as nothing was further from my mind than any thought of being personal in the letter. In the three cases of loss of life mentioned in my last letter, I omitted to mention their cause; not one of them was caused by gas; two of the deaths were caused by falls of coal through insufficient propping when holeing, the remaining one by a corf running over a man.

Now I agree with "Philo" that where wilful neglect on the part of a mine owner for the safety of his workmen causes the death of a man, he is morally guilty of causing that death, but in an accident in the literal sense of the word he is not guilty, and yet I understand "Philo" would make him responsible for these also. As to "Philo's" project for insurance of collieries, I very much doubt if the known recklessness of colliers in fiery districts (where carelessness of colliers could be cause of explosions), would not have the effect of raising the rate of insurance to much more than he says. On my remarks as to the recklessness of colliers, he does not reply, so presume he agrees with me on that point. In my last I admitted that the small collieries did require much improvement. If "Philo" will examine the different inspectors' reports, he will find that it is the small collieries that swell the large total of deaths each year, and where the men in authority are often badly paid, and of little experience, and where the owners cannot go to a great expense in laying out their colliery, and providing the best machinery, &c. KING COAL.

A NEW GUTTAPERCHA.

[3817.]—I BEG to call the attention of the readers of the ENGLISH MECHANIC interested in the question, to a tree of Queensland which deserves an investigation, viz., the Mimusops parviflora, of the Sapodilla order or Sapotaceæ. This tree has a thick milky sap, in taste resembling fresh cream; the same peculiarity with the massaranduba (Mimusops elata) and the balata (Mimusops balata), on which I gave notes in an earlier number of this paper. The balata seems to be, for several purposes, an excellent addition to caoutchouc and guttapercha. Of the use of the massaranduba in Europe I cannot find any mention; perhaps it is confounded with balata by the trade.

I will try to give, in a future number, a list of all the caoutchouc and guttapercha yielding trees. I am for the moment arranging a classification of about 800 tanning materials, with notes on the principal of them.

Melle, near Ghent. BERNARDIN, Museum Curator.

POWER OF HIGH PRESSURE ENGINE.

[3818.]—A PORTABLE engine near me, with two 8in. cylinders, is driving two pairs of 4ft. millstones and a flour-dressing mill (bolter) with about 1cwt. of coals per hour. There has been an iron chimney with two bends erected about 40ft. high; the result was a good draught to raise the steam in less time than before, but with a larger consumption of coals they could with difficulty drive one pair of stones. It was tried in various ways, with and without the exhaust turned into the chimney, but it would not do, and the tall chimney is standing disused, and the chimney on the engine was again replaced.

With the tall chimney this engine is almost identical with "Inquirer's," and leads me to suppose that the 50ft. iron chimney has more to do with his unsatisfactory position than anything else, and I believe the erection of a good brick shaft will yield a more satisfactory result than the same sum spent in law.

Many years since a friend erected an iron chimney which was not satisfactory, and a brick shaft was substituted with very great advantage; this was a high pressure engine, driving two or three pairs of stones. I am working a 7½in. cylinder at 50lb. pressure on a portable engine, or more properly a stationary engine, on multitubular boiler, with rather under ½cwt. of coals per hour, driving one pair of 4ft. 4in. millstones, grinding from three to four bushels of wheat per hour, with which I am very well satisfied. I believe the unpleasant humming of the portable engine is caused by the vibration of the ash-pan. When my engine was used as a portable the noise was deafening; now it is fixed on a brick ash-pit there is no sound but the beat of the exhaust. R. R. SMITH.

LIGHTNING CONDUCTORS.

[3819.]—HAVING had a small bone to pick with "Philo" on my own account, I may as well point out to him his own errors, seeing his facility in providing errors for others. (N.B.—Fault-finding is exhibited thus in two distinct modes.)

Professor Henry is *not* mistaken in recommending rods as lightning conductors, but "Philo" (let. 3733, p. 638) most certainly *is* mistaken, for he asserts "that it is the surface that carries the electricity," whereas it is the mass of metal, and the surface has not the very smallest concern in the matter. Copper is best even if very much smaller, not because it is less liable to rust, but because it is a better conductor. All metallic portions of the exteriors of buildings, gutters, down-pipes, and so on should be connected to the conductor, and that to gas and water pipes, but gutter pipes are not reliable in themselves because of the breach of conducting continuity at the joints.

Without entering into the point debated between "Philo" and "F. R. A. S.," and without adjusting the relative weight to be given to the opinions of Sir John Herschel and "our" "F.R.A.S.," I beg to protest against the definition of the latter by "Philo" (let. 3730, p. 637), as one "whom we do not know." We do actually know "F. R. A. S." a great deal better than we know Sir John Herschel. The name in such cases is simply an indicator to the mind whose expression of opinion we are listening to. The name Sir John Herschel merely tells us that an opinion comes from a mind whose judgment has been ascertained and valued by others. The name "F. R. A. S." *in these pages* does exactly the same; it tells us that an opinion he expresses comes from a mind whose powers have been very fully shown and tested, and which we are, therefore, able to value for ourselves; his own actual name at the most could only tell us whether it was recognised outside of "our" pages, but as we, at all events, well know the man, *i.e.* the mind, the mere possession of his personal name could add in our judgment, no more weight to his statements than would the information that he stands six feet high, or wears a moustache. People who judge by names rarely have much judgment of their own. SIGMA.

CONNECTING LINKS IN THE NATURAL HISTORY OF CREATION.

[3820.]—I HOPE "A Lover of Truth" (letter 3471, p. 640), will not be very angry with me for telling him that he has been sold. The "monkey-fish of Japan," (Barnum's mermaid under a new name), instead of being "a connecting link in the natural history of creation," is simply a manufactured monstrosity.

In an article, "De Monstris," in this month's *Dark Blue* magazine, the Rev. .. G. Wood (whose authority I hope will be enough for 'A Lover of Truth") says the following apropos of this subject:—

"I cannot leave the subject of monsters without a short reference to the Japanese mermaids, which are now and then brought before the public. These are nearly all made to represent the conventional idea of mermaids, except that the upper half is formed in semblance of a monkey and not of a human being. They are quite common, and are manufactured by dozens, most of the makers adhering to the same type, but one or two striking out original ideas of their own. They are well made, but not so well as is generally thought. The late Mr. Waterton, whose skill in taxidermy was supreme, had an entire contempt for

Japanese mermaids, which he stigmatised as clumsy fabrications, saying that he could make better work with his left hand. Certainly the amusing monstrosities which he made, and with which he delighted to delude visitors to his collection, were much superior to the best Japanese mermaid that I have seen. Some years ago a fishmonger in the old Hungerford Market showed me one of these mermaids, and was quite angry with me when I praised the excellence of its manufacture. He really believed that it was a genuine inhabitant of the water, framing his belief on the fact that there was no junction between the fish and the maid. Neither was there. The Japanese taxidermist knew his business too well to have any junction at all, the seeming skin being nothing but the papier-mâché worked over a model, and having fins, scales, teeth, and nails inserted in the proper places."

Will this satisfy "A Lover of Truth"? WILSON.

LIFE IN DARKNESS.

[3821.]—I THINK Professor Thomson must have been misunderstood, for the dictum that "life cannot exist in darkness" is totally opposed to known facts. I send an extract from Hartwig's "Subterranean World," which, although, possibly not conclusive on the point in question, cannot fail, I imagine, to interest many of your readers:—

"While subterranean vegetation is exclusively confined to mushrooms, animal life of almost every class has far more abundant representatives, for plants are in general much more dependent on the vivifying influence of light. The various animals which are found dwelling in caves may be subdivided into two groups; one, which, though preferring darkness, and spending a great part of its existence under the earth, yet often voluntarily seeks the light of day, or at least wanders forth at night; while the other is exclusively subterranean, and is never seen above the surface of the earth, unless by chance or when driven up by violence.

To the first group belong most of the insectivorous and rodent quadrupeds that dwell in self-made burrows, or pursue a subterranean prey, such as the armadilloes and the moles. The large family of the bats likewise love to sleep by day, or to hibernate in warm and solitary caves, where they are sometimes found in numbers as countless as the sea-birds which flock round some rocky island of the north. When Professor Silliman visited the Mammoth Cave (October 16, 1822), he everywhere saw them suspended in dense clusters from the roofs, though a large number had not yet retired into winter-quarters. In a small space, scarcely four or five inches square, he counted no less than forty bats, and convinced himself that at least one hundred and twenty find room on a square foot, as they held not only by the surface of the walls of their retreat, but by each other, one closely crowding over another. Such clusters are found in the interior of the cavern, which branches out in many directions as far as two miles from the entrance, so that a very superficial survey allows them to be counted by millions. Who, in these dismal regions, where no change of temperature or of light announces the various seasons, tells them that the reign of winter is past? who awakes them at the proper time out of the deep sleep in which they remain plunged for months? The same mysterious voice of instinct which regulates the migrations of the birds and the wanderings of the fishes, and which in this case, as in every other, is equally wonderful and incomprehensible.

In the class of birds we find many cave-haunting species. The pigeons like to nestle in grottoes, which also serve as welcome retreats to the moping owl; and various swallows and swifts breed chiefly in the darkness of caverns. One of the most remarkable of these troglodytic birds is the guacharo, which inhabits a large cave in the valley of Caripe, near the town of Cumana, and of which an interesting account has been given by Humboldt, who first introduced it to the notice of Europe.

The *Cueva del Guacharo* is pierced in the vertical profile of a rock, and the entrance is towards the south, forming a noble vault 80ft. broad and 72ft. high. The rock surmounting the cavern is covered with trees of gigantic growth, and all the luxuriant profusion of an inter-tropical vegetation. Plantain-leaved heliconias, and wondrous orchids, the Praga palm, and tree arums, grow along the banks of a river that flows out of the cave, while lianas, and a variety of creeping plants, rocked to and fro by the wind, form elegant festoons before its entrance. What a contrast between this magnificently decorated portal and the gloomy mouth of the Surtshellir, imbedded in the lava wildernesses of Iceland! As the cave at first penetrates into the mountain in a straight direction, the light of day does not disappear for a considerable distance from the entrance, so that visitors are able to go forward for about 430ft. without being obliged to light their torches; and here, where light begins to fail, the hoarse cries of the nocturnal birds are heard from afar.

The guacharo is of the size of the common fowl. Its hooked bill is wide, like that of the goat-sucker, and furnished at the base with stiff hairs directed forwards. The plumage, like that of most nocturnal birds, is sombre brownish gray, mixed with black stripes and large white spots. The eyes are incapable of bearing the light of day, and the wings are disproportionately large, measuring not less than 4½ft. from tip to tip. It quits the cavern only at nightfall, especially when there is moonlight; and Humboldt remarks that it is almost the only frugivorous nocturnal bird yet known, for it does not prey upon insects like the goat-sucker, but feeds on very hard fruits, which its strong-hooked beak is well fitted to crack. The horrible noise made by thousands of these birds in the dark recesses of the cavern can be compared only to the wild shrieks of the sea-mews round a solitary bird mountain, or to the deafening uproar of the crows when assembled in vast flocks in the dark fir-forests of the North. The clamour increases on advancing deeper into the cave, the birds being disturbed by the torch-light; and as those nestling in the side avenues of the cave begin to utter their mournful cries when the first sink into silence, it seems as if their troops were alternately complaining to each other of the intruders. By fixing torches to the end of long poles, the Indians, who serve as guides in the cavern, show the nests of these birds, 50ft. or 60ft. above the heads of the explorers, in funnel-shaped holes with which the cavern roof is pierced like a sieve.

Once a year, about midsummer, the guacharo cavern is entered by the Indians. Armed with poles they ransack the greater part of the nests, while the old birds, uttering lamentable cries, hover over the heads of the robbers. The young which fall down are opened on the spot. The peritoneum is found loaded with fat, and a layer of the same substance reaches from the abdomen to the vent, forming a kind of cushion between the birds' legs. The European nocturnal birds are meagre, as, instead of feasting on fruits and oily kernels, they live upon the scanty produce of the chase; while in the guacharo, as in our fattened geese, the accumulation of fat is promoted by darkness and abundant food. At the period above mentioned, which is known at Caripe as the "oil harvest," huts are erected by the Indians with palm leaves near the entrance, and even in the very porch of the cavern. There the fat of the young birds just killed is melted in clay pots over a brushwood fire, and is said to be very pure and of a good taste. Its small quantity, however, is quite out of proportion to the numbers killed, as not more than 150 or 160 jars of perfectly clear oil are collected from the massacre of thousands.

The way into the interior of the cavern leads along the banks of the small river which flows through its dark recesses; but sometimes large masses of stalactites obstruct the passage, and force the visitor to wade through the water, which is, however, not more than 2ft. deep. As far as 1,458ft. from the entrance the cave maintains the same direction, width, and height of sixty or seventy feet, so that it would be difficult to find another mountain cavern of so regular a formation. Humboldt had great difficulty in persuading the natives to pass beyond the part of the cave which they usually visit to collect the oil, as they believed its deeper penetralia to be the abode of their ancestors' spirits; but since the great naturalist's visit, they seem to have abandoned their ancient superstitions, or to have acquired a greater courage in facing the mysteries of the grotto, for, while they would only accompany Humboldt as far as 236 fathoms into the interior of the cave, later travellers, such as Codazzi and Beaupertuis, have advanced with their guides to double the distance, though without reaching its end. They found that beyond the furthest point explored by Humboldt the cave loses its regularity, and has its walls covered with stalactites. In the embranchments of the grotto Codazzi found innumerable birds. It was formerly supposed that the guacharo was exclusively confined to this cave; latterly, however, it has also been found in the province of Bogota.

The discovery of animals adapted for perpetual darkness is but of modern date, and as the vast majority of caves have not yet been thoroughly explored by zoologists, the number of genera and species already known gives us reason to believe that future investigations will add considerably to their number. In the Adelsberg, Lueg, and Magdalena grottoes, which form but an inconsiderable part of the extensive cavernous regions of Carniola, seven exclusively subterranean insects, one spider, two scorpionides, one millepede, two crustaceans, one snail, and one reptile—in all fifteen different species of animals, belonging to no less than six different classes—have been found.

Among these dwellers of the dark, warfare is as rife as in the regions of light. Thus, in the recesses of the grotto of Adelsberg, the cavern beetle (*Leptodirus Hochenwartii*) is persecuted and devoured by the scorpioniform *Blothrus spelæus*, and by the eyeless spider (*Stalita tænaria*). The black and brown Leptodirus discovered in the grotto of Adelsberg in 1831, by Count Hochenwart, is distinguished by long and delicate antennæ and legs, and comparatively small translucent and smooth elytra. The unique specimen found at the time was unfortunately lost, and although twenty-five florins were offered to the cavern guides for one of these beetles, fourteen years passed before it was re-discovered in the same cave. Since then other collectors have been more fortunate, particularly Prince Robert Khevenhüller, who, during his repeated visits to the cave of Adelsberg, captured no less than twenty specimens of the Leptodirus.

Cautiously feeling its way with its long antennæ, the beetle slowly ascends the damp stalactital columns, and accelerates its movements at the approach of a light. The greater number were found in the evening, thus giving reason for supposing that the leptodirus is a nocturnal beetle, although it is hardly possible to conceive how the alternating influence of night and day can still be felt in these regions of darkness. The manner in which it is pursued by the eyeless blothrus (discovered in 1833, by Mr. F. Schmidt), has been several times observed by Prince Khevenhüller. He once saw one of these cavern scorpions slowly crawling along, stretching out its palpi in all directions, and evidently on the search. He immediately guessed that the animal was engaged in a hunting expedition, and soon found that he was not mistaken, for a fine Leptodirus was crawling about 4ft. higher on the opposite wall. For a long time the Prince left the two insects undisturbed, until he had thoroughly convinced himself that the movements of the Blothrus were evidently regulated by those of the Leptodirus, and that the former was, beyond all doubt, in pursuit of the beetle. A Leptodirus having been thrown along with a Blothrus into a phial, was immediately cut to pieces and devoured.

The eyeless cavern spider (*Stalita tænaria*), with brownish palpæ and a snow-white abdomen, is not seldom found in the hollows of the stalactites, lying in wait for the unfortunate Leptodirus. On the surface of the earth spiders are frequently obliged to fast for a very long time; but in caverns where life is so sparingly distributed, the patience of the Stalita must be exemplary, even among spiders. Her appearance on the snow-white stalactital columns, where she only becomes visible when illumined by the full light of a taper, is very striking. Like a vision, she sweeps away in her ivory robe, accompanied by her increasing shadow, until she finally disappears in the darkness. Torches are not allowed to be carried in the grotto of Adelsberg, that the whiteness of the stalactites may not be tarnished by the smoke.

But the largest and most interesting of all the European cave animals is undoubtedly the Olm (*Proteus anguinus*; *Hypochthon*). This enigmatic reptile was first found in the famous lake of Cirknitz, which, communicating with numerous subterranean caves, alternately receives and loses its waters through openings in the rock. After long and heavy rains the floods, which the hidden vaults are no longer able to contain, gush forth in foaming cataracts, and the lake, which generally forms but a long and narrow channel, then swells to at least three times its ordinary width. Sometimes, after a long drought, the contrary takes place, and the whole lake disappears under ground. Thus, from December, 1833, to October, 1834, not a trace of it was visible, so thoroughly had it concealed itself in its subterranean reservoirs, where its fishes, secure from the persecutions of man, multiplied in a remarkable manner. The olm, which only casually comes to the light of day, along with the overflowing waters of the Cirknitz Lake, was first discovered in 1814, in one of its permanent subterranean abodes. The Magdalena or "Black Grotto" situated about a league to the north of Adelsberg, slants abruptly into the bowels of the mountain. After a long and difficult passage over blocks of stone or through soft mud, a tranquil pool is at length reached, which rises or falls simultaneously with the waters of the Poik, and proves, by this reciprocal action, that in all probability, all the numerous grottoes and subterranean river channels of this so strangely undermined country form but one vast and intricate network. It was in this pool, which no light illumines and no wind ever stirs, that numerous Protei were first discovered; but as hundreds of specimens have since found their way to the cabinets of naturalists, to be observed, dissected, or bottled up in spirits, their number has very much decreased, and the time is perhaps not far distant when they will be entirely extirpated in the grotto, where from time immemorial they had enjoyed an undisturbed security. The Proteus is one of those remarkable reptiles which breathe at the same time through lungs and gills, having on each side of the neck three rose-red branchiæ, which it retains through life, as its lungs are but imperfectly developed. It has a long eel-like body, with an elongated head, a compressed tail, and four very short and thin legs. The skin is flesh-coloured, and so translucent that the liver and the heart, which beats about fifty times in a minute, can be distinctly seen underneath. In spite of its apparent weakness, it is able to glide rapidly through the water. Its four little legs remain immovable while swimming; they are only used for creeping, and then in a very imperfect manner. During rapid movements the gills swell and assume a lively scarlet colour; when quiet, they collapse and become white like the rest of the body. Sometimes the animal raises its head above the water to breathe, but pulmonary respiration evidently plays but a secondary part in its economy, as it can only live a very short time out of the water. The skeleton consists almost entirely of cartilage. The eyes, two little black spots, lie buried under the skin, and, as may well be imagined, are very imperfectly developed. Although more than a thousand specimens have been observed, yet but little is known about its mode of life, nor has it been ascertained whether it is oviparous or brings forth live young. In a captive state the Proteus is able to live for several years without any apparent food; but on fastening a small worm to the extremity of a thin stick, and holding it under the water close to the head of the reptile, it shoots rapidly towards it, swallows it with the same velocity, then ejects it again, and repeats this manœuvre several times, until it finally retains the morsel. The untiring zeal of the German naturalists has discovered the Proteus in thirty-one different caverns, and ascertained seven distinct species, varying by their size, the form of the head, the position of the eyes, and the colour of the skin. Six of these species belong to the caverns of Carniola, and the seventh to those of Dalmatia. Two different species never inhabit the same cavern.

During the visit which the Archduke Ferdinand paid, in 1819, to the Magdalena Grotto, the most remarkable parts of the cave were brilliantly illuminated, so as to produce a magical effect. Charon's boat, issuing from a dark recess, came gliding along over the black surface of the pool. The grim ferryman drew up his net before the august visitors, and presented them with six Protei that had been entangled in its meshes. Dr. Schmidl mentions part of the subterranean river in the Planina cave, 1,715 fathoms from the entrance, as the spot where the Protei are most abundant. Near to a small cascade which the rivulet here forms over a reef, the waters absolutely swarm with them, and the light-coloured animals, darting about in all directions in the dark stream, afford a strange and picturesque spectacle. As the cavern is of most difficult access, they here enjoy a tranquility rarely disturbed, and no doubt they have many other still more hidden retreats, to which man is incapable of penetrating. The best method for transporting the Proteus is now perfectly understood, and living specimens have been conveyed as far as Russia, Hungary, and Scotland. All that they need is a frequent supply of fresh water, and a careful removal of all light. Their food need cause no trouble, as the water contains all they require. It is recommended to lay a piece of stalactite from their native grotto in the vase in which they are transported. When resting or sleeping, they then coil themselves round the stone, as if tenderly embracing it. In this manner they have already been kept above five years out of their caverns. The guides to the Grotto of Adelsberg have always got a supply on hand, and sell them for about two florins each.

On turning our attention from the grottoes of Carniola to those of the New World, we find, in the vast Mammoth Cave in Kentucky, a no less interesting animal creation, which, though different from that of the Austrian caverns, still shows a certain family resemblance, and affords another proof that a similarity of external circumstances always produces analogous forms of organic life. Thus, the two blind beetles which are found in the Mammoth Cave belong to the same genera (*Anophthalmus* and *Adelops*) that have also their representatives in the grotto of Adelsberg. The largest insect is here a species of cricket, with enormously long antennæ; there are also two small white eyeless spiders and a few crustaceans. The Mammoth Cave has no preteiform reptile to boast of, but a peculiar blind rat and a peculiar blind fish.

The cavern rat, which is tolerably numerous, but which, on account of its remarkable timidity, seldom shows itself, differs from the common or Norway rat, by its bluish colour, its white abdomen, neck, and feet, and its soft hair. It has large black eyes, like those of a rabbit, but entirely destitute of an iris, and uncommonly long whiskers, as if Nature had wished to indemnify it for the loss of sight by a more perfect development of the sense of touch. Although the eyes of this rat are large and brilliant, yet Professor Silliman convinced himself of their perfect insensibility to light. All proof is wanting that it ever visits the upper world.

The blind fish (*Amblyopsis spelæus*) is now become tolerably rare from its having been so frequently fished out of the Lethe stream, as the subterranean river of the Mammoth Cave is called. Many physiologists have already made it the subject of their observations, and are generally of opinion that the Amblyopsis was not originally blind, but that, having found its way into the cave, it gradually lost its powers of vision. The celebrated naturalist Agassiz, however, being perfectly convinced that all animals existing in a wild state have been created within their actual bounds with all the peculiarities of structure which distinguished them at the present day, is of opinion that the blind fish and all the other blind animals of the Mammoth Cave are the aboriginal children of darkness, and have at no time been connected with the world of light."

SAUL RYMEA.

ORGAN FEEDERS.

[3822.]—THE arrangement given by "A Young Organist" (letter 3746, p. 642) was described to me by an organ builder two years ago. He called it the French double feeder, and I have a drawing of it, which corresponds almost exactly with that given in the ENGLISH MECHANIC. I have not seen it used, but was given to understand that it was very useful where much wind was required from a small bellows space.

A MERE NOVICE.

HOW WE SEE DISTANT OBJECTS.

[3823.]—ON the 2nd ult. you were so kind as to insert my letter (3493, No. 358), asking Mr. Proctor to explain how the mirror became visible to the spectator under the conditions mentioned. Not having up to the present seen his reply in your pages, I conclude that my letter has either escaped his notice or that press of business has prevented him from sending you the necessary explanation. I will now take the liberty of drawing the attention of your very clever correspondent "F. R. A. S." to the problem, and hope he will kindly supply the explanation thereof. There is a theory called the microscopical, which states that the most polished surface is microscopically rough, and that from the atomic prisms certain rays are reflected in every direction, thus enabling the spectator to see the illuminated object. But it seems to me that the light would be so dispersed, that in the case of a mirror we could not expect to see an object distinctly reflected. But suppose the mirror be removed, and the dark screen transferred to the opposite side of the room so as to prevent the tiny ray of light from being reflected from the opposite wall, we shall see the ray as it passes across the room, but there is nothing to reflect any part of it to the eye of the observer or the camera. Will it be asserted that the atmosphere of the room reflects a portion? if so, it must be again and again reflected, so that in a short distance it would be lost. An old theory, I believe, was at one time held —supposing that the eye had the power of directing the electricity (which is everywhere) on a distant object (illuminated), and receiving back the correct image thereof, the convex lens having the same power. I hope the gentlemen I have asked to explain this will kindly do so, as I think it is deserving of their attention.

E. J. D.

FLOW OF WATER.

[3824.]—I BELIEVE "our" correspondent J. T. Holehouse (letter 3745, page 641) has mistaken the formula. The one that he gives is applicable to "pipes" and conduits when flowing full; but for open channels he will, I doubt not, find that given by me more applicable. Now, using his formula, $V = 140 \sqrt{rs} - 11 \sqrt[3]{rs}$, as given. Thus:—

H = 5ft. per mile.

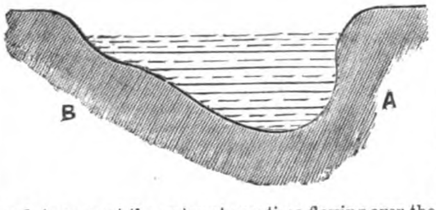
$WP = 5{\cdot}33 + 1{\cdot}0 + 1{\cdot}0 = 7{\cdot}33$, the wetted perimeter in feet.

$A = 5{\cdot}33 \times 1{\cdot}0 = 5{\cdot}33$, the area in feet.

$$r = \frac{A}{WP} = \frac{5{\cdot}33}{7{\cdot}33} = {\cdot}727.$$

$$\text{Then } V = 140 \times \sqrt{{\cdot}727 \times \frac{5}{5280}} - 11 \times \sqrt[3]{{\cdot}727 \times \frac{5}{5280}}$$

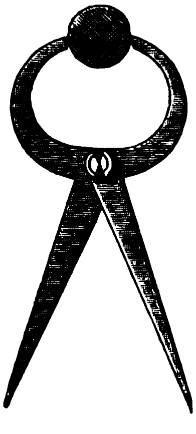
$= 2{\cdot}6875$ft. per second velocity, $= 161{\cdot}25$ft. per minute, velocity × 5·33, area = 860 cubic feet per minute, will give 5,375 gallons per minute, being considerably over the requirement. Besides, in cutting the channel, there would be a much larger excavation than necessary, as the surface of the flowing water should be some inches below the surface or ground



level, to prevent the water at any time flowing over the banks from accidental causes. By his dimensions, the sectional area of the cutting would be about 8 superficial feet. By mine, about 5 superficial feet; on a considerable length, this would materially differ in the cost. The question, as I understand it, resolves itself into this. An engineer (by the bye, we are all engineers now) has to devise the best, simplest, and cheapest scheme to carry a certain quantity of water a definite distance, whereon only a certain fall in feet per mile can be obtained. What form and size of channel will best serve the purpose? I believe, from my own knowledge and practice, the sizes I have given will meet these views. If I take J. T. Holehouse's sizes, and use the formulæ I gave for an open channel, I find the velocity will be 148·5ft. per minute, and the quantity 792 cubic feet per minute = 4,950 gallons. If J. T. Holehouse will kindly refer to "Neville," he will see that he is very precise on the conditions. I omitted in my last to mention that care must be exercised where bends or curves occur in the channel: at these places I would recommend an increased width, so as to somewhat reduce the velocity of the flow, and prevent the scouring of the sides (see Fig.). Wherever there is a bend and the more acute the angle, so will the outside at A deepen, and the inside or side B "silt" up. Every-day experience, by observation, will prove this.

TUBAL-KAIN.

CALIPER COMPASSES.



[3825.]—I HAVE not seen any mention in "ours" of a little tool which is likely to be found useful under certain contingencies, and I send an illustration of it. The compass is so proportioned that the distance of the points of the long legs is 3·1416 times that of the short ones. Your readers will, therefore see, that the upper points being adjusted to the diameter of a bar, as shown in the illustration, the distance covered by the lower ones will give the circumference without farther calculation. I saw it in an American journal; but it is possible that it may be an old idea rejuvenated. What does "J. K. P." think of it?

K. T. L.

PIANO CONSTRUCTION.

[3826.]—THERE are one or two things in the engraving of the improved design for a cheap cottage piano (p. 613, Vol. XIV.) which might possibly mislead an amateur if not a professional pianoforte-maker; the latter I am not presumptuous enough to attempt to instruct. *Imprimis*, the strings of C above the lines ought not to have been represented as if they were not parallel, which they are, to those of C, its octave above. The effect is to show them nearer the strings of pitch C, measured horizontally from where they rest on the belly bridge, instead of slightly divergent.

I ought to have mentioned that in Fig. 1 the horizontal string-plate along its bottom is not shown, because doing this would have hidden the screws which fix the lower edge of the soundboard, that being only a quarter of an inch above the upper surface of the horizontal portion of the string-plate. See section of these parts shown in Fig. 2, which shows the string-plate *in situ*, also one of the cast-iron "lumps," as the pianoforte-makers call them. These lumps are simply cast-iron cranked bars, the T heads of which should be as wide as each wooden brace, and about five-eighths of an inch thick; they ought to be let into the braces to a depth equal to the thickness of their T heads, which should be bedded accurately against the end grain of the wood. Perhaps the easiest method of making this joint perfect is to give the surfaces a thick coating of a mixture of whitelead, ground in oil, whiting, and gold size, which speedily becomes much harder than even the end grain of spruce fir. These lumps must, of course, be fixed and adjusted to the top edge of the string-plate before the soundboard is fixed, because they pass through holes made in the latter.

It has occurred to me that when a cranked brace on Kohlman's system is made in cast iron, it would be a cheap but valuable improvement to carry up a taper feather, projecting in front of that upper portion of the brace which is behind the strings. This would greatly stiffen the flat portion of the brace, which must, unless the belly-bridge be made considerably higher than usual, necessarily be rather thin, say from three-eighths to half of an inch thick, and, therefore, deficient in rigidity. As this projecting part, or feather, as a pattern-maker would call it, must needs be in the space between the strings of two successive notes, and project above the plane of those strings, and as that space diminishes until, at the hammer line, they approach within from a quarter to five-sixteenths of an inch, it will be needful not only to gradually diminish its projection towards its upper end, but also to taper it sideways until reduced to about three-sixteenths of an inch thick, so that there shall be no danger of the strings touching it when they are vibrating; also not to carry it up so high as the hammer line. For causing this feather to leave the sand easily, its top edge should be rounded, and a very small fillet be on each of its sides where it commences to project from the flat surface of the brace. If the edges of the latter, which are moulded downwards, also be rounded, the casting will be at once cleaner, because easier for the founder to mould and run, and require less dressing to prepare it for painting or japanning.

As some of my amateur readers who do not intend to make many pianos, or who might wish to strengthen those they possess, by introducing two or three Kohlman bracings into them, would hardly desire to make two or three wooden patterns for cast-iron bracing-bars, I subjoin a few practical instructions for making Kohlman bracing-bars on the plan of that shown by Figs. 6 and 7.

Instead of spreading out the head of the brace as shown in Fig. 6 for the purpose of causing it to abut against a wider portion of the lower edge of the wrest-pin-plate (a thing, by the way, most pianos are not provided with), I think it preferable to let into the wrest-plank a piece of bar-iron, whose thickness is the same as that of the upper portion of the brace. This iron may be from ⅞in. to 1¼in. wide, and secured in its place by about five No. 14 1½in. screws. It should be pretty long, say, 8in. to 12in., so that it may abut against a considerable length of wood, and distribute the pressure sufficiently to prevent it from being concentrated on a small surface of wood. When a pin-plate is used, it need not be more than half the length required when it abuts against wood, but it is essential the pin-plate be well fitted to the edge of this bar. It will be found very desirable to let the top of the brace extend about 1¼in. above the bottom of the wrest-plank, and secure it to the latter by a 1¼in. No. 16 screw.

The easiest method I can think of for an amateur to form the mortices in the bars N and L, which receive the steel plate O, is to remove most of the metal with a drill about one-sixty-fourth of an inch smaller than the thickness of the steel plate. Having chipped out the metal between the holes, and filed the mortices true to the lines, you can proceed to fit the steel plate into both. It should be what workmen call "a driving fit," not a very easy thing to be effected by an unpractised amateur, even when the said mortices are formed by the slotting machine, or accurately drifted, with their ends and sides perfectly parallel. A steady fit sideways is sufficient, but the steel plate ought to be fitted to bear accurately throughout the whole depths of the ends of the mortices. Fortunately, the absolute parallelism of the latter is quite unimportant, so I prefer to file them taper about one sixty-fourth of an inch, and to taper the steel plate to fit their ends, driving it in with the hammer, and relieving those portions of its surfaces which abut against the ends of the mortices until it bears throughout their depth, and projects, say, one-sixteenth of an inch for forming the rivet. Probably the quickest and easiest way would be to heat the mortices red and drive in the steel plate. Then, having slightly countersunk the external ends and sides of each mortice, rivet the plate and file off any projections. The job is completed so strongly that, in the workshop phraseology of the English mechanic, "you can't pull it apart with your teeth."

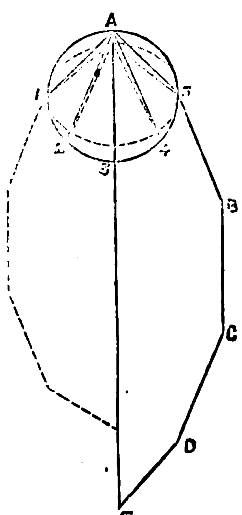
The lower portion of this brace must be morticed into the string plate below the hitch-pins, provided the strings of two successive notes be disposed nearer to each other than the thickness of the bar L, which they certainly would be in pianos not originally designed to receive this kind of front bracing. The only evil which results is that the hitch-pins of those notes must be nearer the bridge than their near fellows, the former necessarily being between the back of the brace L and the plate. There is, however, not the least need to insert all the other hitch-pins equally near the bridge, unless, indeed, we prefer uniformity to utility. Probably it might look prettier, but "handsome is whot handsome does;" and, after all, it is the reverse of good taste to ornament any construction at the cost of its utility.

The tie and strut, combined in one (K), is, by the way, represented in Fig. 3, with the nut, which abuts against the front of the wooden brace A, projecting beyond the front of that brace. Now, as I have designed only about three-eighths of an inch of space between the back of the soundboard and the front of the brace—in fact, the strings may be within 1⅜in. of the braceing —there would be some danger of the belly sinking under the pressure of the strings until it became sufficiently depressed to rest on this nut. The effects on the tone would be, in newspaper reporters' phraseology, "more easily conceived than described," so I designed this nut to be let into the brace to an amount equal to about two-thirds its thickness, leaving only about one-eighth of an inch projecting to turn it by when regulating the position of the Kohlman brace. Probably, although rather more complex, it might be preferable in practice to use a strut formed of a piece of ⅜in. rod iron, having a coarse and shallow-threaded screw (say about ten threads to one inch) formed on it,and screwed through the wooden brace A to receive any back thrust to which the Kohlman brace could be subjected by the tension of the strings in front of it. If it be thought worth while to tie the Kohlman brace—which I think it is, because, with the strut, this would enable its position in relation to the strings and the soundboard to be adjusted,should doing so be found needful, after the instrument has been tuned—I think a piece of 5-16in. or ⅜in. rod iron tapped into the Kohlman brace, passing through a hole bored through the wooden brace A, and having a nut and washer at the back of the latter, would be found to be at once the cheapest and best way of doing it; for,after all, it is difficult to apply a spanner to turn the nut, which is partly sunk in the front of the brace A, the space between the back of the soundboard and the front of the brace being so small that there is hardly room to turn the nut, were it made six or even eight-sided. Facility of adjustment, or regulation, as pianoforte-makers call it, is a *sine quâ non* in their profession.

There is an advantage to be obtained by the employment of Kohlman's or any other efficient system of front metal bracing in cottage pianos which is of considerable value when saving room is important, for it enables the depth of the back and case to be reduced from 1½in. to 3in. There can be no necessity to make the wooden bracings A equally deep when they are no longer subjected to any considerable pressure tending to arch them. Now, efficient front metal bracing relieves them from this pressure almost perfectly, consequently it cannot be necessary to make the wooden back braces more than 2in. or 3in. deep; in fact, only sufficiently rigid to become efficient stays for the metal bracing in front. The late Mr. Mott used, indeed, to say no back bracing at all was needful if the front metal bracing was efficiently tied and strutted in the manner shown in his patent (No. 11180, price 6d.) to the key bottom. He had much experience, and I think he was not far wrong; but this might be a reform far too radical for our conservative feelings (query, prejudices). THE HARMONIOUS BLACKSMITH.

TERRESTRIAL GRAVITATION.

[3827.]—THE method of finding the amount of force exerted by a globe on an attracted particle, described by Mr. Proctor in letter 3711, is too intricate for my comprehension, neither can I show that the amount of attraction is the same as though its mass were condensed into its centre. But I think it can be shown that although the amount of attraction is as the mass, the power is not inversely as the radius.



The circle in the diagram is intended for the outline of a truly spherical metal ball. Divide the circumference from the point A into eight equal spaces, and draw the lines 1 2 3 4 5; now draw the construction B C D E, and the resultant line E A will give in units of length the amount of force exerted at A. The dotted ellipse within the circle is the same ball when flattened in the lathe, the inferior length of its resultant showing the lessened force at the pole of an oblate spheroid. I consider this method gives accurate results; perhaps Mr. Proctor will kindly pass his eye over the diagram. T. A.

ERRATUM.—In letter 3721, page 635, Vol. XIV., line 32, for "defy" read "deify the powers, operations, and objects of Nature."

Preserving Potatoes.—To preserve potatoes in a proper state for food for many years, says the *Stamford Mercury*, it is only necessary to scald them, or subject them to a heated oven for a few minutes. By doing this they will never sprout, and the farinaceous substance will keep good for many years, provided the cortical part (the skin) be entire. They should be well dried after being scalded.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10479.]—**Steam Launch (U.Q.).**—Engine: 4in. cylinder, 7in. stroke, downward vertical, bolted to two stringers running length of boat; shaft to have not less than three bearings, and to have a slight dip towards the stern, in order to raise boat's head when running; fix as large a drum on end of shaft as space will allow, from which your pump may be driven; link motion reversing gear is the best to have. Boiler: two horse-power vertical, five-sixteenths of an inch plates, except top, which is three-eighths of an inch; two cross water tubes are quite enough, 4½in. diameter, pressure 50lb. Screw: four bladed 20in. diameter, 3ft. 6in. pitch, running at 270 per minute, gives in mine a speed of 7¾ miles per hour. Boiler to be set on a ⅝in. plate to keep boat's bottom from fire. Boat, 29ft. over all, beam 5ft. 3in., depth (aft) 3ft. 6in., draft (aft) 2ft. 9in., forward 1ft., engine 6ft. 6in. from stern, boiler 10ft., leaving 19ft. clear space for passengers; mine is so arranged that I can work her single handed. Bare particulars are only given as space is so valuable in the ENGLISH MECHANIC.—G. D.

[10488.]—**Tests for Ores.**—I fully indorse the opinion of our worthy assayer, "Un Irlandais," on page 566. It is impossible for any one to perform a qualitative analysis correctly without they have been through a regular course of study. I have seen students who have been engaged for a year in their scientific pursuits detect sodium and calcium in every mixture given them, when those metals were not present at all, and if this happened after one year's reading, what might be expected from one whose science is only to be "rough and ready"? However, Scheerer & Blandford on "The Blowpipe" is the work I would advise him to procure; published by Williams & Norgate, London.—GEORGE E. DAVIS.

[10501.]—**Water Power (U.Q.).**—Try the water-power engine, but before proceeding see if the pressure is steady at 50lb. per square inch or 110ft. The power required may be obtained with less pressure, but at too great expense, as in such cases the water must go through a meter. A newspaper in this town is printed with a water-power engine fed by 1in. pipe. The writer has three in daily use; one for driving a lathe, and the other for business purposes. He tried a small turbine, and found it a humbug—this remark refers only to small turbines. The water-power engine is most useful where there is a very high pressure, and only small service pipes. If I had the reliable pressure (by a gauge), the time per day it will be used, I could give a fair estimate of the cost, also the rate per thousand gallons for the water.—K. K.

[10510.]—**A Task for Chemists (U.Q.).**—Seeing that no reply has appeared to this query, I suggest that wood may be made pliable for soles of boots,by dissolving out the resinous and siliceous matter. Many methods may be adopted to accomplish this. Some simple ones would be to (1) boil for three or four hours in a solution of caustic soda of specific gravity, say, 1·09; (2) boil for one hour in water; (3) soak for eight or ten hours in a chlorine solution of specific gravity, about 1·02. By making one or two experiments you will find if the doses of caustic soda and chlorine should be increased or diminished. Perhaps the above may be improved by giving it a soaking in dilute hydrochloric or sulphuric acid, previous to the chlorine solution.—BUSY BEE.

[10512.]—**Musette and Voix Celeste Stops (U.Q.).**—The voix celeste stop is simply two dulcianas, one tuned a shade sharper than the other. In putting them in they are made with separate slides, so that one can be used without the other. I believe that it is possible to produce a similar effect with a Viol da Gamba or kerolophaun, with a dulciana tuned to beat to the aforesaid. I cannot exactly describe the musette, but I believe it to be an 8ft. wooden pipe containing a reed.—ORGANIST.

[10565.]—**Pressure under Water, &c. (U.Q.).** —(1) The pressure of 100ft. of water may be reckoned three atmospheres, or 44lb. per square inch. Hence at one mile deep it will about 2320lb; at two miles, 4640lb.; and at three miles, 6960lb. per square inch. (2) Caustic alkalies, as potash, soda, barytes, or lime, greedily attract and absorb carbonic acid; the last the most slowly. The hardening of mortar depends on this absorption, and is not complete for years. (3) The third question must be explained. What is meant by raising "steam to work an engine with hydrogen gas"? Which is to work the engine? The battery to decompose water, in any way, to yield a horse-power, must oxidise 28lb. of iron or 32lb. of zinc, for every 6lb. of coke that would yield the same power by combustion, supposing in both cases no waste, but perfect economy of the forces.—E. L. G.

[10608.]—**Bee-Keeping.**—If "H. H. H.'s" bees swarm twice, which they are not certain to do, it will be better for him to return the second swarm to the parent hive on the evening of the day on which it issued forth. Why? Because the mother queen leaves the hive with the first swarm, and the queen which will lead out the second will be a young unfertile one. If they are added to the first swarm, both the queens and numerous workers may be killed, and the tender new combs in the hive injured in manipulation; but, anyhow, one of the queens will surely be destroyed, and it may be the fertile one. Whereas, if the second swarm be returned to the hive on the evening of the first day, only one queen will be injured, and all other queen cells destroyed (as a rule), and all the power and strength of that swarm will be expended in honey gathering for their owner instead of comb-building for their new home.—C. N. ABBOTT.

[10617.]—**Watchmaking and Isochronism (U.Q.).**—The ability to apply an isochronous hair-spring to a watch must be considered as one of the highest attainments of the art. The literature on the subject of watchmaking is extremely scanty, and with regard to isochronism, I am not aware that there is any work in existence which treats fully on the subject, though I would recommend our correspondent to read a very interesting paper "On the Laws of Isochronism of the Balance Spring," by Charles Frodsham, in the *Horological Journal*, Nos. 159 and 160, also a variety of information on hair-springs in Vol. VI. of the MECHANIC, commencing in No. 139. He should also read Scotchford's essay on the detached lever escapement, in which the existence of such a property as isochronism in the balance spring is disputed. The prize of £50 offered by the Baroness Burdett Coutts, will doubtless produce an exhaustive essay on the subject, and which, like the prize essay on the lever escapement, I should not be surprised to find carried off by a foreigner.—WEST CORNWALL.

[10641.]—**Rabbit Breeding.**—The first thing to be looked to in breeding rabbits is to see that they have a proper hutch, and above all keep them dry, for dampness causes many fatal diseases. The strongest and most prolific are generally gray, black,or black and white. In pairing them I would recommend the female to be gray, and either a black and white or black male. As the males are, as a rule, very much given to devouring the young ones, remove them about a week before the female's time of bringing forth, and about the same time thoroughly clean out the hutch and put in a bed of clean sweet hay or straw. I generally gave my female rabbits a little warm milk shortly after the young ones were brought forth, which they seemed to relish, and which did them much good. —BED OF STONE.

[10660.]—**The Largest Casting (U.Q.).**—Whichever of the iron castings referred to may be the heavier, they must yield the palm to some of the church bells of Moscow. The largest, that which, in 1787, three years after being successfully recast and used, was broken by cold water thrown on it during the conflagration of its belfry, but may, for aught I know, have been lately recast, weighs, according to the dimensions, 220 English tons.—E. L. G.

[10664.]—**Angle of Reflection and Incidence.** —The fact noticed by "A. P. S." that the angles of incidence and reflection made by a billiard ball on striking the cushion are not equal is one well known to all billiard players. It is seen very plainly when the ball is struck hard enough to rebound several times from side to side of the table; each time the angle of reflection becomes less, and the ball comes off the cushion more nearly perpendicular to the side of the table. M. Paris is quite right in saying that the elasticity of the cushion is the cause of this. Making use of the diagram on p. 591, the force of the stroke compresses the cushion not only in the direction E C, but also in the direction A B, and the elasticity of the cushion drives the ball off it again in the directions C E and B A. The latter being small compared to the other, the course of the ball after impact is but slightly changed; and if the ball be moving slowly, so slightly as to be imperceptible; though I believe the change of direction does exist in every case. Let "A. P. S." consider what would happen if the cushion were made of soft clay: the ball, on striking it, would bury itself in a cylindrical hole, the axis of which would not be at right angles to the cushion, but more in the direction of the course of the ball before impact. If the clay were harder, the ball would make a dent in it, and raise a ripple of clay in front of itself, something like the bit of steel raised on a rasp by the punch. This latter is what does happen in the case of an elastic cushion, and it is the force of this lump or ripple recovering its form that slightly tends to drive the ball directly back on its course, and thus lessens the angle of reflection.—LICHFIELD.

[10685.]—**The Electric Spark.**—What is the cause of its luminosity? The querist might as well ask what is the cause of any other luminosity, or of any sound; sound is vibratory movement propagated through air, and if things vibrate in air, the natural thing to expect is sound. A case of silent vibration may call for inquiry as remarkable. Light is also some vibratory movement, propagated through universal ether or matter in its atoms or molecules; and electrical discharges (as well as chemical combustion) are atomic or molecular actions; and it is natural to expect the propagation of their disturbance in the form of radiant heat, which, within certain limits of pitch, affects our eyes as light; just as air vibrations between 16 and about 8,000 per second are sounds to us, but below 16 or above 8,000 they are not sounds *to us*, though they may be to any non-human ear. And the limits of pitch in the rays that are light to us are much narrower, indeed, less than an octave; so that it is quite probable there may be animal eyes seeing by none of the light that is light to us, but wholly by rays that are dark and unknown to us. And the skies may contain galaxies of suns conspicuous to our cat or dog, but eternally unknowable to astronomers, merely because their light may all be of pitches an octave higher or lower than that of sodium!—E. L. G.

[10696.]—**Testing Vegetable Lubricating Oils (U.Q.).**—I presume "W. M." knows the old method of testing by lubricating the axes of a wheel with the oil to be tried, making it revolve with an equal force and counting the number of its revolutions by means of a counting wheel turned by an endless screw on the axis. "W. M." of course knows also that some oils get thick and sticky by exposure to air. I do not know that the plan has been tried, but think it worth trying, whether the lubricating quality of oils might not be correctly tested by oiling a smooth surface of iron and trying which is the angle of rest on it of a smooth piece of brass lying upon it. As the friction or adhesion between similar surfaces is proportionate to the pressure, any convenient thickness of metal may be used, and the angle of inclination may be fixed very accurately by using a fine-threaded screw, or a graduated wedge to raise the iron surface at one end to any desired degree.—PHILO.

[10702.]—**Terrestrial Gravitation.**—I am not sure that I quite understand "T. A.'s" difficulty, but will try again to remove what I suppose it to be. It is easy to prove, though tedious to explain, that the joint attractive force of all the particles of a homogeneous sphere is the same as it would be if the attraction of all of them were exerted at the centre, and therefore that in calculating that joint force it is quite correct and very convenient to assume that point to be the centre of attraction to all other bodies at or beyond the surface of the sphere. The same is nearly true of any ellipsoid, which is nearly a sphere, such as the earth, and a body at the equator being 13¼ miles, or 1 part in 299, further from the centre than one at the pole is attracted less than it is nearly, as the square of 298^2 is less than 299^2—*i.e.*, $89401 - 88804 = \frac{1}{597}$ (more exactly $\frac{1}{590}$) for the centre of a spheroid is not precisely its centre of attraction. The effect would be precisely the same whether the particles of which the spheroid consists be connected or not, so long as they remain in the same position. Perhaps, if instead of considering the case of spheroids, we imagine what would be the effect upon the weight of a body on the surface of a spherical earth, and 13¼ miles above it, the explanation may seem more simple. Supposing the weight at the surface to be 590, it would be 13¼ miles, or $\frac{1}{299}$ more distant from the centre, only 598, for in that case the centre of the sphere would correspond with the centre of attraction. The attraction is not proportional to the diameter, but nearly inversely proportional to the square of the distance from the centre of a spheroid, and exactly so of a sphere.—PHILO.

[10716.]—**Telescope.**—I would from experience warn those who do not know the real qualities of an astronomical and terrestrial telescope from purchasing those at £5. I bought one with (as I was told) graduated powers up to 250. I took it to India, and in three months it was useless; altogether it cost me £8, and I was glad to get ten shillings for it at an auction. Soft French object-glasses imperfectly curved, and badly cemented, for sale only, are utterly worthless. My advice from experience is—go to a thoroughly reliable maker, tell him what you want, and you won't be taken in. A novice who wants to learn something of the hidden lore of the heavens only requires a 2in. or 2½in. object-glass, with eyepieces for 60, 80, and 120, on a firm stand. Most respectable opticians will supply this for £5, and it will be both satisfactory and instructive. Of course a terrestrial eyepiece will accompany as well as a dark glass for sun views. I have had far more pleasure in studying the heavens through such a glass on a calm clear night than in looking through an 8in. refractor.—MASTER OF NONE.

[10718.]—**Sugar Analysis.**—Let "Cornubia" proceed thus:—The copper solution: Dissolve 34·64grm. pure copper sulphate in 200 cubic centimetres water, in another vessel 173grm. of sodium potassium tartrate (Rochelle salt) are to be dissolved in 480 cubic centimetres of 10 per cent. caustic soda, mix the two solutions together, and dilute the clear blue fluid to a litre. Then 10 cubic centimetres of this solution requires for its decomposition 0·05grm. glucose. All sugars are converted into glucose before being estimated, and as 0·0475grm. of cane or milk sugar, and 0·045grm. of starch or dextrine corresponds to 0·05grm. of grape sugar or glucose, 10 cubic centimetres must be equivalent to the weight of the different sugars. As an illustration I give the process I employ in the analysis of flours; I have six or seven samples at once before me, and a rapid and accurate method is everything with me, the only drawback is the long heating it requires, but this I leave to my laboratory youth, who fills up the flasks as they boil away. I take 1grm. of the flour, mix it with 20 cubic centimetres of water to a smooth paste, transfer it to flask and heat until thick. I then add 8 cubic centimetres of dilute sulphuric acid (1 to 4) and heat for eight hours on a sand bath, replacing the water as it boils away. The free acid is then neutralised with caustic soda, and the whole diluted to 250 cubic centimetres; 10 cubic centimetres of the copper solution is then placed in a flask with 40 cubic centimetres of distilled water and boiled, the burette is filled from the 250 cubic centimetres flask, and the solution dropped into the boiling flask until the blue colour of the copper has gone. An indicator of an acetic acid solution of potassium ferrocyanide may be used, the liquor being allowed to settle, and a drop of the clear fluid being taken from the top of the liquid. Whilst copper remains in excess, a drop taken out produces the well-known brown colour. The number of cubic centimetres used divided into 1,125 will give the percentage of starch, thus, in one of my experiments 17 cubic centimetres were taken, which would give 66·17 per cent. of starch. I may as well add, that until the operator has had considerable experience in the method duplicate analyses should be made upon the same sample to insure accurate results.—GEORGE E. DAVIS.

[10728.]—**Blackening Transparencies.**—Try twenty drops of a saturated solution. I expect that is what is intended.—E. H.

[10798.]—**Tortoise.**—The toy called a "lively turtle" is nothing more than an imitation, on a small scale, of a tortoise, inclosed in a wooden box with a glass cover. Its liveliness consists in a perpetual shaking of the legs—"lively," but not lifelike. What the construction is I do not know, but some of "our" readers will possibly be able to explain. I suppose the legs are connected by a spring. I am in the dark as to whether this is what "Willie Scorer" means, but I have seen one of these in a box 1½in. in diameter, and presume it is the "toy" referred to.—SAUL RYMEA.

[10819.]—**Bleaching Powder.**—If "Omega" will turn to p. 135, No. 344, of "our" journal, he will find the most accurate method for estimating the amount of chlorine in bleaching powder there described. It is Bunsen's method, and is given on that page as an illustration of quantitative analysis.—GEORGE E. DAVIS.

[10834.]—**Analysis of Ores.**—To "JANUARY."—Read the answer to "Far West," by "Un Irlandais" on p. 566, and also my reply in this present number, 10488. The only work I would recommend is Sutton's "Volumetric Analysis," 12s. 6d. I believe this last edition. It is a splendid work.—GEORGE E. DAVIS.

[10863.]—**Sulphuric Acid.**—To make 1 ton of sulphuric acid at 150° Tw. per day, or 7 tons a week, 20 tons of sulphur must be burnt, requiring two chambers, each containing 7,000 cubic feet, and these two chambers would have to be supplemented by a column 3ft. square, and about 25ft. high, otherwise there would be a large escape of sulphur into the flues. If 47 per cent. pyrites are used, 5 tons per week must be burnt in order to make 7 tons of vitriol per week. Between 5cwt. and 6cwt. of nitre will be required weekly, but of course, all these calculations depend upon good management. I should advise him not to commence on too small a scale, and could give him further advice if he requires it.—GEORGE E. DAVIS.

[10882.]—**Damp Walls.**—I am obliged to, not offended with, T. H. Saunders; he may be right, and I will consider his suggestion. I submit to him that if vertical percolation is the cause, why is there no internal damp in the south-eastern gable? The filleting behind stone coping of that gable is more exposed to south-western rainstorms than is that of south-western gable. The coping projects some 2in., and the gable is steep to throw off wet; an equilateral triangle. Another correspondent suggested gas tar, surely not an ornamental article to apply to a red brick house with stone dressings. Thanks all the same.—R. J.

[10883.]—**Rust in Iron Vat.**—If "R. J." will say what salts he crystallizes in his vats, perhaps I can help him. Also whether the liquors inserted are alkaline, neutral, or acid.—GEORGE E. DAVIS.

[10889.]—**Rose Trees.**—No one having authority seems to have replied to Mr. Abbott's query. Allow me to say that so far as I have ever heard his definition is perfectly correct. A dwarf rose is one on its own bottom; a standard one budded on a stock, the height of the latter being perfectly immaterial. I will undertake to affirm that no nurseryman would send roses budded on short stocks when dwarfs were ordered.—SAUL RYMEA.

[10919.]—**Chemical.**—Take a mixture of nitric acid and water, which is made of a strength of 74° on Twaddell's hydrometer. Six drachms of this acid is to be placed in a flask and forty grains of silver added, heat being applied until all is dissolved. Two fluid ounces of alcohol are then added, and the flask heated in a sand-bath, or what is better, a water-bath, until a lively reaction is commenced; the flask is allowed to cool after the reaction has proceeded, when the silver fulminate will mostly be found at the bottom. Water dissolves this salt to a certain extent, so silver would always be found in the filtrate. I cannot spare the time to write out a table to show the quantity of water required to reduce the gravity of nitric acid, but "Singlestick" can get the result by adding water to the acid until when quite cold it will show 100°Tw. = 1·5, 80°Tw. = 1·4, 75°Tw. = 1.37, and 60°Tw. = 1·3 specific gravity.—GEORGE E. DAVIS.

[10930.]—**Want of Steam Power.**—Many thanks to those who have noticed my query. The exhaust pipe is a two-inch bore. Would "F. T. S. S. D." recommend a smaller one? And could this be done by cutting the pipe and screwing a smaller one in? This would reduce the size to a one and a half inch bore. To me it seems that the steam is thrown off faster than it can be generated while at work. While the steam is at 30lb. or 40lb. pressure it is quite able to do the work, and does it well; but the difficulty is to maintain that pressure with a speed of 180 or 140 revolutions per minute. Would it be any advantage to direct steam-pipe into the chimney and cause more draught? At present the steam is blown off into the open air. The thrashing machine I use is one of Richmond and Chandler's two horse, with 24in. drum; formerly I worked it with a two-horse gear, my two horses working it with comparative ease. Next autumn I shall have a larger machine, a double blast with 42in. drum; but I want to get my engine right before going to that expense. The engine can be worked continually at 50lb., 60lb., or 70lb. pressure, providing it does not exceed sixty or seventy revolutions per minute. I thought a larger fly-wheel would increase the speed of thrashing machine drum, for it is off the fly-wheel I drive, not having a drum for the strap; the fly-wheel weighs upwards of 8cwt.—is this too heavy? I am confident the engine is strong enough to do the work if I can maintain the speed. When I start, say at 40lb. pressure, for the first five minutes it is all that I could wish, but after that time the speed decreases. The boiler has been tested to 120lb.; to what pressure may I work it with safety?—AGRI.

[10941.]—**Spontaneous Combustion.**—Mr. Tonkes will perhaps excuse me for saying that oily waste will take fire from spontaneous combustion. I knew a case at the Poonah Arsenal, when a man, who had been oiling the paint work of a gun carriage, having put the oily waste he had been using on the wheel nave whilst he went to dinner, found it on fire on his return. The waste was fully exposed to the hot sun. Besides this instance, I have known the same action arise from linseed oil being spilled on sawdust; and to further confirm this, I may say that I gave the man £3 for giving the alarm of fire.—MANUS.

[10950.]—**Madeira.**—Does "E. L. G." mean that the Portuguese of Madeira is so hard? Surely Portuguese to a person knowing Latin is as easy as any of the other Romanesque tongues. I have heard that there is no particular dialectic variation.—M. PARIS.

[10954.]—**Circulation of the Blood.**—Mr. Guthrie, in his very excellent reply to this query, states that death "produced through obstruction of the respiratory system is twofold, by excess of carbon in the air, or by oxygen starvation," but I am inclined to imagine that they both result from the same cause—oxygen starvation. Excess of carbon in the air indicates an insufficiency of oxygen, and consequently is identical with oxygen starvation. The food which we take may be divided into two parts. Building material, to repair and build up the system, and fuel to sustain a constant supply of heat through the body; the former consists of that class of food in which the elements are the same as those employed in the constitution of the human body, the latter consists of those articles of diet only which contain the elements which are acknowledged as those of combustion—viz., carbon and hydrogen, the oxygen to effect the combustion being introduced by respiration. Respiration is on the same principle as combustion, and, therefore, the chemical process of respiration is similar to the process of combustion, in exchanging carbonic acid for oxygen. The oxygen inhaled unites with the carbon of the blood, and forms carbonic acid, and with the hydrogen to form vapour of water, both of which are expired. I wish to identify myself with the opinions that others have expressed in objecting to the assertion that "respiration aids circulation."—C. W. H.

[10954.]—**Circulation of the Blood.**—This question has received several answers, but they are all defective, for though it is true that respiration, so far as it means the taking in and expulsion of gaseous matters by or for the lungs, may not actually aid the circulation, yet the act of respiration plays a very important part in it. The forces which circulate the blood are many and various, and we have a *vis a tergo*, or force acting from behind to propel the blood forward, as does the heart, for instance, and a *vis a fronte* or force from before, or in front of the stream, to encourage the flow back into the chest; such is the effect of inspiration. When we draw in our breath, the cavity of the chest is expanded by the ascent of the ribs and the descent of the diaphragm, and consequently a partial vacuum is produced, and this is immediately filled by a rush of air down the windpipe; but any other body which could obtain access to the chest would act in the same manner. If there be an opening between the ribs, the air or any fluid with which the opening is in connection would find its way in to the exclusion of the air by the windpipe. Now, the impetus given by the heart barely extends beyond the smallest vessels, called capillaries, so that other forces have now to come into operation; of these it is only needful here to speak of the last—viz., the expansion of the chest. The blood has arrived in the ascending and descending *venæ cavæ*, which have become united, when the expansion of the chest acts as a suction pump, finally delivering the blood to the right side of the heart. The contrary action of the chest (expiration), causes a slight regurgitation in the veins; but, at the same time, accelerates the current in the *aorta*. There is here no reflux, excepting in the case of disease, the opening being protected by a valve.—FELLOW OF THE ROYAL COLLEGE OF SURGEONS.

[10964.]—**Tests for Metals.**—To "J. B." AND "CHEMICAL STUDENT."—"J. B." has committed a *lapsus calami* in his answer to "Chemical Student." The filtrate from the barium carbonate precipitate should be acidified with HCl, boiled, neutralised with ammonia, and the zinc and manganese precipitated with ammonium sulphide. This is then to be filtered, and the filtrate freed from barium and calcium with sulphate and oxalate of ammonium, filter and test for magnesium in the filtrate with sodium phosphate. The mixed ZnS and MnS is then to be treated with acetic acid, which dissolves out the MnS and leaves the ZnS. If followed out, as "J. B." states, the precipitate will contain $BaSo_4$, CaC_2O_4, ZnO, MnO, and Mn_2O_3, and upon adding acetic acid these three latter would be dissolved, and the zinc would not be left behind as stated; besides, zinc oxide is dissolved by excess of ammonia, so zinc would probably be found in the filtrate, where magnesium is to be looked for.—GEORGE E. DAVIS.

[10974.] — **Polishing Granite.** — "Buz-Fuz" thanks correspondents for their replies, but cannot think that either have practised what they recommend. The recipes given appear to apply to marble and not to granite. "Buz-Fuz" will send a present worth half a guinea to any one who will forward a recipe that will answer effectively.

[10994.]—**Holly Wood.**—I have cut large quantities of it for cog-teeth and other millright work; it is considered far superior to beech or hornbeam for such purposes.—SAWYER.

[10996.]—**How to Use a Book Without Hands.**—I submit the following very simple expedient. Let the armless man get some one to strap a broad leather band, to which is fastened a tin plate, with a socket on to his forehead round his head; into the tin socket, let him fix a piece of stick, say, 8in. long, upright as sketch; at the end that is free let him tie a ball or knob of cotton, wool, or sponge, the whole ball about an inch diameter, covered over with wash leather, and this slightly damped with clean water (not to stain the book), will prove, or I am very much mistaken, the best and handiest substitute for a wet finger, and who ever saw the page that resisted turning by a wet finger.—CIRED.

[10996.] — **How to Use a Book without Hands.**—I think the following will suit the unfortunate engine driver. Let "T. M. W." get a disc of smooth sheet indiarubber about the size of a half-crown. Make a small hole in the centre of the disc, into which insert the end of a bit of glass or gutta-percha tube (about 6in. long), so that it fits tightly, wrapping it, if necessary, with thread. To use this little instrument, let the sufferer put one end of the tube into his mouth and apply the disc of indiarubber at the other end to the leaf of the book, seeing that it fits closely; then, by sucking through the tube, the air is exhausted and the leaf sticks to the disc, and can be turned over with ease.—CAROLUS.

[10996.] — **How to Use a Book without Hands.**—I feel very much for the engine driver, and will endeavour to invent a revolving desk, whereby he could read the ENGLISH MECHANIC every week. I will send him it free of any expense if he will advertise his address.—M. O.

[10999.]—**Gilding Thin Steel.**—Steel may be gilt by using an ethereal solution of gold. The more usual method is to gild by the electrotype, the steel being first covered with a coating of copper; this is done by using the battery, and a neutral solution of cyanide of copper; not an acid solution of sulphate of copper. Copper will precipitate upon steel or iron from the sulphate, but the deposit is worthless on account of the acid attacking the steel, and disintegrating the surface under the copper.—A BARRISTER.

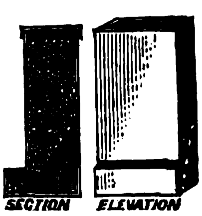
[11023.]—**The Strongest Liquid Explosive.**—Without doubt, the liquid called chloride or quadrochloride of nitrogen is as yet the most powerfully explosive liquid that chemistry can produce. It is prepared by bringing chlorine gas in contact with a tepid solution of hydrochlorate of ammonia, or nitrate of ammonia, but the operation is so fearfully dangerous to life and limb that none but experienced chemists should attempt to make even five grains or drops of it. Its specific gravity is 1·653. The actual cost per gallon is a matter of calculation. Supposing a gallon of this substance to be by any means successfully manufactured without explosion I certainly would not like to be within three miles of it, and I should require a fee of two or three guineas, and pre-payment, to make the smallest sample of it.—EXPLOSIVE.

[11038.]—**Chemical.**—When catechu is boiled with caustic alkali, a deep brown fluid is obtained which contains tannate and japonate of sodium, or potassium, which ever alkali is used. When it is boiled with sodium carbonate, sodium rubiate is formed, together with sodium tannate. The acids are formed by the oxidation of the catechin which is contained in the catechu. The tannic acid may be extracted with cold water—hot water must not be used, as it would extract the catechin. When soda is combined with charcoal (carbon) sodium carbonate is formed, and the inquirer must indeed be a very "Young Chemist" if he is unaware of its properties being in any way affected. In making oxalic acid by Dale's process 80 parts of caustic soda and 56 parts of caustic potash are taken and a solution made which stands 70°Tw. Sawdust is then added to make a thick paste, which is spread in thin layers upon iron plates, and heated to a temperature of 400° Fahr., being kept constantly stirred.—GEORGE E. DAVIS.

[11040.]—**Boiler for Small Engine.**—The small engine referred to has as yet no boiler of its own, but was tried from a large one. The engraver has scarcely done the engine justice (owing to the photograph being rather indistinct), as he has omitted the mouldings that run all round the frame, and has shown one or two details incorrectly. The model is really very handsome—the cylinder covers, steam, and adjusting bosses, and the bearings being all of bright brass, as is also the feed pump.—L. C. E.

[11041.]—**Children's Concert.**—Mozart's melody, "Ah! vous dirai-je, maman." It is the *tema* of one of his airs with variations for piano.—C. J. R.

[11049.] — **Seedbox.** — I once wanted a seedbox which should prevent the waste of seed, and I made one from a cigar box, as per sketch. I think it will sufficiently explain itself. It answers very well.—HARRY WEBB.



SECTION ELEVATION

[11054.] — **Calculating Contents of Cylindrical Vessels.** — Multiply height by half diameter, and this by half circumference; or multiply height by square of diameter and by $\frac{1}{4}\pi$. To multiply any sum by $\frac{1}{4}\pi$ correct to nine figures, you may deduct its quarter and 100th and 100,000th of the same quarter. Then add two-tenths of the second deduction and three-tenths of the third, and to the resulting sum add its twentieth. To take the example mis-wrought by A. J. Shaw (p. 648), 1ft. 8in. is 1·75ft. (not 1·72), and its square is

$1^2 + \cdot7^2 + \cdot05^2$	=	1·4925
2 (1 × ·7)	=	1·4
2 (1·7 × ·05)	=	·17
		3·0625
Multiply by		4·5
		1·53125
		12·25
Contents in cylindrical feet	=	13·78125
Deduct a quarter		3·4453125
And a 100th of it		34453125
And a 100,000th		34453
		10·301449922
Add ·2 of 100th		6890625
And ·3 of 100,000th		10336
		10·308350883
Add 5 per cent.		·515417544
Cubic feet	=	10·823768427

This is exact to the ninth figure. We owe this curiously easy way of bringing round into square units, or cylindric into cubic ones, to Mr. Drach.—E. L. G.

[11054.]—**Calculating Contents of Cylindrical Vessels.**—"Excelsior" has made a terrible blunder in his statement that "the solid contents of a cylinder is equal to the square of the diameter × the height × 3·14159." The solid contents of a cylinder are equal to the square of the diameter × the height × ·7854. Thus his example of a cylinder, 2ft. high and 2ft. in diameter, would come out $2^2 \times 2 \times \cdot7854 =$ 6·2832, and not 25·13272, as given by him.—A BARRISTER.

[11054.]—**Calculating the Contents of Cylindrical Vessels.**—This cannot be done with absolute accuracy, because the proportion of the circumference to the diameter of a circle cannot be expressed precisely; it is very nearly 22 to 7, rather more than 3 to 1, more exactly 3·1416 to 1. As a circle may be conceived to consist of an infinite number of triangles, with the circumference for the bases, with their apices meeting at the centre, and as the area of any triangle is equal to its height, multiplied by half its base, and as the supposed triangles have the circumference for their joint bases, their joint area is equal to half the circumference (*i.e.*, half the diameter multiplied by 3·1416) by half the diameter, or a quarter of the square of the diameter by 3·1416, or the square of the diameter by $\frac{3\cdot1416}{4} = \cdot7854$. It is easier to remember $\frac{22}{7} = 3\cdot14$, which may often be used instead of 3·1416, as near enough. If an approximate estimate be sufficient, it may be convenient to know that the square of the diameter in inches is very little more than the contents of a pipe full of water a yard long in pounds, or with the unit cut off by a decimal point in gallons.—PHILO.

[11060.]—**The Bee Hive.**—F. J. Godden is informed that he will find the way of applying guides to frames described in let. 3269, p. 384, No. 353, and he will only have to vary from the sketch of knife-gauge by making the notch in it so as to come in the centre of his frames. The frames should hang from front to rear of him, and the back should be raised at least an inch, so as to throw both front and back out of perpendicular. "Carr's Hive," described in Neighbour's catalogue, has three thicknesses of glass in rear, and no cover to them, so that the whole of the back is open, and a statement is there made that covering for glass is not necessary, as bees will work as well in daylight as darkness. I have read that daylight acts on honey chemically and induces crystallisation, but have not pursued that branch of the subject. I should recommend Mr. Godden to keep his glass hives under cover, except when under observation, as otherwise they are dangerous things in a house. I know bees will work in daylight, as I have seen combs formed by outlying clusters under the bee stance, but they have always been deserted and emptied in autumn.—C. N. ABBOTT.

[11063.]—**Moth v. Fur.**—In storing woollen goods I use camphor as a preventative against moths. The camphor is laid between the folds of the goods, and some fresh added every two or three weeks.—BUSY BEE.

[11064.]—**Sticking Plaister.**—Ordinary sticking plaister is made by boiling oxide of lead (litharge), olive oil, and water together to a proper consistence, and then spread on calico. Court plaister is made by brushing a solution of isinglass over silk.—J. KING HARRIS.

[11065.]—**Ventilating Rooms.**—"Philo" has described a lucky expedient for inlet that our English windows happen to afford—namely, by either raising the lower sash, or lowering the upper a few inches, and filling up the top or bottom opening thus formed, leaving air to enter only by an upward detour between the two "meeting-bars" (as they are called), which, in short, ought never to meet at all. Every sash ought to be two inches longer (*i. e.*, higher) than they are now made, and they would be all right (only needing, of course, a different fastening). But windows to open are a barbarism that ought nowhere to be required. No dwelling rightly constructed ever did, or ever will, have its ventilation aided by opening windows; but, on the contrary, interrupted and spoilt, if it have any self-ventilative capability at all. Of course, it is "a self-evident truth" that you must have outlet for foul air if any fresh is to take its place; but not a bit more evident or necessary than another that "Philo" utterly ignores—namely, that an outlet is no outlet for foul air if the room contains one cubic barleycorn of space higher than the top of the said "outlet." His Arnott valve "hidden behind a picture," or any of those sold with top borders to come between them and the ceiling, or any that are below a cornice, are "enough to make a cat laugh" at human Victorian-age superstition (see also letter).—E. L. G.

[11086.]—**Georgetown, Demerara.**—I hardly know why my former communication on this subject had "No Name" appended; I suppose, however, I had forgotten to attach my usual signature, and the editor thought that appended the most appropriate. In reply to "Young Man" I beg to say that sailing vessels go from London, Liverpool, Bristol, and Glasgow to Demerara regularly. Inquiry made at the docks of any of these ports will elicit the necessary information, or a letter addressed to Messrs. James Ewing & Co., Glasgow, will do the same thing. The West Indies Packet Companies' steamers leave Southampton on the 2nd and 17th of each month. The passage for sailing vessel averages forty days, and costs about £22, per steamer twenty-one days, and costs £30. There is no season better than another for starting, or at least the difference is so slight that it is not worth thinking about. As to whether a "Young Man" should secure an engagement before going out, or go out on chance, there are certain advantages and disadvantages in both ways. If he can get an engagement made here he would get his passage paid out, and probably an advance for an outfit as well; but then he would not make nearly so good terms as if he went on his own charges and made his bargain on the spot. On the whole I think if a "Young Man" can secure an engagement for three years before starting it would be better. That is, however, a matter of some difficulty, unless he knows, or is known by, some one who is in the habit of sending assistants out, as for obvious reasons we should not think of sending a stranger, or, indeed, any young man that we did not thoroughly know. Demerara is not subject to earthquakes, and is quite out of the hurricane latitude. Trollop's "West Indies," if a superficial knowledge only is required, and may be got at almost any ordinary circulating library; but if more exact and extensive information is desiderated, "Dalton's History of British Guiana" is the best.—AULD REEKIE.

[11091.]—**Turret-shaped Hills.**—There are two ways in which turrets or pillars of that form may have originated. If entirely of hard igneous rock, as "Manus" states the Indian ones to be (p. 674), they are dykes that were thrust up through clay, marl, or soft material, which material the diluvial wash has since carried away, leaving the basaltic turret, like that remarkable square one in St. Helena, called the Chimney, figured in Lyell's "Elements," p. 610 (sixth edition). But "Sansjoy's" drawing (p. 624) seems rather to resemble, in some parts, as the three peaks to the right of Fig. 1, hills of soft material that has been protected by stony caps, like glacier-tables, or the pillars of salt near the Dead Sea. In either case there has been a vast removal of soft material by denudation, and this not gradual, or such as "causes now in action" (as Lyell would say) could effect. The downfall of rain that swept away and moulded in smooth rounded sweeps what it left of the softer strata, everywhere on the present surface, was no downpour of inches per hour, as the greatest tropical monsoon rains, but rather of feet or fathoms per minute, and did all its conspicuous work in a single day. "The day that Noah entered the ark, the flood came and destroyed them all."—E. L. G.

[11092.] — **Champagne Stains.** — Unless the colour of the dress is destroyed, a "Vexed Man" may use the following old-fashioned recipe for cleaning silk. Take of gin, honey, and soft soap equal parts, and twice as much water as any one of the other ingredients. Dissolve thoroughly, and when cold brush the stains thoroughly with a hard, clean nail brush dipped in this mixture; have three large basins or tubs full of cold rain water, and dip the silk three or four times into each (this thoroughly removes all stickiness), pass your hand once or twice lengthwise down the silk in order to remove some of the water, but on no account wring it; then hang it over a clothes' screen near a fire, and when damp—*i.e.*, before the silk begins to wrinkle with heat—iron it quickly with a hot iron. Of course the stained width must be removed from the rest of the dress, and it is best to lay it on a deal table and scrub hard. This recipe has been found efficacious in cleaning the most delicate coloured silks, making them look quite new.—CHAMPAGNE CHARLIE.

[11108.]—**Soda Ash in Boilers.**—I have been using it in a 40 horse-power boiler for ten weeks, and have to-day been in and examined the boiler, and find no injurious result, but the quantity I have used has not been sufficient to entirely remove the scale which had previously been allowed to form.—BUSY BEE.

[11111.]—**Curing Skins.**—"Trapper" will find the following recipe everything that could be desired for large or small skins. I have cured many tiger and leopard skins with it in India. The degree of flexibility attainable depends upon the amount of time bestowed in hand rubbing: with plenty of elbow grease a skin can be made as soft as kid. I regret I can furnish no information as to dyeing skins. To prepare skins for fur: Mix bran and soft water sufficient to cover the skins; let this stand four hours covered before being used; then immerse the skins, keeping them well covered for twenty-four hours (less in India); then take out, wash clean, and carefully scrape off all the flesh. To one gallon of water (hot) add one pound of alum and a quarter pound of salt. When dissolved and cool enough to bear the hand, immerse the skins for twenty-four hours, take out and dry in the shade, and well rub with the hand. Stir the liquor, and again immerse for twenty-four hours, dry, and hand rub as before, and then put the skins for twenty-four hours into warm oatmeal and water, stirring occasionally. Dry in the shade, and when the skin is nearly dry, hand rub till quite dry. Theskin is now white leaher, and fit for use. (Tried with great success.)—ILEX.

[11114.]—**Claret.**—I believe claret to be a very healthy drink, in fact, all the doctors with whom I am acquainted recommend it. It affects particularly the liver and stomach, on which it acts as a tonic. It also renders the blood healthy and pure. It is generally adulterated with logwood.—SCH. Q.C.

[11115]—**Pigs and Pig Feeding.**—If the object be to increase income, I cannot help your correspondent. If he have land, and requires manure for it, fat pigs on barley meal; if with the addition of potatoes, offal, wheat flour, ground peas, or beans—a mixture, but price of article must be his guide as to which. After fifty years' experience, during which I have fattened hundreds of pigs, I find on an average the value of the bacon amounts to the cost of the pig and the food on which it is fattened, sometimes a shilling a score profit is made, sometimes the same amount of loss is incurred. My object in feeding pigs was to dispose of offal food, and to increase my manure heap.—A RETIRED FARMER.

[11115.]—**Pigs and Pig Feeding.**—"Corkeran's" income can be increased by keeping pigs if he has facilities for so doing, but it is a mistaken notion to suppose that any profit can be derived if all the food has to be purchased. From experience, I can say that pigs seldom pay for the expense and trouble in such a case; however, let me strongly advise him to take in as many as he can afford to keep, if he has or can obtain the refuse of a large house, mill, or butcher's stall. They will eat almost anything, roots of all kinds, turnips, carrots, mangold-wurtzel, potatoes, good or bad, and green food, including cabbage, greens, and all kinds of garden produce—the most worthless parts need only be given them—some weeds, such as the sow-thistle, occasionally given for its medicinal property, and which they eat with an extraordinary relish, nettles, docks, rape, and chick-weed. But these must be alternated with more substantial food, as they have very little fattening properties when used unmixed. The same may also be said of roots and vegetables. Coarse meal, such as bran, cracked oats, Indian meal, grains, damaged rice-meal, and mill refuse are the best food for fattening, though seldom given alone, but mixed with boiled roots or vegetables chopped fine, or kitchen refuse. There are many articles of pig feeding omitted here which will occur to "Corkeran" when he begins with his pigs. He need not be afraid of trying them with any kind of eatables. The appetite of large pigs is voracious, and they are by no means epicurean or dainty as to what they eat. Let everything given them as food be cooked; raw food is of little or no use. This does not apply to sow-thistles, chick-weed, and other weeds, which are usually given in their natural state. As to "Corkeran's" second question, as to the time of the year he ought to begin, any time or season will do to take in a stock of pigs. Young pigs are best to buy at this season, if he has a small field or bit of sward over which they can run, as exercise is very beneficial to sucklings or very young pigs. Confinement, however, even in a small space, if proper ventilation is afforded, does not retard the growth of small or large swine. Strict cleanliness must be attended to in all cases, as dirt or moisture is sometimes the cause of disease in the feet and legs, and distemper in other parts of the body, which is their principal malady. Pigs are liable to few disorders, and these are amenable to careful treatment and variation of diet. There is very little experience required in rearing them. Disease seldom appears, and is easily warded off or ultimately cured with little trouble on the part of the owner.—RAT-TAT.

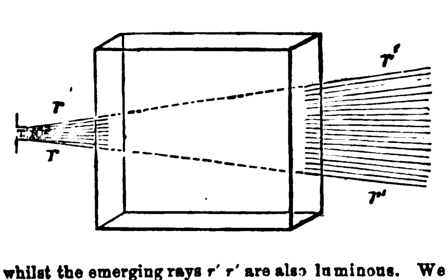
[11116.]—**Spotted Kid Gloves.**—Do not wear the gloves in moist or rainy weather. Keep them under cover as much as possible, and do not allow them to lie for any length of time in damp places. They must also be kept free from greasy or unctuous matter. When touched with oil or grease it shows through them in spots. This also happens if they (the gloves) are a tight fit and the hands perspire. Rub the spots, if white kid gloves, with pipe-clay or powdered French chalk.—RAT-TAT.

[11117.]—**Water-Wheel.**—The form of the buckets, and the angle of the point of the buckets with the ring, will vary with the diameter of the wheel, the depth and number of the buckets, and the velocity of the wheel in feet per second, also with the head of water over the orifice of the fender or sluice which admits the water into the buckets of the wheel. If "Youngster" will furnish sizes I can no doubt give him particulars.—TUBAL-KAIN.

[11120.]—**A Question of Sight.**—I think this is nearly the simplest question we have had, and there have been a few queer ones too. The supposed inhabitants of "Fiddler's" orange would truly see the light of the candle reflected from the walls; he wants to know why we on the dark side of the earth do not see the sun's light in the same way. Well, because the universe happens not to have any walls.—SIGMA.

[11120.]—**A Question of Sight.**—Both "Fiddler" and "A. J. V. G." may be assured "there is more in this," and most other things, than appears to their "first sight." The latter is "agape with speculative wonder" that "a luminous point" produces not exactly the same kind of shadow as the sun. But if his luminous "point" could illuminate "one-half of a globe's surface," he had more reason to be agape. Perhaps he thinks that from a "point"—from one eye—he can see "half of a globe's surface" larger than that eye. Let him note, however, that the sun, even without refraction, illuminates at any moment not merely a half, but about 201 four-hundredths of the earth's surface. He must expose his globe to a luminary that will thus light more than half of it. The sun himself will do exactly the right thing, and cast exactly the kind of shadow from his globe that it does from the globe he dwells on.—E. L. G.

[11120.]—**A Question of Sight.**—May a young student venture to reply to this question, which indeed "has more in it than appears at first sight"? When rays of light proceed from an electric light through the ordinary atmosphere of a room rendered perfectly dark, millions of particles of dust are seen to be floating about in the rays. If, however, these rays of light be directed through a glass case containing ordinary atmosphere, whence all these particles have been absolutely burnt, by passing an electric current through a platinum wire stretched upon points within the case, then luminous rays will be observed on either side of the case, but within it absolute darkness prevails. In diagram let X be the point whence the rays proceed. The rays r r are luminous; the rays within the case indicated by dotted lines are absolutely dark,



whilst the emerging rays r' r' are also luminous. We thus have direct experimental proof that in the absence of the particles of dust, we should perceive no light, unless we look directly towards its source; or in other words light is but reflected by these particles. Therefore, in "Fiddler's" room, strong light from the candle falls upon the day-side of the orange, whilst on the night-side light is not altogether absent, owing to a small amount being diffused by reflection from the small particles of dust existing in the whole room. For like reasons we are not able to see the rays of the sun which are not intercepted by the earth, on account of there being no sufficient amount of matter (if any) in space to render them luminous. On the other hand we can see the stars because we look at them in the direction of their rays of light; and, therefore, even at night time, when, without a moon, we are never absolutely without light, since a small amount is always diffused by our atmosphere, both of rays of the sun and of the stars.—UNDERGRADUATE.

[11120.]—**A Question of Sight.**—"Fiddler" will see that light is conveyed in direct rays and in reflected rays; but some bodies absorb some or all of the rays, and so reflect none, and thus missing direct rays we may miss reflected ones. Tyndall states "the luminiferous ether fills stellar space." So much closer together are the ether atoms than are the atoms of the elements known to chemistry that light travels at the rate of 192,500 miles per second, according to Herschel, while sound travels through air at the rate of but about one-eighteenth of as many feet only—viz., 11,090ft. per second. When "Fiddler" looked at the shadow of his suspended orange, did he cut off from himself all direct or reflected rays from his source of light? No. Now, so excessively minute are the ethereal atoms that (though minuter than the finest needle's point) they have not weight enough in their reflected motion to destroy the eye; and it is only in their reflected motion we receive their impulse in seeing and in observing and looking. If we receive direct rays we destroy the texture of our eyes and lose our sight-power. Evidently the most powerful reflected ray is weak contrasted with a direct ray. Transparency results from the absence of bodies that stop the motion of the light-giving ether: but a transparent atmosphere reflects no portion of the rays of the spectroscope, but the blue ones and the invisible ones—those reflected by clouds are less luminous. Light can hardly be deemed vibration, but force in one direction, light ceasing instantly that combustion stops; so that to a person cut off from direct or reflected rays stellar space is one huge dark expanse lighted only by the distant stars we see of other systems, and not by the sun of our own. As for an earth's shadow, what size is it when cast by the moon on the sun in an eclipse? But its shadow can but be cast on a planet (which reflects Sol's rays) when that planet is not beyond the focus of the shadow. I cannot state just now the limits of the earth's shadow, though it were absurd to suppose it extended to the planet Neptune. Its constant shadow is, nevertheless, easily calculated: it extends an extremely short distance when cast by the sun (so distant is it), than when cast by its own contiguous satellite, the moon.—J. BARWICK.

[11120.]—**A Question of Sight.**—Why should "A. J. V. G." consider the sun as a luminous point? He has only to look at it to see that it is at least more than a point even at our distance of ninety odd millions of miles. The sun being many times larger than the earth, and "A. J. V. G." having reversed this in his experiment, it is not extraordinary that the result of his experiment is the reverse of the known fact. Let him take a moderator lamp for his sun and a marble for his earth, and he will scarcely fail to convince himself of the true nature of the earth's shadow.—V. B.

[11120.]—**A Question of Sight.**—If there is "more in connection with this question than appears at first sight," I should very much like to have it exhibited. To see a shadow of anything anywhere, two things are required—light and a reflecting surface or medium. If "Fiddler" thinks a moment he will see that the only reflectors in the space which Mr. Barwick fills with "attenuated hydrogen" are the stars, the planets, and "our" satellite, the latter of which is obviously the only looking-glass near enough for us to see ourselves in. We don't see those rays of the sun which illuminate the moon until they are reflected from the face of Selene; and I imagine that a man midway between Sirius and the sun would be in darkness, or at least semi-darkness.—SAUL RYMEA.

[11120.]—**A Question of Sight.**—The dark side of the orange in "Fiddler's" supposed case is illuminated by light from the candle after being reflected from the walls of the room. If it were possible to remove the candle and the orange to a place where there is nothing external to the orange from which the light could be reflected to it, a pigmy inhabitant of the dark side would not see the "majority of rays" from the candle any more than we see the "majority of the rays" of the sun at night. Without entering upon the theory of light, I think I am justified in saying that rays of light, in order to be appreciable by the eye, must be directed straight to the eye, whether they come from a self-luminous object or from an object reflecting them. We see the objects of a landscape on account of the rays of the sun being reflected by each object straight to our eyes, the graduated effects between bright sunshine and deep shade being dependent on the number of reflections undergone by the rays between the sun and our eyes. If, therefore, the sun is concealed from us, and is so placed that his rays do not fall on anything in our field of view to reflect or refract them to us, the result is darkness. In looking at a distant star on a clear but dark night we no doubt look athwart the sun's rays streaming in all their glory through space, but as they fall on nothing to reflect them to our eye we see them not. But let the moon or a planet rise across the path of these rays and we immediately become cognisant of light at a spot at which a few moments before we could only discern the vast vault of heaven. The moon is not as described by Demetrius in the "Midsummer Night's Dream," a lantern, with a man, a thornbush, and a dog in it, but a solid body, which in passing through the sun's rays becomes a means of reflecting, and, therefore, revealing to us light which is ever radiating through space, but which without her intervention is often to us as if it were not. Some time ago a slight circumstance showed to me how close the brightest sunshine can be streaming past the eye without producing any impression as such on the retina. I was sitting in an arbour with a narrowish entrance opposite to a bank of laurel bushes. The sunshine was pouring through the boughs of a tree on my right down to the ground on my left, but from where I was sitting the walls of the arbour prevented my seeing either the tree on my right or the illuminated ground on my left. I was accordingly looking at right angles across the rays of sunshine without there being any object in their path to reflect them to the eye. Consequently I perceived no effect of sunshine. All the light apparent to me was what is ordinarily expected from daylight alone. But on blowing a puff of tobacco smoke from my pipe outside the arbour, I became suddenly and unexpectedly alive to the sunshine lying across the line of sight. On perceiving this I increased the volume of smoke, and I saw from where I sat, reflected by the particles of smoke, a sort of map of the rays of sunlight and of the shadows of the boughs through which the sunlight came. On the smoke clearing away the sunlight and the shadows again vanished, and nothing brighter than common daylight was visible between where I sat and the laurel bushes opposite.—V. B.

[11123.]—**Lantern Pinions.**—The pitch or distances of the centres of the pins or trussles should be the same as that of the wheel into which they have to gear.—TUBAL KAIN.

[11125.]—**Silver Bath.**—If the bath has evaporated to about one-third of its former bulk, it must have been very much too weak when last used, or it is much too strong now. Nitrate of silver does not evaporate. Testing the strength is very simple if Charles Lock has the proper instrument for the purpose; if he has not, he had better get one, as it only costs about three shillings, and is always useful. If the bath works well except the clearing of the plate with the cyanide, it must be the cyanide which is at fault; it is either too weak, or perhaps it has been often used and saturated with the iodide of silver, so that it will not dissolve more of it. It is possible, however, that the yellow coating of iodide of silver is readily enough cleared off the plate, but that a dull, white coating remains, which the cyanide will not remove. If this is the case, either the bath is out of order, or light gets at the plate while developing, or going and coming from the camera.—OCCASIONAL PHOTO.

[11125.]—**Silver Bath.**—The silver in Charles Lock's bath all remains behind, but the solution has increased in strength by the evaporation of the water. If he dilutes it down to about the original bulk, neutralises with carbonate of soda, and puts in the sun for a day, then filters and adds a drop or two of dilute nitric acid, it will work well again. (2) Let him try a fresh solution of cyanide, perhaps that he has been using is either very old or has been used until it is saturated with iodide of silver, and has no further solvent action; or it may be that the bath, after standing so long, is very impure and fogs, so that he cannot tell whether it clears or not. (3) There is no simple way of finding the strength.—DÆDALUS.

[11126.]—**Turning Perpendicular Shaft.**—A steam-engine will turn a shaft in any angle of the 360° either approximately horizontal or vertical; proper requirements being attended to.—TUBAL KAIN.

[11128.]—**Making Swimming Bath.**—Build your brickwork in compo, and line the inside with the same (Roman cement), and you will have a waterproof tank. Provide a waste and plug to drain. This is the way I have built the cisterns in malt kilns, and they have always answered well.—M. O.

[11128.]—**Making Swimming Bath.**—If the bath is to be dug out of clay, I would advise "Park Lane" to coat the bottom and sides with a mixture of gas-tar, fine gravel, and sifted ashes, which will render it completely waterproof; or, if the sides are to be of brickwork, he might coat them with Roman cement, and lay the above composition over the bottom.—SCH. Q.C.

[11128.]—**Making Swimming Bath.**—Form the sides and bottom of Portland cement concrete 6in. thick, and afterwards render in Portland cement and sand. This will make a perfectly waterproof bath. Arrangements should be made for supplying and carrying off the water before the concrete is put in.—G. DENOARLGBE.

[11129.]—**Greek Upsilon.**—Seyffarth has investigated the ancient pronunciation of Greek by comparing the proper names in the Septuagint with the same in numerous Oriental versions. He shows most conclusively that the Greek *u* was like the French *u* or German *ü* (something like the Scotch *ui* in guid). The Romans, finding that their *u* was not the equivalent, transferred the Greek letter to their alphabet and called it *y*, which soon lost its true pronunciation, and could not be distinguished from *i*. *Vice versâ*, the Greeks represented the Latin *u* by their diphthong *ou*, which sounded like *oo* in fool.—ARGENT SABLE.

[11129.]—**Greek Upsilon.**—The English *u* gives the only sound of the Greek upsilon. "Pneuma" is not a good example, as in that word there are two letters, *eu*, in Greek, as well as in our manner of spelling it in Roman letters. "Tupto" is a good example; but in English words derived from Greek words beginning with upsilon, the Greek *u* is turned into *y*, as "hydropathy," "hyacinth." There are no such Greek words as "kyklos" and "dryas." If I wanted to write the Greek words in English character that are intended to be represented by the above, it would be thus—"kuklos" and "drus," hence dryads; but a "circle" is more directly from the Latin "circulus."—A HARROW FELLOW.

[11131.]—**Fastening Vulcanite Cells to Glass.**—"Yoiza" must have a bad sample of marine glue; that I am using, which I purchased at a tool-shop in London, adheres to glass most tenaciously.—DÆDALUS.

[11131.]—**Fastening Vulcanite Cells to Glass.**—I have found the cement sold at the Royal Polytechnic Institution, in Regent-street, very effective in fixing vulcanite cells upon glass slides. It is clean to use, dries in twenty-four hours, and holds firmly. Sold as Polytechnic cement.—ILEX.

[11133.]—**Curing Bacon.**—"An Agricultural Labourer" will find the following an excellent method of curing bacon or ham:—To every fourteen pounds of bacon, or ham, use the ordinary quantity of salt, and in addition one ounce and a half each of saltpetre and common soda. The soda prevents that hardness in the lean of the bacon which is so often found, and keeps it mellow all through.—G. DENOARLGBE.

[11133.]—**Curing Bacon.**—The following recipe is copied from the *London Journal* (February 21, 1857):—To 1 gallon of water add 1¼lb. of salt, ¾lb. of sugar, ¼oz. of saltpetre, ¾oz. of potash. Boil the whole together until all the dirt rises to the top, skim off, and when cold pour over your meat. One month is sufficient for it to lay in the pickle. This pickle may be used again several times. It is well to boil and skim when you think it requires it. To smoke bacon, if you have a wide, old-fashioned chimney, and burn wood, you may hang it up in the chimney and dry as I do, or send it to the bakehouse. It will dry if hung up there.—NORTH DEVON.

[11138.]—**Violin.**—I have no doubt that "J. W. L.," being "well acquainted with the Tonic Sol-fa system," will readily acknowledge its superiority over the old notation for singing. Having had some practical experience of its adaptability to stringed instruments, I can confidently recommend "J. W. L." to obtain the "String-Band Book," edited by Rev. Jno. Curwen, and published at the agency, and if he will apply himself assiduously to the instructions and exercises it contains, he will be astonished at the progress he will have made in a short time. For, as he already knows the notation, he can devote all his care and attention to learning the best styles of bowing and fingering; whereas, if he had to learn the clefs, signatures, flats, sharps, and other crotchets of the old notation, the time left to master the bowing and fingering of the instrument would be small indeed. As I am speaking on stringed instruments, I may perhaps be allowed to refer to query 10945, and recommend "R. W. T." to adopt the Tonic Sol-fa system for his violoncello, and he will find the same book replete with excellent advice and exercises for learning that instrument.—J. G.

[11138.]—**Violin.**—It will be necessary for "J. W. L." to learn the old notation, on account of all music for this instrument being written in it. He should buy an instruction book, which would assist him materially, but it would require the aid of a master to give him the "finishing touch."—J. KING HARRIS.

[11139.]—**Geometrical Drawing.**—The best books on descriptive geometry (orthographic and isometric) are E. A. Davidson's "Orthographic and Isometrical Projection" and Bradley's "Elements of Practical Geometry" (Chapman & Hall). For problems and exercises see the "Science and Art Examination Papers" on the above subject.—SCH. Q.C.

[11139.] — **Geometrical Drawing.** — Binns' "Orthographic Projection."—EXCELSIOR.

[11141.]—**Phrenology.**—I should think the best way of studying phrenology would be by observation; at least, I have found it so. For instance, select a certain class of men who have all a certain clearly defined taste for some one subject in particular—as for mathematics, say; observe the way in which their foreheads, &c., are formed, and lay down the rule that all other men who have their heads formed in the same manner have similar tastes. Then set to to find out the exceptions to this rule, and ascertain the reason for those exceptions, and so proceed for every other form of head that may come under your notice. By proceeding thus, you lay down a certain set of rules which you can use when occasion requires.—SCH. Q.C.

[11142.]—**Centre Points.**—Use a wrought-iron crank of 1⅜in. or 1¼in. diameter, with steeled ends hardened, and the radius of the cranks 2½in. to 3in., depending upon the size of the lathe and work to be done.—TUBAL KAIN.

[11143.]—**Height of Swiss Mountains.**—Mont Blanc, 15,732ft.—EXCELSIOR.

[11145.]—**Rose Trees.**—I have found plenty of pure water and a syringe as good for rose-trees as tobacco water. Cabbage, French, and moss roses require all the same treatment; and in order to have fine flowers it is necessary to remove them every three or four years, as they, like potatoes, cast an abundance of slime. Pruning is the most important feature in their cultivation. Until I used my clippers about them most liberally I had poor and degenerated flowers. The shoots must not be uniformly shortened to within a certain distance of the stem; the strong and vigorous shoots should be annually shortened to within six inches of their base, while the weak and slender may be reduced to three or four. Standard roses require still more closely pruning, and all old wood cut from the centre of the head. It is very necessary for standards to be supported firmly to strong stakes.—SARAH.

[11145.]—**Rose Trees.**—"Katrine" will find bitter aloes very good to syringe the trees with. One pennyworth will make three or four gallons. It is very good, also, for any flowers. The trees ought to be cut the beginning of March, and I advise that they be cut at once. Should not pluck any of the buds off unless they seem pretty thick. Water every other day this cool dry weather, and in summer every day, the water being put to the roots and not over the tree.—HARRY W. WEBB.

[11145.]—**Rose Trees.**—"Katrine" need not use either tobacco or lime-water for her roses. If they are well painted with a solution of soft soap before they start, they will not require more than syringing with clear water afterwards. Cut them now: dwarfs as short as you like; standards should have the heads trimmed into shape and weak branches removed; then cut back to the fourth bud, if that is suitable—*i.e.*, if it points downwards or outwards. Roses cannot well have too much manure; watering depends entirely on the season: they did not require much last year. An old gardening friend of mine always digs all round his rose-trees on purpose to cut off the tap-roots, which only assist in forming wood—a method of pruning quite applicable to fruit trees also.—SAUL RYMEA.

[11148.]—**How to Disinfect a House.**—Have all the paper stripped off the walls, and have all the floors, ceilings, and walls washed with lime and water. Any defect in the drainage should be made good, or it may cause a fresh outbreak.—G. DENOARLGBE.

[11148.]—**How to Disinfect a House.**—There are two methods which are believed to be superior to all others. 1. Chlorine gas. 2. Sulphurous acid gas. Both of these plans are noticed in the ENGLISH MECHANIC last week, but hardly in a practical manner "E. L. G." directs the use of a mixture of black oxide of manganese, salt, and sulphuric acid, which will give the chlorine gas, but he directs that one pound of the mixed salts and an equal weight of sulphuric acid be used to each cubic yard of the contents of a house. This is absurd, and shows "E. L. G." has not written from any practical knowledge of the subject. A room 12ft. square and 9ft. high, would require 48lb. salts, and as much acid; a house 24ft. × 15ft. and 30ft. high would take 400lb. of each—a nice joke to capsize 400lb. of sulphuric acid by pulling a string outside the house. The most practical plan I know is that used by the New York officials: it is to place a pan containing one pound of sulphur in each room to be disinfected; this should stand in a larger pan containing sand or earth to avoid risk from fire. Doors and windows are shut, chimneys stopped with a handful of shavings, the sulphur lighted after some strong methylated spirits of wine has been poured over it, and the house abandoned for 24 hours. The sulphur does not light readily without the above preparation.—A BARRISTER.

[11148.]—**How to Disinfect a House.**—Mix well together 1lb. of Calvert's No. 5 carbolic acid with 5 gallons of water, and sprinkle well over the house. Take also the concentrated liquid acid, and vaporise it on hot iron plates in the various rooms, keeping the windows and doors shut to keep in the vapour for two days; then allow a good current of air through the place, and after having whitewashed with ordinary whitewash and carbolic acid, the house may be said to be perfectly safe. Infected clothing should be steeped in carbolic acid solution (1 to 80). Bedding, &c., should be placed in a disinfecting oven and exposed to a temperature of 220° Fahr.,and a large flat jar,of equal parts of carbolic acid and water, should be placed in the oven with the beds. Under the influence of the aqueous vapour and heat, the carbolic acid is volatilised, and the vapour is absorbed by the goods. I have seen zymotic diseases return when a chloride of lime disinfection was relied on, but never with carbolic acid, if enough was used.—GEORGE E. DAVIS.

[11149.]—**Examination Question.**—I agree with the querist that such a question should not have been put, unless opportunity of reference was afforded, or it was put to a very advanced chemical class, and one which had been specially studying subjects of this order. I could not answer it offhand, or without reference to tables and authorities, as it relates to subjects I have never had occasion to deal with, and, therefore, cannot charge my memory with the requisite figures; and being away from home I leave the reply to others.—SIGMA.

[11150.]—**Scaring Foxes.**—I am sorry to inform "A. B. C." that the above subject is not my forte. If it was my difficulty I should try a few shot.—GEORGE E. DAVIS.

[11155.]—**Amalgamated Zinc.**—I always do this in Bunsen's battery by putting some mercury at the bottom of the zinc cell, filling the cell a little fuller than I intend to keep it while working. The mercury then covers the zinc as high as it is wet with the diluted sulphuric acid. After a short time I lower the acid to the proper height. This effectually amalgamates the zinc.—W. BROWNE.

[11155.]—**Amalgamated Zinc.**—I am surprised at "Yakew's" failure, as I have always tried the plan he speaks of and have found it to succeed. Perhaps the dilute acid in which he dipped the plates or cylinders previous to rubbing on the mercury was not strong enough.—SCH. Q. C.

[11162.]—**Aerated Drinks.**—Seltzer water should be a correct imitation of the celebrated German spring. The following is a recipe which I have not tried, but give it as I have it written. Muriate of lime and muriate of magnesia, of each 32grs.; dissolve these in a small quantity of water and add it to a similar solution of 64grs. of bi-carbonate of soda, and 160grs. muriate of soda, and 16grs. phosphate of soda, and add a solution of ½gr. sulphate of iron; put the above together, filter carefully, and add to a gallon of water, then charge with carbonic acid gas to a pressure of 120lb. Potass water:—Dissolve a quantity of bi-carbonate of potass in your water, then charge your water with gas. About 1dr. carbonate of potass to 1 gallon of water. Lithia: Use the carbonate of lithia. Carrara:—Put a quantity of Carrara marble in a crucible, and when calcined add to your water and charge up to 160lb. or 180lb. of pressure—about 10grs. to each bottle. For magnesia use carbonate of magnesia.—SODA-WATER.

[11162.]—**Aerated Drinks.**—"L. W. D." will find the following a good recipe for seltzer water:—Carbonate of soda, 10dr.; carbonate of magnesia, 6dr.; sulphate of potash, ½dr.; common salt, 13dr.; chlorate of potash, ½dr. Of course the gas will have to be forced into it as in soda-water. This quantity is sufficient for two gross of the water.—J. KING HARRIS.

[11163.]—**Currency.**—Here is an account of the new German coinage:—The *Borsen Zeitung* of Berlin gives details of a bill, to be introduced into the German Parliament during the present session, for the regulation of the coinage of the empire, a measure the necessity of which is obvious to any one who has ever been perplexed with the multifarious currencies of the many German States. According to this sketch, the new bill establishes the mark of 100 pennies as the unit of account, and the following will be the small coins:—1. A tenpenny piece, 1,035 of which will contain a pound of fine silver, and 227·7 of which will weigh a pound. 2. A fivepenny piece, with half the value in silver and half in copper. 3. A twopenny piece in copper. 4. A onepenny piece in copper. Higher silver coins: 5. A quarter-mark piece, value twenty-five pennies. 6. A half-mark piece, value fifty pennies. 7. A mark piece. 8. A three-mark piece, corresponding to the present thaler. As the gold money established by the last bill was to consist of twenty and ten mark pieces, the whole new coinage system, if this bill is carried out, will consist of ten coins—the gold pieces corresponding to the English sovereign and half-sovereign, but worth respectively fivepence and twopence halfpenny less; the higher silver coins (quarter-mark, half-mark, mark, and three-mark) corresponding to the threepenny piece, sixpence, shilling, and what would be a three shilling piece, if there were such a coin, but all of fractionally less value, corresponding to the less value of the gold coins; and the smaller silver and copper pieces (ten, five, two, and one pennies) corresponding to the penny and halfpenny, and what would be the fifth and tenth of the English penny, but all of fractionally greater value—the German tenpenny piece being the 200th part of 19s. 7d., whereas the said penny is only the 240th part of 20s. I presume if this is adopted in Germany, Austria will follow suit.—Saul Rymea.

[11164.]—**Making Gunpowder.**—Gunpowder is a compound of saltpetre, sulphur, and charcoal; its quality depends more upon the intimate combination of the ingredients than their absolute purity. The following are the proportions used by the English, French, United States, Russian, and Chinese Governments:—The Royal Mills, Waltham Abbey: Nitre, 75lb.; charcoal, 15lb.; sulphur, 10lb. The French National Establishment: Nitre, 75lb.; charcoal, 12·5lb.; sulphur, 12·5lb. The United States: Nitre, 75lb.; charcoal, 12lb.; sulphur, 13lb. Russian powder: Nitre, 73·78lb.; charcoal, 13·59lb.; sulphur, 12·63lb. Chinese powder: Nitre, 75·0lb.; charcoal, 14·4lb.; sulphur, 9·9lb. The charcoal (which is generally willow, birch, alder, or dogwood) is examined, and all brands and imperfectly burnt coal are removed; it is then sifted and placed in the mill, and reduced to a very fine powder, and passed through a bolting sieve of fine brass wire. It is necessary to reduce the charcoal to as fine a powder as the nitre and sulphur in order to effect an intimate mixture. The sulphur is broken in small pieces, and all extraneous matters picked out, then ground in a mill and passed through a bolting sieve the same as the charcoal. The saltpetre (previously refined) is melted and cast into cakes, which before being broken are carefully brushed, in order to remove any particles of dust or grit which may have got on the surface during the exposure to the air (this precaution is necessary to prevent any accident by explosion during the manufacture of the powder). Having been cleansed, they are broken up with a boxwood mallet, placed in the saltpetre mill, and ground small enough to pass through a fine wire sieve, which is worked in a covered hopper, and received in a tub placed under the hopper, and so connected with it by a cushion that by the weight of the former it presses closely upon the tub and prevents the finer particles of saltpetre flying off. This mode of operating is necessary, because the velocity of the bolting machine would otherwise occasion the saltpetre to form itself into lumps, which would clog the wires of the sieve, and prevent the separation of the powder from that which is imperfectly ground. The saltpetre, sulphur, and charcoal having been prepared as above, are put into separate bins, and when the charges are to be got in readiness for the powder-mill, a quantity of each ingredient for the surface of one bed-stone at a time is to be weighed out according to the proportions required. The three ingredients are put into a charge tub, in the following manner, so as to make the most intimate mixture possible:—(1) A layer of charcoal, then a layer of sulphur; a second layer of charcoal, and a layer of saltpetre. Great care must be taken that these layers bear exactly the same proportion to each other as did the three quantities when weighed off. The charge is then put in the tub and a cover put on; to which is affixed a wooden instrument with eight prongs for stirring the charge, so constructed as to be worked by a handle outside. After the charge is thoroughly incorporated it is taken out and passed through a fine brass wire sieve into another tub placed under the bottom of a covered hopper (similar to the one used for the nitre). The charges having been prepared at the mixing house are deposited in the charge magazines. When wanted the mill-man takes out a charge and places it on the bed stone as equally as possible. The dust which may fly off from the charge in loading the mill is carefully swept down from the stones, wheels, and curb, as soon as possible; for if left till the charge is nearly wrought, and then swept in, it would make the powder foul. After two or three revolutions of the stones to level the charge, it is sprinkled with pure cold water from a copper watering pot, the exact quantity must depend upon the experience of the mill-man and the wet or dry state of the stones. The charge is ground from three to five hours and then taken back to the charge magazine. The next day the charge is carried to the hydraulic press and carefully laid so as to form a mass as equally dense as possible, and it remains under pressure as long as the state of atmosphere requires. The quantity mostly pressed at one time is about 400lb. The mass having stood long enough, it is taken out and broken with a large wooden maul, the pieces being carried to the breaking trough, and further broken by wooden mallets to pieces about the size of peas; 7lb. weight of this is put into the corning sieve; 32 sieves being contained in the corning engine. When the corning man observes that the dust from the pieces of composition has passed through the corning sieve, he puts in a piece of lignum vitæ, called a roller, circular, with ends convex, which granulates the press cake, and makes it pass through the holes of the sieve into another sieve called a hair duster, which allows the dust to separate from the grains by passing into a trough for its reception. The grained powder is now put into a reel lined with canvass, of such a texture as to allow the fine grain and dust to pass through it, while the large and small grains remain in it, and are glazed by friction. The time required for this process is from 30 to 35 minutes. Gunpowder thus glazed is found to keep longer and travel better than when not glazed. The different sorts of powder are then dried in a stove specially constructed. After drying it is removed from the stove and passed through a screen, composed of two inclined planes, covered with fine brass wire sieves. This operation is necessary to cool the powder and remove any dust formed in the drying. From the screens it is removed into wooden barrels which generally contain about 90lb., but which would hold 100lb., room being left for the powder to move about when the barrels are rolled. The barrels are then removed to the magazine—a sample being previously taken from each barrel for proof.—William H. Hey.

[11164.]—**Making Gunpowder.**—In practice the manufacture of 100lb. of gunpowder takes 77½lb. of nitre or saltpetre, 10½lb. of sulphur, and 16lb. charcoal; in all 104lb., the 4lb. being allowed for waste. After the several ingredients have been ground to an impalpable powder, they are well incorporated and worked into a stiff paste. The particles are then separated by mechanical means into small pieces, these again are granulated by being passed through hair sieves. After being pressed and glazed in order to impart to it the property of resisting moisture, the powder is last of all dried thoroughly in what is called a gloom-stove at a temperature of from 140° to 150° Fahrenheit.—Excelsior.

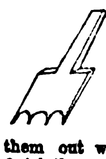
[11165.]—**Radius of Surface of Object-Glass.**—The curves of object-glasses for astro-telescopes require to be calculated very correctly, according to the dispersive and refractive powers which the formula is calculated or based on. The curves given by Mr. W. H. Cash are altogether wrong for a good object-glass. The refractive power of plate, specific gravity 240, is 1·503, and flint, specific gravity 3·230, is 1·652, and the dispersive power of flint is 00·462, and plate 00·290; and if W. H. Cash would make his flint-glass in the proportion of 1 to 2, and crown or plate, specific gravity 24·7, to the proportion of 3 to 5, and calculate the radius of the flints and plate so as their ratios will be as 1·660, he will have an object-glass that will be correct. And when the plates and flints are of the kind stated above, the focus will be to the radius of the flint lens as 1 to 2, or supposing the radius of the flint lens to be, say 24·00, then the focus will come out 48in., with the ratio of radii at 1·660. These proportions I know to be correct, by the formula I have used, and proved over and over again; though I have not used them myself for a long time, I know they are good, and may be useful to many. W. H. Cash might well say he was on the blue rays: with a power of 100 he would have found himself in the midst of it. My advice to him will be to alter the form of his object-glass to these proportions, for his object-glass is now what is called over-corrected, and when he has corrected it for chromatic aberration he will find it is not corrected for spherical aberration.—W. Oldfield.

[11165.]—**Radius of Surface of Object-Glass.**—As Mr. Cash has given me the refractive indices and dispersive ratio of his glass, I can answer his query. Let us take his radii, and let us see what focal length they will produce. Now, we have for the crown glass, $\frac{23{\cdot}422 \times 93{\cdot}786}{46{\cdot}893 + 23{\cdot}422} = 30$in., the geometrical focus of the convex, and $\frac{30}{10{\cdot}58} = 28{\cdot}35$, the refracted focus of the crown. In the same way, $\frac{175{\cdot}91 \times 23{\cdot}422}{87{\cdot}955 - 23{\cdot}422} = 63{\cdot}86$, the geometrical focus of the flint, and $\frac{63{\cdot}86}{12{\cdot}76} = 50$, the refracted focus of concave and $\frac{28{\cdot}35 \times 50}{50 - 28{\cdot}35} = 65$in., the refracted focus of the compound object-glass; and, as Mr. Cash says that his compound focal length is 63·85in., my calculation and his results are very nearly the same, allowing probably for slight errors in workmanship, and I do not think that my severe critic, Mr. Vivian, can work this out more simply than I have done. And now we can see why Mr. Cash's object-glass has a shorter focal length than he intended. The reason is that he has worked his glasses to a higher dispersive power than what he gives me, for $\frac{28{\cdot}35}{50} = 56{\cdot}7$. Consequently, if his dispersive power is correct, his flint lens has too long a focal length, which accounts for his focal length coming out too short. Now let us take the refracted focal length of the convex, 28·35, and we have 28·35 : x : : 636 : 1000, and the refracted focal length of the flint must be 44·57in., and then we have $\frac{44{\cdot}57 \times 28{\cdot}35}{16{\cdot}17} = 70{\cdot}8$in., exactly what his object-glass ought to be, instead of 63·85in., or 65in. Now let us apply the proper correction to the flint lens, and we have—taking 23·422 as the interior curve—44·57 × 12·76 = 56·871, the geometrical focus of the concave lens. Then $\frac{46{\cdot}844\ r}{r - 23{\cdot}422} = 56{\cdot}871$, and consequently the back curve of the flint lens, instead of being 87·955in., ought to be 105in., and then the compound focal length of the object-glass will be 70in. very nearly, exactly as it ought to be, according to Mr. Cash's refractive indices and dispersive ratio, and he will observe that this correction of the flint lens makes the curves far more nearly approaching to Sir J. Herschel's formulæ than his own do. As regards eye-pieces, I strongly advise him to go to the expense of purchasing them, as they are now very reasonable. I have procured mine from Browning of the Minories, and very good they are.—Orion.

[11166.]—**Area of Segment of Circular Ring.**—Observing the discrepancy of "V. B.'s" solution with mine, I searched for the cause, and found, what I had perceived at first, that the given data are incompatible: since, when the centre angle is 60°, 70 is the side of the inscribed hexagon, and 50 must be its apothegm; now, the apothegm side × 0·866, which is not equal to 50, as is given for the side of the inner hexagon or radius of the smaller circle: hence problem not possible with those data.—Bernardin.

[11166.]—**Area of Segment of Circular Ring.**—I see I made an error (p. 675) in saying the segment is one-third of a complete ring—I should have said one-sixth. "E. L. G." has dismissed the question as an incomplete one, and I was very near doing so at first. "Bernardin" has misunderstood it somehow, for the number that he has put down as 85° should be 9,600, which is the square of 97·97. "V. B.'s" solution is correct.—J. K. P.

[11168.]—**Wood Rods.**—"Joiner" will find a bead plane very useful to make wooden rods, the "iron" is somewhat as per sketch, but of course the number and size of the "teeth" must be in accordance with his desire and his strength. His timber should be of the diameter of his rods in thickness, and the plane should have stops screwed on to the sides to prevent it going more than half through it; when, by working on both sides of his stuff, he will be able to turn them out wholesale, and a bit of glass paper will finish them off. I have used this kind of tool to make bird-cage rods for blackbird cages with success, but do not recommend that the plane should be made for more than three rods at once.—C. N. Abbott.



[11168.]—**Wood Rods.**—I should make them with a five-sixteenth bead plane; stick one side; turn the wood and stick the other; the quirk will cut off the bead. When I was in the building line the carpenters made them so.—M. O.

[11168.]—**Wood Rods.**—Plane up a piece of hard wood to the exact thickness, put it in the vice with another piece to back it, and cut a bead on the upper edge with the beading plane held horizontally; then reverse the board and cut a bead on the other side, till the rod comes off. A slight feather is sometimes left which can be planed off, and the rods may be "papered" in the lathe.—Argent Sable.

[11171.]—**Equations for the Formation of Hydric Sulphate.**—"W. N. Oswad" perhaps knows that the heat of the sulphur kilns is employed to heat the pots which contain the nitrate of soda and sulphuric acid, consequently we have varying temperatures, and, I think, varying results. All the text-books are right, and they are all wrong, for they do not mention any variation in the process. If the heat is too low, nitric acid is simply distilled, and is washed down the flues into the acid. If the heat is too high, and in the presence of sulphur dioxide, the nitrogen trioxide and tetroxide are reduced to simple nitrogen. If the happy medium is obtained it is a question whether the trioxide or tetroxide of nitrogen is obtained. I believe the former, for when reducing substances are heated with nitric acid, nitrogen trioxide is the result, and a conclusive proof of this lies in the fact that, when the nitrous fumes are absorbed in the column at the end of the chambers, no other nitrogen compound but the trioxide and a little nitric acid is found in the issuing acid, therefore the reaction would probably be:—$N_2O_3 + SO_2 = SO_3 + N_2O_2$, then $2N_2O_2 + O_2 = 2N_2O_3$, the SO_3 becoming H_2SO_4 by the action of the steam. The chamber crystals, for which so many formulæ have been devised, have been supposed by some to play an important part in the manufacture of sulphuric acid but this is thought by some to be erroneous, and the practical result is thought better if these crystals are never allowed to form.—George E. Davis.

[11172.]—**Punching and Shearing Machine.**—"F. T. S. S. D." will not be able to punch ½in. hole in ⅝in. plate; practically the size of the hole to be punched must not be less than the thickness of the plate. But you can easily punch a ⅝in. hole in ½in. plate, the machine being sufficiently strong for the purpose.—Tubal-Kain.

[11176.]—**White Hard.**—This was an omission of mine or the compositor's: it should have been pasted on and varnished with white hard. The only objection to paste is the swelling the veneer, thin glue is better, if you put a little treacle in it to keep it adhesive

longer. If "R. C. K." is in the country I will send him some veneer if he requires it, and advertises his address.—M. O.

[11179.]—**Covered Wire.** — Copper carefully selected and tested for conductivity should be used; but many makers know nothing or care nothing about such a "theoretical" detail; as "practical" men they want to make money. The number of the wire, of course, varies from 10 to 40, according to the purpose it is required for, and the colour of silk is usually green, but for very delicate instruments white is best, as the dyes often contain iron which produces some very slight disturbance.—SIGMA.

[11181.]—**Centre-Making.**—"Don Pedro" had better square the half width, and the rise or height. Add these squares together, and divide by double the height, thus :—

The height 20in. squared	=	400
The half width 34in. squared	=	1156
Divide by double weight = 40)		1556
		38·9

The radius will be 38in. 9-tenths exactly.—E. L. G.

[11181.]—**Centre-Making.** — First divide the square of half the span by the rise of the arch. Secondly, add the rise of the arch to the first-named quotient, when one-half of the sum so found will give the radius required.—S. J.

[11184.]—**Shortness of Breath.**—John Smith had better be careful how he gets "out of breath." So far from his heart not supplying sufficient blood it supplies him with too much—*i.e.*, sends more to the lungs than they can take, and the best thing he can do is take the advice of a medical man. Dr. Haughton attributes the death of Master M'Grath to the fact that the lungs were diseased and were incapable of preserving that *balance* between the respiration and the circulation which is the true measure of health. It is quite a mistake, he points out, to suppose that an hypertrophied heart is necessarily a sign of disease, for given a corresponding development of lung, a large heart is a positive benefit; the heart of Eclipse is said to have weighed 14lb. But with a large heart and even slight lung disease, congestion of the venous system is apt to occur. Pedestrians and athletes are often afflicted with tubercle. I don't mean that J. Smith is "in a consumption," but he had better take advice if he persists in "getting out of breath."—SAUL RYMEA.

[11186.]—**Length of Sidereal Day.**—I am sorry that by a mistake, either of mine or the printer's, the length of the sidereal day was stated to be 3m. 55·11s. instead of 3m. 55·91s. less than that of the mean solar day, being the difference between 23h. 56m. 4·09s. of mean solar time and 24h. I shall be glad to learn the easiest mode of setting a clock after it is rated, when neither the true time or the meridian is accurately determined without instruments of precision. Is there a better mode than by observing from what point south of the edge of a board fixed vertically the pole star is just visible when on the meridian? As this time may be known very nearly, the meridian may be thus known without sensible error. A point precisely opposite to the north of the vertical board will, of course, be due north, and from that point the exact instant of southing of a star may be observed as it passes the vertical edge.—PHILO.

[11186.]—**Length of Sidereal Day.**—According to the *Nautical Almanac* for 1872 neither "Philo" nor "T. H. M." is right as to the exact length of a sidereal day. Twenty-four hours of mean time are equivalent to 24h. 3m. 56·5554s. of sidereal time, consequently a clock to go correctly should apparently lose 3m. 56·5554s. between each return of a fixed star to the meridian.—T. M.

[11187.]—**Cryolite.**—Can supply cryolite. Is quantity ultimately required? Let "Associate" advertise his address.—R. S. WARLEY.

[11188.] — **Arithmetic.**—£19 19s. 11¾d. × £19 19s. 11¾d. Let "J. Lewis" multiply £20 by £20, and subtract 20 farthings.—J. KING HARRIS.

[11188.]—**Arithmetic.**—I am sorry "E. L. G." can only give a Yankee's answer to my question—namely, another question; but since this is the only reply, I suppose that there is no way to work out the sum in the way I require. As, however, in the second part of "E. L. G.'s" answer he seems to infer that it cannot be worked by any method, I have inclosed for his and the other readers' benefit O'Gorman's method, which, however, is more to show that such a sum can be worked out than for any practical purposes, as the decimal method—viz., reducing the shillings and pence to decimal parts of a pound is by far the simplest and easiest.—Rule: Pounds × pounds, produce pounds; pounds × shillings, produce shillings; pounds × pence, produce pence. Shillings × shillings: every 20 is a shilling, every 5 is threepence, each 1 is 2 farthings and four-tenths. Shillings × pence: every 5 is a farthing, every 1 is two-tenths of a farthing Pence × pence: every 60 is a farthing, every 6 is one-tenth farthing.—J. LEWIS.

[11188.]—**Arithmetic.**—Multiply by £20 and subtract the 19,200th (one farthing the difference between £19 19s. 11¾d. and £20 being the 19,200th part of £20) part of the product; the difference will be the answer required.—G. DENOARLGBE.

[11193.]—**Pumps of Portable Engine.**—The pressure, in the case of the two-valve pump, being alternately above and below the centre of effort of the valve, it will obviously be unable to overcome the barometric resistance to initial suction. When three valves are used one surface is always at a maximum, and the pumps will start, as your correspondent suggests, of their own accord. I had an unpleasant instance of this on one occasion: having left the pump and hose near a pond on my grounds one evening, a mischievous boy inserted it, and in the morning the pond was dry.—MENDEX.

[11194.]—**Restoring Worn Black Cloth.**—I should advise the use of a strongish solution of sesquicarbonate of ammonia to sponge the cloth.—W. F. TRINDER.

[11224.]—**Books on Ceylon.**—The "Catalogue of the Indigenous and Exotic Plants of Ceylon," by Alex. Moon, Colombo, 1824, might, I think, among many others, be useful to the querist; it gives the vulgar names with their scientific translations.—BERNARDIN.

[11235.]—**Eels in Paste.**—"Microscope" must not buy his paste at the shops but make it himself, from flour and water only. It should be made thick, and of course boiled; when cold it should be well stirred with a wooden spoon, this should be done daily to prevent the growth of mould. In warm weather a few days will generally produce a plentiful supply; in cold weather a longer time is necessary. To exhibit the animalcula in the microscope, a little of the paste should be put in some water on a glass slip. They will keep for years if a little fresh paste is occasionally added.—J. KING HARRIS.

[11239.]—**Photography.**—I cannot see the possibility of giving "Caswallon-ap-Davies" sufficient information for him to set up as a photographer (he being ignorant of the art) in the small space which it would be necessary to devote to him in this journal. I am afraid he will find photography not such a simple thing as he, perhaps, imagines. At all events, he had better acquire a knowledge of it before he thinks of setting up in business in that line. He can obtain works on the subject and all information where he purchases his apparatus.—J. KING HARRIS.

[11240.]—**Electromotive Force.**—The force of the Leclanché is so very variable that it is quite possible 100 cells after use may only equal 70 that of a standard cell in good order. But if each cell be tested separately and then in series the result of the last should be the sum of all the cells alone. If not it is most probable that the resistance measures are erroneous. I consider Poggendorf's method a troublesome one, for which reason I did not give it among those I selected as the best. Has "O." got his other resistances, the galvanometer, &c., correct.—SIGMA.

[11243.]—**Deaf and Blind.**—At the Deaf and Dumb Institute of the late Canon Carton, at Bruges, Belgium, a deaf and blind girl has been educated. I think the querist applying there, by letter or otherwise, might receive every information desired.—Y. Y.

[11245.]—**Felspar.**—The analyses differed because the felspar was of different kinds. Felspars are anhydrous double silicates, consisting of a silicate of alumina, combined with a silicate of a protoxide of either potash, soda, lithia, or lime. These oxides being capable of mutually replacing each other, it commonly happens that two or more of them co-exist in the same species. Felspars are generally classified into five groups. Potash felspar, soda felspar, soda-lime felspar, lime felspar, and lithia felspar. Orthoclase or common felspar belongs to the first group, and is the most common. An analysis of one variety is given in Ure's Dictionary as silica, 65·72; alumina, 18·57; potash, 14·02; soda, 1·25; lime, 0·34; magnesia, 0·10—KAPPA.

[11249.]—**Concrete Walls and Buildings.**—Has "W. W." read "Kho Bux's" letters, p. 407, Vol. XIII.? See also pp. 445 and 456, same volume. If in London, "W. W." should inspect a concrete warehouse erected some three or four years since in Great Guildford-street, Southwark, for a Mr. H. Goodwin. See also a capital series of articles describing the different systems of building in concrete on pp. 461, 548, 564, and 579, Vol. XV., of the *Building News*. I visited the building referred to in Great Guildford-street at different stages of its progress, and I think the owner had good reason to be satisfied with it as regards cost of construction and stability. It was built with Tall's apparatus.—KAPPA.

[11251.]—**Iron Stains in Oak.**—A solution of oxalic acid will completely remove the stains, but care should be taken to thoroughly remove all traces of the acid by copious washing with water immediately the stains have disappeared, or it might damage the oak.—KYNCKER.

[11258.]—**Rollers of Wringing Machine.**—I have seen a wringing machine with lignum vitæ rollers that have been in wear for years, and are now equal to new.—WILLIAM H. HEY.

[11262.]—**Electricity from Steam Boiler.**—Vide, in works of Natural Philosophy, the description of Armstrong's hydro-electric machine.—Y. Y.

[11271.]—**Naval Architecture.**—Water-lines or lines of flotation: These are horizontal lines supposed to be described by the surface of the water on the bottom of a ship, and which are exhibited at certain depths upon the sheer draught. Of these, the most particular are the light water-line and the load water-line, the former showing the depression of the ship's body in the water when light or unladen, and the latter the depression when loaded. Water-ways: The edge of the deck next the timbers, which is wrought thicker than the rest of the deck, and so hollowed to the thickness of the deck as to form a gutter or channel for the water to run through the scuppers. Dead water: The eddy which the ship draws after her at her seat or line of flotation in the water, particularly close aft. To this great attention should be paid in the construction of the vessel, especially those with square tucks, for such being carried too low in the water will be attended with great eddies and much dead water. Vessels with a round buttock have but little or no dead water, because by the arching of those vessels the water more easily recovers its state of rest. Bulkheads: The various partitions which seperate one part of a ship from another. Those in the hold are mostly built with rabbeted or ciphered plank. Run: The narrowing of the ship abaft, as for the floor towards the sternpost, where it becomes no broader than the sternpost itself. The term is also used to signify the running or drawing of a line on the ship or mould loft floor, as to run the wale-line, the deck-line, &c.—W. H. HEY.

[11273.]—**Cement for Water.**—Line with (½in. thick) neat Portland cement—that is, without the admixture of sand. Let the cement be exposed to the air in a dry place for a week before used, to avoid shrinkage while setting, and to increase the strength of the cement; use a moderate amount of water with it when mixing, and lay it on quickly, having previously well saturated the stone with water. Do not be sparing of labour in well trowelling the material till it is set moderately hard. The tank can be filled with water in about forty-eight hours after.—T. F.

[11273.]—**Cement for Water.**—Let "Geethe" take his stone cistern to pieces, and use some fresh "Roman cement" (to be obtained at any builder's yard), screwing the cistern together again before it is set.—J. KING HARRIS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "G. D." has answered 10479; "K. K.," 10501; "Busy Bee," 10510; "Organist," 10512; "E. L. G.," 10565, 10660; "West Cornwall," 10617; "Philo," 10696.

10708	Vox Humana, p. 545
10710	Drying Stoves for Cores, and Loam Moulds for Iron Castings, 546
10711	Magnesium Lamp, 545
10712	Duet Flageolet, 545
10717	Writing Ink, 545
10739	Centre Drill Chuck, p. 546
10752	Paris Diamonds, 546
10759	Transparent Photographs, 546
10765	Trombone Reeds, 546
10772	Breeding Small Birds, 546
10773	Fern Case, 546
10776	Gilding on Glass, 546
10780	Modelling in Plaster, 546
10793	Paper, 546
10805	Tin Plate Measurements, p. 547
10808	Bevel Gear Wheels, 547
10810	Shafting, 547
10811	Boiler Construction, 547
10812	Small Boiler for Steam Engine, 547
10813	Spring Biscuit Cutters, 547
10814	Pigeons, 547
10815	To Clean Furs, 547
10816	Scouring Paisley Shawls, 547
10817	Model Screw Steamer, 547
10819	Bleaching Powder, 547
10822	Permanent Polish, 547
10824	Ozone, 547

Cleaning Old Engravings.—Instead of carbonate of soda, use the bicarbonate, in slight excess, for decomposing chloride of lime. The reaction is very violent, and Javelle water is easily separated from the precipitate produced. Old engravings, woodcuts, and all kinds of printed matter that have turned yellow, are completely restored by being immersed in it for only one minute, without the least injury to the paper, if the precaution is taken to thoroughly wash the article in water containing a little hyposulphite of soda. Undyed linen and cotton goods of all kinds, however soiled or dirty, are rendered snowy white in a very short time by merely placing them in the liquid mentioned. For the preparation of Javelle water, take four pounds of bicarbonate of soda, one pound of chloride of lime, put the soda into a kettle over the fire, add one gallon of boiling water, let it boil from ten to fifteen minutes, then stir in the chloride of lime, avoiding lumps. When cold, the liquid can be kept in a jug ready for use.

Velocity of Rays of Light.—A prize of 1,000 dollars has been offered by Mr. Uriah A. Boyden, of Boston, Massachussetts, to "any resident of North America who shall determine, by experiment, whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." Any resident of Mexico, the West Indian Islands, or of what is more generally known as North America, may compete. Competitors must forward their memoirs, which must describe every detail and particular of the apparatus employed, and of the method of experimenting, to the Secretary of the Franklin Institute, Philadelphia, before January 1, 1873. Three judges will be appointed, selected from citizens of the United States of known scientific ability, who will examine and report as to which (if any) of the memoirs is of sufficient importance to receive the premium. The memoirs sent in are to become the property of the Franklin Institute, with whom the money is deposited.

QUERIES.

[11274.]—**Cement for Stourbridge Clay Fire Backs.**—I have in my house two of Pierce's patent firegrates with air chambers behind, for warming fresh air and admission into the room (Great Exhibition, 1851). The front of the chamber is the back of the fire-grate, formed in four pieces. Two of these (smaller) pieces describing a curve are at the back of the grate, and the two larger ones rest on the smaller ones. The fire by time has burnt away the smaller pieces at point of junction with each other, and so the smoke gets into the air chamber. Will iron cement or any other prove a good stopping and stand the fire? The Stourbridge clay formed into a cement crumbles away under the action of the fire.—R. J.

[11275.]—**Darkening Walnut.**—Would any subscriber tell me how to darken solid walnut, not veneer? I want to darken it in the raw state from the bench. It must leave the wood clear, but darker than before.—S. Paine.

[11276.]—**Extracting Glass Stopper.**—Can any brother reader inform me if a stopper that has the head broken off can be got out of an empty scent bottle?—A.H.

[11277.]—**Soap Boiling.**—Of what ingredients is soap made? In what proportion are they mixed, and how long are they to boil? Of what are the moulds made for moulding the bars?—Bell.

[11278.]—**Steam.**—Will some of the correspondents of "ours" be good enough to inform me what quantity of steam per minute will pass through straight cast-iron steam pipes, of the following dimensions:—1. 1in. diameter and 10ft. long; 2. 2in. diameter and 20ft. long; 3. 3in. diameter and 60ft. long; the pressure of the steam at the boiler being 30lb., 40lb., 50lb., and 100lb. per square inch?—Vulcan.

[11279.]—**Fire-Damp.**—A friend of mine, whilst searching for dead bodies in the working places of a colliery after an explosion, observed a great many drops of a liquid substance upon the floor of the mine, and along the roof indications similar to those left by the burning of oil on the ground in a zig-zag line. Is it possible that the drops could be the product of an explosion of fire-damp, or of a mixture of fire-damp and sulphuretted hydrogen?—Vulcan.

[11280.]—**Light for the Middle of a Room.**—Will any of your correspondents kindly inform me if there are any means of throwing light into the middle of a room, 20 yards wide and 100 yards long, which is lighted on both sides by windows, so that the middle of the room may have nearly as much light as the sides?—One in the Dark.

[11281.]—**Value of One Second on the Sun's Disc.**—Will one of your readers inform me of the value of one second of arc on the sun's disc? Chambers in his "Astronomy," says: "The lineal value of one second of arc at the mean distance of the sun is 448 miles." Is this a correct estimation? I have seen it questioned in your columns.—A Young Astronomer.

[11282.]—**Preserving Plates.**—Will some of our experienced photo. friends give the formulæ and manipulations necessary for preserving plates wet with golden syrup or honey, and how much longer exposure is required?—Aremac.

[11283.]—**Photo. Lens.**—What is the most generally useful lens for a photo. amateur to get?—Aremac.

[11284.]—**Holtz's Induction Machine.**—Would "Sigma" or any electrical correspondent give me any practical hints about constructing Holtz's induction machine? Would thin window glass do for the discs, or would vulcanite be an improvement? What kind of paper is best for the armatures? and whether, if using glass, would it require to be coated with shellac varnish or otherwise? I have made such a machine from the description in Ganot's "Physics," but have failed. I made my discs of thin window glass with an ebonite spindle running in metallic centres. Perhaps some one would be kind enough to point out my mistake.—New Subscriber.

[11285.]—**Chemist's Certificate.**—Having served part time as a druggist, and having nearly 20 years' practice with drugs prior to the passing of the Act in 1868, and being well acquainted with the nature and properties of drugs commonly used in medicine, and qualified to read Latin prescriptions, and having a knowledge of dispensing, I have lost a great deal of trade in not being a certified chemist, thereby being prohibited from selling medicines containing opium, such as laudanum, syrup of poppies, etc., and I wish to know if any correspondent can inform me how to get a certificate, and what examination is necessary to be passed.—Phœnix.

[11286.]—**Blacking the Barrels of Breech-loading Sporting Fire-arms.**—A recipe for the plan now usually adopted for producing the beautiful black (not brown) on the barrels of breech-loading sporting guns, with particulars how the process is done, would much oblige. Does any book treat on the subject?—B. & J.

[11287.]—**Annuals.**—I should be glad if any gardening correspondent would name a few of the best annuals that remain in bloom at least three or four months in the year.—Aster.

[11288.]—**Hardening Iron Plates.**—Would some kind reader inform me the best and simplest plan to harden and toughen iron plate as much like steel as possible?—John Hogg.

[11289.]—**Flexible Oil Painting.**—I wish to prepare an oil painting on canvas or calico, which will fold up like a map, without cracking at the folds. I shall be obliged, therefore, by some of your scientific and chemical readers informing me how to prepare the calico for this purpose. It should be free as possible from smell, and the colour should not show on the unpainted side.—Verdant.

[11290.]—**Cut-throats or Coral-throats.**—Will some reader of the English Mechanic, learned in birds and their ways, kindly give me some information concerning "cut-throats" or "coral-throats." (1) What is the classical name? (2) What are their food and habits? (3) Where do they come from? and (4) will they breed in confinement? and if so what sort of nest will they build? Any information on the subject will oblige.—Sansjoy.

[11291.]—**Common Sense.**—Can Dr. W. B. Carpenter (p. 632, Vol. XIV.) or any mathematical reader of "ours," kindly give me a key to the discoveries of Professor Sylvester, in relation to "Formula for the Solution of Equations"?—S. J.

[11292.]—**Linseed.**—Would any one inform me what are the medicinal properties and uses to which linseed is applied, and whether its frequent use would prove injurious to the system, especially to infants and young persons?—O. W. Greenhalgh.

[11293.]—**Colour Blindness.**—I wish to know if there is any remedy for the above, also if there is any mode of learning colours. Any information on the above subjects will be thankfully received by—Anxious.

[11294.]—**Dividing Metal Disc.**—A disc of metal 12in. (say) in diameter, of equal density and thickness, and which weighs 12lb., is required to be divided into diameters, so that when cut into three rings and one disc, each should weigh 3lb. A geometrical method for finding the above (as also any other division) with mathematical proofs, will much oblige—Disc.

[11295.]—**Electrical.**—Thanks to Mr. Tonkes for replying to my query. I think, however, he misunderstands the purpose for which I want the machine. I am not just commencing to study electricity as a science, but want it for general experiments, instruction, and amusement. Probably perfect insulation is impossible, but I think it possible to "insulate the prime conductor so as to prevent the spark from flying off;" the lac varnish would prevent the spark passing into the spindle itself, but not the other parts of the machine; supposing a large secondary conductor connected with the prime conductor, capable, if it could be fully charged, of giving a 12in. spark, but this is impossible. A few revolutions of the machine, and before it is half charged, flash goes the spark to the spindle or handle. Stop this by interposing a piece of glass, it actually runs down the disc itself to the rubbers, which are, of course, connected with the earth. How to prevent this is what I want to know? I have heard of a small Winter (I think) machine, giving 12in. to 18in. sparks. If this can be accomplished in a small, why not in a large machine? As I make my own instruments, a description of this machine, with an engraving, if possible, would be more like the thing.—Forked Lightning.

[11296.]—**Chemical.**—Can any one inform me of a cheap substance that will form a powerful fulminate with chlorate of potass? Phosphorus explodes too easily, sulphur not easily enough.—Forked Lightning.

[11297.]—**Spruce Beer.**—Will any one kindly inform me how to make spruce beer?—A Constant Reader.

[11298.]—**Four-inch Centre Lathe.**—I lately purchased a 4in. centre lathe (second-hand). I find that a hole about five-sixteenths of a inch in diameter, is bored up the centre of the mandril some 4in. Can any of your correspondents inform me for what purpose this is intended, as I have never seen it in any new lathes I have inspected with a view to purchase?—G. Thompson.

[11299.]—**Tarpaulings for Railway Carriages in the Tropics.**—Would some of the very obliging correspondents of the English Mechanic kindly afford any information that may be in their power, as to whether these coverings can be made waterproof and fireproof by immersion in any kind of aqueous solution? and whether, if paint, oil, varnish, wax, or similar substances are indispensably requisite, and which are the best methods of preparing and applying them? It is understood that plain tarpaulings, like tent-cloths, are preferable in the topics, on account of not intensifying heat by radiation, and that the lightest fabric is the best. Hence also the question, which is the lightest cloth that can safely be used for all weathers? and can it be made to answer all purposes without composition, or at all events with one of not too compact a nature?—J.G.

[11300.]—**Air Pumps.**—Will H. Turton (letter 3591, p. 560, Vol. XIV.), explain the stuffing boxes, the leather packing, and the piston of his air-pump; and if there is any oil silk valve at either end of the pipe that connects the barrels? A drawing will be of great service.—Last.

[11301.]—**Limits of Resistance in Telegraph Wire.**—How many B. A. units of resistance are there in a mile of ordinary overhead telegraph wire?—W. F. G.

[11302.]—**Circular Brass Box Levels.**—Will some practical reader kindly inform me what liquid is used in circular brass box levels, and what material is employed to fix the flat glass top?—W. F. G.

[11303.]—**Transferring Fluid.**—Can any one inform me of the composition of transferring fluid for taking copies of engravings, and method of use?—J. King Harris.

[11304.]—**Nessler's Ammonia Test.** — In Mr. Tichborne's lecture on "Atmospheric Dust" mention is made of this test. Can a brother reader give me particulars of it?—Kyncker.

[11305.]—**Bakers' Ovens.**—Is there any better way of heating bakers' ovens than the furnace to burn coal placed in the front side of the oven, and can any instrument be got to place in the oven when heated to ascertain the heat?—A Subscriber.

[11306.]—**Glass House.**—I am desirous of having a good glass house for amateur photographic purposes. Will some one of our brotherhood tell me the best and cheapest way to go to work?—W. F. Trinder.

[11307.]—**Design for Garden.**—Will some brother subscriber kindly suggest an artistic design for re-arranging a garden 120ft. long by 11ft. wide (out of which room must be left for a photographic glass house 30ft. long), without having the unsightly straight gravel path and long flower bed all down the side?—W. F. Trinder.

[11308.]—**Geocentric Longitude and Latitude.**—Would any of your correspondents—Mr. Proctor, "F.R.A.S.," or "E. L. G."—explain to me the manner in which I can get the geocentric places of the planets (longitude and latitude) from those of the heliocentric? I am astonished that our "Nautical Almanac" does not furnish us with such information, and that it should be so much behind the "Spanish Almanack" in this respect. I have been told that the geocentric longitude and latitude could be computed from the geocentric right ascension and declination; but why should the savants of the "Nautical Almanac" keep such valuable information from the public?—H. Ellis.

[11309.]—**Breaking Strain of Hollow Iron Columns.**—Will some one give a rule for calculating the breaking strain of long cast-iron hollow columns up to, say, 60ft. in length, when standing plumb, and also when standing at an angle?—A Young Builder.

[11310.]—**Logarithms.**—I would feel exceedingly obliged if Mr. Proctor or any other able correspondent would explain the use of logarithms, and the difference between the common logarithms and hyperbolic logarithms, and the best method of finding their natural numbers. Also, which is considered the best book of logarithms up to, say, 20,000?—A Young Builder.

[11311.]—**Electric Bell.**—Will any kind friend tell me the following? 1. Will one cell of Leclanche's battery, as described on pp. 568 and 596, Vol. XII., be sufficient to work a bell, distance about twelve yards indoors? 2. Would not a cylinder of zinc be as efficient as a wedge? 3. What number cotton-covered wire should I want, or would galvanised iron wire do as well? 4. Shall I want an earth wire? if so, would a piece of galvanised iron wire sunk in the ground, fastened to a piece of iron or lead, answer the purpose, or would a return wire from the bell be best?—An Electrical Beginner.

[11312.]—**Boiler.** — Will "Jack of All Trades," "Liverpool," or any other reader of the Mechanic tell me what kind of steam boiler is now considered the best, the boiler to be stationary, and about 30ft. long × 7ft. diameter? What thickness should the plates be for a boiler of these dimensions, and where steam will be got up to 50lb. per square inch? Would two small boilers be preferable and more economical to a large one as above 30ft. × 7ft.?—One in Trouble.

[11313.]—**Setting Lathe.**—Would "J. K. P." inform me as to the best and sharpest method of setting lathe-head parallel after using for conical turning, as I am given to understand there is a method of obtaining the lathe's dead centre without putting it to the test to see if it is so?—F. Hume.

[11314.]—**Polishing Oak Floors.**—Can any one inform me how oak floors are polished?—H. C.

[11315.]—**Cart Wheel.**—Would some reader kindly inform me how to make a cart wheel, and to put the bush in, with illustrations?—C. Carpenter.

[11316.]—**Oxalate of Chromium, &c.**—Will any chemical correspondent kindly inform me how to make the following salts on a small scale for experimental purposes—viz., oxalate of chromium, oxalate of chromium and potassium, chrome alum, and nitro-prusside of sodium?—Dædalus.

[11317.]—**Sugar Boiling.**—Would "L. W. D." kindly oblige by giving information, through our valuable journal, of the reason why either lump or raw sugar, after being boiled and poured upon the slab, crumbles before there is time to work it? Also, what causes the white stripes in mint lozenges?—X. Y. Z.

[11318.]—**Gravitation.**—If a small thermometer be inverted, the mercury will remain suspended from the glass bulb, not in the least affected by gravity. I have heard, also, that if a sovereign and a feather be simultaneously dropped in an air-pump, they will reach the bottom precisely together, while, according to the attraction of gravitation, bodies should fall with velocities proportioned to their masses, and I cannot understand what contrary effect a vacuum could produce. If any one will kindly explain the cause of this I shall deem it a great favour.—O. W. H.

[11319.]—**Small Copper Coin.**—I have a small copper coin: on one side is an impression of one of the kings of Rome, surrounded with the words "Urbs Romæ;" on the other side is a she-wolf suckling Romulus and Remus. It is in excellent preservation, weighing 37½grs. Will any of your readers be good enough to give me some information respecting the coin, and its probable value?—E. F. M.

[11320.]—**Marking Leather for Ornamental Stitching by Machine.**—Can any of your talented readers help me out of a difficulty? I want to transfer to hogskin various patterns for stitching. I have tried black transferring paper between the pattern and the hogskin, which makes a very black mark; but it comes off too easily, making the leather very dirty. I want some plan to make a clear mark, which will not come off as easily as that mentioned above, and yet come off when the leather is cleaned with indiarubber. Can any one help me?—Seedsman.

[11321.]—**Galvanometer.**—To "Sigma." An answer to the following examination question will oblige:—You are required to describe some system of calibration by which the higher degrees of the galvanometer may be expressed in terms of the lower ones. (Sci. Exam. Honours Paper, 70).—Honours.

[11322.]—**Concrete Building.**—I ask some of your readers to give me a better idea than I possess of concrete building; the moulds I understand and can manage perfectly, but being almost out of the civilised world, I cannot get Portland cement. I have good gravel of different sizes, good sand, good stone lime, white clay, &c. The question is can I build a durable house with the said materials? if so, the quantities, how to mix them, &c.? I have heard that burnt clay and lime makes a kind of hydraulic cement—would they answer the purpose? If any one would make me acquainted with the process, they would greatly oblige—A Man on the Steppes.

[11323.]—**Retardation of Moon.**—Would any of your correspondents inform me the meaning of the term "Retardation of the Moon"? I have looked in several astronomical works, but I cannot get any correct idea of how the moon's motion is retarded when she arrives at the meridian later every day.—John Taylor.

[11324.]—**Salt Damp in Walls.**—Would any one kindly advise the best way of curing dampness of this description. The walls, 14in. thick, are built with 2½in. cavity, and are cemented outside. A breadth of the plaster inside and near the fireplace is covered with a kind of crystalline fur, which is salt to the taste; it rots the wall-paper and throws it off. I have had the wall replastered without any better effect, and therefore suppose that sea sand must have been used in the brickwork.—W. M.

[11825.]—**Moulded Carbon Filter.**—I have one of the above filters, but have rendered it useless through washing the cylinder of carbon in hot water. Will a correspondent kindly inform me how to restore the property of filtration to the carbon, or how to make a new cylinder of carbon?—FILTER.

[11826.]—**Japanning.**—Will the "Welsh Shepherd," "Jack of All Trades," or some other reader kindly tell me how to mix a good japan that will stove well in black, red, green, and yellow?—JAPANNER.

[11827.]—**Monster Magnetic Machine.**—I wish to know Mr. Sprague's opinion about the possibility of constructing a magnetic machine of very large size, with which I could generate 50,000 cubic feet of oxygen from water, within 10 hours. I have seen one of Browning's small magnetic machines, which I think is capable of producing 10 cubic feet of oxygen per minute. Now the principle of doing the same on a small scale being established, I wonder that several instrument makers ridiculed the idea of making such a grand machine, although I told them that the price, if thousands of pounds, would be no objection as long as the above query could satisfactorily be solved, and its result be guaranteed by the maker. I should have even accepted 20 or 30 such machines, if all of them would be required to effect my purpose. But the people I applied to could not say anything positive about it, although such an order with a large sum offered should have induced them to consider my offer.—SIEGM. RAUDNITZ, Asch, Bohemia.

[11328.]—**Organ Stops.**—Can any reader give me a description and scale of Lieblich Gedact and salicional stops, likewise of the Cremona stop.—A SUBSCRIBER WHO APPRECIATES THE MECHANIC.

[11329.]—**Electro Deposition of Iron.**—Can any one give me information on the above? What are the solutions, strength, the best battery and material for moulds, and the best method of making moulds to make solid articles in copper, as I have failed in getting anything but two deposits, one from each face of the mould, and the middle empty?—PUCK IN HOLLOW.

[11330.]—**Vacuum Gauge.**—Will "Jack of All Trades" or some brother reader, be kind enough to favour me with what be thinks is the best vacuum gauge, with a barometer attached to it?—J. W.

[11331.]—**Smallpox.**—Can any of our readers inform me of any way to take away the effects of smallpox? I am slightly marked on my face, but on no other part of body.—INKESFALL.

[11332.]—**Hydraulic Jack.**—Could any reader give a description of an hydraulic jack? I have seen a small one lift enormous weights in a mechanic's shop. They put about a pint of water in at the top, and one man worked a lever.—ZOO ANDRA.

[11333.]—**Motive Power for Amateurs.**—Perhaps some correspondents could publish some of their experiences upon the above subject, as proposed by "W. H. N.," p. 632. Has any correspondent ever tried weights as a motive power? if so, a description would be useful to others besides myself.—ZOO. ANDRA.

[11334.]—**Squinting.**—Can anything be done with a little boy about four years of age to cure him of squinting?—G. W. F.

[11335.]—**Eccentricity of the Earth's Orbit.**—Would some of your correspondents inform me if, with the exception of Grant's "Physical Astronomy," there is any treatise or encyclopædia article on astronomy, published in this country before 1864, when the superior limit of the eccentricity of the earth's orbit, as determined by Lagrange or by Leverrier is given, or even any reference made to the researches of these geometricians on the subject?—JAMES ELLIS.

[11336.]—**To Mr. Tonkes.**—Will Mr. Wm. Tonkes inform me whether, in his answer to query 10758, that it is his real opinion that $\frac{1}{0} = \infty$? If so, will not $\frac{1+1}{0} = \infty + \infty = 2\,\infty$? Again, if $\frac{1}{0} = \infty$, am I justified in writing $\frac{1}{0} = \frac{\infty}{1}$, so $\therefore 1 : 0 :: \infty : 1$, and $1 : \infty :: 0 : 1$? or shall I write $\frac{1}{0} = \frac{\infty}{0}$, so $\therefore 1 : 0 :: \infty : 0$, and $1 : \infty :: 0 : 0$? or otherwise, $\frac{1}{0} = \frac{\infty}{\infty}$, so $\therefore 1 : 0 :: \infty : \infty$, and $1 : \infty :: 0 : \infty$? all of which appear to me most truly absurd.—S. J.

[11337.]—**Equation.**—I should be obliged if any of your correspondents would solve the following equation:—

$$l = a + (n - 1)\,d$$
$$S = \frac{(a + l)\,n}{2}$$

Required to find the value of l and S, a and d and S being known.—SMOOTIUNG PLANE.

[11338.]—**Marseilles Soap.**—In Herschel's "Familiar Lectures," he gives Marseilles soap as one of the ingredients for making the soap bubble fluid. I cannot get hold of any of this soap, however, none of the chemists of a large northern manufacturing town knowing what it is, or where it may be had. Can any of our obliging contributors assist?—TOUCHSTONE.

[11339.]—**Astronomical.**—In a solar year of 365 days, there are 366 sidereal days, and to my reading there is no compensation from the latter as there is of leap year, compensating for fractions of a solar day, in four solar years, the consequence is, that in $\frac{366}{2}$ solar years, Orion, which now souths at midnight of Dec. 21, will south at midnight of June 21. Is this correct, as I can see no notice of it in my authority? Again, why does the polar star always occupy the same place when the earth's axis, by reason of its orbit, changes position?—W. J. PORTER.

[11340.]—**Bread Barrow.**—As I am about having a new bread barrow, I should like to consult my brother subscribers about the best plan to make it, the best wood to make it of, and any other useful hint. I should like to make the body myself. Could not make the wheels, springs, or axle.—BAKER.

[11341.]—**Colouring Photos.**—Will any brother reader inform me how I can colour these? I mean what size is used to take off the greasy nature of them so that they will take the colour well; likewise, whether ordinary water-colours will do. Any practical hints on the above will be much esteemed by—AMATEUR ARTIST.

[11342.]—**Analysing Cast Iron.**—Will some kind reader inform me of a book on analysing cast iron, or kindly help me through the medium of the ENGLISH MECHANIC?—J. W.

[11343.]—**Catechu.**—How can the catechu extracted from Areca catechu be distinguished from the catechu coming from Mimosa catechu? From which tree is obtained the catechu or cutch of commerce?—THANKFUL.

[11344.]—**Australian Trees.**—What Australian trees are called jamwood and manna bark? Scientific names will oblige.—THANKFUL.

[11345.]—**Camping Stoves and Necessaries.**—I should be glad if any of your numerous correspondents would give their experience of the best sort of camping stove and necessaries. Several of us generally take some aquatic excursions, and are generally in a difficulty as to cooking. I saw last year at Henley a capital affair of the sort, in which spirit was used, and when not in use could be packed together in a very compact manner; it comprised gridiron, kettle with spout, and handle to screw on, a frying pan, canisters, &c. I think if any of our friends would furnish a diagram of same it would interest others as well as myself, as the rage seems to be camping now.—W. T. GOULD.

[11346.]—**Induction Coil.**—Will Mr. Wm. Tonkes kindly send details and drawings of the induction coil he mentions in his reply to query 10959, p. 640? I think many correspondents are in the same difficulty as "A. E. T." and myself, and have only a vague idea of the use and position of the ebonite discs of which he speaks.—T. H.

[11347.]—**Velocities of Air and Steam.**—Bourne, in his book on "The Steam-Engine," gives as the rule for the area of steam pipes: "Multiply the square of the diameter of the cylinder in inches by the speed of the piston in feet per minute, and by the decimal ·02, and divide the product by 170." An area thus found gives a velocity to the steam, when it is cut off at two-thirds the stroke, of about 80lb. a second, or 55 miles an hour, or the velocity of the wind in a great storm. Now, in Molesworth's "Pocket-Book of Engineering Formulæ," it is laid down that the velocity of air in the pipes of a blowing engine should not exceed 35lb. a second, or about 25 miles an hour, or the velocity of a brisk gale. Is there any sufficient reason why the velocity of air should be so much less than that of steam? It is true the pressure of the air in a blowing machine rarely exceeds 3lb. on the square inch. But Bourne does not seem to regard the pressure of the steam as a necessary element in the calculation. Can any of your readers refer me to any reliable data as to what the speed of air in pipes may be without extravagant loss from friction, or inform me what was the speed of the air in the pipes which worked the drills in the Mont Cenis tunnel, or any other well-tried cases?—AMATEUR.

[11348.]—**Meteors, Comets, &c.**—M. Paris (3728), in your issue March 8, p. 637, under this heading, states: "The celebrated Whiston was (he believes) the first to start the comet origin of the solar system." Many of your readers would, with myself, no doubt be much obliged if your correspondent would cite his authority for such belief. If I have read your interesting journal correctly, cometic systems is a discovery of a very recent date. Schiaparelli has just had awarded to him the gold medal of the Royal Astronomical Society for verifying the correctness of these theories, which, I learn from the ENGLISH MECHANIC, were propounded in 1854.—JOSEPH A. SONGEST.

[11349.]—**Heating Bar Iron.**—Will some of "our" kind practical readers inform me the best, quickest, and cheapest method of heating bar iron for crank bending purposes, in lengths of 10 to 12 inches heat, and 1¼ inches diameter and upwards?—CRANK ARM.

[11350.]—**Dairy Farming and Pig-keeping.**—Will some one be good enough to inform me what is the smallest scale on which dairy farming, combined with pig-keeping, can be carried on in order to yield a profit of £100 per annum, without allowing for rent and house-keeping expenses—viz., number of acres and cows required, probable yield of milk of each cow per annum, the labour required, cost of food for each cow per annum, number of pigs to begin with, number of pigs to be annually killed, and probable weight of each, and cost of pig-food.—W. M.

[11351.]—**Homœopathic Medicines.**—I have to thank "Jack of All Trades," and Dr. Ussher, for their notices of my last query. Will either of these gentlemen be good enough to state the most economical way to get the mother tinctures, and if they can be got from an ordinary chemist who does not profess to deal in the homœopathic preparations? Also whether these tinctures will keep good for a length of time? How are the sugar pillules treated to give them their homœopathic value? With regard to the tinctures, do I understand aright when I read the answers formerly given as meaning that: 1 drop of mother tincture to 99 of spirit, equal No. 1; 1 drop of No. 1 tincture to 99 of spirit, equal No. 2; 1 drop of No. 2 tincture to 99 of spirit, equal No. 3; and so on. If I am right, then, as one small phial of No. 1 tincture will make thousands of No. 3, would it be worth while to try and get the mother tinctures at all?—A MERE NOVICE.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31 Tavistock-street, Covent-garden, W.C.

	£	s.	d.
Amount previously acknowledged	£326	11	1
L. T. Y., Philadelphia, U.S.A.	0	18	8
The Wolverley Naval Brigade, 4th don. ..	4	14	9
T. H. S.	0	1	0
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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, March 19, and unacknowledged elsewhere:—

Major J. F. Bland.—Alexander Dallas.—John Bellows.—J. I. Vincent.—John Dalley.—John Barton.—G. R. Hallam.—J. J. Collins.—C. N. Abbott.—R. C. Jay.—Brown and May.—J. K. Mellor.—J. Belchin.—F.R.A.S.—Ashley Dakin.—Harmonious Blacksmith.—Rev. C. R. Holmes.—S. Shiels.—A. E. Oakes.—Sigma.—G. C. Price.—Percival Thorn.—Robert Tongue.—W. P. Buchan.—Rev. H. S. Syers.—Jas. Griffiths.—John Dawson.—Dr. Caplin.—J. B.—Lilly.—Battle Axe.—Waterman.—J. M. W.—Superintendent.—Robt. Hamson.—J. F. Stanistreet.—G. Whittle.—Soap Bubble.—W. H. E.—F. Graham Young.—Liverpool Subscriber.—W. G. H.—A Hater of Humbug.—A. C.—H. B. E.—Aqua.—R. S.—Campanile.—S. C. E.—T. R. B.—Osa.—Chloride of Sodium.—Modeller.—J. T. Critchett.—W. J. H.—J. H.—C. J. Rearden.—Z.—J. J. Allingham.—Atomic.—E. W. Corke.—Truefitt.—Alpha.—Peronelle.—James South.—E. Barber.—Cleos.—W. Q. R.—J. T. Turner.—Old Wallsend.—G. W.—Miller.—Stilton Cheese.—W. G.—James Hume.—Jos. Davis.—E. W. P. Edwin.—Young Astronomer.—Camera.—J. Broadhurst.—A Country Subscriber.—Artillery Captain.—Vermillion.—James Cunliffe.—R. Macmichael.—Hedera.—W. F.—N. L. B.—J. A.—H. W. Henfrey.—S. W. B.—Charles Bentley.—B. D. T.—Thos. Marshall.—H. Bradshaw.—Gig Lamps.—A. J. F.—C. J. Recordon.—S. Bottone.—John Standring.—A. E. S.—C. Campbell.—Cygnas.—Un Ecosse.—S. King.—R.—Tubal-Kain.—E. L. G.—Thetamu.—S. Tremayne.—X. Y. Z.—Flactem.—H. G. M.—Marcus Wicks.—T. P.—F. W. Shearing.—Francis Radcliffe.—Starkey and Co.—Ed. Hudson.—A. T. M.—W. H. Edwards.—Sholto Douglas.—Valve.—Arley Mine.—Excelsior.—Quercus.—S. H. L.—S. H.—Beta.—Duffer.—Bob J.—F.R.A.S.—F. C. S.—R. H.—Joe.—James Wroe.—Bladud.—J. S. M.—G. F. S.—Ralph Lowden.—E. L. C.—C. Williams.—R. Green.—F. W. H. J.—J. S.—W. D. T.—A Young Subscriber.—Wm. Smith.—Apiarian.—E. Tappen.—Advertisement.—C. W. M.—Inquirer.—Thomas Stone.—C. C. Jannifred.—H. J. W.—Manx Man.—Boots.—A Watchmaker.—Gillem.—Don Pedro.—Adam.—W. P. N.—Sarah.—J. H. T.—C. P. H.—Wm. Hendy.—J. J. Griffiths.—M. P. R.—Col. Clifford.—E. P. W.—Investigator.—W. T.—P. H. Holland.—An Old Indian Officer.—Three Years' Subscriber.—B. B.—F. W. Clarke.—Cheeswring.—Would-be M.P.—C. D. Campbell.—John Kitchen.—J. G. Bergman.—A. Oates.—John Wilkes.—W. H. Hollis.—Col. D. G. Anderson.—Horton Corbett.—C. R. T.—A Barrister.—J. F. T.—W. Airey.—Philo.—W. R. Birt.—Housekeeper.—Scotch Tom.—Sigma.—L. S.—Saul Rymea.—Barley Bree.—R. Meekham.—H. G. W.—Tyro.—E. F. Courath.—Busy Bee.—Robert Smith.—Cuprum.—M. O.—John Pescod.—M. B.—An Architect.—A. O. F.—Whitley Partners.—J. Knowles.—E. Barrett.—A Novice in the Art.—Blacking.—E. Nayler.—Labour.—E. Wheldon.—Practical Farrier.

F. I. M. E., E. L. M., see "Hints to Correspondents," No. 4.

H. HENDLEY.—Please ask for the desired information through our columns, as we do not answer by post.

THOS. AMOS, J. J. LEWIS.—Your queries are advertisements.

ELFIN.—Read the last half-score impressions of this publication, and you will find what you are in search of in more than one form. You will also be repaid for your labour in other useful hints you are sure to pick up.

A SUBSCRIBER TO EIGHT VOLS.—Some numbers in each list you mention are out of print. The "Practical Treatise on the Harmonium" ended—or rather was discontinued—on page 198, Vol. XII.

W. P. C. D.—We don't know what queries you refer to.

J. W. LEWIS.—Designs to hand.

MARCH.—Thinks there is room for a practical amateur turner's society in London, and we think so too; and if he or any other person think well to establish such a society, we would encourage it. We never looked approvingly on the suggestion for an English Mechanics' Scientific Society for London, because London abounds in scientific societies of almost every description. We know of no society similar to that indicated by "March," and we therefore say go on and prosper.

J. K. HARRIS.—Thanks for the answers to queries. A discussion on the best form of government would be out of place in our pages.

E. D. J. (Chuckfield.)—These who believe in perpetual motion, are perpetual fools.

E. W. HARRIS.—You deal too much in generalities in your letter on colliery accidents. You write as any educated man might write who may have read a few articles in the newspapers on the subject. What our readers want, and what the scientific world wants, is specific practical information, being the result of your own certain knowledge or experience.

95, VOL. IV.—You can do nothing with such floors but renew them. You can at all times get back numbers by sending stamps.

F. BRIGHTON.—See indices to back vols.

Communications which can only appear as advertisements to hand from Alpha.

A. OAKES.—See recent back numbers, pp. 192, 525, 600, and 343, Vol. XIII., for information on incubators; also previous volumes.

DE T.—Apply to the Secretary of the Manchester School of Art.

AITCH AITCH.—Stained and varnished.

F. PRATT.—We cannot allow the promulgation of such views on smallpox in these pages. You, like all self-commissioned teachers, accuse your fellowmen of "blind fatalism," &c., &c. We think their indisposition to receive your teaching a strong proof of their common sense.

The following correspondents are referred to "Hints to Correspondents," for reasons for the non-appearance of their communications:—G. Ross.—C. H. Gibbins.—Bell.—Amateur Photographer.—W. H. March.—Tyro.—R. E. A.

Frederick Hume.—2s. 1d. post free. See book advertisements.

Griffin.—For recipes for relief of tender feet, &c., see pp. 421, 470, 522, and 546, Vol. XIII.

G. Denoarlgbe.—For directions to remove stains from and whiten ivory, see pp. 167, 241, 95, and 141, Vol. XIII.

R. H. Garth.—If the information cannot be given through our pages it cannot be given at all.

W. J. H.—See back numbers.

Last.—Trübner and Co., Paternoster-row.

J. E. Davis.—We cannot advise in such matters.

E. G.—Yes.

Zoo Andra.—Putty powder is oxide of tin. See p. 509, Vol. XIV., and subsequent numbers.

A Subscriber who Appreciates the English Mechanic.—Unobtainable new in any form.

Thomas W.—Take her to an Ophthalmic Institution—that in Moorfields, if you live in London.

Woodstock.—We are not barbers.

"E.L.G." as a Correspondent.—Besides the communications in answer to "E. L. G." on the metric system, we have received others which we cannot well insert, but from which we may make one or two extracts. "Kappa" says he "looks upon 'E. L. G.' something in the light of a roaring lion, who goes through the columns of the English Mechanic seeking whom he may devour." "1872" in a longer letter, says:—"'E. L. G.' is certainly to be admired and feared. I have often thought who he can be; sometimes I have imagined him Prof. Beesley, at other times Mr. Gladstone, and at other times Felix Pyat; but whoever he may be he is a remarkable man. But, unfortunately, he materially diminishes his influence for good by extravagance in thought and language. Instead of carrying his heart in his head, he carries his head in his heart, and the consequence is he gets in a rage. Take for instance his tempestuous letters on "Co-operative Societies," and the "Glorious Metric System." He vindicates the one with more than Communistic zeal, and attacks the other with more than Lutheran energy. This zeal and this energy may be all very well, but it so happens that the writer expends his power outside the questions respectively in erratic wanderings, and says but little on the questions themselves. It would, in my opinion, be much better if he would moderate his enthusiasm; give us reason instead of passion, which he is well capable of doing, and so turn his great acquirements and abilities to better account."

Ascertaining Apparent Time.—N. S. Heineken says: "Will you be so good as to state that the drawings of my instrument for ascertaining apparent time have been reduced by your engraver to a scale of a little more than one-third. My plate is six inches in diameter."

F. Burling.—Read motto preceding correspondence and write in future about what you understand. No doubt you know many things, but you are at sea on "ship building."

E. J. Thomas.—You are mistaken as to the number of queries inserted. You say yours "is as important as either of the eleven thousand and odd queries which have been privileged with insertion since the English Mechanic commenced its useful career." About thirty thousand queries have been inserted. We commenced to number them for reference purposes about two years and a half since, and began with No. 1. All the queries which appeared in the preceding volumes were unnumbered. We commenced numbering the letters some time after.

Phœbus.—You ride too fast. You have mounted Pegasus with a vengeance. You should at least have a base of operations for your theories to rest on. It may do very well in poetry to separate yourself from everything and everybody; but in science it is essentially different. In art the artist, whoever he may be, is the standard of excellence; but in science, Nature is the groundwork and standard of truth. If you wish to harness electricity to the car of industry, you cannot do it by a flight of imagination, but must enter into the labours of others, and possibly begin where they have left off. By strict observance of the scientific method, you may, by accurate observation, careful experiment, and inexhaustible patience, secure a portion of what you think you are justified in expecting; and even if a very small portion be thus obtained beyond the reach of dispute, a substantial gain will be achieved for man.

Errata.—In letter 8723, "42,000½ metres," and "31,000 metres," should respectively be 42½ thousand metres, and 31¼ thousand.

S. Bottone.—Postscript too late.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MARCH 12, 1872.

669 T. Broughton, Albert-villas, Dalston, for improvements in the construction of foundations of buildings and in apparatus employed therein.

670 F. G. Underhay, Crawford-passage, Clerkenwell, for improvements in apparatus for controlling the supply of water to dwelling-houses and other buildings.

671 R. Blackburn, Exeter, for improvements in apparatus and in means for treating sewage for agricultural purposes.

672 W. Exall, Reading, for improvements in tube expanders.

673 R. Sutcliffe, Idle, Leeds, for an improvement in steam engine lubricators.

674 J. H. Johnson, Lincoln's Inn-fields, for improvements in apparatus for night signalling. A communication.

675 W. E. Newton, Chancery-lane, for improvements in breech-loading ordnance. A communication.

676 W. E. Newton, Chancery-lane, for improvements in hoisting apparatus, parts of which improvements are also applicable to other purposes. A communication.

677 S. H. Stephens, Breage, Cornwall, for improved machinery for reducing tin stuff and other partially pulverised ores to extract the metal therefrom, and also for grinding paint, cement, and other hard substances, together with feed apparatus therefor, which is also applicable to other pulverisers.

678 C. Bradley, W. Waring, and F. Waring, Bradford, for improvements in apparatus for the combing of wool, silk, and other fibres.

679 W. R. Lake, Southampton-buildings, for improvements in railway rails. A communication.

680 W. R. Lake, Southampton-buildings, for improvements in the manufacture of refined sugar, part of which improvements relate to the production of currents of heated air for the same and for other purposes. A communication.

681 W. E. Carrington, Stockport, for improvements in the construction of felt hats.

682 J. W. Melling, Birkett Bank, Wigan, for improvements in engines actuated by steam or other elastic fluid.

683 W. Lancaster and J. Bullough, Accrington, Lancashire, for improvements in machinery for sizing and dressing yarns.

684 W. Dalgliesh, Kilmarnock, Ayrshire, for improvements in the manufacture of Scotch bonnets, and in the machinery or apparatus employed therefor.

685 C. D. Abel, Southampton-buildings, for improvements in the manufacture of Bessemer steel and iron, and in the production of iron castings, and in apparatus therefore. A communication.

686 J. G. Frei, King-street, City, and G. Kember, Northampton-street, Clerkenwell, for improvements in the construction of pumps for raising and forcing beer and other liquids.

687 T. Taylor, Glasgow, for improvements in turning bowling-green bowls, and in the machinery or apparatus employed therefor.

688 H. Perry, Fetter-lane, City, for improvements in the manufacture of bottles for containing liquids.

689 J. Drevet, Paris, for an improved hydraulic beton.

690 C. Sargent and C. Temple, New Cross, for improvements in steering apparatus.

691 W. O. Palmer, Clapham-road, for improved machinery or apparatus for working the brakes of railway and other carriages.

692 W. H. Cope, Old Gravel-lane, St. George's-in-the-East, for improvements in machinery for boring, cutting, and working rock and other hard substances, chiefly designed for mining, tunnelling, and other like operations.

693 H. J. Griswold, Oxford-street, for improvements in knitting machines.

694 J. C. Lee, Littleborough, Lancashire, for improvements in processes for recovering oil and other useful matters from soap-suds or scourings, and from other waste waters resulting from manufacturing processes.

695 S. Elson, Oldham, for improvements in and relating to fuel economisers and steam generators.

696 J. Roberts, Seaford, Sussex, for improvements in the construction of tramways, and in apparatus to be used in connection therewith.

697 J. W. Carden, Camden-grove North, Peckham, for facilitating linen marking.

698 H. Glover, Brooklyn, U.S., for improvements in local magnetic attraction indicators.

699 J. Arnold, West Smithfield, for a new or improved instrument or appliance for administering balls and other medicines to horses and other animals.

700 B. Smith, J. Stake, R. Tolson, M. Firth, and C. Bradley, Bradford, for improvements in apparatus employed in the combing of wool and other fibres.

701 A. M. Clark, Chancery-lane, for improvements in horse-shoes. A communication.

702 A. M. Clark, Chancery-lane, for improvements in covering top rolls of carding, spinning, and twisting machines. A communication.

703 G. White, Queen-street, Cheapside, for improvements in the manufacture of shuttles for weaving. A communication.

704 E. W. Elmslie, Parliament-street, Westminster, for improvements in the manufacture of hermetically-closed cases and the opening thereof.

705 A. F. Andrews, New Haven, U.S., for improvements in the process of making malleable cast iron, and in apparatus therefor.

706 W. R. Lake, Southampton-buildings, for an improved type-setting machine. A communication.

707 E. Ozanne, Guernsey, for improvements in apparatus for opening and shutting gas valves, and in lighting and extinguishing gas lamps.

708 T. H. Blamires, H. Blamires, and H. Marsden, Huddersfield, for improvements in or applicable to carding engines.

709 M. Brierley and F. L. Stott, Rochdale, for improvements in the manufacture of yarns or threads formed of mixed cotton and animal wool.

710 G. T. Bousfield, Loughborough-park, Brixton, for improvements in sewing machines. A communication.

711 M. A. Wier, Great Winchester-street, City, for improvements in pneumatic apparatus for the transmission and indication of signals.

712 J. Smith, Bishopsgate-street, for improvements in steam boilers and their appendages.

713 S. Littlejohns, North-street, Edgware-road, for improvements in that part of harness called the pad, to effect the instantaneous release of the horse when fallen from accident.

714 C. Avery, Little Cross-street, Islington, for improvements in rotary steam engines and pumps.

715 J. Garneri, Gracechurch-street, City, for a new process for the production and decomposition of anhydrous chlorides and apparatus for those purposes.

716 J. Holden, Hanover Quay, Dublin, for a new or improved compound for use as pavement.

717 W. R. Lake, Southampton-buildings, for improvements in machines for cleaning cotton. A communication.

718 C. W. Lancaster, New Bond-street, for improvements in shot, shell, and other similar missiles.

719 J. G. Harrison, Birmingham, for improvements in the manufacture of gridiron steps for carriages.

720 F. Trotman, Zoological Gardens, W. Turner, Augusta-street, Regent's-park, and W. H. Ryves, Maitland-park-road, St Pancras, for improvements in the closing and opening of necked vessels or bottles.

721 W. Gray, Hendon, for improvements in rotary engines and pumps.

722 W. R. Lake, Southampton-buildings, for improvements in governors for steam engines. A communication.

723 T. D. T. Sparrow and C. G. Spencer, Piccadilly, for a new or improved boomerang and mechanical apparatus for propelling or projecting the same.

724 J. J. Grinlinton, Storey's-gate, Westminster, for further utilising and giving additional value to the products of the coffee bush. A communication.

725 R. Edwards, Deal, for improvements in portable and self-propelling engines, and in adapting them for the purpose of steam ploughing.

726 T. Brearley, Batley, Yorkshire, for an improved finish of woollen textile fabrics and means or apparatus for producing the same.

727 J. F. C. Farquhar, Long-acre, for improvements in light-house and other lamps.

728 T. Perkins, Hitchin, Herts, E. Faux, Yaxley, Huntingdonshire, and S. W. Campain, Deeping Saint Nicholas, Lincolnshire, for improvements in implements for cultivating land, and for actuating the same by steam power.

729 J. A. Anderson, Grosvenor Hotel, Pimlico, for improvements in preserving the cargoes of ships, and in the extinction of fire in ships' holds.

730 R. H. Patterson, Hammersmith, for improvements in the purification of coal gas.

731 S. Corbett, Wellington, Salop, for improvements in ploughs and cultivators.

732 A. Johnson, New York, for improvements in machines for rolling metal.

733 A. H. Hodges, Boston, U.S., for improvements in machinery for trimming or burnishing the soles or both soles and heels of boots or shoes.

734 W. R. Lake, Southampton-buildings, for an improved apparatus for producing and utilising artificial waterfalls for propelling vessels and operating machinery. A communication.

735 C. W. Harrison and A. H. Harrison, Brook-street, Holborn, for improvements in apparatus for heating and cooking by gas.

736 C. de Negri and G. Herrmann, Hornsey-road, and W. Guest, Great Saffron-hill, Middlesex, for improvements in machinery for the manufacture of hat bodies, sacks, bags, hose pipe, and various other articles.

737 F. H. Oclee, New Bailey-street, Salford, for improvements in dentists' busts employed in the display of artificial teeth.

738 G. W. Wigner, Great Tower-street, City, and J. Williamson, Stockport, for improved mechanism applicable to dry closets and commodes.

739 J. Dove, Whitcomb-street, Pall Mall East, for a new or improved metallic heel for boots and shoes.

740 S. Moorhouse, Cheadle Bulkeley, Cheshire, W. J. Kendall, Heaton Norris, Lancashire, for improvements in apparatus for communicating between guard and driver and passengers on railways.

741 F. Cooper, Manchester, for improvements in finishing velvets and velveteens.

742 J. B. Denton, Whitehall-place, and R. Field, Cannon-row, Westminster, for improvements in the method of regulating intermittent filtration of sewage and irrigation, and in apparatus for that purpose.

743 W. H. May, Birmingham, for improvements in stoppers for bottles and jars.

744 W. Gray, Hendon, for improvements in boilers.

745 A. Strauss, Basinghall-street, for improvements in apparatus for indicating the height of bilge water in ships and vessels. A communication.

746 W. J. Curtis, Holloway, for improvements in the construction of the permanent way of railways and tramways, and of the carriages to run thereon.

747 R. F. R. Lucas, Pennfield, Wolverhampton, for improvements in the coking of pitch, and in the manufacture of solid hydrocarbons therefrom.

748 F D. Sargent, Lower Tottenham, for improvements in the construction of cornice poles and roller window blinds to be used either in combination therewith or separately.

749 A. Broune, Gracechurch-street, City, for an improved machine for sewing gloves. A communication.

PATENTS SEALED.

2383 J. Fletcher, for improvements in packing rings for steam engine piston rods, stuffing boxes, pumps, and other similar articles.

2385 J. Livesey, for improvements in asphalte or similar composition, and in the application thereof to various useful purposes.

2394 M. Mirfield and J. Scott, for improvements in extracting or recovering grease and oil from soap-suds and "seak" or saponaceous liquor.

2396 J. Hall, for improvements in breech-loading fire-arms.

2398 R. Long, for improvements in latches or fastenings for gates, doors, and other similar purposes.

2405 R. F. Miller, for improvements in omnibuses and other public vehicles.

2429 J. Gillespie, for improvements in the modes and means or apparatus for preparing fire-clay, and in the moulding and manufacture of articles thereby and therefrom, applicable also to other loams and wares.

2431 J. Gillingham, for improvements in invalid couches.

2434 T. Sampson, for improvements in apparatus for piece-dyeing or dyeing woollen and other fabrics in the piece.

2437 H. D. Furness, for an improved method of lubricating the cylinders and valves of locomotive and other engines.

2443 C. Naylor, for improvements in commodes or closets for sanitary purposes.

2447 W. Brooke, for an improved method of forming or making in the neck of bottles a groove or socket for the reception of washers, and in machinery or apparatus employed therefor.

2452 W. Pawson, for improvements in taps or valves for hot and cold water apparatus.

2556 J. F. Cooke, for an improvement in the manufacture of pocket pencils.

2598 A. V. Newton, for an improved construction of sad iron.

2955 A. E. Samels, for improvements for adjusting and fastening door knobs or handles to lock spindles, and for preventing lateral play or tendency to bind in the woodwork of the door.

3044 R. Douglas and L. Grant, for improvements in utilising the husks or shellings of grain as fuel, and in furnaces employed therefor.

3139 J. Betteley and G. W. Bremner, for improvements in ships or vessels and in the arrangements of apparatus for steering them.

3219 W. Austin and H. D. Ellis, for improved constructions of blocks suitable for paving roads, streets, and other places.

3266 H. Witzenmann, for improvements in the manufacture of linked chains and in means or apparatus employed therein.

3383 G. H. Ellis, for improvements in asphalte roads, ways, and floors.

3419 J. Wood, for improvements in bedsteads, spring mattresses, and other articles for sitting or reclining upon, and in the seats of omnibuses, railway carriages, and other vehicles.

3449 J. E. A. Gwynne and B. Beale, for improvements in the construction of rotary engines, which said improvements are applicable for lifting, forcing, and exhausting.

6 W. S. Fish, for improvements in the construction of packing for piston rods, pipe joints, and other similar purposes.

7 W. S. Fish and J. Wotherspoon, for improvements in yarns, threads, twines, cordage, or ropes, and in the employment or application thereof.

157 W. R. Lake, for improvements in bronzing machines.

181 W. S. Luscom, for improvements in applying power to the wheels of traction engines, portable engines, excavators, and other self-moving machines.

2418 J. L. Clark and J. Muirhead, jun., for improvements in telegraph instruments.

2421 J. E. Wood, for a new paint or varnish for preserving the bottoms of ships and other submerged structures from fouling and decay, also for preserving iron, wood, and other substances (not submerged) requiring protection by paint or varnish.

2425 W. E. Newton, for improvements in furnaces or fireplaces and boilers for the generation of steam.

2441 J. Gowans, for improvements in tramways.

2446 D. B. Peebles, for improvements in gas regulators.

2448 F. A. A. Manier, for improvements in pneumatic telegraphy.

2460 M. Pedley and D. Pedley, for improvements in looms for weaving.

2487 J. W. McCarter, for improvements in sawing machinery.

2605 W. H. Kent, for an improved machine for plaiting textile and other materials.

2671 W. R. Lake, for an improved fastening for boots and shoes.

2759 A. V. Newton, for improvements in electric batteries, and in the means for exciting the same.

2818 L. Perkins, for improvements in locomotive and traction engines.

2819 L. Perkins, for improvements in marine and stationary engines.

2959 J. A. B. Williams, for improvements in machinery for mixing materials for artificial fuel and moulding them into blocks, part of which machinery is applicable for moulding bricks and other analogous articles.

3454 A. Hugentobler, for improvements in the preservation of fresh meat and vegetables, and in the preparation of extract of meat.

91 G. Price, for improvements in muffs or finger protectors.

111 J. Sullivan, for improvements in apparatus for administering pills.

169 W. R. Lake, for improvements in printing presses.

188 J. Booth, for improvements in the manufacture of fabrics in twist lace machines.

264 W. R. Lake, for improvements in machinery for nailing or pegging the soles of boots and shoes to their vamps or uppers.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MARCH 29, 1872.

ARTICLES.

ASTRONOMICAL NOTES FOR APRIL.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE right ascension of the Sun at Greenwich mean noon on April the 1st is 0h. 44m. 23·5s., and his declination 4° 46′ 27·5″ north. He may therefore be said, roughly, to form an isosceles triangle with δ and ε Piscium, ε being at the apex of it. He rises in London on the 1st at 5h. 36m. a.m., and sets at 6h. 31m. p.m.—his rising and setting on the 30th taking place, in the same locality, at 4h. 35m. a.m., and 7h. 19m. p.m., respectively. The equation of time is additive, but diminishing, up to the 14th instant, after which date it becomes subtractive. On the 1st 3m. 47·2s. must be added to the time indicated by a sundial to obtain true clock time, and this quantity decreases to 9·26s. on the 14th. Subsequently, on the 15th, 5·59s. must be subtracted from the time shown by a meridian instrument; and, by the 30th, 2m. 58·49s. must be taken away from apparent time to get mean time. The semi-diameter of the Sun at his Greenwich transit is, on the 1st, 16′ 1·7″, and this occupies 1m. 4·5s. of sidereal time (convertible into mean time by the subtraction of 0·18s.) in its passage over the meridian. The semi-diameter will have diminished to 15′ 54·1″ on the 30th, and this will occupy 1m. 6·01s. of sidereal time (convertible as before) in its transit. The sidereal time at mean noon on April 1st is 0h. 40m. 36·24s., while on the 30th it is 2h. 34m. 56·31s. The mean time at sidereal noon, or mean time of transit of the first point of Aries, is 23h. 15m. 34·5s. on the 1st, and 21h. 21m. 33·16s. on the 30th. Solar activity is now perceptibly diminishing, and spots are becoming both smaller and less frequent than they have been.

The Moon will be New at 31·7m. after midnight on the 7th, will enter her first quarter at 10h. 11·3m. on the night of the 15th, be Full at 1h. 37·2m. in the afternoon of the 23rd, and enter her last quarter at 8h. 20·9m. a.m. on the 30th. She is exactly 23 days old at noon on the 1st, and, of course, 29 days old at the same hour on the 7th. At noon on the 8th her age is 0·5 days, and so on to the 30th, when it is evidently 22·5 days. At 7h. in the evening on April 8th libration will render an additional part of her south-west limb visible, while at 8h. a.m. on the 21st more of her south-east quadrant will come into view from the same cause. The Moon will be in conjunction with Saturn at 4h. 50m. in the afternoon of the 1st, with Venus at 7h. 23m. in the evening of the 5th, with Mars at 4h. 21m. p.m. on the 8th, with Mercury at 8h. 1m. the next morning, with Jupiter 36m. before noon on the 15th, with Uranus at 11 o'clock the same night, and lastly with Saturn again at 11h. 18m. on the night of the 28th.

There will be only three occultations of fixed stars by the Moon, and one close approach to a star by her during this month. First, on April 13, 5 Geminorum will disappear at the Moon's dark limb at 6h. 55m., to reappear at her bright limb at 8h. 6m. Then, at 11h. 48m. on the night of the 14th, she will pass quite close to 48 Geminorum. On the 18th, at 7h. 59m. p.m., B.A.C. 3579 will disappear at the dark limb, reappearing at the bright limb at 9h. 16m.; while, later on the same night, *i* Leonis will be occulted by the dark limb at 10h. 14m., and emerge from behind the bright one at 11h. 10m.

Mercury is now an evening star, and attaining, as he does, his greatest eastern elongation (19° 7′) at 3h. 11m. a.m. on the 5th, and, moreover, having now considerable north declination, is very favourably situated for observation during the early part of April. His apparent diameter increases from some 7″ at the beginning of the month to something like 12″ at the end of it. As he does not set until nearly two hours after the Sun during the first part of April, he may be looked for in the evening sky after sunset, a little to the north of west. He travels from Pisces into Aries, but does not pass near any sufficiently conspicuous star for it to be taken as a mark. His conjunction with the Moon at 8h. 1m. a.m. on the 9th has been noticed above, and he will also be in conjunction with Mars at 1h. 20m. after midnight on the 19th. Our remarks as to his visibility apply only to the earlier part of April, as during the latter half of it he is travelling rapidly towards the west, and is, as a matter of fact, in inferior conjunction with the Sun at 8h. 54m. in the evening of the 24th.

Venus is a morning star, but is indifferently situated for observation, as she only rises between half and three-quarters of an hour before the Sun, in strong twilight; souths between ten and eleven in the morning, and sets, of course, in bright sunshine. Her diameter, too, is now only about 11″, and is diminishing; her disc is approaching a circular form; and she is, altogether, a poor telescopic object. Her conjunction with the Moon at 7h. 23m. on the evening of the 5th has been previously adverted to.

Mars, with his minute disc of only some 5″ in diameter, is too close to the Sun to be visible. His conjunctions with the Moon at 4h. 21m. in the afternoon of the 8th, and with Mercury at 1h. 20m. a.m. on the 20th, have been before referred to.

Jupiter, although rapidly approaching the west, still continues to be the chief and most conspicuous object in the sky, up to, and for a little while after, midnight. He is travelling slowly eastward, through the barren region to the south of Castor and Pollux. He rises on the 1st at 10h. 39m. a.m., souths at 6h. 46·5m. p.m., and sets at 2h. 55m. the next morning—his rising, southing, and setting, on the 30th, taking place at 8h. 58m. a.m., 5h. 3·9m. p.m., and 1h. 10m. a.m. the next day, respectively. 43m. before noon, on the 10th, Jupiter will be in quadrature with the Sun. The effect of this on the interval elapsing between the entry on, or departure from, the disc of Jupiter, of his satellites, and of the shadows which they respectively cast, will be noticed in the list of the phenomena of the Jovian system for this month which we give below. His apparent diameter continues steadily to decrease, from about 40″ at the beginning of April, to 36″ at the end of it. We have previously spoken of his conjunction with the Moon at 11h. 24m. a.m. on the 15th.

Owing to his position with reference to the Earth, the phenomena exhibited by Jupiter's satellites now are decreasing both in number and frequency. During the month of April the following will be exhibited:—Firstly, on the night of the 1st, at 7h. 40m., the transit of satellite 1 will begin. It will be followed by its shadow at 8h. 57m. The egress of the satellite will occur at 10 o'clock, that of the shadow at 11h. 17m. On the 2nd, satellite 1 will reappear from eclipse at 8h. 24m. 6s. A reappearance from eclipse of satellite 3 will also take place at 8h. 3m. 55s. on the evening of the 4th; and it is possible that afterwards, at 1h. 42m. after midnight, the occultation of the 2nd satellite may be perceptible. On the evening of the 6th, satellite 2 will begin its transit at 7h. 59m., its shadow not entering on to the planet's limb until 10h. 32m. At 10h. 54m. the satellite will leave Jupiter's opposite limb, as will the shadow at 1h. 28m. the next morning. 16m. after midnight, on the 7th, satellite 1 will be occulted; while the transit of satellite 3 will commence somewhat later, at 1h. 21m. On the evening of the 8th, at 7h. 43m., satellite 4 will enter on to the face of the planet, satellite 2 will reappear from eclipse at 8h. 25m. 49s., the transit of satellite 1 begin at 9h. 35m., that of its shadow at 10h. 52m., the egress of the satellite at 11h. 54m., that of satellite 4 two minutes later, while the shadow of satellite 1 will not quit Jupiter's limb until 1h. 12m. the next morning. On the night of the 9th, satellite 1 will reappear from eclipse at 10h. 19m. 35s. The egress of the shadow of this same satellite will take place at 7h. 41m. the next evening, the 10th. Perhaps satellite 3 may be perceived to reappear from occultation at 6h. 52m. p.m. on the 11th. It will afterwards disappear in eclipse at 8h. 38m. 19s., reappearing from it at 4m. 54s. after midnight. The transit of satellite 2 will begin at 10h. 37m. on the night of the 13th. Perhaps, under very favourable circumstances, the ingress of its shadow at 1h. 10m., and the egress of the satellite itself at 1h. 32m. the next morning, may be discerned. On the night of the 15th, satellite 2 will reappear from eclipse at 11h. 1m. 6s.; the transit of satellite 1 will commence at 11h. 30m., its shadow come on 47m. after midnight, while it is conceivable that the egress of the satellite may be caught at 1h. 49m. At 8h. 40m. on the night of the 16th satellite 1 will be occulted, to reappear from eclipse at 12h. 15m. 5s. The shadow of this same satellite may perchance be detected in its entry on to the planet, at 7h. 16m. in the evening of the 17th; the egress of the satellite casting it occurring at 8h. 18m.; and the shadow itself passing off at 9h. 35m. Later, satellite 4 will reappear from eclipse at 10h. 22m. 33s. On the 18th it may happen that the occultation of satellite 3, at 7h. 25m., may be discernible. It will reappear from occultation at 10h. 55m., only, however, to suffer eclipse at 12h. 38m. 11s. It may happen that the ingress of satellite 2 may be detected at 1h. 16m. a.m. on the 21st. Satellite 2 will be occulted at 8h. 13m. on the 22nd. The transit of satellite 1 will begin at 1h. 26m., and satellite 2 reappear from eclipse at 1h. 36m. 16s. the next morning, but the observation of these phenomena is problematical. On the night of the 23rd, satellite 1 will be occulted at 10h. 37m. The beginning of the transit of satellite 1, at 7h. 55m., and the egress of the shadow of satellite 2, at 8h. 2m., on the evening of the 24th, may possibly be caught. Afterwards, the ingress of the shadow of satellite 1 will commence at 9h. 10m., the satellite leave the planet's face at 10h. 14m., and the shadow at 11h. 30m. Satellite 1 will reappear from eclipse at 8h. 39m. 31s. on the night of the 25th, and satellite 3 be afterwards occulted at 11h. 30m. The egress of the shadow of satellite 3 will happen at 10h. 7m. on the night of the 29th; satellite 2 will subsequently be occulted at 10h. 52m. Lastly, it is just possible that the occultation of satellite 1 may be perceptible 34m. after midnight on the 30th.

Saturn, in his old quarters in Sagittarius, continues in a deplorable position for the telescopic observer. He rises on the 1st at about a quarter to 3 a.m., souths at 6h. 49·1m. a.m., and sets at 10h. 53m. a.m. On the 30th his rising, southing, and setting take place at 54m. after midnight, at 4h. 58m. a.m., and at 9h. 2m. a.m., respectively. He will be in quadrature with the Sun 35m. after noon on the 10th. Reference has previously been made to his conjunctions with the Moon, at 4h. 50m. p.m., and 11h. 18m. p.m., on the 1st and 28th, respectively.

Uranus, like Jupiter, is travelling towards the west, but is still observable during a good deal of the working part of the night. The directions given for finding him last month (Vol. XIV., p. 576) are equally available for the present one, as his movement is so extremely slow. His diameter remains stationary at 4″. He is in quadrature with the Sun at 10h. 41m. on the night of the 16th. We have spoken, under the proper heading, of his conjunction with the Moon at 11h. p.m. on the 15th.

When we have said that Neptune is in conjunction with the Sun at 9h. 5m. a.m. on the 13th, it will scarcely be necessary to add that he is wholly invisible during April.

Shooting stars would appear to be tolerably common in the month of April. Suspicion exists of a periodical shower at some period between the 4th and the 11th, while a pretty well ascertained one is referred to in the B.A. report for 1870 as occurring between the 19th and 21st of the month.

WEATHER CHARTS.

THE first four weather charts of the Meteorological Office, March 16 to 19, 1872, at 8 a.m., are now before us. The arrangement is good, the land being shaded and the water white. On the left hand we have the weather reports, and on the right the chart for the day, which consists of four maps; one for depicting the isobars, one the isotherms, a third for the general direction of the wind and state of the sea, and a fourth for giving a statement of cloud, rain, &c.

So far the general description. A word on the utility of the charts may not be out of place. Confining our attention to the barometer and temperature, a glance at the four charts will convince us that the area embraced by the maps is but small, the *isobars* and *isotherms* being mere fragments. The directions and values of these lines are the only elements of pressure and temperature attainable from the charts. The relation of the meteorology of the British Islands and France to the Continental area on the east and the oceanic area on the west is unattainable, and these relations are of the first importance in judging of the *progression* of weather. On the 16th we had the barometer ranging from 30· to 29·57, being a gradient N.N.W. of about ·

On the 17th the directions of the lines were altered, running S.W.—N.E. instead of W.S.W.—E.N.E. We are, however, entirely ignorant of the barometric state of the countries in advance of these lines, and quite as ignorant of the nature of the isobars likely to succeed them. This is particularly illustrated in the isobaric chart of March 18, a new system being manifested over the whole of the area. This great and decided alteration in the direction and value of the isobars shows that a single telegram daily is insufficient, according to our views, for the requirements of meteorology.

The most valuable feature of the charts is the connection between barometric pressure and wind. In this notice we cannot enter into a description of the relation existing between the two, further than saying that the wind maps show unmistakably that the general course of the wind is parallel to the direction of the isobars.

COMPRESSED AIR AS A MOTIVE POWER.

WE have had occasion within the last twelve months or so to call the attention of our readers to the progress which is being made in the application of compressed air as a means of obtaining motive power. In this country machines have been constructed, and we believe with satisfactory results, which are put into motion by the expansive force of air compressed by means of water or suitable steam-engines, the power being conveyed to the scene of its operations in pipes, the length of which is practically unlimited. So far as we know, however, compressed air has not been employed in this country for obtaining motion, except in those cases where it is almost impossible to use steam—for instance, in coal-mines; and an account of its successful application to colliery working will be found at p. 2, Vol. XIII. In the United States, on the contrary, compressed air as a motive power has received more than usual attention, especially since its value was proved beyond doubt by the operations at the Mont Cenis tunnel, and American engineers and inventors have been both experimenting and theorising on its capabilities and the best methods for its utilisation—its application to locomotion being the principal object sought by our cousins.

It is actually more than 60 years ago since Medhurst proposed to drive carriages through a brick tunnel by means of an air-blast, and various projects for accomplishing a similar object have been introduced, but have invariably failed, either from mechanical difficulties or from the absence of any economy—perhaps we should say from the great expense incurred in keeping the apparatus in working order. Probably the most notable of all these attempts was the Atmospheric System tried on the South Devon Railway, in 1847, by Brunel, which although successful as far as the mere propulsion of the trains was concerned, was yet so hampered by constantly recurring difficulties that it was finally abandoned by the directors, for "prudential" reasons. The principle of this atmospheric system, which was patented by Clegg and Samuda, consisted in a tube containing a close-fitting piston, which was driven along by the pressure of the air behind it, a vaccuum being created in front of it by means of powerful steam-engines. The tube had a slit in its upper surface which was covered by a valve of leather, and through this slit the bar connecting the piston with the carriages passed. It is obvious that the construction of a valve which should fit with the requisite closeness, and yet open readily, to allow the passage of the connecting bar, must necessarily be a work of great difficulty, requiring much ingenuity and skill for its accomplishment; and it is no wonder, therefore, that in the early life of the system, before experience had been gained by extended trials, many failures should have occurred, and that even Brunel should have recommended no further persistence in the attempt. It was, however, the opinion of many persons at the time that, given the requisite funds, the atmospheric system might eventually have triumphed, and the defects in the original apparatus have been successfully remedied.

A resuscitation of the old system has been frequently proposed of late in the United States for the motive-power of trains in tunnels to be constructed underneath the crowded and busy streets of the principal cities; for although ...ys are there as common as lampposts, ...nd incapable of accommodating the ...onsequence chiefly of the slowness with which the cars are drawn by horse-power. It is in the direction of applying compressed air as a motive-power for tramway cars, however, that experiments have been carried out which bid fair to lead ultimately to success. In several instances cars have been propelled by compressed air, but as the apparatus employed is only regarded as tentative, the details of the mechanism and the characteristic action of the air have not been published with sufficient minuteness to enable an accurate estimate to be made of the power obtained and of its cost. The necessity of some improved means of transit in cities is acknowledged on all hands, and as we know that "Necessity is the mother of Invention," it will probably not be long before some economical, easily-controlled force is applied to the propulsion of street cars, at all events in America. We have already illustrated the American ammonia engine, and we recently described a steam car in course of construction in this country; but we think that compressed air will ultimately be the chosen means of propulsion. Mr. J. A. Whitney, in a paper read before the New York Society of Practical Engineering, after alluding to the objections against the employment of steam in carriages traversing public thoroughfares, and protesting against its use for underground railways in tunnels without openings, declared that horse power is acknowledged to be inadequate to the wants of New York street railways; the transmission of power by ropes, as illustrated in the elevated railway on Greenwich-street, has proved a "mediocre and insufficient method of propulsion," and it is only in pneumatic power that he considers sufficient promise of success appears to justify the outlay required to thoroughly test the principle. The plan, which has hitherto given the best results, consists in compressing the air to a very high degree, and storing it in tanks or cylindrical chambers arranged about the body of the car in the most convenient manner; from these the air is led to a receiver supplying the cylinders, which are constructed in much the same manner as those of steam-engines. In all this there is, of course, but little difficulty; if air is compressed to, say, 200lb. on the square inch, and is then allowed to exercise its elastic force on a piston fitting closely in a cylinder, we can calculate approximately the amount of power the piston should exert, but if we omit to take into consideration the surrounding conditions and the peculiar characteristics of expanding air we shall, without doubt, make a grievous mistake in our calculation. Most of our readers are aware that when compressed air is allowed to expand it robs the surrounding matter of all the heat it can, and, indeed, by virtue of that property has been used for refrigerating purposes. It will be evident, therefore, that unless the air is considerably raised in temperature, or the cylinder heated by means of water or hot air circulating in a jacket, that whatever moisture may be contained in the compressed air will be converted into ice, which will speedily block up the exhaust port and the pipes connected with it, as well as lower the temperature of the air in the reservoir. To obviate this difficulty one inventor proposes to construct the main reservoir of a material which will prevent the loss of heat, and consequently of power, by radiation—the air in the process of compression becoming, of course, considerably raised in temperature—heat which it is desirable to retain; another proposes to pass the pipe conveying the air to the cylinders through the warming apparatus of the car; while a third suggests an arrangement whereby the air from the stove used for warming the car should be made to circulate in annular jackets round the cylinders. Independently of the fact that the stove is not always in requisition to "warm the car," *e.q.*, in the summer, these plans are open to objection on several grounds; and it appears to us that the proposal to heat the cylinders by means of jackets containing hot water is to be preferred, as the water could be changed at the end of each journey, and facilities would be also afforded for warming the air of the main reservoir, in which the refrigerating effect would be experienced during the early part of the piston stroke. Another proposal has for its principal feature the heating of the air by burning hydrogen or carburetted hydrogen in a vessel near the cylinders. The hydrogen is compressed to the same degree as the air, and burns in jets in the air which passes through the above-mentioned vessel on its way to the cylinders. The gas is to be set alight by means of electricity: so that the apparatus for working the car would become a trifle too complicated and expensive, we think.

It will be apparent, then, to our readers that there is nothing impossible in the proposal to run street cars by means of compressed air—in fact, it has been done, and an account of a trial of one at Chicago will be found on p. 345, Vol. XII., in which it is stated that the only fault was the noise made by the exhaust of the engines. This latter can be easily remedied, and the escaping air used to cool the atmosphere of the car in summer and urge the fire in winter. The next question, then, is in reality the main point. What is the cost? There is, first of all, the construction of the reservoirs, which for the sake of lightness must be of steel or copper; and then there is the requisite apparatus for compressing the air, which must be supplied in duplicate, one for each end of the road, for the weight of the car would scarcely be increased for the sake of storing sufficient air for a double journey. The other expenses would be much the same as now, so that it is a matter of comparatively easy calculation to approximately ascertain the first outlay, and whether the increased comfort and speed of travelling could not be obtained for the same amount as is now paid for horseflesh. The system would doubtless be more expensive than steam; but there are "obstructions" to the introduction of the latter which could not well be thrown in the way of compressed air. Mr. Whitney, who is perhaps rather enthusiastic in the matter, believes that passengers may be cheaply carried at a speed of from 20 to 40 miles an hour "with all the comfort of ordinary railways, and none of the dangers or inconveniences incident to the employment of locomotives." His proposal for a pneumatic railway will show how far in this direction the ideas of the Americans are advanced. "An elevated pneumatic tube is to be carried over the buildings and cross-streets, sustained on iron supports constructed on the principle of a suspension bridge over each block; this tube is to be of wrought iron for strength and lightness; lined with wood for moderate warmth and for reduction of friction to the air blast; glazed throughout its length with panes sufficient in size and number to light it well; furnished with switches, to enable a car to be stopped at a station without interference with the others; furnished with electric signals automatically actuated by the cars themselves, to indicate their approach to the stations; the working of the line to be placed, from the lowest duty to the highest, in the hands of educated, careful and properly remunerated engineers, and the question of quick transit, in one of its phases at least, will be solved with greater satisfaction to the public and credit to the engineering profession than the most ardent advocates of speedy passenger travel now dare hope for."

Whether the system will be adopted in this country for propelling street-cars will probably depend in a great measure on the success of the attempt in America; but as a means of obtaining coal that is otherwise out of reach there can be no doubt of the great utility of the compressed-air apparatus. Machines for getting coal are capable of working in a temperature where muscular exertion is almost impossible; and the air having done its work in actuating the apparatus will cool the underground passages, and enable human beings to penetrate much deeper into the crust of the earth than they have hitherto succeeded in doing.

THE METALLURGY OF IRON AND STEEL.

THE following is an abstract report of a course of lectures on the above subject delivered by Dr. Percy, F.R.S., in the lecture theatre of the Geological Museum:—

We have heard of precious metals, noble metals, and base metals: but if a metal is to be judged noble in respect of its utility to mankind, iron holds the highest rank. It is extremely widely diffused, is, in fact, everywhere; however deep we go iron is to be found, and it is a large constituent of many rocks. It exists even in our blood, and without it we could not live. I have seen sufficient iron taken from out of a man's blood to make a medal.

Iron ores contain always the metal in a state of combination, the only case in which we are acquainted with the native metallic iron is that of meteoric iron. This comes probably from some interplanetary spaces—we know not where—and occasionally masses of it have dropped down on our earth, varying in weight from ounces to tons.

Red oxide of iron, or red iron ore, is one of the most important ores in this country; it is now largely in demand for making the metal suitable for the Bessemer steel process, and on this account has lately risen to double its former value. It occurs in large nodular, sometimes "kidney-shaped" masses, and occasionally crystallised, and presenting a bright metallic lustre, when it is known as "specular iron ore." In all these cases it contains the same proportion of chemical elements, and these are iron and oxygen. Oxygen forms about one-fifth of the atmosphere; without it no combustion could occur, no human being could live. The metals have a strong affinity (or liking) for oxygen. A steel spring burns in it with vivid scintillations. Placed in a jet of flame, from a mixture of coal gas and oxygen, the combustion is very striking. If we take a piece of metallic iron and leave it exposed to the air it soon becomes covered with rust. This rust is the oxide of iron, being nothing more than a combination of the metal with the oxygen of the air; in most cases a certain proportion of water is added.

If we take a piece of iron, heat it, and keep it for a long time, it undergoes a change. It increases considerably in weight; and if the heat be continued, especially if the metal be finely divided, as in the state of filings, it becomes converted into an oxide just like the above ore. There is still another way of producing this oxide, —namely, by dissolving the metal in an acid (as muriatic), and then precipitating it by the addition of another substance (as potash or ammonia). If this oxide of iron be rubbed on a piece of paper it will always give a distinct red mark, and never a brown or black one, and in this way we can distinguish between one kind of iron ore and another. This ore, when perfectly pure, contains 70 per cent. of metallic iron. Some of it is used for a very important purpose—viz., burnishing, and when you get hold of a good bit it is worth a good deal of money. It is also used as a pigment, the so-called Indian red and Venetian red are oxides of iron. Also for polishing plate glass, for which purpose the oxide is ground and washed in water, and after the coarser particles have settled the liquid is poured off, and the finer particles for use allowed to subside, and thus they are obtained in a state of great tenuity. Rouge, used for polishing silver, is also an oxide of iron, and the oxide is also frequently used for adulterating "red lead." It is found in Cumberland and Lancashire, and is very much in request on account of its purity; large quantities are now imported from Spain.

Another kind of iron ore is called brown iron ore; it is nothing more than the red ore combined with water, and may be called a natural rust. There is a great deal of it in various parts of the world; much in the Forest of Dean, where it has been worked since the time of the Romans. When perfectly pure it contains 59·89 per cent. metallic iron and 14·5 water. Ochres are an artificial sort of it. It forms the bases of the so-called "Northampton Ore."

The third kind of ore is magnetite or magnetic oxide of iron, and of this kind we have not much in this country. It is a combination of the protoxide and the red or peroxide—viz., $FeO + Fe_2O_3$. It is the natural loadstone, and attracts the magnetic needle, hence its name. It contains 24 parts oxygen to 56 parts iron. It forms one of the most important ores of Sweden, Canada, and the United States, and is one of the purest ores of iron, being in great request for iron adapted for steel manufacture. It contains 72·4 per cent. iron. The next kind is sparry or spathic iron ore. We have not much of it in this country. It is found in Somersetshire, Germany, Austria, and other parts of the world. It is the carbonate of iron, and contains, when pure, 48·25 per cent. of the metal. In addition to its elementary constituents it frequently contains another metal which plays an important part in the manufacture of iron—manganese. When heated it loses all its carbonic acid, and you get not the protoxide of iron remaining, but a mixture of the two oxides. All the important ores of iron from the coal-measures are of this kind; not pure carbonate however, but mixed with more or less clay; a little carbonate of lime, carbonate of magnesia, and always more or less phosphorus, the latter being an inveterate enemy in iron and steel manufacture. From the fact of these clay iron ores containing phosphorus they are unsuitable for many purposes—*e.g.*, the Bessemer process; thence the great demand for the red oxide. Sometimes these ores contain other impurities, as zinc; occasionally lead in form of lead ore; copper in form of copper ore; nickel; and sometimes, but rarely, silver. There is also more or less coaly matter, and when that reaches eight or ten per cent. it gives a dark colour to the ore, which is thence called "black band." They are called "clay" iron ores because the nodules resemble clay; they are found in many parts of the world. They are not confined to the coal-measures, but are also found in the Weald of Sussex—the iron railings round St. Paul's are made from Weald iron ores. The Cleveland iron stone is mainly a carbonate of iron.

Iron varies notably with the kind of ore from which it is made, but this depends not on any difference in the metal itself, but in the presence of certain impurities varying in nature and proportion.

In the extraction of iron the ore is in every case treated as an oxide. If we take the red oxide there is nothing more to do in that respect; the brown variety must be heated to drive off the water; the magnetic ore requires no further treatment; the clay and sparry ores must be previously raised to a red heat to drive off the carbonic acid. Thus in every case we find, without exception, that the material treated for the purpose of obtaining iron and steel is the *oxide of iron.*

If we take the oxide and reduce it to powder, and mix with it a small quantity of charcoal, and then heat it in a closed vessel for a short time, the charcoal will remove the whole of the oxygen. This process requires a very high temperature. If we take a lump of oxide and simply imbed it in red hot charcoal, and keep it so for a few hours, we shall find that every particle of the oxygen will be perfectly removed from it, and there will remain a mass of workable, metallic iron. It is not even essential that there should be extensive contact between the ore and the charcoal, it is sufficient to imbed the former in the latter.

We have heard of the stone age, the bronze age, and the iron age, and are told that they occur, in this sequence. Now bronze is an alloy of copper and tin, usually 10 per cent. of tin, and the production of bronze would imply a considerable degree of advance in the art of metallurgy, as both copper and tin had to be extracted from their ores. They require to be melted together in proper proportions, and then to be melted again and cast. Metallurgically speaking, one would expect to find, other circumstances being clear, that the iron age would be next after the stone age. Iron is so very readily destroyed by corroding, while bronze endures well, that it is no wonder if iron was used by these early people, that it has not come down to us. In the Assyrian collection in the British Museum are some very interesting objects of iron and steel, which show that these people were well acquainted with the use of iron, and that it was plentiful and cheap we may infer from the fact that they used it for hammer heads.

In other instances, in ancient times and at the present day, in countries where it is commonly said that civilisation is not advanced, the process for extracting iron from its ores is essentially a reduction of the oxide by means of charcoal. They take a small furnace, often not larger than an ordinary chimney-pot (cost about three halfpence); this is lined at the bottom with fire-clay, or the best substitute they can get, and has a hole by which to admit the air. These are sometimes circular in section, sometimes rectangular, and frequently the bottom is made to take out. They next reduce the ore to coarse gravel, and place it in the furnace in layers, alternating with layers of charcoal. To keep up a continuous blast, if they have not a double acting bellows, two or three pairs of bellows are worked in alternation. The oxygen is removed, and with the charcoal forms carbonic oxide, which burns at the top of the furnace. After working hard at the bellows for some hours, the ore is reduced, and the iron forms a metallic mass at the bottom of the furnace.

The lecturer then described a kind of bellows used by the Hindoos, who have, no doubt, bellows properly so called, but use a kind of which one man can work two alternately, and so keep up the blast. It consists of a rude piece of wood with a cavity hollowed out, and covered over by a piece of supple buffalo hide. In the hide over the centre of the cavity is a hole through which a string passes, and is fastened to a small peg to prevent it drawing through. The other end of the string is fastened to a long bamboo spring, which thus keeps the hide stretched. A bamboo tube leads the air from the side of the bellows to the furnace. They are worked by a man covering the hole with his heel, at the same time pressing down the hide, and he can work one with each foot. Another example of Indian bellows was shown, consisting of the skin of an animal sewn up, excepting a tubular portion (for the nozzle) at one end and a longitudinal slit at the other. The edges of this slit were fastened to two sticks; and the bellows were worked by setting one end of the sticks firmly together on the ground as a fulcrum for the leverage, and working the other backwards and forwards, closing the sticks as you advance it to force out the air, and opening them on withdrawal. If the hide be supple a good blast can be thus obtained.

A third kind of bellows—double acting—was exhibited, as used in China and Japan, the one in question having been used by an itinerant tinker in China. It consists of a rectangular box, closed at bottom, but with a movable lid, and a hanging valve at each end, opening inwards. Inside is a piston worked by a handle outside, and having a packing of cocks' feathers. On the bottom is a canal running the whole length, with an opening on the top into the box at each end. The exterior opening (in reality two) is about halfway of the length of this canal, inside of which valves are placed to regulate the passage of the air during the working of the piston. This apparatus works remarkably well, giving a good, practically continuous blast.

(To be continued.)

LESSONS ON CHEMISTRY.*

BY SELIMO R. BOTTONE.

(Late of the Istituto Bellino, Novara, Italy.)

(Continued from p. 4.)

c. CHLORINE TETROXIDE.—*Synonym: Chloric Oxide.*[1] *Symbol:* $Cl'O_2''$, or $Cl_2'O_4''$? *Molecular weight:* 67·5.

110.—PROPERTIES.—A gas of a deep yellow colour, with a smell resembling that of chlorine, though not so pungent and suffocating. Its specific gravity is 2·3365, or, what amounts to the same, it is about thirty-four times as heavy as hydrogen, hence we are led to conclude that its molecule contains only one atom of chlorine, united to two of oxygen, and not two of chlorine to four of oxygen (see foot-note referring to chlorine trioxide). In common with the compounds just examined, it possesses great bleaching powers. It may be condensed to a red liquid at a temperature of about—4° Fahr. It is a most dangerous body to operate upon, as it is liable to explode with a very slight rise of temperature, sometimes fracturing the containing vessel, and thereby endangering the experimenter. It dissolves freely in water, but does not appear to unite with it to form an acid,[2] though the solution formerly went by the name of hypochloric acid. This solution, when placed in contact with metallic oxides, gives rise to a mixture of a *chlorite* and a *chlorate*[3] of the metal employed. Up to the present time chloric oxide has received no practical application.

111.—PREPARATION. — A small quantity of potassium chlorate is made into a paste with sulphuric acid. The mixture assumes a deep yellow tint, and is then to be introduced into a retort, which must be carefully heated with *warm water* (bain marie). Chlorine tetroxide is evolved, and may be collected by downward displacement, as water decomposes it, and mercury is attacked by it. The interchanges which take place during the action of sulphuric acid on potassium chlorate occur in two phases—viz., 1st. The production of chloric acid and sulphate of potassium; 2nd. The splitting of chloric acid into water, perchloric acid, and chloric oxide. The following equations may serve to illustrate these changes:—

1st Phase.

$$3K'\overline{\overset{\prime}{Cl}O_3} + 3H_2'\overline{\overset{\prime\prime}{S}O_4} = K'H'\overline{\overset{\prime\prime}{S}O_4} + 3H'\overline{\overset{\prime}{Cl}O_3}$$

2nd Phase.

$$3H'Cl'O_3'' = H_2'O'' + H'Cl'O_4'' + 2Cl'O_2''.$$

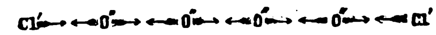
112.—The formula of chlorine tetroxide may be represented in two modes, according to the view taken of its constitution. If we take the view, with some, that an open chain (see 26) cannot exist in the free state for an appreciable

1 Peroxide of chlorine.

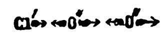
2 According to some, water decomposes the gas, splitting it up into chlorous and chloric acids.

3 See paragraph 114 in explanation of the term "chlorate."

space of time, we must represent its molecular constitution as being—



But, as we have already seen, this does not agree with its vapour density, hence many chemists hold its constitution to be—



Attention has already been called to the fact (78) that chlorine appears in certain cases to act as if bivalent; this being the case, no difficulty would arise from stating its graphic formula to be—

a formula which would bring its molecular constitution into direct agreement with its vapour density, for $Cl = 35{\cdot}5 + O_2 = 32 = 67{\cdot}5$, which is, as theory leads us to expect, twice its vapour density 33·75 (see 17).

D. CHLORINE PENTOXIDE.—*Synonym: Chloric anhydride.*[4] *Symbol:* $Cl_2'O_5''$ (?). *Molecular weight:* 151 (?).

113.—This body is as yet unknown in the separate state. In combination with the elements of water it exists in chloric acid, to which it bears the same relation as the hypochlorous and chlorous anhydrides bear to hypochlorous and chlorous acids.

D (2). CHLORIC ACID. — *Synonym: Hydrogen Chlorate.*[5] *Symbol:* $H'Cl'O_3''$. *Combining weight:* 84·5.

114.—PROPERTIES.—An oily, colourless fluid, of a strongly sour taste. It reddens vegetable blues, but does not possess bleaching powers. It has never been obtained entirely free from water, for on reaching a certain point of concentration it is decomposed with evolution of oxygen. Heat also effects this decomposition, resolving chloric acid into a higher oxide of chlorine, viz., perchloric acid and oxygen. In fact, its most marked property is the facility with which it parts with its oxygen. For this reason it is a most powerful oxidising agent. A few drops allowed to fall on a piece of paper cause it to ignite, owing to the rapidity with which oxidation takes place (see paragraph 80). In contact with metallic oxides, chloric acid gives rise to a metallic chlorate and water; thus:—

$$M_2'O'' + 2\,H'Cl'O_3'' = 2M'Cl'O_3'' + H_2O.$$

The chlorates are all soluble in water; and on heated split up, as we have already seen (87), into oxygen and a chloride, thus:—

$$M'Cl'O_3'' = M'Cl' + 3O''.$$

Hence potassium chlorate is a most convenient source of oxygen.

115.—PREPARATION.—On passing a current of chlorine through a solution of potash or soda, or through a stratum of slaked lime, *if the temperature be kept low*, a mixture of a chloride and a hypochlorite is produced (see 103), but if the temperature is high, or the resulting compounds be afterwards heated, no hypochlorite is formed (as the hypochlorites are all decomposed by heat) but a chlorate of sodium, potassium, or calcium, as the case may be, mixed with a corresponding chloride. The resulting chlorides, being much more soluble in water than the chlorates, remain in the mother liquor[6] on allowing the solution to crystallise.

From the potassium chlorate $K'Cl'O_3''$, chloric acid may be easily obtained, by dissolving it in water and allowing a body called hydrofluosilicic acid $H_2Si''''F_6'$ to act upon it; when a substitution of the potassium in the chlorate for the hydrogen in the acid takes place, and chloric acid, together with potassium silico-fluoride, are the results, thus:—

$$2K'Cl'O_3'' + H_2'Si''''F_6' = K_2'Si''''F_6' + 2H'Cl'O_3''.$$

The silico-fluoride is insoluble in the resulting chloric acid, hence it may be separated from it by filtration through asbestos, or by decantation.

By treating barium chlorate with sulphuric acid this latter seizes on the barium and liberates the chloric acid. The chlorate must be dissolved in water, and the sulphuric acid (previously diluted and cooled) added gradually as long as a precipitate of barium sulphate is formed: this is separated as in the previous case. The interchanges which take place may be expressed as follows:—

$$Ba''2Cl'O_3'' + H_2'S''O_4'' = Ba''S''O_4'' + 2H'Cl'O_3''.$$

In both these processes, the resulting chloric acid contains a quantity of water, which may be *partially* removed by careful evaporation under the receiver of an air pump, under which sulphuric acid is also placed to absorb moisture. The molecular constitution of chloric acid may be represented graphically thus:—

However, as chloric acid has never been obtained in the state of vapour, this must not be taken as certain: all we know is, that for every atom of chlorine in this compound there are three atoms of oxygen and one of hydrogen. Hydrogen chlorate, or chloric acid, was first isolated by Gay-Lussac.

E. CHLORINE HEPTOXIDE.—*Synonym: Perchloric Anhydride.*[7] *Symbol:* $Cl_2'O_7''$ (?). *Molecular weight:* 183 (?)

116.—This body has not been obtained in the free state. Combined with the elements of water, it forms the compound known as perchloric acid, or hydrogen perchlorate, to which it is related in the same manner as the other anhydrides are to their respective acids.

E (2). PERCHLORIC ACID. *Synonym: Hydrogen Perchlorate.*[8] *Symbol:* $H'Cl'O_4''$. *Combining weight:* 100·5.

117.—PROPERTIES.—Perchloric acid, the most stable of the oxy-acids of chlorine, is, when pure a syrupy, transparent, and colourless fluid, which has been cooled to − 31° Fahr., without solidifying. It is very volatile, and fumes when exposed to the air, owing to its powerful affinity for water. Its specific gravity at the ordinary temperature is 1·782. The readiness with which it parts with its oxygen when in presence of oxidisable bodies causes it to be one of the most powerful oxidising agents known. A drop allowed to fall on any combustible, such as wood, paper, charcoal, &c., produces combustion with explosive violence. Like most acids, it reddens litmus[9] paper; but it possesses no bleaching properties. It combines with water to form a white solid crystalline hydrate, which melts at 122° Fahr. The composition of this hydrate is $H'Cl'O_4'' + H_2'O''$. This hydrate is almost as powerful an oxidising agent as perchloric acid itself. If these crystals be dissolved in water, they form a solution which resembles very much the pure acid, being like it of an oily aspect; it boils at the constant temperature of 392° Fahr. This solution contains 72·3 per cent. of real acid, which corresponds to the formula, $9H'Cl'O_4'' + 19H_2'O''$.[10] In combination with metals, perchloric acid forms a series of compounds called perchlorates, the general formula of which is $M'Cl'O_4''$. As in all other cases where an acid acts on a metal, hydrogen is evolved, and replaced by the metal, thus—

$$H'Cl'O_4'' + M' = M'Cl'O_4'' + H'.$$

The valency of an acid can always be measured by the amount of replaceable hydrogen contained in its molecule. Hence perchloric acid is monovalent, as its molecule contains but one atom of replaceable hydrogen; it can, however, combine with a bivalent metal, but in this case two molecules are required to saturate the bivalency of the metal, thus—

$$M'' + 2H'Cl'O_4 = M''{<}^{Cl'O_4''}_{Cl'O_4''} = 2H'.$$

When perchloric anhydride unites with water to form perchloric acid, the following interchanges are supposed to ensue—

$$Cl_2'O_7'' + H_2'O'' = H'Cl'O_4' + H'Cl'O_4',$$

or, in words, one molecule of water, and one of perchloric anhydride, give rise to two molecules of perchloric acid, or hydrogen perchlorate.

118.—PREPARATION.—Three processes will be described:—1st. By boiling a solution of chloric acid it is converted into water, chloric oxide gas (which escapes), and perchloric acid, thus:—

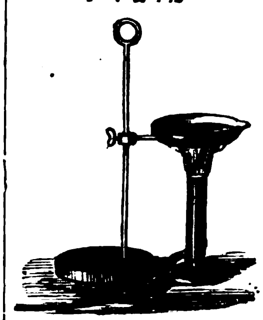
$$3H'Cl'O_3'' = H_2'O'' + Cl_2'O_4'' + H'Cl'O_4''.$$

2nd. On heating potassium chlorate it melts, and if kept in gentle ebullition, without raising the temperature, it gives off oxygen. After some time the fluid mass begins to thicken, and at last assumes a dough-like consistence. If the heat be withdrawn at this point, the mass is found to be a mixture of chloride, chlorate, and *perchlorate* of potassium. On treating this mixture with hydrochloric acid, the chlorate is decomposed, while the perchlorate remains unchanged; washing with a small quantity of water removes the chloride, which is very soluble in water, while the almost insoluble perchlorate remains behind. From potassium percholate perchloric acid may be obtained by distilling it with sulphuric acid, which seizes on the potassium, setting free the perchloric anhydride, which instantly unites with the liberated hydrogen of the sulphuric acid to form perchloric acid, thus:—

$$2K'Cl'O'' + H_2'S''O_4'' = K_2'S''O_4'' + 2H'Cl'O_4''.$$

3rd. Potassium perchlorate may also be prepared by adding well-dried and finely-powdered potassium chlorate, in small portions at a time, to an equal weight of sulphuric acid, and gently warming in an evaporating dish (Fig. 10). The sulphuric acid first liberates the chloric acid from the chlorate; but this is immediately decomposed by heat, and converted into hydrogen, chloride tetroxide, and perchloric acid, which combines with part of the potassium, thus:—

FIG. 10

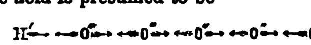


$$6K'Cl'O_3'' + H_2'S''O_4'' = 3K_2'S''O_4'' + 6H'Cl'O_3'',$$

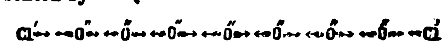
and then

$$3K_2'S''O_4'' + 6H'Cl'O_3'' = 3H'K'S''O_4'' + 3H' + 3Cl'O_2'' + 3K'Cl'O_4.$$

The compound of sulphuric acid with potassium is readily soluble in water, which is, therefore, used to remove it, leaving undissolved the perchlorate. From this the acid may be obtained as above, or the potassium may be removed by hydrofluosilicic acid, as recommended for chloric acid (115). The molecular constitution of perchloric acid is presumed to be



while that of chlorine heptoxide may be represented by



SOUND WAVES.

M. A. M. MAYER, in a note communicated to the Académie des Sciences, gives an account of certain experiments made by him with reference to alteration in wave length produced from a motion of translation in the sounding body:—Having procured, he says, four tuning forks, fixed to sounding cases, and giving the note $Ut^3 = 256$ complete vibrations per second, I numbered them 1, 2, 3, and 4. I brought Nos. 1 and 2 to perfect unison, by a method to be described. No. 1 was placed before a magic lantern; a little ball of good cork, 6mm. in diameter, was suspended by a silk thread against one of its prongs; the images of fork and ball were projected on a screen. No. 3 had a little wax attached to one of its prongs, so that it gave two beats in a second with No. 1 or No. 2. No. 4 had its extremities filed, and also gave two beats per second with No. 1 or No. 2. Thus No. 4 gave 2 vibrations per second *more* than No. 1, while No. 3 gave 2 vibrations *less*. The following were the experiments:—

EXPERIMENT 1.—Fork No. 2, attached to its case, and held in the hand, is put in vibration at a distance of 30ft. to 60ft. from No. 1 (projected on the screen as above mentioned.) The ball is driven from the prong of No. 1, which vibrates in unison with No. 2.

EXPERIMENT 2.—I placed myself at a distance of 30ft. from No. 1, holding fork No. 2 in one hand and its case in the other. I then set the fork vibrating and moved rapidly towards No. 1. When my movement had become uniform I placed the fork on its case, and did not remove it till just before stopping. Although I came to about a foot distance from No. 1, the ball continued in contact with the prong.

[4] Chloric acid. Barff., 1871.

[5] Hydric chlorate. 1871.

[6] Mother liquor, a term used to denote a solution which has furnished crystals.

[7] Perchloric acid. 1871.

[8] Hydric perchlorate. 1871.

[9] Litmus, a vegetable blue, prepared from a lichen, commonly called orchil.

[10] Roscoe doubts the truth of this being a definite compound.

Experiment 3.—I again approach fork No. 1, as in Experiment 2, but without removing the fork from its case after having attached it. The ball did not move till I stopped. At that moment my assistant, who held his ear near the case, while he watched the screen, noticed No. 1 fork vibrate and the cork leap from it.

Experiments 4 and 5.—I moved away from No. 1 instead of towards it. Results the same as in Experiments 2 and 3.

Experiment 6.—I set No. 3 vibrating as in Experiment 1, this fork making 254 vibrations per second. The ball did not move. Then I removed the fork from its case, and placing myself 30ft. from No. 1, I swung the case in my hand towards No. 1 at a quickness of 8ft. to 9ft. per second, and, while making this forward motion, I put No. 3 above the case. The ball was suddenly thrown from No. 1. When the motion of the case was increased or diminished the vibrations of No. 3 did not affect No. 1.

Experiment 7.—Fork No. 4, which made two vibrations per second more than No. 1, was substituted for that employed in Experiment 6, but placed on the case in its backward movement from No. 1. The results were the same as in Experiment 6.

Experiment 8.—I placed No. 3 before the lantern, and swung No. 1 as in Experiment 7, with the same result.

Experiment 9.—I placed No. 4 before the lantern, and swung No. 1 as in Experiment 6, with the same result as in Experiment 6.

By these simple experiments I have been able to prove the change in wave-length produced by the translation of the vibrating body. By analogy they perfectly explain the modern method of determining the motions of a celestial body by variations in the refrangibilities of its ray's motions, which it is often impossible to ascertain by any other means. It may be useful to offer some remarks on the details of these experiments, which must be attended to in order to succeed.

The forks 1 and 2 must be really in unison. It may happen that two forks vibrating together give no appreciable beats, and are constrained into giving the same number of vibrations per second; while, by making them vibrate separately, the equality is destroyed. I adopt the following method. Having taken three forks, warranted to make the same number of vibrations in a given time, I load one of them so that it gives two or three beats per second with one of the other two which I wish to bring into complete unison. I determine the interval of time between twenty or thirty of these beats by a chronograph. I then determine the interval between the same number of beats with the second fork; and if it is different from that obtained with the first, I attach wax to the more rapidly vibrating fork till it makes the same number of beats as the slower. Having thus adjusted the forks, I have had no difficulty in Experiment 1 at 60ft., and believe the effects would be the same at 100ft. The cork ball should be spherical, and should not do more than touch the fork. It is advisable to varnish the ball. A machine has been invented by which one can communicate a uniform motion of translation to the forks. A small mirror held between two vertical threads may be substituted for the cork ball, giving very delicate indications by the motion of a reflected ray.

The fork No. 1 makes 256 complete vibrations per second; while No. 3 makes 254, thus giving for wave lengths, 4·367ft. and 4·401ft. respectively, reckoning the velocity of sound at 1,118ft. per second.

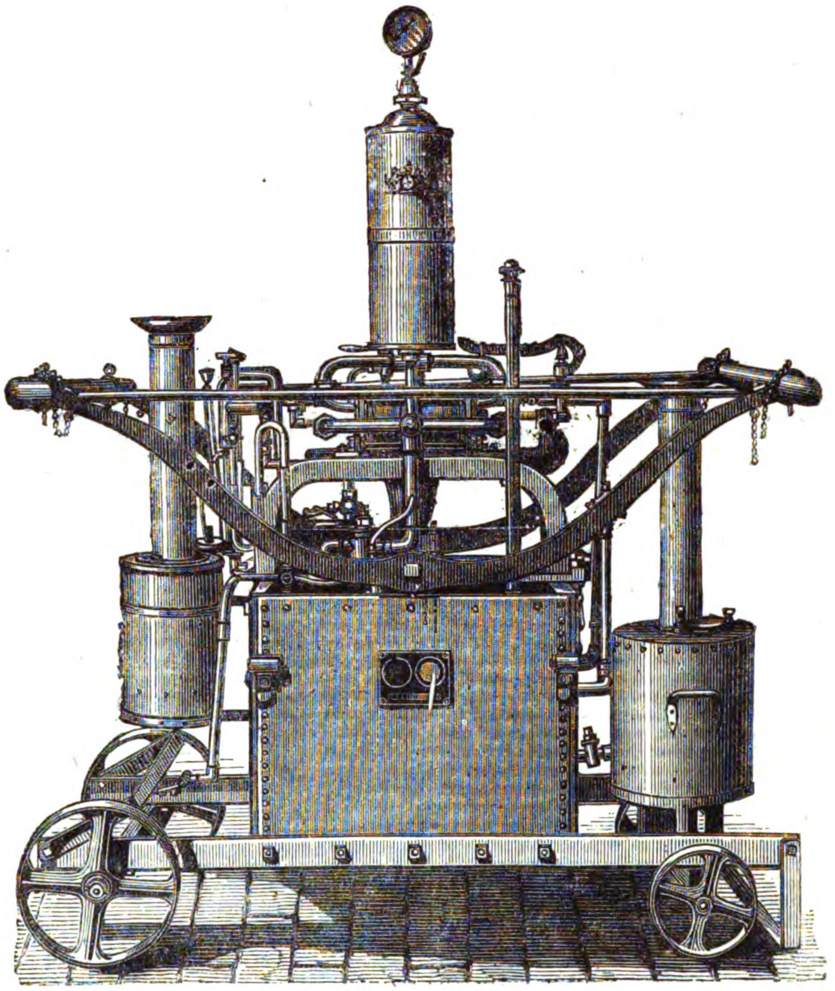
M. Mayer then proves that 256 vibrations of a fixed body will produce the same effect on a distant surface as 254 vibrations of a body which approaches the surface with a speed of 2λ, or twice the wave length of the No. 1 fork—*i.e.*, 8·734ft. per second, which was the speed given to the fork in Experiment 6.

Take next the case of light. Suppose that the fork No. 1, which makes 256 vibrations per second, made 595 millions of millions of vibrations, the number belonging to ray D in the spectrum. Then the fork No. 3 will represent 590 millions of millions of vibrations per second, which will give us a wave length ·0000042 mm., greater than that of D, and which nearly corresponds to a line of iron situated 43 divisions above D, in Angström's map.

We have seen that the fork No. 3, giving 254 vibrations per second, must approach the ear with a speed of 8·734 feet to produce the note belonging to 256 vibrations per second from a fixed point; in the same way the light of a star whose ray vibrates 590 millions of millions of times should reach the eye with a velocity of 28470 per second to give the colour produced when the ray D comes from a stationary flame. A. M. B.

A NEW FIRE-ENGINE.

THE annexed diagram is an illustration of a fire-engine on an entirely new principle patented by Mr. Thomas Atkins, the main features of which will be gathered from the following description. In the trials made recently at Welwyn very satisfactory results were obtained, a fire made of faggots smothered with tar being brought completely under control for an hour, and finally extinguished when its purpose was served, at an expenditure of two and a half gallons of water. The principle of the invention consists in charging the water used with carbonic acid and nitrogen, but its chief novelty lies in the remarkably cheap method of obtaining the carbonic acid, which is made by drawing the atmospheric air through a charcoal fire and forcing it into a tank containing



water. This tank is 2ft. 6in. long by 2ft. wide, and 2ft. deep. The vacuum chamber, which connects the pump with the water to be used in the tank is 1ft. in diameter and 2ft. deep. The pump is 4in. in diameter, double action, 10-in. stroke. On the left hand side is a small stove, with a pierced ring in its interior; this stove is 9in. in diameter and 14in. deep, with a ventilator in the bottom for admitting air to the stove, and a door and frame fitted air-tight to the top, 3in. in the clear, to admit fuel. A small pipe runs from the stove about 18in. high. Half way up the pipe is a small pulse-valve for preventing back action from the pumps in case of leakage, and so adjusted as to work in harmony with a foot-valve in the vacuum chamber that supplies the water to the pump. Between the pulse-valve and the vacuum chamber are two adjusting cocks for regulating in exact proportions the supply of gas and water. A combination of mineral, animal, and vegetable charcoal is used, and when the pump is set in motion and a light applied, in one minute the stove is in full action. The gases being blown through the air vessel on the top are wasted for a minute or two, the apparatus connecting the water and gas cocks is then adjusted, and the machine is ready for use, two minutes being ample for bringing it into full operation. The three-way cock on the delivery nozzle is shut off, and the pressure in the air or gas chamber, shown by the gauge on the top or on the tank, is brought up to 150lb. on the square inch. A pipe of any convenient length, and about 1in. in diameter, is then connected with the machine, and on the end of the pipe a discharging nozzle is attached capable of furnishing a single jet, a spray, or a fine mist. On the inside of the discharging nozzle a pressure gauge is fixed, so that the fireman may keep the point of discharge at 150lb. pressure on the square inch.

According to the inventor, the gases generated and poured into a glass 6in. long, at the pressure before-mentioned, are retained in the water for several minutes, and when thrown upon the fire sink to a temperature of from 40° to 50° Fahr. One cubic foot of this fluid discharged upon any burning pile is capable of doing as much execution in extinguishing fire as 50 cubic feet of water from an ordinary fire-engine, and in one-twentieth part of the time now occupied, while the results are said to be unfailing.

Under the arrangements proposed by the inventor, fire-engines will, he thinks, be of little use, as new conditions will be submitted entirely altering our present notions of dealing with fire. A large skeleton map of London is being prepared, indicating 2,500 receivers or store vessels. These may be fixed in cellars, under pavements, or in warehouses. The contents of such vessels will vary from 150 to 1,000 gallons of water charged with carbonic acid. Pipes, valves, and all necessary apparatus will be attached to these stores, which may be instantly brought into operation, and a fire extinguished by merely turning on a tap and allowing the water to fill the building in the form of spray.

Another important point is the capability of the invention to instantly depolarise vast quantities of sulphurous vapours, carbonic acid gas, carburetted hydrogen, and sulphuretted carburetted hydrogen. A delivery jet of ½in. in diameter is said to be capable of instantly extinguishing and depolarising carburetted hydrogen from a 2ft. main, working at 3in. pressure from the gasometer. Arrangements may be made in coal-pits, mines, caverns, cellars, tunnels, ships, and subterranean railways, for instantly rendering the air pure and healthy. Numerous uses are claimed for this invention. For instance, it may be utilised for softening water, for brewing and dyeing, and particularly for preventing incrustations in steam-boilers.

The inventor also points out that in buildings containing a store-vessel or receiver the whole of the gas-fittings may be used to distribute the charged water, by simply fitting on a pulse-valve here and there which would yield to a pressure greater than that of the coal-gas, and a connection being made between the gas-pipes and the receiver about one or two feet from the meter tap, the "spray" would be conveyed into every room in the building, and the fire extinguished by the carbonic acid gas liberated. The trials hitherto have given encouraging results, and as a company is formed to construct the engines, which will be worked by the London Volunteer Fire Brigade, the invention will be judged by its performance in an actual fire. Those of our readers who have witnessed the powerlessness of plain water in the fierce heat of a raging fire will readily appreciate the utility of carbonic acid cheaply and conveniently thrown upon the flames. Further information on the subject may be obtained of Mr. E. W. Allen, of Ave Maria-lane, E.C., who, we believe, will be happy to explain the invention and give particulars as to the steps which are being taken to introduce it.

INDUSTRIAL USES OF MAGNESIA.

THE oxide of magnesium is a native dark green, glassy, hard, anhydrous oxide, found in rocks under the name of periclase, but is rarely of sufficiently pure water to be of use as a precious stone; a hydrated oxide occurs as the mineral brucite, from which is prepared a valuable cement, and the pure oxide for other purposes. A common way to prepare the oxide is also to heat the carbonate. The uses of the oxide of magnesium have latterly been considerably extended, and it is well to make note of them. Professor Henry St. Claire Deville, of Paris, exposed a piece of caustic magnesia to the influence of a stream of running water, and after the lapse of a few months found that it had become hard like alabaster; he left it in the same position and re-examined it after seven years, and found that it had not in the least deteriorated, but, if anything, had become still harder. An analysis showed it to be nearly pure hydrate of magnesia, similar to the mineral brucite. Deville then stirred up pure caustic magnesia into a paste with water, and sealed it in a glass tube. In a few weeks this also became transparent, and proved, after analysis, to be a pure hydrate, containing 69·3 per cent. magnesia and 30·7 per cent. water. These results instigated Deville to pursue the subject further, and also to hand the matter over to manufacturers of cements. He found that a mixture of magnesia and sulphate of lime did not harden under water, but that magnesia and pulverised chalk or marble dust, when exposed for some time to the action of water, form a hard stone, similar to artificial marble. The magnesia which yielded the hardest mass was that prepared by heating the chloride of magnesium obtained from the bittern of salt water. The heat must not be raised to redness, as the hydraulic properties of the magnesia are diminished by too high a temperature. An important result was obtained from dolomite or magnesian limestone. This is a double carbonate of lime and magnesia, and when heated to below redness, pulverised and mixed with water, yields under water a mass of extraordinary hardness. If magnesian limestone be heated to whiteness, so as to expel all of the carbonic acid, it will no longer set under water; in other words, it loses its hydraulic property when both constituents are deprived of their carbonic acid. The lime of the mineral must retain its carbonic acid, while the heat is raised sufficiently to expel the carbonic acid from the magnesia. The result is an intimate mixture of caustic magnesia and carbonate of lime (marble), which yields a cement that hardens equally well under fresh and salt water, and appears to be admirably adapted to the manufacture of artificial building-stone. The late M. Sorel modified Deville's process by mixing caustic magnesia with chloride of magnesium; the latter ingredient can be substituted by other chlorides, but as the magnesium chloride is a waste product it is better to employ it. The caustic magnesia is stirred into a concentrated solution of chloride of magnesium, and the more concentrated the solution is, the harder will be the cement. This cement becomes perfectly white and very hard. It can be poured into moulds, the same as plaster of Paris, and as any colour can be mixed with it, it can be used for the repair of different kinds of building-stones, as well as in the imitation of a variety of fancy articles. It serves a good purpose as a coating for soft limestone or plaster casts, and for this purpose may be applied with a brush. The cement made by dissolving calcined magnesia in chloride of magnesium is employed as the basis of the manufacture of artificial stone in Boston: by mixing the prepared cement with sand, a peculiar brick is formed; by employing flint, whetstones and hones are made; with kaolin, ornaments of all kinds, statuettes, imitation porcelain, &c., are produced; with sawdust, it gives a good material for covering floors; with carbonate of lime, imitations of marble. Whether it is preferable to use Sorel's method of caustic magnesia and chloride of magnesium, or to adopt the plan proposed by Deville, and make an intimate mixture of carbonate of lime and caustic magnesia, must largely depend upon the cost of the material.

THE MANAGEMENT OF BEES.

THE method of treating bees adopted by the Americans often affords a hint to bee-masters in the old country; we therefore reproduce the following remarks from the *Rural New Yorker*:—

There is no arrangement of a hive that can compensate for the lack of movable frames, and the more simple in construction the better. We prefer a two-story hive, where the honey extractor is employed to obtain surplus honey. But if the one-story hive be preferred, make the hives large enough to contain two or three extra frames upon each side. Honey can be extracted from the brood combs; but great care must be used, or the unsealed brood will be thrown out of the cells. We deem the honey extractor to be of great value, and every apiarian should have one of his own. Oftentimes the hive will contain too much honey, not giving the queen a chance to lay sufficiently to keep up the strength of the colony. Hence the reason why we so often hear the complaint in the fall of the year, "too few bees and too much honey." The reason why so many bee-keepers find, in the spring, that their bees have died leaving plenty of honey in the hive is attributable to the same cause. Bees, to winter in good condition, must have empty cells to cluster in at the commencement of cold weather; and in very many cases we can accomplish this in no other way than to empty some of the centre combs with the extractor. In fact, we consider the honey extractor to be of equal importance to a successful and profitable prosecution of bee-keeping with the movable comb frame; and we should speedily abandon all hope of making this pursuit a remunerative one were it not for these two all-important aids.

Many bee-keepers have complained that dysentery is destroying their bees, in many instances threatening the total destruction of whole apiaries. In this, as in some other cases, we think a little prevention to be far better than a great deal of cure. There are two principal causes of this disease (if it may be called a disease), the first and most important of which is insufficient ventilation. In some seasons the honey gathered by the bees is of a poor quality, being thin and watery; this is especially true of a very wet season. Now, when a considerable quantity of such honey is stored in the hive at once, it is very liable to ferment and sour, before it thickens sufficiently to be sealed over by the bees, especially during a warm and moist spell of weather, unless the hive has ample facilities for thorough ventilation. Again, if the hive is not properly ventilated in the winter season, frost will accumulate upon its walls and the combs; and when this melts the combs will oftentimes be drenched with moisture.

Should there be any considerable quantity of unsealed honey at such a time it will absorb a part of the moisture, rendering the honey thin and watery. The direct cause of this complaint is the consumption of such honey by the bees; and we believe that ninety-nine cases out of a hundred originate from improper or insufficient ventilation. The bees are compelled, or do at least, consume greater quantities of honey than they ought, and are compelled to discharge their fæces in their hives. We have seen combs of such stocks that were literally besmeared with this offensive smelling excrement of the bees. Our advice to all would be, ventilate your hives properly and thoroughly, and you will have little or no trouble from this source.

SURFACE ELECTRICITY.

IT is well known that Faraday made numerous experiments upon this subject, and has varied, under different forms, that which Coulomb has realised with the hollow sphere and its two covers. It is still under this form, the least commodious, that this experiment is repeated in the lecture-room. If the loss is considerable on the day when this experiment is performed, it ceases to be sufficiently conclusive; for it requires, first, to electrify the sphere alone; second, to recover it rapidly with its two covers; third, to take them off; fourth, to prove that these covers are electrified; and, fifth, that the sphere is not. The second operation cannot be executed with great rapidity on account of the form of the covers. Amongst other experiments Faraday has made the following:—He took a cylinder made of metallic gauze placed upon an insulated horizontal metallic disc, the design being to afford proof that the exterior is alone electrified. An animal, such as a mouse, placed in the interior, showed no commotion, even when the whole apparatus was electrified so strongly that bright sparks might be obtained from it.

Faraday did more, he constructed a cubical chamber 12ft. on each side, with laths; the walls were of wire gauze and of paper, and the whole chamber was suspended by means of silken ropes. The chamber, even the interior, could be electrified strongly on connecting it with an electric machine. Faraday inclosed himself in this chamber with electroscopes and various other apparatus, but he failed to find the least trace of electricity, whilst the walls were so strongly electrified that vivid sparks were obtained from the outside, and "brushes" escaped spontaneously.

M. Terquem has endeavoured to repeat this experiment in his lectures, on a small scale, in the following manner. He took any form of bird-cage, whether of wood and iron wire, or entirely of metal, and suspended it to some insulated conductor in communication with the electric machine. Inside the cage was placed a gold-leaf electroscope, and also pieces of tinsel, the feather of a quill, and pith balls. Whilst it was possible to obtain vivid sparks from the cage nothing moved in the interior. Within the cage was suspended a bundle of linen yarn, and underneath the cage a similar bundle; the interior bundle remained undisturbed, whilst the exterior was greatly excited and electrified, all the bits of yarn spreading out, and on approaching the hand the peculiar crackling due to electricity was heard.

Bands of paper being stuck along the length of the wires of the cage, the exterior bands would twist strongly, and get displaced, whilst the interior remained vertical and unmoved when the cage was electrified. To complete the experiment, a bird might be placed inside the cage, and by his singing and general demeanour prove that he was not only completely indifferent to the phenomenon of electrical charge and discharge, but that behaving so proved that the interior of the cage was perfectly free from all electrical phenomena, whilst the exterior alone was susceptible to the electrical influences.

We quite agree, says *Engineering*, with M. Terquem, that this experiment is very simple, full of proof, very easy indeed to prove, and, above all, requires neither complicated nor costly apparatus, and is one that might be frequently introduced into the lecture room as a proof of one of the most interesting points in electricity.

THE DECOMPOSITION OF WATER BY ZINC.

THE decomposition of water by zinc in conjunction with a more negative metal was the subject of a paper presented to the Royal Society, by Dr. J. H. Gladstone and Mr. A. Tribe, F.C.S. According to the authors, pure zinc is incapable of decomposing pure water, even at 100° C., but at a considerably higher temperature it is known to combine with its oxygen. Davy exposed pure water for two days to the action of a pile of silver and zinc plates, separated only by pasteboard, without obtaining any hydrogen; Buff, however, had shown that a very minute trace of gas can be formed at the ordinary temperature by a pair of zinc and platinum plates. By bringing the metals closer together, and thus increasing the electrical tension of the liquid, the authors could effect the same combination of zinc with oxygen at the ordinary temperature which takes place without the second metal at a very high temperature. On thin sheets of zinc and copper being hammered together, and placed in a bottle filled with distilled water, small bubbles of gas were formed; the same result obtained when the experiment was tried in a more perfect form. Under the microscope the bubbles of gas are seen to form, not on the zinc, but among the copper crystals, and sometimes to make their appearance on the glass at some distance off. Lest it might be contended that the free oxygen usually present in distilled water had been the means of starting this action, the experiment was repeated with water as free from oxygen as could be obtained by boiling. Iron and lead, under similar circumstances, also decomposed pure water, and the action of magnesium was greatly increased by conjunction with copper. The effect of the more negative metal was the same as would have been produced by an increase of heat. From a practical point of view this experiment may serve as a ready means of preparing pure hydrogen; from a theoretical point of view its interest seems to lie in the fact that the dissociation of a binary compound by means of two metals may take place at infinitesimally short distances, when it would not take place were the layer of liquid enough to offer resistance to the current, and also in the correlation between this force and heat.

PSYCHIC FORCE—SPIRIT FACES.

THE following is clipped from the last number of the *Scientific American*:—One of the marvels of spirit jugglery, or "psychic force" as the learned Dr. Crookes denominates it, is the production of images of human forms, hands, arms, faces, &c., which are seen by the observers to float around in the air. In some cases, the faces have been recognised as those of departed friends by sitters in spiritual circles. Quite a thriving business is done in this city by professors of the art; but some queer revelations have lately been made. One Gordon carried on a spirit establishment and was doing a profitable business, at 50 cents. a head, until his partner, the business manager, in a quarrel peached on him, and revealed to the public how the thing was done. Professor Gordon, it appears, dressed in the paraphernalia of a high priest, appears before his audience, turns down the lights, and then by means of strings and bands manipulates a series of large lithographic coloured pictures of faces, causing the pictures to rise from behind an altar, float and sway in the air. These pictures represent females, children, and men, and in the dim twilight are from time to time pronounced, by this or that person in the audience, to be the spirit faces of their departed friends. Only a small stock of pictures is required to produce these supernatural effects.

A higher priced professor of this mystic art is one Slade, who until recently has confined his spirits to the more commonplace dodges of spirit-writing on slates, rapping, table lifting, accordeon playing, knife throwing, &c. His circles are more select, generally only two admitted at a time to the performance; tickets 3 dols. each. Lately he has added the spirit face business and raised the price to 5 dols. An intelligent friend of ours, who visited the show, pronounces the faces to be those of genuine spirits, and regards the whole performance as most astonishing. He came away completely converted to the doctrine of the bodily presence and power of the spirits. *Per contra*, the New York *Sun* recently published an *exposé* of Slade's manipulations, as derived from a member of his own household. The faces are produced behind a black curtain, and make their appearance before a small opening in the same. Slade employs a stock of masks and pictures, which he works by means of threads, making them rise and appear before the opening, the gas being turned down so as give a dim sepulchral effect. How it is that any intelligent person can be brought to attribute these tricks to spiritual agency passes comprehension.

THE INFLUENCE OF THE PLANETS UPON SOLAR ACTIVITY.

AT a recent meeting of the Royal Society Messrs. De La Rue, Balfour Stewart, and Loewy presented a memoir containing the results of further investigations into this matter. In previous memoirs they pointed out that the behaviour of sun-spots with regard to increase and diminution, as they pass across the sun's visible disc, is not altogether of an arbitrary nature. It has been supposed that during a period of several months sun-spots will, on the whole, attain their minimum of size at the centre of the disc. They will then alter their behaviour so as, on the whole, to diminish during the whole time of their passage across the disc: thirdly, their behaviour will be such that they reach a maximum at the centre; and lastly, they will be found to increase in size during their whole passage across the disc. These various types of behaviour appeared to the observers always to follow one another in the above order; and in a paper printed for private circulation in 1866 the authors discussed the matter at considerable length, after having carefully measured the area of each of the groups observed by Carrington, in order to increase the accuracy of their results. In the present instance nineteen or twenty months were obtained as the approximate value of the period of recurrence of the same behaviour. The observations extend from the beginning of 1854 to the end of 1860, forming the series of Carrington; the Kew series commenced in 1866. There is, then, nearly a continuous series of observations. The behaviour, with regard to size, of the various groups as each passes from left to right across the sun's visible disc is discussed in this memoir.

The average behaviour of spots, as far as can be judged from the information at present attainable, is not quite symmetrical as regards the centre of the disc. Without attempting at present to enter into an explanation of this remarkable phenomenon, the authors point to it as a confirmation of their view that most spots are accompanied by a wall-shaped surrounding of facula. Observations show that, on the whole, the life-history of the facula begins and ends earlier than that of the spot which it surrounds, and that throughout a gradual subsidence of this elevated mural appendage seems to be taking place. But such a diminution of the wall discloses more of the spot itself, and hence the spot areas, measured on the eastern half of the hemisphere, might be expected, *cæteris paribus*, to be smaller than those observed in the western half. In order to investigate the causes or concomitants of a departure from the average behaviour of spots, the whole mass of observations is divided into four portions, depending upon the position of a planet, and the planets chosen are Venus, Mercury, and Jupiter. If the results are examined it will be found that in the cases of Venus and Mercury there are indications of a behaviour of sun-spots appearing to have reference to the positions of these planets. This behaviour may be characterised as follows:—The average size of a spot would appear to attain its maximum on that side of the sun which is turned away from Venus or from Mercury, and to have its minimum in the neighbourhood of Venus or of Mercury.

The authors leave it for others to remark upon the nature and strength of the evidence now deduced as to a connection of some sort between the behaviour of sun-spots and the positions of the planets Venus and Mercury. They think, however, it must be allowed that the investigation is one of interest and importance; and they trust that arrangements may be made for the systematic continuance of solar observations in such localities as will insure a daily picture of the sun's disc. The influence of blank days in diminishing the value of a series of sun observations is very manifest. The behaviour across the sun's disc of 421 groups of Carrington's series out of a total number of 885 groups has been recorded; the same for 373 out of 544 groups observed at Kew. Thus, out of a total of 1,429 groups, the record only contains the behaviour of 794. Blank days necessitate interpolations. It is, therefore, of much importance for the future of such researches that there should be several observing stations so placed as to insure the daily record. These are not experiments that can be multiplied *ad libitum*; for in this case Nature gives us in a year or in ten years a certain amount of information, and no more, while it depends upon ourselves to make a good use of the information which she affords. It is already universally acknowledged that we ought to make the best possible use of the few precious moments of a total eclipse; but such observations must necessarily be incomplete unless they are followed up by the equally important if more laborious task of recording the sun's surface from day to day.

ACTION OF HEAT AND VARIOUS CHEMICAL AGENTS ON THE PRIMITIVE FORMS OF LIFE.*

DR. CALVERT said that his experiments led him to disbelieve in spontaneous generation; that he had found great difficulty in securing pure water free from germs; but at last he succeeded in preparing it so that it would keep for months without life appearing. He introduced some of this water into small tubes, and placed them near putrid meat; and on opening the tubes from time to time life was observed after twenty days, whereas in the pure distilled water in the flask no life appeared. If the production was spontaneous, why, he asked, did not life appear in the liquid contained in the inclosed flask, as well as in the tubes which had been exposed to the atmosphere? Speaking of the effects of heat, he proceeded to say that he had found that the greater portion of all microscopic life was destroyed by a temperature of 200° Fahr., but that there was one form which survived all temperatures below 300°. He dipped calico in a putrescent solution of albumen, and then submitted it to a temperature of 300°. The calico was softened, but a black opaque vibrio was afterwards found to be as lively as ever. To test the action of various chemical agents, mostly disinfectants, he added the one-thousandth part to one part of a solution of white of egg and four of pure water. In the first series the white of egg solution was quite fresh; in the second it was alive with vibrios. Thirty-eight substances had been experimented on, and special note was made when vibrios, fungi, and odour were first observed:—1. Chloride of lime or bleaching-powder, instead of stopping, actually promoted, the decomposition of the albumen liquid—vibrios were found in great abundance, but no fungi. 2. Sulphate of quinine retarded the production of vibrio life, which appeared on the twenty-sixth day; but even after eighty days there were no fungi. 3. Acids promoted the formation of fungi, particularly the sulphuric and acetic; whilst arsenious acid had no marked effect. 4. Alkalies, on the other hand, promoted the formation of vibrios, and prevented the growth of fungi. Chloride of zinc and bichloride of mercury prevented the formation of vibrios, and fungi were not found before the fifty-third day. 5. Carbolic and chrysolic acids were the only agents which prevented the formation both of vibrios and fungi. 6. Permanganate prevented smell, but had no effect in retarding the production of primitive life. In the second series the albumen solution was putrid and full of life. Sulphuric acid and acetic acid seemed to paralyse the microscopic life, but at the end of twenty-four hours the vibrios recovered, and then fungi began to form rapidly. Soda produced little or no effect. Ammonia and lime promoted the putrescence, and had very little effect on the microscopic life. Chloride of zinc destroyed the greater part of life, and there was no reappearance until after 80 days. Sulpho-carbolate of zinc is nearly as powerful as chloride of zinc, and Dr. Calvert thought it would prove a most convenient and useful disinfectant. Permanganate destroyed the odour, even for eighty days, but life continued most active. Sulphate of quinine did not affect the motion of vibrios. After six days the putrid odour was increased, but no fungi were formed. Picric acid acted in the same way. Charcoal added to the pure albumen prevented the development of smell. Vibrios appeared at the end of six days, fungi at twenty-one days, and putridity at fifty. Added to putrid albumen, the putrid odour was removed, but life was unaffected. Under no circumstances was life entirely destroyed. One part of putrid albumen solution was added to two parts of strong sulphuric acid. There was a great rise of temperature, and yet the black vibrio before noticed was as lively as before.

In the discussion which followed, Dr. Letheby remarked that bleaching-powder acted by supplying oxygen, which was an important agent in the production of life, but it might nevertheless act as a powerful disinfectant. It was most important not to jump to the conclusion that infectious matters were necessarily associated with microscopic life. He could not understand the action of sulphate of quinine, for he had a vivid recollection that decoction of bark was apt to become mouldy.

Dr. Barclay believed that vibrio and fungus life had very little to do with disease. He believed disease arose from putrefactive change in dead animal tissue, and from this, while undergoing a special process of change, being introduced into the living tissue, and superinducing a similar change in the living tissue.

* By Dr. F. Crace Calvert. Delivered before the Association of Medical Officers of Health.

INCREASE OF HEART-DISEASE.

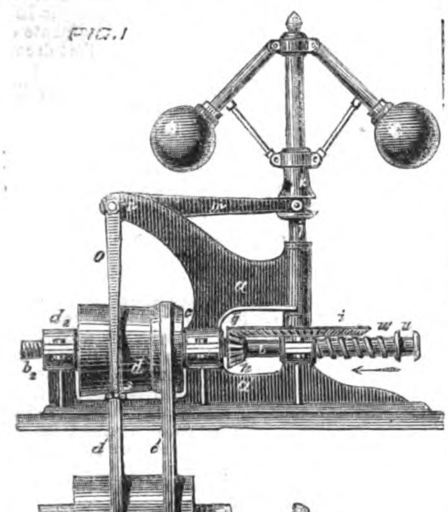
THE tendency of modern investigation into the influence of civilisation on longevity seems to show a twofold series of agencies at work. On the one hand, sanitary improvements and the lessened mortality from epidemics undoubtedly tend to diminish the average death-rates; but, on the other hand, there is practically much less improvement in total death-rates than might be expected if these ameliorating causes were not counterbalanced by the increasing fatality of other classes of disease, such as diseases of the brain and heart. It is important to recognise the precise facts. The excess may, probably, to some extent, be regarded as an unavoidable result of the great mental strain and hurried excitement of these times, in which steam and electricity mark time for us, in an overcrowded community, where competition is carried to the highest point, and where the struggle for existence, not to say for intellectual and other distinction, is carried on with sleepless and exhausting energy. But an evil recognised is sometimes half cured; and the intellectual classes, looking at figures such as those Dr. Quain has displayed at his interesting Lumleian Lectures at the College of Physicians on Diseases of the Walls of the Heart, may well consider the propriety of attending to the hygiene of their lives, as well as of their houses; and to remember that, to enjoy and benefit by even pure air, soil, and water, they must avoid disabling heart and brain by the incessant labours which too often make useful lives joyless, and embitter the harvesting of the crop which has been too diligently shown. These warning figures tell that, during the last 20 years, the total of deaths of males at all ages from heart-disease has increased in number from 5,746 in 1851 to 12,428 in 1870. The percentage of deaths from heart-disease for 1,000 of population living was ·755 between the years 1851 and 1855; it has risen to 1·085 from 1866 to 1870. This increase, it must be observed too, has taken place wholly in connection with the working years of active social life. There is no change in the percentage of deaths from this cause in males under 25 years of age. Between 20 and 45 years of age it has risen from ·553 to ·709, and that almost exclusively in males, for there is almost no increase in the percentage of females dying from heart-disease during the 25 years of life from 21 to 45. These figures convey their own lesson, and warn us to take a little more care not to kill ourselves for the sake of living.—*British Medical Journal.*

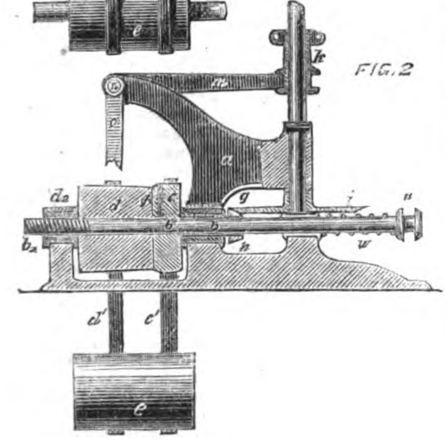
SIMMONDS'S GOVERNOR.

WE subjoin illustrations of an arrangement of governor for steam engines or water wheels, designed by Mr. William Edgar Simmonds, of Hartford, Connecticut. Fig. 1 being a side elevation and Fig. 2 a vertical longitudinal section. In these figures *a* shows the supporting bracket or frame, and *b* the main shaft, on which are two pulleys, *c* and *d*. The latter of these is the frustrum of a cone, whose diameter at the centre of its length is the same as the diameter of the pulley, *c*. Both these pulleys are driven by belts from the drum, ...

is of equal diameter throughout its whole length. These belts are indicated by the letters c^1 d^1. Neither of these pulleys, *c d*, are fast on the shaft, *b*; but the shaft is made to always revolve with the pulley, *c*, by means of a pin, *f*, driven through from the circumference, its inner end projecting into a slot made in one side of the shaft, and extending from the point, b^1, to the end b^*, which, while it serves to make the shaft, *b*, revolve synchronously with the pulley, *c*, yet allows it to move back and forth lengthwise.

From the side of the pulley, *c*, a sleeve, *g*, fitting around the shaft, *b*, and serving as a bearing both for itself and the shaft, extends through the frame, *a*. Upon the side of this sleeve is the small bevel-wheel, *h*, gearing into the horizontal bevel-wheel, *i*, which is fast on the shaft, *j*, to the upper end of which is attached a common ball-governor, actuating the sleeve, *k*. This sleeve moves the arm, *m*, attached to the shaft, *n*, to the opposite end of which is fixed the arm, *o*, attached at its lower end to the fork, *s*, which controls the sidewise movements of the belt, d^1, so that, when the balls of the governor rise, the belt, d^1, will be shifted from the centre of the latter toward that side of the pulley where the diameter is the smallest, and when the balls fall the opposite effect will be produced.





The pulley, *d*, has a sleeve, d^*, upon its side, which serves as a bearing for itself and for the shaft, *b*. Within this sleeve a screw-thread is cut upon the shaft, *b*, which fits in a female screw in the sleeve, d^*. The effect of this arrangement is this:—The ball governor is so adjusted that, at the speed which it is desirable to observe, the sleeve, *k*, will be in the centre of its vertical play, and at this point it should hold the belt, d^1, in the centre of the length of the pulley, *d*, so that it and the pulley, *c*, will revolve synchronously.

Now suppose a greater load to be thrown on the engine, or other motor, the balls will fall, and the belt, d^1, will move toward the large end of the pulley, *d*. This will cause the pulley, *d*, to revolve more slowly than the pulley, *c*, and will cause the shaft, *b*, to move lengthwise in the direction indicated by the arrow, which movement, by means of proper connections, made from the collared groove, *u*, will allow more steam or other motive power to have access to the motor, and this movement will continue till enough of the motive power is admitted to attain the desired speed, when, of course, the belt, d^1, will move back to the centre of the pulley, *d*; but—and this is the important feature of the invention—the shaft, *b*, will not move back toward its first position unless the belt, d^1, moves beyond the centre of the pulley toward the smallest diameter of the latter. When the speed of the governor balls exceeds the desired rate this action will be reversed, and the shaft will move in the opposite direction, and the steam or other motive power will be shut off till the desired speed is again reached; but as before the shaft will not again move toward its first position till the belt, d^1, passes by the centre of the pulley, and toward the large end; so that, however much the power or the load may vary, the governor will immediately adapt itself thereto, and still maintain a uniform rate of speed. The difference between it and the common ball governor is readily explained.

In using the common ball governor no more steam can find access to the cylinder when the load is increased unless the speed slackens, and the balls are thus allowed to drop down, while to give a continuance to extra steam the balls must remain down, and the speed remain decreased; and *vice versa*, when the load is lightened and the speed becomes too much accelerated. In Mr. Simmonds's governor, on the other hand, when the load or the power is varied, the supply of steam is modified until the requisite speed is attained, and the valve is then left at that point till the speed again varies from the desired rate. When the belt, *d*, is running on the centre of the pulley, *d*, which it will do when the balls are running at the desired speed, both the pulleys, *c* and *d*, are running at the same speed, and the shaft, *b*, is stationary so far as its length-wise motion is concerned.

If, by any chance the end, b^*, of the shaft, *b* should move so far out in that direction as to entirely clear the screw from the female thread, then the spiral spring, W, will press the shaft in the opposite direction, so that the screws will again engage when the opportunity is offered. The object of this arrangement is to prevent the valve or gate being operated upon after it is pulled open to its full width, as would be the case if the screw thread on the shaft, *b*, moved continuously. After the valve is open to its full width, to move it further, will of course, be of no use.

Of course, the pulley, *d*, instead of being the frustrum of a cone, might be made of equal diameter throughout, and the drum which drives it might be the frustrum of a cone, and the same purpose would be served.

If, for any reason, it is found desirable to have the difference between the diameters of the cone-pulley anything very considerable, then the same friction—at all times—on the belt can be attained by the use of a small idle pulley. It is not deemed necessary to show how the shaft, *b*, is connected with the valve or gate which controls the inlet of motive power to the engine or wheel, that being a very simple matter to do, the connection being made from the collared groove, *u*. In using this governor on steam-engines it can be connected directly with a stationary cut-off, or be made to control a cut-off which is the steam valve itself, or be made to control the position of the "block" in a "link," or to control any of the valves in use.

According to *Engineering*, one of these governors is at work with most satisfactory results at the Phœnix Works, in Hartford, Connecticut, U.S.A., where the inventor is employed as foreman, and preparations are being made to commence the manufacture on a large scale for the American market.

SPIRAL GRAILING.*

THE operation called "grailing," by which a flat surface of wood or ivory is prepared, previously to being ornamented with the eccentric cutter, drill, or other instrument, is usually performed by cutting a series of fine concentric circles from the circumference to the centre of the work, produced by moving a pointed tool in the slide-rest, say the 150th or 200th of an inch for each cut, until it forms a mere dot in the centre. This is a slow and tedious operation, especially on a piece of work of any size—such, for instance, as the lid of a box four inches in diameter, and unless the greatest care be taken to move the tool the exact distance for each cut, certain circles will catch the eye more than others, and the surface will not have that even, "dead" look, which contrasts so well with the ornamented portions. Moreover, the point of the tool is apt to lose something of its sharpness before the grailing is completed, and thus, again, the surface may lack that evenness of appearance which is its greatest beauty. Many turners are, of course, aware that grailing may be effected by means of a single fine spiral line, running from the circumference to the centre of the work, and some lathes are fitted with the necessary apparatus for doing this; but I think the practice ought to be more generally known than it seems to be, for the trifling addition to the lathe which it requires is within the power of any amateur to make for himself, while there can be no question about the saving of time which it effects, in spite of the minute or two required for putting the bands in position; and the result is in every way satisfactory, the surface presenting a perfectly even, uniform appearance, fully equal, if not superior to ordinary grailing when performed in the most careful manner, and, like it, showing a beautiful play of light as it is moved about in different positions. It is, of course, requisite that the surface should be perfectly flat and even before commencing the cut, and that the tool should be as sharp as possible. This sharpness will be found to be much better maintained during the cutting of one spiral line than when the tool has to cut a considerable number of separate circles. All that is necessary is to connect the screw of the slide-rest with the mandril by a series of bands, in such a manner that the point of the tool will move slowly across the face of the work, while the latter revolves rapidly on the lathe. This may be effected in the following manner.

The usual lathe-band, from the largest groove of the driving wheel of the lathe to the smallest groove of the mandril pulley, gives a rapid motion to the work. A second band passes from the smallest groove of the double-bevelled wheel to the largest on the left-hand pulley of the overhead gear. A third band descends from a *very small* pulley on the overhead spindle to a large one fixed upon one end of the slide-rest screw. This wooden pulley or wheel, as well as the smaller one from which it is driven, any turner may make for himself of box or other wood. It should have a square hole through its centre if it is to be slipped on the square end of the slide-rest screw, which may be done if the overhead gear admits of being pushed sufficiently far back over the bed of the lathe to bring it directly over the right-hand end of the rest as it stands across the lathe-bearers; or, if the slide-rest is adapted for the spiral apparatus, and has a projecting piece at the left-hand end of its screw, the wooden pulley or wheel may be placed on that. In my own case, in consequence of the limited range backwards and forwards of my overhead spindle, which is supported by two uprights rising from either end of the lathe-bed, I was unable to place it directly over either end of my slide-rest, and therefore had to make my large pulley on the larger end of a conical piece of boxwood, hollowed out so as to admit within the hollow about 3in. of the left-hand end of the rest. In this manner I was able to bring the groove of the wooden wheel beneath the overhead spindle. Of course, a simple stout disc of wood with a groove formed on its edge is sufficient, if the end of the rest can be placed immediately below the spindle. Any desired degree of fineness can be given to the grailing by altering the position of the lathe-band. The following are the diameters of the various wheels and pulleys that I use, and find to answer.

Large wheel, about 27in. diameter.
Mandril pulley, about 3¾in. diameter.
"Slow motion" of driving wheel, about 14in. diameter.
Large pulley overhead, about 4in. diameter.
Small pulley, about 1¼in. diameter.
Wooden pulley on slide-rest, about 5¼in. diameter.

These proportions produce grailing as fine as can possibly be required—almost too fine, as it takes good eyes to distinguish the lines at all. By shifting the lathe band to about the centre of the large bevel of the driving wheel and of the mandril pulley, grailing is produced of about the usual degree of fineness. As, from the smallness of the lesser pulley on the overhead spindle, the band might possibly slip upon it should the slide-rest screw work at all stiffly, or the work offer too much resistance to the tool, it is as well, instead of forming its groove of the usual V shape, to leave it of sufficient width to allow of the band, which should be of small catgut, being passed twice round it.

In grailing by the means here described, the tool should be so set as to penetrate no deeper than will suffice just to remove the original surface of the work from between two adjoining coils of the spiral line. If it be set to cut too deeply, the work is apt to be torn by it. The progress of the tool, which must always be from the outer edge or circumference of the work towards the centre, must be carefully watched, and the moment the centre is reached, the tool must be withdrawn quickly. G. C. C.

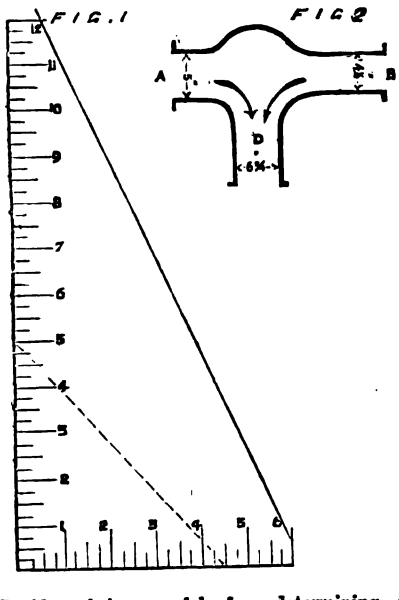
* From *The Quarterly Journal of the Amateur Mechanical Society*.

Brilliant Experiments.—The *American Chemist* reports some lectures on science that appear to have been illustrated with experiments of unexampled brilliancy. President Morton, of the Stevens Institute, in a demonstration of the decomposition of light, produced a rainbow 15ft. in diameter. Professor Barker, of Yale College, in a lecture on the "Chemistry of the Sun," managed by means of the electric light to project upon the screen continuous spectra 20ft. in length, and successfully reversed the sodium line. By some ingenious devices of Professor Morton a representation of a total eclipse of the sun was given, showing the advance of the moon, the crescent sun, Bailey's beads, and, at totality, the outburst of the corona, and the red prominence or solar flames. The formation of the sun flames was further illustrated before the vertical lantern by means of a layer of water, coloured red by carmine, at the bottom of a tank of clear water. The flames were produced by passing electricity through a fine coil of wire in the tank, for on heating the wire the red liquid was carried upward.

THE PROPORTIONS OF PIPES.

ANNEXED is a sketch of a handy little contrivance, designed by Mr. G. Cockburn, of Glasgow, for ascertaining the diameter of a pipe, &c., having a sectional area equal to that of two other pipes, or *vice versa*. The instrument consists simply of a piece of wood or cardboard shaped like a set square, as shown in Fig. 1, or a diagram of the same form drawn on paper, and divided out along the two edges which are at right angles to each other, the divisions being taken to represent inches, feet, or yards, &c., according to the kind of work for which the instrument is used. When employed for determining the equivalent diameters of pipes or bars, inch subdivisions are generally found most convenient.

The mode of using the instrument will be readily understood from an example. Suppose, for instance, that two pipes, A and B (Fig. 2) respectively 5in. and 4½in. in diameter, deliver into a third pipe, D, and it be required to find the proper diameter for the latter pipe. Then from 5 on the scale of one of the divided edges to 4½ on the other draw a line, as shown in Fig. 1, and the length of this line measured with the same scale as that to which the edges are divided will be the diameter of pipe required—in this case 6¾in. On the other hand, if a pipe, D, 6¾in. in diameter, be delivered into a pipe, A, 5in. in diameter, and it was required to know what other size of pipe, B, should also be supplied, all that would be necessary would be to take the division point 5 on one edge as a centre, and with 6¾in. as a radius, describe an arc cutting the other divided edge. The point at which the latter edge was cut by this arc would show the diameter of pipe required.



Besides being useful for determining the diameters of pipes or circles of equivalent areas, the instrument is also available for determining the sides of equivalent squares, while by a little contrivance it can be made available for determining the diameter of a pipe or bar having a sectional area equal to the aggregate sectional areas of any number of other pipes or bars of which the diameters are known. To use it for this purpose it is only necessary, first, to determine by its aid the diameter of pipe or bar equivalent to any two of the whole number, and next to ascertain the equivalent of the diameter thus ascertained, and that of a third pipe or bar, and so on. The arrangement of the instrument is, of course, founded on the fact that the areas of squares and circles increase as the squares of their sides and diameters respectively, and that the square of the hypotheneuse of a right-angled triangle is equal to the sum of the squares of its two sides.

SCIENTIFIC SOCIETIES.

THE METEOROLOGICAL SOCIETY.

AN ordinary meeting of this Society was held on Wednesday, March 20, Dr. J. W. Tripe, President, in the chair.

Thunder Storms.

A paper was read by R. H. Scott, Esq., Director of the Meteorological Office, entitled "Notes on Thunder Storms during the last six years." The author remarked that on the Continent the disastrous effects of thunder and hail storms had given rise to the existence of offices for effecting insurances upon property and stock in the event of the destruction of either by lightning or hail, and while Continental meteorologists were engaged in tracing out the tracks, and ascertaining the principal features of thunder and hail storms, it behoved English meteorologists to be up and doing, so that they might not be left ingloriously behind in the race in which our neighbours were engaged.

The Scottish Meteorological Society had already examined the thunder storms recorded at its stations during twelve years. The storms mentioned in the present paper extended only over half that period, the data having been contributed by fourteen stations connected with the office. The most remarkable results were that London had furnished the greatest number of thunder storms, 84 having been recorded in the metropolis, and that the next large number, 64, had occurred at Valencia, on the west coast of Ireland. The distribution in time of these storms is interesting, the greatest number occurring in July at London, and in January at Valencia. A secondary maximum at Valencia occurred in September. On the contrast between London and Valencia, Mr. Scott remarked that the great winter gales which impinge on Ireland and our western coasts are highly charged with clouds, and he consequently attributes the occurrence of the winter maximum at Valencia to the arrivals of the winter gales.

In the discussion which followed the reading of this paper, Mr. Glaisher said that even as compared with Greenwich, London had the greatest number of thunder storms; a storm coming up over Greenwich is generally deflected either over London or Epping Forest. A speaker alluded to the fact that the maxima of large rain-fall usually occur in the winter, and those of small rain-fall in the summer, and suggested that as Valencia has a large rainfall, the maximum both of its rain and thunder storms would be observed in the winter; while in London, which has a smaller rain-fall, these phenomena would occur in the summer. In reference to a suggestion that London contains numerous spires, Mr. Scott mentioned that having resided some little time in Munich, where spires are both lofty and numerous, he could bear testimony to the frequency of thunder storms, and it is well known that in that city they are more numerous than in many other places on the Continent.

Acid Bulb Thermometer.

Mr. Whitehouse read a paper on "A Modification of the Wet and Dry Bulb Thermometer," in which he proposed to obviate the uncertainty attendant upon the use of the wet bulb in frosty weather by employing a third thermometer, the bulb of which should be kept constantly covered with a film of concentrated sulphuric acid. A drawing of the instrument was exhibited, in which it was shown that the mode of supplying the bulb with acid was by means of a siphon, by which a regular flow was secured. The author explained the action of the acid bulb to be that of absorbing moisture from the air, and the evolution of heat in consequence of the mixture of the moisture with the acid, the result being that the acid bulb reads constantly higher than the dry, and gives directly the amount of vapour in a given space of atmosphere. The sensibility of the acid bulb was described as being ten to one that of the wet bulb. The paper was accompanied by numerous results of observations projected in curves.

An interesting discussion followed the reading of this paper, the President pointing out several difficulties which presented themselves to him as affecting the use of the instrument. Mr. Glaisher considered that the author had broken some important ground, as especially connected with the unreliability of the wet bulb when frozen. There is much, doubtless, to work out as regards the general principle, but it is an endeavour to meet a difficulty which is continually presenting itself at low temperatures. A question was asked relative to the effect of electricity on the regular flow of acid from the siphon on the bulb, and in reply it appeared that the delivery of the acid could be regulated with considerable nicety. Some experiments were made on the evolution of heat by immersing the bulb of a delicate thermometer in sulphuric acid.

At the conclusion of the meeting, Mr. Scott announced the issue, by the Meteorological Office, of daily weather charts.

Meteorological Conference.

Dr. Buys Ballot has issued a pamphlet (in English) entitled "Suggestions on a uniform system of Meteorological Observation," in the preface to which he speaks of a meeting of the General Congress of Meteorologists to be held, probably at Vienna, in the course of the present year. That much remains to be effected in the various branches of meteorological inquiry there can be no doubt, and if a perfect understanding between the leading meteorologists of the world were established, much valuable time would be saved, and much misdirected effort prevented; and it is to be hoped that at the anticipated Congress the important subjects now engaging the attention of theorists and observers will receive the consideration of the distinguished physicists who will doubtless form the members of the Congress. With the view of saving the time of the Congress, and of giving a greater circulation to his own views, Buys Ballot has written the pamphlet, and adopted the English language as being widely known. His principal aim is to draw attention to the *general method of observing*, and of printing records of the facts observed at the least expense, in order that particular investigations may be facilitated. In the establishment of a uniform system of observations throughout the world, we recognise a power far superior to the imperfect and disconnected systems of the past, and while Buys Ballot is devoting all his energies to securing so desirable a result, there is another portion of the work of the Congress which we trust will not be lost sight of. In meteorology, observation is an advance of theory. Millions of observations are accumulating, and we may ask the question, when and how will they be used? Investigations, some of which are mentioned by Buys Ballot, for example, the progress of storms, the origin of depression, systems and the laws of winds prevailing in all parts of the globe need a *theory* to connect them, and to show their dependence on certain physical and thermal conditions. The Congress will do but half its work if amongst its members it lacks those, who, with enlarged views of the physics of the globe are capable of setting forth a theory which—by its unbending mathematical relations, its cognisance of forces which produce those disturbances so useful, and at times so disastrous, to man and its power of grasping facts of various complexions—can be employed in solving the great problems of the meteorology of extra tropical regions. It is the theory of meteorology that needs advancing, and we hope that this great object will receive its due attention from the Congress.

THE IRON AND STEEL INSTITUTE.

A PAPER entitled "On Dormoy's Process of Mechanical Puddling," by Frederick A. Paget, C.E., was read at this Institute recently:—

The plan about to be described has been applied to forty puddling furnaces in different parts of Austria and France. The nearest of these works are at Rimancourt in the Department of the Haute-Marne, France. Three of M. Dormoy's apparatus are now there at work, and the plan is being adapted to all the remaining puddling furnaces. Its leading feature consists in placing a rabble, rapidly rotated by steam power, in the hands of the puddler. The ordinary furnace itself is left unchanged, except that the sides of the beds are set at an angle instead of being vertical.

To adapt the plan to any common existing puddling furnace, a shaft conveying power from any prime mover is carried about six feet above the furnace. A belt from a pulley transmits the rotation of the shaft to another pulley or sheave below, which rests on the belt a little in front of the furnace door. One end of the boss of the pulley is so jointed to a handle held by the puddler that the pulley can rotate without carrying round the handle. The other end embraces the outer end of the rabble, to which it is held by a cross-pin. The belt is thus made to rotate the rabble in any required position, in a somewhat similar way to the well-known rotating hairbrush. The number of revolutions employed is from three to five hundred per minute for white pig iron, and from eight hundred to one thousand for gray pig iron. The belt, while carrying and rotating the rabble, endows it with mechanical energy, and allows the stirring and puddling action to be directed to any portion of the molten metal. The rapidity with which the tool can be worked round gives the metal such an impulse that it turns horizontally on the bed, continually renewing the surfaces in contact with the atmosphere.

The point of the rotating rabble, instead of being hooked, carries a disc. When the iron has come to nature, this is replaced by a rabble having a short twisted point.

The following are figures giving the work done at Rimancourt by one of these furnaces during the first two weeks of last December:—

Working day of 24 hours—1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15; number of charges—23, 23, 23, 24, 24, 24, 25, 28, 26, 25, 26, 26, 25, 24, 23.

Total—369 charges, during which the furnace was fettled only nine times, or an average of one fettling per 40 charges.

The charges of pig and of hammerslag for the furnace bed amounted to 97,060 kilogrammes. The amount produced 81,921 kilogrammes, with an expenditure of coals of 45,240 kilogrammes, which gives 1,185 kilogrammes of pig per 1,000 kilogrammes of wrought-iron, with an expenditure of only 552 kilogrammes of coal per metric tonne.

Briefly, the result of different trials shows an increase of at least 30 per cent. in the yield, with a proportionate diminution in the consumption of fuel. In spite of the greater number of charges, the puddler is very little fatigued.

This process, both in Austria and France, is found to eliminate phosphorus and sulphur to such an extent that inferior brands of pig produce iron equal to charcoal iron.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

TERRESTRIAL GRAVITATION.

[3828.]—WITHOUT at all wishing to say anything that may annoy "T. A." I am compelled in answer to his queries (letter 3827) to assure him that he is wandering hopelessly. Why on earth should eight chords in a circle, converging to a point on the circumference, represent the attraction exerted by a globe upon a point at its surface? This is simplifying matters with a vengeance. Of course, if the chords *did* represent all the forces, his method of resolving these forces into a single force would be perfectly correct; but they don't. They do not even in any way come near representing any of the forces.

If "T. A." will insist on attacking questions lying beyond his (present) range, he must not be surprised if he gets explanations "too intricate for his comprehension." I answered as I did because, first, I did not wish to say point blank "it is useless to answer," and secondly, because others might find a use in an answer too intricate for "T. A." But, if "T. A." will only take this assurance from me, that *the attraction of a sphere on a particle outside it or on its surface, cannot possibly be determined without the use of the integral calculus*, he will perhaps understand why I cannot make the matter altogether clear to him. I have a tolerable knowledge of what can be done without the integral calculus (for I took my degree at Cambridge when I was almost wholly ignorant of the calculus), and I have over and over again attempted to master this very problem by considerations—not simple indeed, but still—not directly involving the integral calculus. I have been able to satisfy myself that the thing cannot be done. "T. A." might as well try to catch a whale with a hairline gut and a minnow hook as attempt to master the problem on his present line.

Every particle in the sphere must have its attraction separately taken into account, and then all such attractions must be summed up. Nothing short of this will do, and this sort of summation, viz., of an infinite number of infinitely minute quantities, is the special work of the integral calculus.

RICHARD A. PROCTOR.

HOW WE SEE A DISTANT OBJECT.

[3829.]—"E. J. D.'s" letter (3493, p. 510) invited explanation either from me or from "some of your clever correspondents;" and as I could not explain his difficulty, but greatly wanted to have his query explained, I waited the action of the clever correspondents. As "E. J. D." has now addressed his query to "F.R.A.S.," whom he rightly describes as your very clever correspondent, he is almost certain of an explanatory response, while I look forward, not unhopefully, to some remarks from "F. R. A. S." suggesting what may be the real nature of "E. J. D.'s" difficulty. For between the mirror at one end of the room ("carefully arranged to exclude all light with the addition of the walls, &c."), the shutter somewhere, and the opaque screen projecting from some wall, and the camera at the other end on a similar table "in a right line with the former," I am utterly bewildered.

Whatever may be the nature of "E. J. D.'s" difficulty and its explanation, I feel tolerably safe in denying the justice of the "old theory" "that the eye has the power of directing the electricity (which is everywhere) on a distant object (illuminated) and receiving back the correct image thereof" (that is, I suppose, of the object), "the convex lens having the same power." I cannot quite imagine this to be a correct view of anything in particular. What does "Sigma" say about this power of the eye in directing electricity? I can imagine a pair of eyes directing something very like electricity (in its way) upon a not too distant object, and a correct image of the object coming in the course of events into the possession of the owner of those eyes. But this seems a long way from "E. J. D.'s" difficulty.

I find that by not trying to understand "E. J. D's" explanation, and as it were "averaging everything" in his letter, the idea is suggested that what he really wants to know is how a mirror can be seen when the rays its polished surface reflect do not reach the observer's eye, but are quenched or got rid of. In this case the answer is undoubtedly that scattered reflection renders the frame of mirror discernible. The glass of the mirror is not seen. Indeed, the glass of a mirror can only be seen under exceptional conditions if the mirror be a good one. But we recognise the shape of the mirror whenever any light at all reaches its whole face, because the frame does not specularly reflect the incident light (or much of it) while the quicksilvered glass does.

When the mirror is removed the course of the ray is seen, because the ray illumines the dust always floating in the air. The paper on "Atmospheric Dust," at pp. 5 and 6 should be read. RICHARD A. PROCTOR.

SAVE US FROM DECIMALISM!

[3830.]—ONLY one bit of sense, that of "Scrutator" (p. 661) to at least six recitals (p. 630, let. 3723, p. 661, 3760 2-3-4, and p. 12, 3806) of the stale brags of this paragon of blundering priggery. "But one poor halfpenny 'orth of bread to all this intolerable lot of sack!" The first, indeed, Mr. Petrie sees, like "Scrutator," the delusion of the French standard (for on every detail of the wretched scheme a Nemesis seems to have poured all possible irony); but, nevertheless, he is for pure decimalism, the chief and radical blunder of the whole! And he even fancies our old measures were once centesimal, and in making them so, the perch for example = 200 inches, we should be restoring something lost! I defy him to find proof that our race were ever so absurd as to repeat tens in the successive steps of any table, or to make units in the ratio of 100 or any square number above 36, though Mr. Bottone fancies (p. 662) that ancients "in nearly all cases" made systems what he calls "uniform and consistent throughout." They everywhere knew better than to do any such thing, with any lesser steps than the Chaldean sixties. All over Christendom they had what he calls "*our* mixed quarternary, duodecimal, and ventesimal" money table, and denoted its units by the letters £., *s.*, *d.*, *q.*, which he must be aware never stood for English words. The names and ratios were common to Europe, and so had the actual values—the weights of silver—been at one time; but successive royal swindlers in different kingdoms, of course, debased the standard to different extents; furthest in France, where the *livres*, *sous*, and *deniers* came down to about an *eightieth* of true libræ, solidi, and denarii; but the least in England, where, even since our Tudors, we still have them little under a *third* of the originals.

I must come, however, to the next critic, "Metric System" (let. 3760), who answers his own question, "is it inferior or superior to others in use?" amusingly enough. Ten lines further he tells us he "need not fear the denary division of days." The Chaldean divisions of time he thinks firm enough to last. We need not *fear* denary time will supplant them! So then he tells us which would be to be *feared* if it had a chance; that seems much the same as telling which is the "inferior."

But he meanwhile commits a great error of fact in saying "the week has from time immemorial been universal." It has never yet extended to even half of learned and civilised mankind. A majority of our race, by their own accounts, and as the best informed of our westerns believe, dwell east of the Ganges, and all those nations have not, nor "from time immemorial" ever had a week; but instead thereof a cycle of sixty days; and to which (even more than their cycle of sixty years instead of our century) our astronomy may be extremely grateful, for its immense utility in preserving the exact dates of observations of theirs long before Europe was scientific enough to preserve any.

Next, let me assure "Campanile" (let. 3761) I did not leave his "dodecadic" system unmentioned from oversight, but design. I was quite aware that this preposterous mare's nest (with its two new figures for ten and eleven) is the triumphant invention of about three new geniuses per generation, and will continue to be invented as regularly as circle-squaring or perpetual motion; and that wise "Sigmas" will lay down (like "ours," p. 662) it "would be far preferable" to the immemorially used Ninevite sexagintals. The only news to me is that the dodecadic system was ever taught at St. Cyr, a bit of priggery perfectly worthy of Frenchmen who had produced the hardly more crude and shallow scheme of universal decimalism. Of course they were led to it for the sake of the one advantage of terminating fractions whose denominators are 3 and its powers. But this will never be worth the two added numerals and proportionally bigger multiplication table, and perplexing change of meaning in all figures above 9. It would not even do if we all became, in one generation, sex-digital like those "born to the giant in Gath." Let "Campanile" and "Sigma" just observe that the mere fact of 12 being one of the six very best metric numbers does not make any of its powers even eumetric; nor yet its multiples in general, beyond the first 4—not even 72, the half of the next unit that would be written "100," nor any of those written with a single numeral, except "500" (our 720), nor any written with 00 till the septuple of that, and not only no power of the base 12, but no half or double of any power of it. But in the Ninevite system (which, observe, uses no figures but our ten) the first compound unit (written 1,00) is one of the six that excel metrically all under their double, and not only itself but its multiples, 2,00, 3,00, 4,00, 6,00, 12,00, 14,00, 21,00, 28,00, 42,00, are all eumetric numbers, ten successive ones of that useful series being thus expressed, five with but one numeral, and five with two; and the two upper of the superexcellent ones (our 360 and 2,520) by one and two—namely, as 6,00 and 42,00. These facts make it no wonder that while the dodecadic system, perpetually retried, has never got the least footing; the sexagintal (that "Sigma" dashes off as "far more impossible") has left marks everywhere, from the Chinese day and year cycles to our minutes and seconds, and in its purity (at least for descending notation) held its ground as the standard scientific method, really through "immemorial time," from undated Nineveh and Babylon, through Greeks, Romans, Arabs, and revivers of learning, down to Fahrenheit, and even this miserable century; which made, in its opening years, the experiment by which, "Sigma" tells us, "it is pretty clear that calculations would be greatly facilitated," by "dividing the right angle into 100°," more laboriously and thoroughly than perhaps experiment was ever made, and with utter failure! I have before me and in use Callet's logarithmic tables, whereof about 100 leaves in the middle are taken up by the trigonometric functions of this very division, stereotyped and embodying, probably, some scores of people's some years' labour; and, like most users of the book, I long ago found it worth while just to pass a needle and thread through the outer margin of these 100 leaves, so that they may all turn *en bloc!*

But I am glad of "Sigma's" notable regret that we were not all Goliathites, because the idea has impressed on me how providential for our arithmetic it is that we were *not* so. In that case all human notations would have been either senary or duodenary, and *nothing better*; these would almost have become what "Sigma" falsely lays down the denary notation to be, "an inevitable and natural fact." Even Chaldeans would not have developed the splendid sexagintal improvement for the sake of introducing the third prime number 5, if that number had only presented itself in the petals of flowers and starfish. I never before saw that the five fingers are providential, as well as the ratios of the day, lunation, and year of the planet we are placed on; and thank "Sigma" for the hint. Of course, I totally deny the ground into which he finds it convenient to say the metric system resolves itself. There is no notation "given as a natural and inevitable fact." If there were, all civilised nations would have used the same; whereas it is a historical fact that the Assyrians never had centesimal notation, and the present French have, perhaps, no other. But "Sigma" neither uses historical fact himself, nor allows my way of using it to remain unperverted. There was nothing of the good old Tory, or "whatever is, is right," in my argument from general practice. I never implied that "*these* compound arithmetics," any *particular* ones, must be good because ages had used them, but that compound arithmetic, *as a principle*, distinct from "simple," or the general principle of what Mr. Bottone stigmatises as "mixed" numerations, would not have appeared or held sway (as it has everywhere) if not having real advantages over what he calls "uniform and consistent" systems. I believe we might repeat continually (like the Assyrians) the step 60, but that no lower number has ever been found good enough to be so used. If only the sixteenth century trigonometers had adhered to Ptolemy's notation of the straight measures, radius, sine, &c., which he expressed sexagintally as well as the arcs (instead of absurdly disconnecting the lengths of arc and straight function, and making two incommensurable units), then Briggs would assuredly have made 60 instead of 10 the base of his logarithms (whether expressing *them* sexagintally or not, and I believe they would be best not so); and an intelligent adherence, like that of Fahrenheit, to the tradition of this unrivalled system, by later scientific men, together with a compact way of writing it, as I suggested, by two sizes of figures alternately, without the clumsy and, indeed, outrageously needless °, ′, ″, ‴, &c., would by this time have almost, or quite, reduced the inferior denary notation to its right subordinate place. A little thoughtful example-setting by professors of science (when there was any) had more effect on the world, and would have more even now than they dream. They might easily both have prevented the disgracefully retrograde French "system" arising, and have gradually so leavened all arithmetic with the old sexagintals as to make their unrivalled convenience suggest itself to all without argument. Any compulsion in such matters is ridiculously absurd, or any Government action, beyond setting the best example in its own accounts, and striking the best coins, whose ratios (unless decidedly bad like the French) will in time make their way into all other tables but those of time. And those of time are fortunately still either natural or of the very best artificial system, which money ought to follow, and does with us actually, though not in names and notation.

Herschel's "Yard, Pendulum, and Mètre" is not, as Mr. Bottone thinks, an argument for decimalism. "Philo's" theory (p. 663) of the hundredweight (which I once broached myself) will not hold water. He will find any of these neighbouring numbers to 112 would have had the same advantage:—

96	104	120
124	126	127.

Also, with the right seven weights he could weigh not merely all up to the 112th multiple of the lowest, but all up to the 1,093rd. E. L. G.

SIR J. HERSCHEL ON THE METRIC SYSTEM.

[3831.]—I AM much interested in the discussion now going on in "ours" on the subject of a decimal system of weights and measures, and as but few of your correspondents seem to be aware of the work done by Sir John Herschel on the subject, I think an epitome of his views, with certain additions of my own, may prove of interest.

Sir John Herschel objects to the French standard as being unscientific and inaccurate, and because the meridians have not the same length in different parts of the world. The one chosen by the French philosophers was a line from the pole to the equator passing through Paris. No one can seriously doubt the advantage of having a regular system of weights and measures, instead of suffering from the almost entire absence of system, as we do at present. The chief objection to the French system is not that it is founded on inaccurate observations, for there are so many reliable standard metres in existence that the chance of losing them all is extremely remote. The real objection to its adoption is that the people are so obstinate, and object to make any alteration even for their own convenience. In England the enforcement of a new system would meet with peculiar difficulties, owing to the form of government, and to the notion that the right to inconvenience ourselves and other people is part of the liberty of the subject, and a thing to be strongly contended for. Although an octesimal or a duodecimal system would in many respects be preferable to a decimal notation, it must be admitted by every candid thinker that the latter notation is immutable, and it is in the adoption of ten as its basis that the French system has its great advantage, not in its being founded on any really scientific standard of length. If such fragments of system as we possess could be arranged decimally and "patched" without much change, such a system would be preferred by the great majority of Englishmen, as involving a less radical and confusing change than would necessarily occur on the enforcement of the French system. That our present weights and measures can be so patched, and that there is also the advantage of a thoroughly accurate and scientific standard to work from, I now propose to show. Although the number of quadrants of a spheroidal body like the earth are infinite, there can exist but one polar diameter. The length of a straight line drawn through the earth from pole to pole is 500,500,000in. If our present inch were increased in length by only 1,000th part, an almost inappreciable quantity, the length of the earth's polar diameter would be 500,000,000in. exactly. The increase of the inch by the above-mentioned amount would make a cubic foot of water weigh exactly 1,000oz., instead of being only supposed to do so, as at present. Our measures of length are sadly in want of re-arrangement, which could be effected by the introduction of new measures of 10in., 50in., and 100in., &c.

If a cubic foot of water weighed exactly 1,000oz., we should at once have the connection between measures of length and weights, while the measure of capacity is obtained from the measure of 1 cubic foot = 6¼gals., or 4 cubic feet = 25gals., or 16 cubic feet = 100gals. Now, we have ounces and drachms both as measures and weights, the measure of a fluid ounce of pure water being the space occupied by an ounce in weight. As no inconvenience arises from such an arrangement, which, on the contrary, is found to be advantageous, why should we not do the same with the pound and gallon, making each of them both a weight and a measure? In the fact that 10lb. of water = 1gal. we have the germ of a very easy and convenient decimal system of weights and measures of capacity. At present we have a very deceptive weight we call a "hundredweight," which is equal to 112lb. If we had a new weight and measure = 100lb. = 10gals., it would have the advantage of both convenience and truth, and I think such a palpably beneficial change would be readily adopted. To avoid confusion, the new weight might be abbreviated by the letters "hwt.," while the letters "cwt." would mean 112lb. as at present. Our present ton is equal to 20cwt. = 2,240lb. I would propose a new weight and measure of 20hwt. = 2,000lb., to be called a "new-ton" or "Newton." Such a name would entirely prevent confusion, and would serve to remind the user both of the origin of the weight and of the immortal discoverer of gravitation. For quantities less than a pound, I would suggest the introduction of a new weight and measure of 700 grains = 10th of a pound. This is about an ordinary wine-glass in capacity, and thus might be readily extemporised. It might be called a "verre" (the French for wineglass), or shortened to "ver," and symbolised by "V." A weight and measure of 70 grains = 10th V. = 100th part of a pound would be so near the present apothecaries' drachm of 60 grains that it could replace it in nearly every instance. It might be called a "Newdrachm" (Nd.). A weight and measure of 7 grains has already been proposed by Griffin, and appropriately called a "septem." The smaller weights and measures are rarely employed, except in dispensing, and are therefore used by an intelligent class of men, who would soon become accustomed to them. The proposed table of weights and measures of capacity would therefore be as follows:—

7 Grains = 1 Septem.	S. = 7 grains.
10 Septems = 1 Newdrachm.	Nd. = 70 grains.
10 Newdrachms = 1 Ver.	V. = 700 grains.
10 Vers = 1 Pound.	Lb. = 7,000 grains.
10 Pounds = 1 Gallon.	G. = 70,000 grains.
10 Gallons = 1 Hundredweight.	Hwt. = 100lb.
20 Hundredweight = 1 Newton.	Nt. = 2,000lb.

The majority of tumblers do not hold half a pint as popularly supposed, but just about ½lb. = 8oz., and it could readily be made a definite weight and measure to equal exactly ½lb. = 5 Vers = 1 "Tumbler" or "Rummer."

I cannot but think that such a system as the above would be far more readily accepted than the French or any other perfectly new system. At present we have three "quarts" of different value; the reputed wine quart, the imperial measure, and the "Winchester." The latter is just half a gallon, and a very convenient measure = 5lb. weight. At present the "stone" varies from 5lb. to 32lb., and there is little doubt the introduction of a definite weight and measure of 10lb. would meet with a warm welcome.

In my own practice, as a scientific man, I habitually employ the metric system, but I think it possesses but slight advantages over decimalised inches and grains.

Although the French system is the best in use, it is not the best possible, but I should hail its compulsory use as a vast improvement upon the utter confusion and want of system under which we at present labour.

Sheffield. ALFRED H. ALLEN.

SOME HINTS ON METRICALISM.

[3832.]—THE neglect of this really noble and difficult subject for centuries, and the utter chaos into which *laissez-faire* and "survival of the fittest" (for trade mystifications and rascality) have everywhere brought it, produced at length the crude and wretched French decimals; and now the spread of that pitiful disgrace to European intellect, through the same causes, by mere force of its unity against their anarchic and haphazard multiplicity, daily makes attention to the rights and reason of the matter more urgent: if, alas! we were in an age capable of looking to the real ground of any matter, however trifling or simple! Now, it would be one step toward clearness if every arguer would deign to treat quite separately the question of *standards* and that of *divisions*. There is no shade of excuse for mixing up these. They are so independent that a system might have the very best kind of standards and very worst divisions, or *vice versâ*. The standard question is purely one of physics, not directly mathematical at all. The division question, on the contrary, is nowise physical, but mathematical in the purest sense, perfectly independent of what planet or kind of world we might be in, or how many fingers we might have. There is a third part of the subject, nearly, but perhaps not quite as unmixed with physics as the division question—namely, the *interconnection* of the different tables (as that of weight, value, surface, volume, &c.), *i.e.*, the mode of derivation of one unit in each from the unit of length, which as simplest ought to be their basis.

Now, I maintain, and this is also, I believe, the main position of Sir John Herschel in his "Yard, Pendulum, and Metre," that it is only in this third point, the interconnection of dissimilar units, that the French system is at all commendable, or made any advance, or rather, revival of an ancient principle. In both the main essentials, the standard and the division question, its vaunts are ludicrously false, its failure more than remarkable, unique, ironical, almost supernatural. Its kind of standard (which was to be the earth's circumference) is, in fact, though no worse than many others (as the Winchester bushel), yet of the *worst kind* that any the most savage human race ever has had or can have; but worse remains! I further maintain that the other feature of the unlucky system, its uniformly decimal division, is at the same time the very *worst kind* of division any race have yet perpetrated, and almost as bad as possible. (I grant that the continued powers of 5 or 7 would be slightly worse.)

On the former failure, of course, I have plenty to keep me in countenance. As "Scrutator" says, the length of a platinum bar kept at Paris that was intended to be (but is not) such a fraction of the meridian, is exactly as *scientific* as the length of Punch's nose; and though rather more definite and useable, yet incomparably less so, and inferior in every way, than the kind the ancients fixed on as early as Pericles, with perfect success, a recorded round fraction of the dimension of some noble, world-durable building, some "Hecatompodon," hundred-foot fane, as they called their "intactæ Palladis arcem," whose chief steps, front and flank, of 100 and of 225 standard feet, are just as good for the purpose to-day as when squared and polished this very year 23 centuries, and may, therefore (if no comet falls), be as good for 23 more. And still older and less destructible, and equally uninjured, are the built standards (whether meant for such or not) of the pyramid of Cheops, either its rock sockets or his finished, but never occupied, tomb-chamber; or of the two untouched 400-cubit walls, the west and south, of Zerubbabel's temple-terrace at Jerusalem, by him, of course, religiously copied from Solomon's standard. (They have none of Solomon's work, because many of their stones are *too large*, often double the lengths "of 10 cubits" and "of 8 cubits," that the Bible records as wonders of his time.) Have not such standards, then—widely different from a "bar" kept at Paris, or a "Winchester bushel," but yet artificial—been experimentally found at least as good as any natural invariable length, of which we have really none between the diameter of our planet and the wave lengths of standard rays, as of sodium light or thallium light! Either these latter have to be multiplied some millionfold or the earth's dimension divided some millionfold, to yield a unit we can handle or measure our own works by! Of the two, I believe multiples of the spectral ray-waves would be the more practical and verifiable; but, remember, we have no *direct* natural length standard between them. We can get one of length through gravity-force and the subdivisions of the time-unit, the day. We can take the distance fallen at the equator, or at a given latitude and altitude, in a given day-fraction, as a second; this being, though not measurable directly with any exactness, yet derivable by the multiplier, π^2 from the length of pendulum vibrating that same fraction of the day. Now, the English, Russian, and Swedish foot happens to be wonderfully near the quarter-second fall of bodies at the equatorial sea-level. It might either be modified to exactly that fall, or remaining unaltered, be defined, I believe, as the quarter-second fall at some moderate fixed height (or equal depth) above or below the equatorial sea-level, a height quite accessible on the Andes, even if higher than Quito city. Neither Herschel nor Smyth seems to have noted this near coincidence in our foot.

But I submit that built standards, the idea of Pericles' time, are not yet superseded—they are the most successful to this day. And remember that we, too, and probably many a modern race, have their Hecatompodon in their Parthenon, in some chief Christian virgin's fane, sometimes even nobler on the whole, or as creditable to humanity, as that of Pallas in its prime; some Mary Church, as the massive world-strong one of Chartres, storied with its 8,000 population in stone and gem-like glass; or its contemporary, but extreme opposite, the wondrously delicate Salisbury, our Anglo-Saxon race's Parthenon, and the chief, or rather sole noble work we ever finished on the plan begun. There, according to the best surveys, the ten nave compartments make as accurate a 200ft. standard of our present long measure as could now be made; and what is still stranger, considering the effect of settlement on most buildings' heights, the extreme from floor to cap-stone of spire falls not two inches short of the double thereof. So there we have, well preserved above six centuries, the original of this foot, now base of Anglo-Saxon, Gothic, and Sclavonic measures, all round our hemisphere, and over the two greatest empires. Nor are the round enmetric multiples of the same in such modern monuments as Waterloo Bridge, London, or Grosvenor Bridge, Chester, to be despised even in the face of Cheops' or Pericles' standards. And let me add a disproof of Mr. Petrie's fancy, p. 636, that because our perch is 198in., it was ever centesimal. The perch governed the dimensions of our ancient buildings perhaps earlier than the foot. At least at Salisbury, the choir half of the building (the first built), is planned on a basis of perches, as true to the present standard of them as the nave dimensions are to round numbers of feet. And all the leading lines of Westminster Hall (nearly two centuries later, it is true), he will find by Pugin's measurements to have been of perches, and not of 200in., but of 198in., as at present.

Neither "Sigma" nor Mr. Bottone have any right to pillory me as defending multiplicity or absence of system, or, indeed, in the matter of divisions (which I must defer to another letter) approving any other of our numerous English tables than that of time (common to Europe), and those of our money, troy, and apothecaries' weight. What I say of the rest is simply that, however bad, none of them is worse than, or hardly so bad as, the French decimals. I would alter all, and assimilate all. I supposed it to go (as the French say) *sans dire*, that whatever numerical series is best for one table is best for all; and I would have no two *so* different and incommensurable as the present French table of everything else is with their time. E. L. G.

THE METEOROLOGICAL OFFICE AND ATMOSPHERIC WAVES.

[3833.]—HAVING had occasion lately to look into some of the publications of the Meteorological Committee, more particularly Mr. Scott's report on "Strong Winds and Barometric Differences," and Capt. Toynbee's report on the use of isobars, I found, as it appears to me, a want of information on a subject to which more than five-and-twenty years ago I, in conjunction with the late Sir John Herschel, devoted considerable attention. It would be out of the question within the limits of this letter to point out those particular features of "atmospheric waves," which ought, I apprehend, to have been mentioned, or at least alluded to, in the descriptions of Capt. Toynbee's isobars and Mr. Scott's gradients, and I can only account for the omission by supposing that the director of the office, the marine superintendent, and the members of the Meteorological Committee are unacquainted with the results arrived at by Sir John Herschel and myself. The late director of the office, Admiral Fitzroy, was certainly acquainted with them, for he was the only meteorologist, so far as I am aware, who controverted them, and under these circumstances he would not have employed them in his researches; but in an attempt to trace the progression of barometric differences, and to show the connection of strong winds with these differences, the most important agent, the "atmospheric wave," has been lost sight of. Capt. Toynbee appears not to have suspected that information of the kind was available, for I find in his report that the examination of the isobars of January, 1867, *opened up new views to him* of precisely the same character as I found in my researches on atmospheric waves so many years before; and it is somewhat remarkable that an office absorbing the large sum of £10,000 a year should be content to limit its inquiries to the comparatively small area of 700 miles in diameter, when it has been shown that at least five times this area is necessary for examining the phenomena of barometric differences as "connected with "atmospheric waves." The connection between the prevailing wind and the line of greatest barometric difference is really nothing more than a portion of a line drawn from the crest of an atmospheric wave to either of its troughs at right angles to its direction, the wind must consequently blow at right angles to this line. Much time of the office would be saved and more valuable results secured by determining the general laws of "atmospheric waves" than by confining the operations of the office to the present limited area.

W. R. BIRT.

COLLIERY EXPLOSIONS AND THEIR PREVENTION.

[3834.]—Our friend "King Coal" (8641, p. 587) seems to lay very great stress upon the colliers for being reckless and careless in their daily avocations; in fact, he seems to say that the greatest portion of accidents, if not all, are caused by the carelessness of the workmen themselves. Is our friend aware that prevention is better than cure—hence, if the cause be removed, the accidents would not occur. Now, if a sufficient amount of ventilation be made to travel through all the working places and back "slums," or places that contain gas, both likely and unlikely to keep the gas from accumulating; there would be no fear of any workman igniting the gas in any shape or form. This could be done with care and a proper system of ventilation.

Now, I am aware that the goaf is the likeliest place to contain gas, and there is a way to ventilate the goaf and keep it clear of gas, as well as the working face, if the mine be properly set out at the commencement, and afterwards conducted in a proper systematical form.

Now, I can't see why masters or their managers cannot be made punishable for their negligence as well as the workmen. If a workman is found to have in his possession a tobacco-pipe or matches, or an unsafe Davy lamp, where such are prohibited, they are liable to be brought before a magistrate and imprisoned. Then, why not apply the same law to the masters or their agents if they allow gas to accumulate knowingly in any part of the mine, or neglect to repair anything which is dangerous in its due course?

I am aware that the colliers generally are a class of men that are rather careless over their work, but at the same time I do not like to see too much saddle put on the one horse; let them carry their own burdens according to their merits, then shall we have a chance of havnig these things put right. Arley Mine.

AUSTRALIAN MEAT.

[3835.]—Having been troubled with indigestion for three or four years, and having been unable to eat animal food, I tried Australian mutton and found it agreed with my stomach very well. I had previously tried Liebig's beef tea, but did not appreciate the flavour of it. Before eating Australian mutton, I was quite emaciated, and found great difficulty in walking a very short distance. I can now walk long distances (say 12 miles) amongst lofty hills with ease.

After eating the above mutton, I do not feel any crudities of the stomach or heaviness. I am much heavier, and have a good appetite for other food, which I could not relish before.

It is quite true that a man may eat a large quantity of it, as a child can eat an enormous quantity of tarts and custards. But there is this difference, that after eating an unreasonable quantity of pastry the stomach feels distended and overworked; but after eating an unnecessary quantity of Australian mutton the stomach feels easy and comfortable.

I do not doubt that Australian meat sooner digests, and that the stomach is sooner empty than after eating a meal of ordinary flesh meat, but I believe that the nourishing portion of it is more thoroughly taken up in the system than that of ordinary meat (especially the flesh of an ancestral bull or patriarchal ram), and if a man has a very great appetite he must eat more vegetables to the Australian meat than the other, and I feel convinced he will feel lighter and stronger for eating it. I need say nothing about the difference in price, as every one can calculate for himself, whether he buys good English beef at 1s. or splendid old bull beef at 6d. per lb. Lastly, I cannot perceive any stains on the knives, &c., after using them in connection with this meat. J. Broadhurst.

CALIPER COMPASSES.

[3836.]—In answer to "K. T. L.'s" question as to what "J. K. P." thinks of the caliper compasses (see letter 3825, p. 16), I can only say that in principle they seem perfect, but as I was once told by a mathematical instrument maker that the most difficult job they have to accomplish is dividing a pair of proportional compasses, so I should imagine proportioning the legs of these calipers would be a most difficult job. Besides that, supposing them made, I can conceive only one possible use to put them to, and that is pricking off the width of a sheet of metal which is to be made into a tube of a certain internal diameter, and that width might be got more accurately by twisting a piece of wire round the rod, and nicking it (as people call notching) with a chisel or file. So, on the whole, I should say, don't make them. J. K. P.

A WONDERFUL GUN BARREL.

[3837.]—On p. 539, Vol. XIV., let. 3539, I see the Government officials have been trying the Soper rifles. The last trial was with 200grs. and six bullets; that was quite satisfactory. The writer of the letter, C. H. W. Biggs, says he believes he is correct in stating that no other gun has withstood more than 170grs. of powder and two bullets. I have had a barrel in my hands that has had 18drs. of powder for one charge, and a tap screwed in at the muzzle. When discharged it blew the tap out, but did not injure the barrel, only where it stripped the threads. I think that surpasses the Soper rifle; it is cast on the Bessemer principle, but surpasses the Bessemer; it also can be made cheaply. If it should be a bad ingot, it will stand a heat equal to any iron that is made, and rolled down to No. 32 wire gauge for locomotive tubing.

J. L. Minshes.

COMPETITIVE EXAMINATIONS.

[3838.]—As nobody who knows Prof. Barff's book seems to have noticed Mr. Bottone's recent letter (No. 3686, page 612), permit me to ask him for the "comment" which, he said, was "superfluous." But before he writes let him read the Professor's preface and the paragraph at the end of the article on "Sulphuric acid" (page 174, 2nd edition), when he will, I think, find his quotation from the witty Dean singularly unfortunate. Hedera.

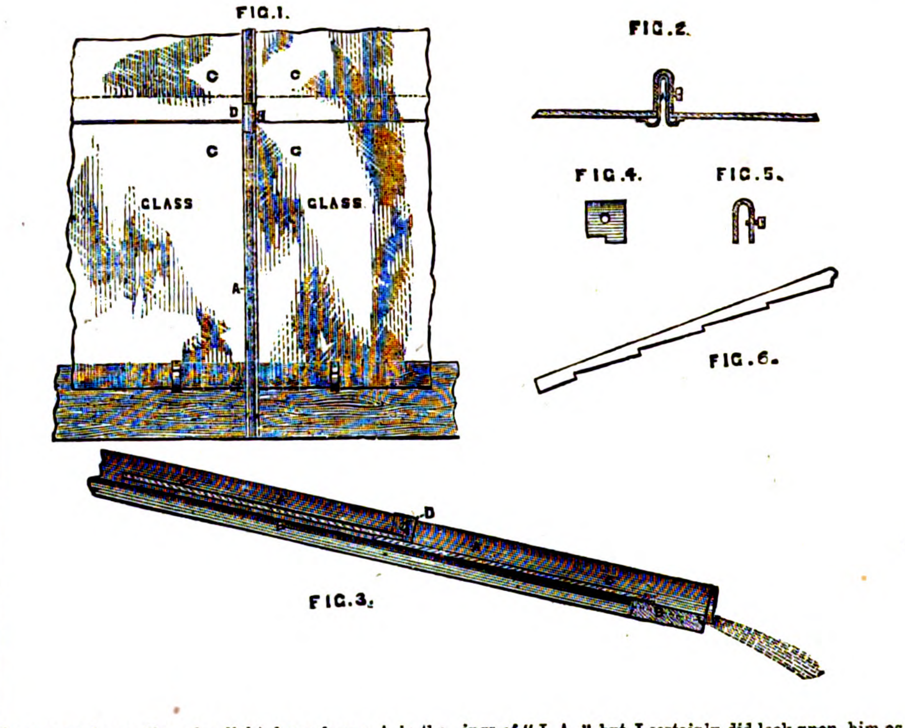
APPARENT LOCAL TIME.

[3839.]—I beg permission to thank N. S. Heineken for the description of his instrument for determining the meridian, at p. 664, Vol. XIV. Perhaps, if made on a rather larger scale, a still greater accuracy may be got, but his gives it near enough for most purposes. I think also the instrument may be simplified by those who wish to ascertain the meridian of one place only, but probably Mr. Heineken wishes to use his at many places.

Philo.

IMPROVED METHOD OF GLAZING.

[3840.]—I beg leave to bring before the notice of your readers an improved construction of sash-bar, especially suitable for greenhouse roofs and lights for frames. The use of putty in fixing the glass is at all times a nuisance, and the necessity of chipping it out in the event of a pane being broken a work of time, besides the liability to damage more panes than you repair when the situation of the fracture is not easily accessible. This sash-bar, and the system of which it forms a part, is patented by Messrs. Rendle & Burrows, and it will be readily understood by the drawings. In Fig. 1, which is



to represent a portion of a light for a frame, A is the sash-bar, C the glass, and D a metal cramp to keep the panes in position. Figs. 2, 3, 4, and 5 show the cramp and its position from different points of view, and Fig. 6 is a cramp intended to run the whole length of a sash-bar where greater strength and security is desired. The sash-bars are made in metal or wood, the latter being necessarily of a different sectional shape to that shown in Fig. 2, although the principle is the same. Thus the wooden bars are about 2in. deep when the cover is on, the bar being cut with a centre tongue, and a gutter on each side. The glass being laid on, the cap, which covers the whole length of the bar, is put in position and secured to the bar by means of screws. It seems to be a convenient and serviceable arrangement, and the makers say perfectly water-tight. Saul Rymea.

PHRENOLOGY.—AMALGAMATED ZINC.—CENTRE MAKING, &c.

[3841.]—(11141.)—Phrenology.—Get McPhunn's "Catechism" and use it as a pocket companion until you have acquired a thorough knowledge of the names and assumed functions of the different organs, referring, when convenient, to one of the phrenological heads made in plaster; they are very cheap now. Then obtain Coombe's "Phrenology," and, if possible, a work by, I think, O. S. Fowler, an American treatise upon the subject; and if you can get a copy of Slade's "Colloquies" study that well. This achieved, try your hand upon your own immediate friends, with whose general characteristics you are more immediately acquainted. Compare the results of your judgment from simple manipulation and the knowledge you have acquired from the books named, with your personal knowledge of the individuals you experiment upon, taking the widest distinctions of character available first, and as you improve by practice coming gradually down to the finer distinctions of development. This will serve you for six months, and then apply again.

(11155.)—Amalgamated Zinc.—By far the simplest method is to make a guttapercha, bath in which the plates or cylinders of zinc can be immersed in mercury after being removed from the sulphuric acid bath. When you have once determined upon the size of plate or cylinder you intend to use, cover it with three or four thicknesses of brown paper, and upon this mould your guttapercha bath, leaving a lip on one side to pour the mercury out when necessary. In the case of cylinders the same arrangement can be made, and the centre space filled up with a wood cylinder, coated with sealing-wax varnish, say 1-16in. less in diameter than the inside of the zinc cylinder. By this means a very small quantity of mercury will suffice to cause complete immersion of the zinc in the fluid metal, and amalgamation will take place rapidly and equally throughout. Wash the zincs thoroughly in a jar, and carefully collect any superfluous mercury that may fall from them, and return it to the bath. Judging from "Yakew's" statement, his cells are too porous for Bunsen's, allowing too rapid exosmose of nitric acid.

(11181.)—Centre Making.—For about the twentieth time let me repeat this rule:—To the square of the versed sine add the square of half the chord, this sum divided by twice the versed sine gives the radius. Templeton was the first I know of who gave this simple rule, and its demonstration has been given in "ours" a long time ago.

(10482.)—Poles of Electro-Magnets.—When previously replying to this query it was farthest from my thoughts to have any intention of wounding the feelings of "J. A.," but I certainly did look upon him as one who had sadly neglected the sage counsel of the Chameleon—

"When next you speak of what you view
Think others see as well as you."

I willingly withdraw any expression of mine that may appear discourteous to him, but he must excuse me for still retaining my firm belief that his experiment was ill-devised in some one or other particular, or he would not have obtained the results recorded. Had his statement merely differed from my own experience I should have doubted the latter, and set to work to verify my conclusions by fresh experiments before I had ventured to write upon the matter, but his single experiment was placed by him in juxtaposition with, and said to disprove, the experience of all other physicists and electricians who have studied and written upon the subject, and in the fervour of my admiration for some of these—notably Prof. Joule—it is quite possible that my pen may have forgotten that "Montaigne" ever had corporeal existence.

(11218.)—Smee's Battery.—If you can get as perfect a deposition of platinum on copper as you can on silver then you have no longer a Smee's cell, but one of your own design, and the relative values of the two will be nearly as the conductivities of the two metals, for which see "Sigma's" papers. With regard to iron, while acting as a negative, it would not, if in any degree pure, be attacked by the dilute acid, but the electromotive force of the cell would be considerably reduced, the very thing which should, if possible, be avoided; and when the plates are not acting as negatives then chemical action takes place on the iron, only giving you a surface of oxide of iron as a negative (a very bad conductor). When you resume operations if you remove this you take away your platinum also, and must replatinise, so that, on the whole, you had better take "Smee" as you find him and stick to him.

(11269.)—SMEE'S CELLS.—In reply to "Intensity's" first query I can only at present quote the authority of Mr. Latimer Clarke, viz., "that Grove being 100 Smee is 25, or quarter the electromotive force when in action, hence his 12 Smee's would be equivalent to three Groves, and I apprehend the electric light they would produce would be a minimum. 2. With the utmost safety, but a serious waste of zinc if your coil is of the ordinary construction; rather join them up in a series of three, that is, four zincs and four silvers in each of the three divisions; then couple these up for resistance or in alternations—*i.e.*, zinc to silver, &c., in the same manner as you now propose to use the twelve. This should give sufficient electromotive force, combined with intensity of current, for any ordinary induction coil. 3. You can use gold in lieu of platinum, but it has two disadvantages—viz., it is dearer and much softer, the latter quality rendering it less useful in withstanding the rapidly repeated blows, slight in themselves individually, but very marked in an instrument under continuous action. Any metal which, in the presence of the atmosphere, can be raised to the temperature produced at the point of contact (when the current is broken at that point) without undergoing oxydisation, will do equally as well as gold or platinum, but unfortunately so far we have not found a substitute that supplies the conditions, ergo we must use gold or platinum, and that is the actual reason.

(11262.)—ELECTRICITY FROM STEAM-BOILER.—If "Boiler Minder" means an ordinary electric bell, in which the result is produced by the use of an electro-magnet, the answer to his query is decidedly No! All the phenomena we have as yet been able to obtain electrically from a steam-boiler belong to, and are consistent with, static electricity, and hence out of the pale of producing dynamic effects. It is possible with proper arrangements to generate electricity of such a tension with a boiler, such as described by "Boiler Minder," as to give a shock to the human system that "no fellah could understand," or that would leave no understanding in the fellow who allowed it to traverse his body, and yet the same discharge would traverse the convolutions of the most delicately made electric bell without giving any visible evidence of its existence—"per contra" a plate of zinc 1½in. square, opposed to a similarly sized plate of carbon with suitable interventions, will ring the same bell for twenty consecutive minutes, while the individual above alluded to may complete the circuit without the slightest inconvenience for hours if he chooses so to do.

(11261.)—I marked this query off for reply, although addressed to another gentleman, but when I reflected that our fourteenth volume was just completed, and the inquirer was "A Subscriber from the First Number," it struck me that, after seven years gleanings from all that has been plenteously shown forth in "ours," the querist must be one of those unfortunate offsprings of Nature's mésalliances, born blind, certainly deaf, and, therefore, should remain in accordance with all natural laws—*dumb*. WM. TONKES.

MUSICAL NOTATION.

[3842.]—ONE word in reply to "Tafa-tefe" (let. 3771, p. 664, Vol. XIV). If he will look at my former letter (3666) he will see that I did not object to the use of figures, as he assumes. What I said was, "I see no advantage in using figures, but calling them do, re, &c., over Mr. Curwen's plan of using the initial letters of these notes," and I stick to it.

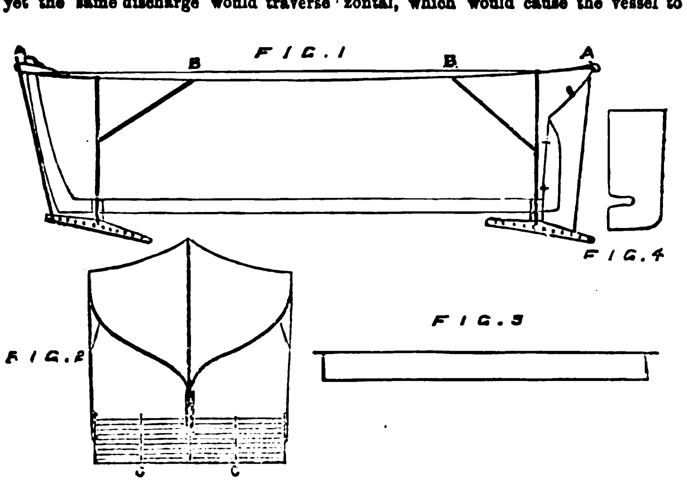
The question of writing figures or letters is trivial: no more precautions are required for the latter than the former, the *f* is the only one with a tail, and in many MSS. it is written f, which exactly corresponds with lopping off the tail of the 7.

It is evident that the cipher and Sol-fa notations are identical in principle; in both the stave and ordinary characters are set aside, a few signs are used to represent tones in key, and a few others to represent time. Their relative merits, therefore, will depend upon the perfection of their detail—a question which can only be decided by those who possess an intimate knowledge of both, and not by the general reading public. H. T. W.

ALLINGHAM'S PROPELLER.

[3843.]—BEFORE entering upon a description of this provisionally-protected propeller, I may premise that having studied the fact which impressed itself upon my mind eight months ago—viz., that if a ship of, say, 1,000 tons be lifted any given height by the action of the waves, there is a force exerted of more than 1,000 tons, and in falling she will exert that force minus the friction of plunging in the water. We will, therefore, assume that there is a force of 1,000 tons exerted every time the vessel's head or stern rises or falls. I don't say this exact weight is mathematically correct, be it understood. The next consideration was if it were possible to communicate this immense power to machinery for propelling, and after repeated trials and failures of the most disheartening nature with a model in a washing-tub in the backyard, I am now in a position to propel any floating body against, sideways, to, or before the wind and waves, doing away at one "fell sweep" with boilers, coals, steam-engines, engineers, stokers, &c., substituting in their place an apparatus which will act effectually as long as the vessel rises, falls, or rolls to one side or the other, which will not probably weigh over 10 tons for a 1,000-ton ship, leaving the whole hull available for passengers and cargo, and, barring accidents, costing a merely nominal sum for repairs.

And now to the proof. Fig. 1 represents a model 3ft. 6in. long, 1ft. 2in. beam, and 1ft. deep. To each end of her is attached a framework, which carries 32 blades or louvres—16 on the port and 16 on the starboard sides. This frame measures outside 1ft. × 8½in., and is proposed to be made altogether of mild steel to obtain the requisite strength combined with lightness. These blades measure 5⅝in. × ⅛in. each, and work freely in the frame on two spindles each (see Fig. 3), slightly overlapping each other. This frame is supported by two flat rods of steel edgewise to the direction of motion, and when lowered into the water slips into the catches attached to the keel (Fig. 4), and is held in position by the stays marked B, thus relieving the rods of the thrust when the ship plunges. Fig. 2 shows an end view of the framework, which is hinged to the vertical rods, and capable of being shifted from horizontal, which would cause the vessel to stop to the



proper angles with the keel in order to produce forward or backward motion as required. As the wave lifts the bow, the blades are lying flat, and present a large surface endeavouring to go forward in the direction of the angle to the ship's bottom. The moment she begins to fall, these blades open to the corresponding angle in the opposite direction, which opening is regulated by guards, as marked C C, Fig. 2. Thus the vessel is converted into a double-acting lever at each end, and if she rolls to one side the blades on that side open, while those resisting the roll are shut; thus is she also double-acting as regards side motion. The reason for keeping these blades as narrow as possible is that they may reverse their angle as soon as possible, so that the least motion of a ship will be sufficient to propel her. In the case of very long vessels, I propose to use a species of float to agitate the framework of blades. In this arrangement it would be requisite to tow the vessel to the open sea as usual with sailing vessels; but if desirable, it can be arranged so as to be worked by a steam-engine until the swell is reached. This system is also applicable to driving machinery by the side of any large reach of water. The only drawback is that if the sea be perfectly without motion (which I think, from experience, rarely happens, except in some parts of the world), my apparatus will not act—the rougher the sea the better it acts, and best when going straight into the wind's eye. JAS. ALLINGHAM.

DR. CARPENTER AND PERSPECTIVE.

[3844.]—DR. CARPENTER, in his article on common sense published in your journal of the 8th inst., states correctly a rule of perspective, but gives a reason for that rule which I think ought not to pass unchallenged. After stating that the perpendicular lines of two towers (for instance, York Minster) must visually converge towards a vanishing point in the sky, whilst common sense tells of the improbability of their being actually inclined towards each other, he says, "And the best proof of the complete possession of our minds with this improbability is to be found in the rule of perspective that all the vertical lines in a building must be pictorially drawn as vertical, so as to represent what is seen by the mental rather than by the bodily eye."

The true reason why all the vertical lines in a building must be pictorially drawn as vertical I had supposed to be because all such lines are parallel to the plane of delineation; thus, if the towers be viewed through a window which will represent the plane of delineation, it is evident that the sides of the window visually converge to the same vanishing point in the sky as the lines of the towers; and, therefore, if the towers are drawn upon the window exactly as they are seen by the bodily eye, it will be found that all the vertical lines are pictorially drawn vertical. For the same reason all horizontal lines which are parallel to the plane of delineation are drawn parallel to the top and bottom of the picture, their vanishing points being the same. This is readily seen whilst travelling in a railway carriage, when the window represents the canvas on which the picture is painted. The rails and telegraph wires all have the same vanishing point as the top and bottom of the window, and if drawn upon the window exactly as seen will be parallel. B. D. T.

LIGHTNING CONDUCTORS.

[3845.]—"PHILO" (letter 3733, p. 638, Vol. XIV.) advises using metal roof ridges, gutters, and rain down-pipes. I am anxious to do so; and will be obliged to "Philo," or any other correspondent, for further details—such as how to establish metallic connection between :—

1. Six-feet joints of cast-iron down-pipes, generally left loose in the sockets.
2. Eave gutter and down-pipe, whether connected by a drop or a head.
3. The lengths of cast-iron rhones of eave's gutter, spigot and faucit, bolted together.
4. Between lead-valley gutters and cast-iron eave gutters.
5. Between the lengths of the lead in valley gutters and ridges which overlap each other, and which, if soldered or otherwise fixed, might be torn by expansion.
6. Between the wire-rope conductor and the lead ridge.

These connections made, how high must the point of the conductor be above the chimney cap? And what addition to the lowest point of the rain-water down-pipe is necessary to carry the lightning safely off from the house into the ground? J. G.

[3846.]—THE destruction of King's Norton Church steeple, described by "J. K. P.," at p. 668, Vol. XIV., shows how useless metal conductors are unless they are well connected with the ground, a point very often neglected. The common expression that the electric fluid made a hole is inaccurate. Electricity causes a hole to be made, sometimes by the sudden production of steam, sometimes by making the particles electrified repel each other: why they repel each other is unknown to me. By the way, the King's Norton I know is in Worcestershire, not Leicestershire. PHILO.

CO-OPERATIVE SOCIETIES.

[3847.]—I AM much obliged to the writers of letters 3775 and 3776, p. 666, for their answers, but I will take the last first, as "E. L. G." seems quite to have mistaken the drift of my inquiry. The suggestion of "Pro Bono" is a good one, if practicable; but a little consideration will show him that so far from there being no difficulty in "so limited a concern" in entering the quantity of every article sold in a book, the fact really is that the difficulty is the greater on account of the smallness of the transactions—*e.g.*, Saturday afternoon—the neighbouring factory has just paid off its hands—there will be five or six customers in the shop at a time for the rest of the day. A. wants 2oz. of tea, 1lb. of sugar, 1oz. of tobacco, 1 pennyworth of biscuits, and a deal besides, amounting perhaps to three or four shillings. B., C., and D. are waiting patiently. Now I ask "Pro Bono" how is it possible for an entry to be made of the weight or quantity of each article sold? and if it were done what are the chances of the sold tallying with the bought weight at the end of the quarter? In large concerns, where a clerk is kept to take the money and book the sales, the system may answer; but anxious as I am to find a "check-system," I fear I must relinquish this one as inapplicable to our case. To "E.L.G." I would say, *Bis dat qui cito dat:* he only promises a solution to my problem, and asks questions. No doubt, though, he is employing the Socratic method, and by answering his questions, I expect to throw a light which shall illuminate both myself and him.

1 and 2. The store I represent is worked by one man (styled manager) and a boy, who are employed to distribute the groceries of the . . . Co-operative Society, so called because its members furnished the capital and "co-operate" through their committee in managing or mismanaging the business.

3. The objects of the society are such as "E. L. G." supposes, and I see no objection to changing its name to the "Distribution League," if any benefit will thereby accrue to the shareholders. I do not see how poor men can be expected to know what exact amount they have expended in provisions in any given year, as they seldom keep such accounts; but as that datum is required only in order to fix the secretary's pay (which in this case is *nil*), that suggestion of "E. L. G." may be passed over. In conclusion, I do not profess to understand clearly "E. L. G.'s" method of co-operation, but I believe the form adopted by our society to be a legitimate and useful one, though without any claim to novelty. About 100 mechanics, &c., club

together, induce their employer to build them a store which they rent at £10 per annum, stock with groceries, &c., and go to work. The distance from a town being nearly five miles, they soon get the trade of the whole neighbourhood, and return £30 to £40 weekly. The said society does not "pay," but the members stick by it. The causes of failure are more patent than the remedy, but they are in hopes of finding a remedy when they meet with an eligible "check system."

F. C. S.

WARMING AND VENTILATING.

[3848.]—I WRITE to describe a warm air ventilating fireplace which I have used extensively in buildings on which I have been engaged professionally as architect: it is called "Lewis's patent warm air-chamber fireplace." The cold air enters the air-chamber at the back or underneath the fire, and can be brought from the external air or from any passage near at hand, and after being made to traverse the air-chamber backwards and forwards by means of gills, comes out warm into the room, or can be conveyed into any other room or passage required by means of pipes. The essential difference between this grate and all others I have seen, and in which, I believe, the patent partly consists, is, that it is complete in itself, requires no air-chamber building, and no more setting than any ordinary register grate.

I have these grates fixed in three sitting-rooms of my own residence, the cold air entering from, and returning warmed into, the hall. During the coldest weather of the severe weather of 70-71 the hall and staircase, three stories high, were nicely aired when only one fire was lit. When two fires were lit they were comfortably warm, and when there were fires in all three sitting-rooms the hall and staircase were as warm as the rooms themselves, and the bedrooms aired also; this result being obtained without using an ounce more fuel than if ordinary grates had been used, and the waste heat allowed to escape up the chimney.

One day when the external air was 25° Farenheit, I tested the velocity and temperature of the air issuing from one of the air-chambers (by means of Negretti and Zambra's standard thermometer and Byron's delicate anemometer) about an hour after the fire was lit. I found the air going in near the hall door at 35° and issuing from the air-chamber at a temperature of 130°, and at the rate of 140 lineal feet per minute, or nine cubic feet raised 91°, or equal to about eighty-two cubic feet raised 10° in temperature a minute; and as the hall and staircase to be warmed contain about seven thousand cubic feet, it follows that when all three sitting-room fires are lit they can raise the temperature of the hall and staircase, &c., 20°, or say from 40° to 60° in an hour after the fires are well burnt up.

There is an entire absence of smoke, offensive smell, or oppressive dryness in the air, the fireplaces being lined with fire-clay tiles.

AN ARCHITECT.

PIANO ALLIANCE.

[3849.]—I SHOULD also be glad to join with other subscribers in some scheme whereby a genuine instrument might be secured at a fair price. I suggest, however, that it might be prudent if we wait a few months, that we may first have the opportunity of seeing what will be shown at this year's Exhibition, as I believe "musical instruments" are to form one of the chief features. I hope, too, that the relative merits of the different pianos and harmoniums then exhibited will be fully discussed in "our" valuable journal, and after such enlightenment, we shall be better able to decide on what special construction of pianoforte to adopt.

BUSY BEE.

DEFECTIVE ORGAN.

[3850.]—IN a recent number was a letter complaining of an organ made by Kemble & Johnston, of Manchester, and asking for advice what to do to it. Mr. Kemble being, I regret to say, dead, I think I may mention a fact which he once related to me, and which may throw light on your correspondent's difficulty.

He said that an organ made by him having got out of order, he went to examine it, and found that through a defect in the hot-water pipes used for heating the building the unfortunate instrument got thoroughly steamed whenever the fire was lighted, which certainly accounted for the state it was in when at length he was asked to see it. As I have mentioned his name I cannot help alluding to his loss as one of "our" correspondents and contributors. He was very fond of experimenting on new devices in his business, and any information which he thereby gained he was always willing to impart to others, and amongst them was the writer of this.

L. C. E.

ORGAN FEEDERS.

[3851.]—THE bellows sketched by "A Young Organist" (letter 3746, p. 642, Vol. XIV.) is not a new invention, having been used both by the English and Continental builders for some years past, but having these alterations:—1. The valves are made to close without springs (in fact, I do not see why those in the sketch which are not inverted should need them); the organ builders do not have any inverted pallets in these feeders—making the top one to draw its wind from the bottom board of the same by leaving a space of about 1½in. between the bottom board of the top feeder and the top board of the bottom feeder; therefore the pallets close by their own weight and the pressure of the wind. 2. The trunk from the bottom feeder is open as far as the reservoir, and a valve is placed on the bottom board of the reservoir just over the trunk, instead of inside the trunk; this also closes by its own weight, &c. 3. The blowing action designed by him would have to be made very strong and heavy if the bellows were large, but a better arrangement is usually employed—viz., having a lever, as in ordinary instruments, working on a fulcrum, placed at any distance from the feeders,

so as to obtain either great leverage, or short traversing distance; this lever is connected to an iron fork (see sketch) the two long arms of which are attached to two gudgeons fixed between the two feeders. Of course, by this plan the reservoir has to be kept at a greater elevation to allow the requisite movement of the lever; and in consequence of this they are sometimes placed in a vertical position at the side of the reservoir, or in a separate chamber (as in the organ at Winchester Cathedral, rebuilt by Hill & Son, blown by water power). I, for my own part, like these feeders, as they give a large amount of wind, and are easily constructed.

E. F. CONRATH.

MACKENZIE'S TOUCH LIGHTENER.

[3852.]—IN the number of the MECHANIC dated Dec. 22, and at p. 346, I notice an article, with illustration, on "Mackenzie's Touch Lightener." This clever contrivance is no doubt of great service in small organs, but I consider it practically useless for large organs. Take, for example, an organ with 13 stops on the great, 14 on the swell, and 8 on the choir. The great organ would require a pallet 15in. by 1¼in.; the swell, 15in. by 1¼in.; the choir, 12in. by 1in. Taking the proportions given in the above-mentioned article, the great organ CC key, with touch lightener and 4in. pressure of wind, would require, say, 10oz. weight to take it down—the swell, with 4in. pressure of wind, would require 10oz. also; the choir, with 3in. pressure of wind, would require 4oz. Now, if the swell be great, and choir to great couplers were drawn, 24oz. would be required to take down the CC key. Octave couplers would, therefore, be quite out of the question. But the pneumatic lever has no limit in this respect, provided it has sufficient pressure of wind. If properly made it is no more complicated than other parts of the intricate mechanism of an organ. I think the pneumatic lever can never be superseded by the touch lightener, as the former is unlimited in its application, whilst the latter can only be successfully introduced into small organs. The promptness of action of the pneumatic lever is another great point in its favour. I have not yet seen the touch lightener working; but I should imagine that when the key is half down there is an unpleasant sensation to the finger, caused by the two surfaces of the touch lightener coming wholly into contact. Can any reader speak on this point?

PNEUMATIC LEVER.

THE MOON'S AXIS.

[3853.]—IN reference to the remark of "F.R.A.S.," that the inclination of the moon's axis to the plane of her orbit *about the earth* determines the amount of libration in latitude, it may be well to notice that the moon really describes *two* orbits—one about the sun, which determines the length of her year, her seasons being dependent upon the inclination of her axis to the plane of this orbit, and one about the earth, which slightly modifies as to shape her orbit about the sun. It is, as mentioned by "F.R.A.S.," the inclination of her axis to this orbit upon which libration in latitude depends. The two orbits are perfectly distinct from each other, the phenomena resulting from one having reference to the moon only, the phenomena resulting from the other being principally witnessed from the earth.

W. R. BIRT.

OCCULTATIONS OF URANUS.

[3854.]—HAD Mr. Clements spent the small sum of *five minutes* in consulting the "Nautical Almanacs" for 1867 and 1868, he would, at all events, have hesitated before he submitted to the readers of the ENGLISH MECHANIC the remarkable query which has drawn forth from "F.R.A.S." the very severe remarks on the probable insane condition of "Captain William Noble, of Uckfield." That the Captain is fully able to demonstrate his own sanity, I have no doubt, for unlike "F. R. A. S.," I have the honour and pleasure of knowing Captain William Noble, of Maresfield, Uckfield, and gladly leave to him, should his eye rest for a moment on the remarkable suggestions to his friends contained in let. 3795, p. 9, the right of a reply. It could rather seem that the concoctor of the query would be the fittest inmate of Hanwell or Colney Hatch, for how he could have ascertained that Uranus was occulted by the moon 187 times in 1867-68, is beyond conception; for in those years Uranus was not once occulted, the only planets hidden by the moon being Mars, Venus, and Mercury. Surely the notion must have originated in his own brain, as there is certainly no foundation for a paper of the title given. Mr. Clements will find a list of Captain Noble's communications to the Royal Astronomical Society in the General Index to the 29 volumes of the monthly notices.

W. R. BIRT.

JUPITER'S SATELLITES AND "F.R.A.S."

[3855.]—MR. PROCTOR is very much mistaken if he supposes, as he seems to do, that I meant anything more than I said respecting this gentleman's astronomical knowledge. All I said was that we—*i.e.*, the majority of your readers—did not know who he is; all I implied was a doubt whether the mere fact of his being a "F.R.A.S." gave such presumption of knowledge as should induce me to place greater reliance upon his authority than on that of Sir John Herschel. If there be anything even apparently disrespectful in that, I beg to disclaim any intention of passing a judgment upon one of whom I know nothing; but I cannot suppose that one who, like "F.R.A.S.," expresses his opinion upon the supposed errors of others with great freedom, would have been offended, even if I had (which I did not) accused him of being seriously in error himself. Neither will Mr. Proctor, I feel sure, be offended by my stating that I think he is not quite correct in saying that Sir John Herschel "only says that the eclipses of Jupiter's satellites are *applicable* to the purposes in question, because they *can* be predicted." He does not say that they "*have been* predicted with the requisite accuracy." The italics are Mr. Proctor's. In my copy of this treatise on "Astronomy," 1833, the words Sir John used are, "This prediction is sufficiently precise and certain to stand in the place of corresponding observation. So that an observer at any station whatever, who shall have observed one or more of these eclipses, and ascertained his local time, instead of waiting for a communication from Greenwich to inform him at what moment the eclipse took place there may use the *predicted Greenwich time* instead, and thence at once, and on the spot, determine his longitude." I presume, as Mr. Proctor seems to say so, that the times cannot be thus determined with such great exactness as Sir John's words imply; but I do not see why "F.R.A.S." should have expressed his surprise that any one relying upon Sir John's authority should suggest resorting to a plan he proposed, when in doubt of a better, which doubt I am sure either Mr. Proctor or "F.R.A.S." could have removed, if they had either of them taken half the trouble to set me right as they have, with very poor success, in trying to prove me wrong. I do not see what other meaning can be put upon Sir John Herschel's words than I put on them, and I still think that if in error, as I suppose I was, I erred in very good company.

PHILO.

LUNAR OBJECTS FOR OBSERVATION, APRIL, 1872.

[3856.]—APRIL 10, Mare Humboldtianum, Gauss Condorcet; April 11, Langrenus, Vendelinus, Petavius Furnerius; April 12, Mare Nectaris, Isidorus, Capella Guttemberg; April 13, Piccolomini, Fracastorius Maraldi, Römer; April 14, Abulfeda, Almanore, Tacitus, Bessel; April 15, Ptolemæus, Alphonsus, Arzachel Timæus; April 16, Tycho, Straight Wall, Thebit Alpetragius; April 17, Plato, Pico, Archimedes, Pallas April 18, Bullialdus, Agatharchides, Gassendi, Sirius Iridum; April 19, Bianchini, Sharp, Mairan; April 20, Campanus, Mercator, Capuanus.

W. R. BIRT.

MERCURIAL VAPOUR.

[3857.]—AT p. 668 Dr. Stenhouse's charcoal respirator is called Dr. Henhurse's. I fear I wrote the name badly, and hope you will allow me to correct it. The invention is a very valuable one, not nearly so well known as it deserves to be. The inventor, like a true philanthropist, seeks no profit from those who use his respirator, and, therefore, deserves the more honour.

PHILO.

[3858.]—THANKS to "Philo" for his attempt to enlighten my darkness. My object, however, is not to ascertain the effects of mercurial vapour on animal life, but to obtain the means of referring to records of experiments if such be in existence, by which the *habitudes* of mercurial vapour have been determined. Perhaps my questions (letter 3674, No. 362, p. 611), were not sufficiently explicit. I am desirous of knowing the weight in grains of mercurial vapour which fills a cubic foot at the following temperatures—32°, 60°, and 212° Fahr.; also the tension of the vapour at the same temperatures.

W. R. BIRT.

THE A 1 CLOCK.

[3859.]—IT is years since I contrived a clock somewhat on this principle. The string of the descending weight passed once round a fixed pulley, the arbor or axle of which carried an hour-hand, and showed the time on a dial. I would recommend such an arrangement to the consideration of Mr. Stanistreet, as an improvement scarcely interfering with the simplicity of his astronomic clock, and adding to its appearance, if not to its efficacy. I fear, however, the effect of changes of weather on the gut may somewhat mar its qualities as a time-keeper.

C. B. FENNESSY.

CHEAP OBSERVATORY CLOCK.

[3860.]—I HAVE much pleasure in replying to the inquiries of your correspondent "Regulator" (query 11250, p. 677), and giving the particulars desired by him and others on the subject of the timekeeper described at p. 630 of "our" last volume.

1. The drawing of the clock is not strictly according to scale, but the dimensions given below will afford the means of correcting it in this respect.

2. The lantern pinions were made as follows:—A short rod of brass (I used a piece of stair-carpet rod) was firmly held in an American die-chuck, and a hole drilled centrally of sufficient size to receive the arbor of the intended pinion. The brass is then turned away so as to form the frame of the pinion, which is exactly like a miniature cotton bobbin or reel. The holes to receive the pinion leaves are then drilled by a drill made of part of a needle of the same size as the leaves are intended to be (I used No. 8

needles). The drill is placed in a small drilling spindle held in the slide-rest, and worked by a fine cord from the overhead pulley, the pinion being meanwhile held by the index of the dividing plate, and after each hole is drilled it is turned one-twelfth or one-sixteenth of the circle by means of the divisions on the dividing plate of the lathe so as to insure equi-distance of the holes, each of which should be drilled quite through both the discs of the pinion at the same operation. When all the holes are thus drilled the pinion is removed from the lathe, and pieces of needles of the same size are inserted in all the holes, and fixed there by running in a morsel of fusible metal as solder by means of the blow-pipe. This is effected in a moment of time, and if the pinion staves are protected by holding round them a piece of moistened sponge, the heat required for soldering them does not even blue the steel, which retains its admirable polish and hardness unimpaired, and they are so firmly fixed in the pinion that the rough ends may be ground off by a grindstone or corundum disc.

3. The clock might be made to go for eight days by the addition of another wheel and pinion; but it would then require a heavier driving weight, and the weight would descend too slowly to be available for carrying the hour hand as in the A 1 clock, the plan of which I prefer in this respect.

4. The "little wheel" referred to by your correspondent "Regulator" is the ratchet wheel, and its pall or click will be seen just on the right-hand side of the ratchet-wheel in the drawing. The click is formed by a piece of watch-spring bent into shape and riveted to the brass plate which holds the ratchet-wheel and pulley. Nothing could work better than this simple and easily-constructed ratchet and click.

5. The gut is joined by hook and eye of the very smallest size. I adopted this plan for the sake of the facility it afforded of taking out any twist which might occur in the cord when new; but there has been none, as the gut was well stretched by heavy weights before it was used, and if the clock should happen to be stopped for any purpose, I shall probably splice the ends of the gut together as preferable, although it works very well as it is.

6. The drill for serrating the sides of the V groove of the centre pulley, and of the ratchet pulley, must be shaped exactly like the groove, though a little larger. The pulley, of brass, when turned and grooved with a deep and narrow V groove, is held fixed in the lathe by means of the index of the dividing plate, and the drill held in the slide-rest and worked from the overhead pulley is advanced so as to notch the groove pretty deeply, and then withdrawn, the pulley being turned by the dividing plate the desired distance (say one-forty-eighth of a rotation), another cut is taken to the same depth, and so on round the circumference. Although this mode of roughening the pulley is very efficacious for preventing the cord from slipping, I attach still greater importance to the position of the guide pulleys shown in the drawing, which make the cord grip the pulley throughout the greater portion of its periphery, instead of merely resting upon one-half the circumference in the usual way.

7. The dimensions asked for are as follows:—The perpendicular height of the clock frame from the upper surface of the seat-board to the apex of the A-shaped frame is 9in., the depth of the frame about 2½in., the diameter of the 120 wheel is 3·48″, of the 96 wheel 2·8″, and of the scape-wheel 2·0″. Diameter of the 16 leaved pinion 0·45, and of the 12 leaved pinion 0·87. The pulley upon the centre-wheel arbor is three inches in circumference, making the descent of the driving weight and "hour hand" exactly 1·5″ per hour, which affords ample space for divisions, showing five minutes or less of time.

8. The plan of the clock is so very simple that it did not occur to me as necessary to send any section of it with the drawing, nor did I even prepare such during its construction. I hope your correspondent "Regulator" will communicate his "new form of maintaining power," which may interest many besides myself.

JOHN F. STANISTREET.

Abercromby-square, Liverpool.

BUCKMASTER, SNAITH, &c.—To "BEACON LOUGH."

[3861.]—SINCE writing my last letter, I have been informed by letter, from a high authority, "that there is no accepted Government class book for chemistry; certainly not the two mentioned. The ones most generally used are Roscoe's 'Elementary Chemistry,' and Barff's 'Chemistry.'" S. BOTTONE.

"VALENCY v. ATOMICITIES."—To "MERCURIC."

[3862.]—THIS correspondent has evidently not read my "Lessons" and letters carefully, or he certainly would not call my attention to points which I have already discussed, or noticed. As, however, his positive assertions on dubious hypothetical subjects might lead to grave misconception and much fruitless discussion, I feel it incumbent on me to point out a few phrases in his letter, hoping by so doing to lead him to ponder more before venturing on such sweeping assertions. 1. The term "atomicity" to indicate saturating power is incorrect, for "atomicity" points to the number of atoms in a molecule. The atom of nitrogen can only contain one atom: hence to affirm that the atom of nitrogen is "pentatomic," or "triatomic" is as great a perversion of words as to state that 1 is 3 or 5. 2. It was "Beacon Lough" who proposed ammonium as a poser, not I. To this gentleman, also, are we indebted for the formula NH_4 (see letter 3420), which, by the bye, is correct as far as it goes, for it represents a known fact—viz., that in this body there are four parts of hydrogen to every one part of nitrogen. 3. Unless "Mercuric" has weighed ammonium vapour and ascertained its density, I fear that he has very doubtful grounds for asserting that $\left\{\begin{matrix}NH_4\\NH_4\end{matrix}\right.$ is a more correct formula than NH_4. Presuming, however, that my correspondent has not made a statement that has no basis or fact, I invite him to give us in our pages the vapour density of this body at 0° Centigrade. 4. While thanking "Mercuric" for the flattering allusion to "ruses" and blunders with regard to phosphorus pentachloride, I beg to refer him to Odling's "Manual" for information on this point. Perhaps he is not aware that the formula usually given—viz., PCl_5, does not agree with its vapour density. I take no note of the ammonium chloride formula, as the one given by "Mercuric" does not concord with its vapour density. 5. With regard to phosphorus being pentavalent in phosphorus acid, I can only say, as I have said before: Our only certain measure for the valency (always supposing there is such a thing as valency, which I am beginning to doubt) of any element, is hydrogen. Now, no compound of the formula of $P'''''H_5'$ is known to exist; only $P'''H_3'$ is known; and we can (I do not mean to say this *is* so) account for the existence of phosphorus acid, without losing sight of the trivalence of phosphorus, thus:

$$\begin{array}{c} H'--O''--P'''--O''--H' \\ \phantom{H'--O''--{}}|\phantom{{}--O''--H'} \\ \phantom{H'--O''--{}}O''\phantom{{}--O''--H'} \\ \phantom{H'--O''--{}}|\phantom{{}--O''--H'} \\ \phantom{H'--O''--{}}H'\phantom{{}--O''--H'} \end{array}$$

I further call attention to the fact that when we base our calculations of valency on any other element except hydrogen, we introduce an element of error into our reasoning. S. BOTTONE.

SEWER GAS.

[3863.]—"MANUS" (let. 3780, p. 667, Vol. XIV.) does not explain in what respect he thinks I have misinterpreted his remarks on sewer gas, but I now guess he did not mean to say what he appeared to say, that the absence of bad smell is proof of the absence of danger. I, like "Manus," have not by me the number in which his remarks appeared, but I remember a statement implying that the escape of sewer gas into a dwelling would be certainly detected by those whose smelling organs are in good order, which seemed to me to give support to the very common and very dangerous notion that what does not stink won't hurt. It is certain that often, and probably always, that which is the real exciting cause of typhoid or pythogenic (filth-begotten) fever is not offensive, though often accompanied by that which is. I am glad to think that "Manus" does not support the erroneous notion, which he appeared to do. Sulphuretted hydrogen, if uncontaminated with organic matter, never caused fever. It has got a bad character by keeping bad company, as is a common case. P. H. HOLLAND.

THE FAIRLIE LOCOMOTIVE.

[3864.]—IN letter 3787, p. 668, "A. G. Boyd" raises objections to the Fairlie locomotive which I think are more than outweighed by other advantages which he does not mention. Before I say more I may as well remark that I do not approve of the Fairlie system, except under peculiar conditions of gauge, traffic, &c. I will now detail some of the advantages which the promoters of the system claim for it. Firstly:—Fairlie claims to get tractive power with his 4-cylinder engine equal to that of two 2-cylinder engines, and at a less cost. There is less machinery and fewer parts required where four cylinders are fixed on one carriage instead of on two. The space occupied is less, and the whole construction more compact, while the weight, being better distributed, tends to increase the adhesion. There are many other minor advantages growing out of the general plan of design which I will not go into now as I have forgotten them. The one great advantage, however, is that fewer men are required—two, or at the most two and a boy, instead of four. This is, of course, a great saving, especially where the system is largely adopted. It is on the point of economy, I think, that Mr. Fairlie should more particularly base his arguments, and not on superior tractive power, as what little gain (and it is little) may be got by his system in this respect is more than counterbalanced by the practical convenience of two separate engines.

For narrow gauge railways the Fairlie system is more particularly applicable, because it is by its form well suited to a compact disposition of parts, which is so necessary in a narrow gauge locomotive.

I have said that the strongest point of the Fairlie system is the question of economy. Now, although at first this may appear to be a great advantage of the system, I think I shall be able to show that it is not so.

The lowest average life of a locomotive is about seven years, and if it can be patched up so as to work for ten years, there will be a considerable saving effected. It is, therefore, the most economical policy to repair defects as soon as they appear, rather than let the engine work itself out, and so be effective for a shorter period. The consequence of this is that on a large line a considerable percentage of the locomotives is always in the repairing shop. Now, supposing a line is worked with 100 locomotives, and that 50 Fairlie locomotives will do the same amount of work, it is obviously preferable to have 100 locomotives with ten of them in the repairing shop than to have 50 with five laid up.

I may not have expressed myself clearly enough in the foregoing. What I mean is, that to work a heavy goods traffic with efficiency, a greater aggregate stock of locomotive power will be required with the Fairlie system than with the old system, although the actual number of Fairlie locomotives would, of course, be less.

A great deal was made of the power of the Fairlie engine in taking a great load up a long incline in the recent trials, but what is the use of dragging a lot of non-paying loads say 90 miles, so that it may come into action to take the train up the last ten miles of stiff incline? It is truer economy to have a bank engine specially for those ten miles. OSA.

[3865.]—A LETTER (No. 3787), signed by A. G. Boyd, appeared in your number for March 15, which should be replied to, and with your kind permission I do not think this can be done better than by asking you to insert the letter herewith, which I received from the writer, one of the gentlemen who conducted the experiments described in his letter, when Mr. John Fowler and others of the Indian Railway Commission went to Wales to test the Fairlie against the ordinary engines on the Festiniog line. Mr. Allan's letter has never been published, and as it bears particularly on the questions raised in Mr. Boyd's letter, I believe your readers would be glad to see it appear in your very excellent journal. R. F. FAIRLIE.

[*Copy.*]

17 & 18, Leadenhall-street, London, E.C.,
August 18, 1870.

DEAR SIR,—Several weeks' absence in the North has prevented me from replying earlier to your request for particulars of the experiments Mr. Spooner has advised you he carried out, at the request of Mr. Glover, railway contractor, Bombay, and myself on the 8th July last.

Mr. Glover having been called on to tender for a line of railway in India, desired some further confirmatory evidence of the advantages of your system beyond that which he had witnessed a few weeks before in company with Colonel Dickens, Colonel Strachey, Mr. Rendell, and others; and as there were what was considered by many at the time most important experiments omitted —such, for instance, as the testing two ordinary engines coupled together, whose combined power and weight should be equal to or about that of the "Little Wonder" —we deemed it expedient to return to Port Madoc, and finally set at rest this question. The experiment referred to had also been omitted by the Russian Commission, as shown in the printed account of their experiments.

With the exception of Colonel Anderson, of Kattiwar, and Monsieur Barossa, of Brazil, no one was advised of our intentions, as we desired, if convenient and agreeable to Mr. Spooner, to leisurely carry out the experiments ourselves with as little inconvenience as possible to him. You will understand, therefore, why you were not informed of our intentions.

At first Mr. Spooner was of opinion that such a trial was unnecessary, as previous experiments with the single engines had established the fact that two of them were not equal to one of yours. But this, after all, I told him was only an opinion, and we considered it would be more satisfactory, having dealt with simple facts all along, to test the matter, and see what it disclosed—if it proved Mr. Spooner's opinion correct, so much the better for the Fairlie engine. But we wanted the facts, and Mr. Spooner very kindly consented that the trial should be made the following day, if sufficient loaded waggons could be got together. It turned out next day that a sufficient number could not be had, consequently eight empty waggons were added to the train to make up a load approximating to that of the "Little Wonder" on the 16th June.

Unfortunately, M. Barossa, who was very anxious to see and report the trials to his Government, was at the last moment unable to attend; but on the morning of the trials, Colonel Dickens and Colonel Strachey, with Mr. John Fowler and Mr. Rendell, arrived at Port Madoc, and on Mr. Spooner's invitation after their return from examining the line, these gentlemen attended the experiments, which took place as follows:—

EXPERIMENT No. 1.—This was made with the "Little Giant" and "Welsh Pony" coupled together and attached to a train made up as follows—

	Tons	c.	Tons	c.	q.
75 loaded slate trucks weighing			183	13	3
8 empty slate trucks weighing			5	0	3
Passengers			1	0	0
			189	14	2
"Little Giant"	10	0			
Tender	1	2			
"Welsh Pony"	10	0			
Tender	1	6			
			22	8	0
Gross load			212	2	2

Both engines started from near the bridge at Port Madoc at 4·52 p.m., with the steam pressure in each at 150lb. The weather was very favourable, being warm and dry.

Both engines slipped much at starting, but on sanding five or six yards of rails they both went off well. At the middle of the embankment the "Little Giant's" pressure was 160lb., then it dropped to 155lb., and rose at far end of embankment to 160lb., after which it gradually increased until the two engines were pul up by the load, when it stood at 165lb. The "Welsh Pony's" pressure fell to 142lb. at the far end of the embankment, and to 140lb. at the Weighhouse, then a little beyond it rose to 144lb., and increased to 150lb., at which it stood when the two engines were pulled up by the load. The speed of the train increased to the far end of the embankment, then gradually diminished as we got round the curve, and when the whole train was on the incline of 1 in 85·65 both engines began to slip, and slipped frequently over this and the next two gradients of 1 in 100 and 1 in 90·51, on which they were pulled up by the load about 50 yards on the Port Madoc side of the Memfodd Gate crossing.

The distance run from the Port station was 1 mile 5 furlongs and 8 chains (nearly one mile of this distance being over the Traethmaur embankment, which is perfectly straight and nearly level), and the time occupied was 12 minutes, which gives an average speed of over 8½ miles an hour.

Everything was done that could possibly be done to get the utmost power out of these two engines; both were in good order, and their fires were strong and clear at starting, and it will be seen the boiler pressures were well maintained throughout. With their regulators full open, the engines made steam fast, whilst their speed slackened on the inclines, and some time before they were pulled up they were enveloped in clouds of steam. The train was allowed to drop down the inclines and run back to Port Madoc, and the "Little Wonder" was then attached to the train in place of the "Giant" and "Pony."

Experiment No. 2.—The train not having been shunted far enough down the line below the station, the "Little Wonder" stood opposite the water tank, and the rails there being always wet and greasy, she slipped considerably at starting. At the first effort, a link broke about twenty waggons from the front; and at the second, another of the adjoining waggon; after which, on sanding six or seven yards of rail, she made an easy and good start, and rapidly increased in speed until beyond the curve at the far end of the embankment, when she gradually slackened over the inclines of 1 in 85·65 and 1 in 100 to a rate of about 10 miles an hour, at which speed she passed the point where the others were pulled up on the gradient of 1 in 90·51, and went half a mile beyond, continuing to do her work well.

At this stage it was quite apparent that the engine had perfect command over its train, and on Mr. Spooner asking Mr. Fowler if he wished to proceed on further, the latter expressed himself satisfied, and at his instance the engine was stopped.

Her steam pressure on starting was 160lb.; it rose to 162lb. and fell to 158lb. at the signal post on the embankment, after which it gradually increased to 165lb. at far end of embankment, to 167lb. at weighhouse, fell to 160lb. at the gate crossing, to 157lb. at second gate crossing, to 155lb. at signal post, then 153lb. a little beyond, and rose to 155lb., at which it stood when the engine was stopped. The start was made at 5·45 p.m., and the stoppage at 5·55 p.m. The distance run was 2 miles 1 furlong and 3 chains, at an average rate of 18 miles an hour. The fires were not so frequently stoked as those of the other engines.

When the engine was stopped, a conversation took place as to whether it could start the train from its state of rest on the incline, and on Mr. Rendell remarking to me that he did not think the engine could do it, Mr. Spooner was asked to try it. Meantime, the driver, concluding that the experiment was over, and having only to return to the Port, lowered the fires and allowed the pressure to fall to 140lb., when the order to go a-head was given; and this being observed, it was decided to raise the pressure to that at which it stood when the engine was stopped. The rails were sanded for five or six yards, and with the gauge standing at 160lb. a good and easy start was made, and at an increasing speed for a quarter of a mile, when she was stopped, at Mr. Fowler's request, the experiment being satisfactory.

When stopped on the first run, the engine was at the head of the gradient of 1 in 90·51 on a curve of 15 chains, and as the heavier gradient of 1 in 82·71 was within 7 or 8 yards, her second start was practically made on that incline, and on it she attained a speed of 5 to 6 miles an hour, and was increasing when stopped, the gauge then indicating a pressure of 170lb.

For the first second or so after starting she slipped three times, with one-fourth of the train still under the brake, after which she again slipped twice, but went away easily, as stated, at an increasing speed.

Such were the results of the trials between the ordinary engines and your double-bogie engine, and they prove undoubtedly that the double-bogie engine, although only 19¼ tons gross weight as against 20 tons of the "Giant" and "Pony," and with a steam force at the rails of about 6 per cent. less in the "Wonder" than in the "Giant" and "Pony," that there is evidently a very great difference in favour of the double-bogie engine over ordinary engines; and from what Mr. Spooner, Mr. Roberts (of the Brecon line), and Captain Luckraft (of the Bury Port line), affirm, from their experience, there is a very considerable saving in fuel.

Now, how such great differences arise I cannot understand. I am prepared to admit there must be a saving, both in maintenance and fuel, by reason of the absence of flange friction from the bogies, and of oscillation, which increases so much (as proved by the experiments of M. de Weber) the normal load on ordinary locomotive wheels; but whence comes the considerable gain in power neither Mr. Glover nor myself are as yet able to fathom.—I am, dear sir, yours faithfully,

R. F. Fairlie, Esq., Westminster. G. Allan.

ELECTRICAL SPARKS.

[3866.]—"Sigma" is, or affects to be, angry with me for not having correctly understood his remarks: perhaps because I did not read them with the close attention he thinks they deserve, but possibly because he did not express himself so clearly as he would have done had he thought more of explaining what he meant and less of showing that somebody else was mistaken. From the same cause, apparently, he has again, at p. 667, left his meaning obscure, at least to me. I do not clearly understand whether he means to deny the possibility of gas being lighted by a spark from the finger, the electricity being unintentionally excited, or to dispute the adequacy of my suggested explanation of the phenomenon. If the former, he places me in the dilemma of either disputing his infallibility or of doubting the truthfulness of my informant; and as she is a pretty young lady, and he may be, for anything I know, a crusty old bachelor, I cannot hesitate which to do. If he means only to dispute my attempted explanation of the mode in which I imagined that the electricity had been excited—namely, by friction of a very dry shoe against a very dry carpet, he may be right, though no other probable explanation occurs to me, and it does not seem to me impossible that in a very dry air, which would carry away electricity much more slowly than our moist air does, electricity of tension enough to light gas might be thus excited.

He is so kind as to warn me of the danger of trying to rub sparks either out of a cat or out of "Sigma." He is mistaken in thinking sarcasm to be his forte. I do not think he will try, and am sure he will not succeed in riling Philo.

MISTLETOE BERRIES.

[3867.]—Since I replied to qy. 10386, about mistletoe berries, I have received a great number of letters, asking for berries, and how, when, and where to plant them, but I could not spare the time to answer them by post, so I hope the writers will not think me unkind in not answering them; but, sir, with your permission, I will reply to some of the questions through the English Mechanic. First the name, *Viscum album*, from the Latin *viscus*, clammy, on account of the sticky nature of the berries. This may be considered the only true parasitical plant indigenous to Britain, as at no period of its existence does it derive any nourishment from the soil, like *Orobanch*, or from decayed bark or wood, like certain fungi and other Epiphytes. Trees on which it grows here: apple, hawthorn, lime, maple, poplar, mountain ash, and acacia. Situation: the finest specimens are seen on trees growing in clayey soil, or near running streams, but sometimes it is found on the sides of the Cotswolds, at an elevation of 600ft. or more above the level of the Vale of Gloucester. It is seen in almost every conceivable position on trees, under the branches, or on the top, and on branches the size of one's finger, to some as large as a man's body. One may frequently see a number of little plants growing in a crevice, but more often some stuck on the smoothest parts of the bark, where, for the first part of their existence, they look like little warts; but after a time, say twelve months, the first leaves are formed, they are somewhat like the seed-leaves of the cucumber in shape. The seeds may be stuck on the trees in either of the first five months in the year, and should be placed on live, clean, healthy bark, as they will not grow on decayed bark, as has been stated by some writers. Plant high enough to be out of the reach of cattle, as it is said by some farmers to cause abortion in cows. There are male and female plants; sometimes both are found on the same tree, and again one tree is seen bearing only males, and another only females; sometimes as many as twenty bushes are seen growing on one apple tree, of various sizes, from 1ft. to 5ft. in diameter. I see no reason why it should not grow on many other trees besides those mentioned above, seeing it thrives on such dissimilar ones. Why one correspondent has failed to raise a single plant from many hundreds of seeds planted, is a mystery; no doubt birds would pick them out, but one would expect a few out of so great a number to escape them. Where birds are suspected of taking the seeds, a little matting may be tied over for protection. I think it would be better to plant the seeds on the shady side of the tree, in dry soils, and sunny aspects. R. Green.

A PLEA FOR HOUSE PLANTS.

[3868.]—Though "L. S. F." (letter 3792, p. 668) is quite correct in maintaining that plants in houses improve the air, I much doubt the possibility of having so many in any dwelling as to produce any appreciable effect upon the proportion of carbonic acid; neither do I agree with "L. S. F." in attributing the ill effect of close air wholly or chiefly to the excess of carbonic acid, though the proportion of that is not a bad measure of the degree of closeness. I believe the injury is almost entirely caused by that which certainly produces the feeling of closeness, the organic matter contained in pulmonary and cutaneous perspiration. When the watery vapour, with the organic matter combined with it or carried by it in a close room, is condensed with cold, the feeling of its closeness is greatly diminished, without any diminution of the carbonic acid, and if a larger proportion of that acid than is ever found in inhabited rooms be mixed with air, it produces no appreciable effect, if it be untainted with organic matter.

"L. S. F." probably meant to say that carbon is the solidifying principle of most substances possessing life, and wrote "all" inadvertently. "L. S. F." states, inadvertently of course, that carbon is the solidifying principle of all substances possessing life. He meant of most vegetable substances, not remembering at the moment that our bones, the most solid parts of our body, are so because of the phosphate and carbonate of lime they contain, and that some, both animal and vegetable living substances, are rendered rigid by silica, and by other matter than carbon. Though plants give out carbonic acid at night, the quantity is too small to be injurious. Philo.

VOLCANIC MOUNTAINS V.—BOILING FOUNTAINS AND LAKES.—UNDERGROUND SOUNDS.

[3869.]—In the eruptions of mud volcanoes, spoken of in the former letter 3794, p. 668, Vol. XIV., a frequent ingredient is boiling water. There are, however, several instances in which there are thrown up boiling waters, that are not at all intermingled with mud, but in which the water is either pure or impregnated with some mineral which it holds in perfect solution. Of this nature are the Geysers of Iceland and California, as mentioned in letter 3625, No. 361, p. 585. In New Zealand there is another variety of this phenomenon: the boiling water issuing forth not in intermittent jets, as in the Geysers, but in perpetual flowing springs, forming lakes, in which the water remains at the boiling point; these springs and lakes are to be found at Rotomahana. There are several basins raised, one above the other, and strange, all higher than the large lake; the highest is of an oval form, and about 250ft. in circumference; it is filled from an opening at the height of about 100ft. above the level of the lower lakes. At various stages below this upper basin are numerous other springs, from which several similar basins are filled; the whole of these basins empty themselves into the lake below, and the water in all of them is nearly boiling hot, giving forth with a hissing noise volumes of white vapour. These waters are richly impregnated with carbonate of lime, which has formed all round the margins of the basins beautiful incrustations of snowy whiteness. The sand round the lakes is very warm on both banks of the river Waikato; also in this neighbourhood are found numerous basins full of boiling mud or slime, which cannot be approached save with extreme care, owing to the softness and slipperiness of the soil. The largest of these basins is of an oval form, 14ft. long by 8ft. wide, and about as much in depth; it contains hot mud of a bright red colour, being strongly impregnated with oxide of iron; large viscous bubbles are continually rising to the top, and on bursting they emit a fetid sulphurous smell, and in many instances are nearly akin to those of a mud volcano. The underground soundings produced by volcanic forces are very remarkable. For the most part these are the preludes either of shocks of earthquakes or of volcanic eruptions. Those for months preceded the upheaval of the volcano of Jorullo (or Jorullo Monument).

Don Pedro di Jorullo was a Mexican gentleman, who lived about the middle of the last century; his residence was about ninety miles from the coast of the Pacific Ocean, westward of Mexico. In the beginning of the year 1759, underground rumblings were heard, and frequent shakings of the ground, which lasted fully two months, and then rested till September 28, when louder rumblings, like those of thunder, were heard, which caused the Indian servants to flee to the mountains. Next morning they saw that an immense tract of land had been upheaved fully three and a half miles square. The upheaval assumed the shape of an inflated bladder. At the edges this singular elevation rises only about 39ft. above the level of the plain, but so great is the general convexity of the mould that towards the centre it swells up to 524ft. above the original level. At this eruption thick clouds of ashes rose into the air, illuminated by glowing fires beneath, and the surface of the ground seemed to swell into billows like those of a tempestuous sea. Into the vast burning chasms whence these ejections were thrown two rivers plunged into contact, but the water only increased the violence of the eruptions; it was thrown into steam with explosive force; great quantities of mud and balls of basalt were ejected. On the surfaces of the swollen mud were formed thousands of small cones from 6ft. to 10ft. in height, and sending forth steam to heights varying from 20ft. to 30ft. There are other cones, particularly one, which is 1,600ft. high; this constitutes the volcano of Jorullo.

The crater of this mountain (or cone) sent forth vast torrents of molten lava, and it still continues. Many times when passing this scene we paused and reflected over its past history. About a month before the great mud eruption from Tunguaragua, on the 4th of February, 1797, there proceeded from the interior of that mountain noises of the most fearful kind: these would occur suddenly. They were heard by Antonio Pineda, the naturalist, who was there at the time, and they led him to foretell the approach of some great convulsion.

It is stated by Humboldt that on the grassy plains of Calabose, on the banks of the Rio Apure, a tributary of the Orinoco, there were heard over a large extent of country loud underground thunders, unaccompanied by any shaking of the ground, while some streams of lava were being poured forth from the crater of Morne-Garou in the island of St. Vincent, at the distance of no less than 632 miles. There have, nevertheless, been instances of the existence of such underground noises without their having been followed either by an earthquake, by a volcanic eruption, or any other outward appearance whatever. One of the most remarkable cases of this kind is that mentioned by Humboldt as having occurred at Guanaxuato, in Mexico, a mountain city, situated far from any active volcano. He states that noises began on the 9th of January, 1784, and lasted about a month. The sounds were at first neither very loud nor frequent, but from the 15th to the 16th of

January they resembled continuous low rolling thunder, alternating with short loud thunder-claps. The sounds then gradually died away.

A still more singular phenomenon occurs on the borders of the Red Sea, at a place called Nakous, where intermittent underground sounds have been heard for centuries. It is situated about half a mile from the shore, whence a long reach of land ascends rapidly to a height of about 300ft. It is about 26½ yards wide (from personal measurement), and resembles an amphitheatre, being walled in by low rocks. Sounds at this spot of underground rumblings occur regularly at intervals of about half an hour's duration. They first resemble a low murmur, but ere long there is heard a loud knocking, somewhat like the strokes of a bell, and this continues till the land is seen to move. The explanation of this curious phenomenon given by the Arabs is, that there is a convent under the ground there, and that these sounds are those of a bell, which the monks ring for prayers. So they called it Nakous. Philosophers attribute the sounds to suppressed volcanic action, probably to the bubbling of gas or vapours underground. RALPH LOWDON.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10578.]—**Alexandra Palace Organ (U.Q.).**—I send, as promised, specification of the organ erected by Mr. Henry Willis in the Alexandra Palace, Muswell-hill :—

GREAT ORGAN.

1. Double Diapason, 16ft.	11. Quinte Octaviante, 2⅔ft.
2. Bourdon, 16ft. tone.	12. Super Octave, 2ft.
3. Open Diapason, 8ft.	13. Piccolo, 2ft.
4. Open Diapason, 8ft.	14. Sesquialtera, 5 ranks.
5. Open Diapason, 8ft.	15. Mixture, 3 ranks.
6. Viol di Gamba, 8ft.	16. Trombone, 16ft.
7. Claribel, 8ft.	17. Bombard, 8ft.
8. Quinte, 5⅓ft.	18. Trumpet, 8ft.
9. Principal, 4ft.	19. Posaune, 8ft.
10. Flûte Traversière, 4ft.	20. Clarion, 4ft.

SWELL ORGAN.

1. Double Diapason, 16ft.	11. Twelfth, 2⅔ft.
2. Bourdon, 16ft. tone.	12. Fifteenth, 2ft.
3. Open Diapason, 8ft.	13. Sesquialtera, 5 ranks.
4. Open Diapason, 8ft.	14. Mixture, 3 ranks.
5. Salcional, 8ft.	15. Contra Posaune, 16ft.
6. Lieblich Gedact, 8ft.	16. Contra Fagotto, 16ft.
7. Flûte Harmonique, 8ft. tone.	17. Cornopean, 8ft.
	18. Trumpet, 8ft.
8. Flûte Octaviante, 4ft.	19. Hautboy, 8ft.
9. Flûte Traverso, 4ft.	20. Voix Humaine, 8ft.
10. Principal, 4ft.	21. Clarion, 4ft.

CHOIR ORGAN.

1. Contra Gamba, 16ft.	9. Gemshorn, 4ft.
2. Viol di Gamba, 8ft.	10. Viola, 4ft.
3. Salcional, 8ft.	11. Lieblich Flöte, 4ft. tone.
4. Claribel, 8ft.	
5. Flûte Harmonique, 8ft. tone.	12. Flageolet, 2ft.
	13. Mixture, 3 ranks.
6. Lieblich Gedact, 8ft. tone.	14. Corno di Bassetto, 8ft.
	15. Trompette Harmonique, 8ft.
7. Vox Angelica, 8ft.	
8. Flûte Octaviante, 4ft.	16. Clarion, 4ft.

SOLO ORGAN.

1. Violoncello, 8ft.	8. Bombardon, 16ft.
2. Viola, 4ft.	9. Trumpet Harmonic, 8ft.
3. Flûte Harmonique, 8ft. tone.	10. Ophicleide, 8ft.
4. Flûte Octaviante, 4ft.	11. Bassoon, 8ft.
5. Concert Flute, 4ft.	12. Oboe (orchestral) 8ft.
6. Piccolo, 2ft.	13. Clarionette, 8ft.
7. Claribel, 8ft.	14. Clarion, 4ft.

PEDAL ORGAN.

1. Double Diapason (open wood), 32ft.	7. Contra Basso (open wood), 16ft.
2. Double Diapason (open metal), 32ft.	8. Octave (wood), 8ft.
	9. Principal (metal), 8ft.
3. Sub-Bourdon (wood), 32ft. tone.	10. Super Octave, 4ft.
	11. Sesquialtera, 3 ranks.
4. Open Diapason (wood), 16ft.	12. Mixture, 2 ranks.
	13. Bombard, 32ft.
5. Violon (metal), 16ft.	14. Trombone, 16ft.
6. Bourdon (wood), 16ft. tone.	15. Ophicleide, 16ft.
	16. Clarion, 8ft.

COUPLERS.

1. Solo to Great Organ.	9. Pedals (in Octaves) on Stops Nos. 14, 15, and 16.
2. Sub-Octave Solo.	
3. Super-Octave Solo.	
4. Solo to Choir.	10. Pedals (in Octaves) on Stops Nos. 10, 11, and 12.
5. Swell to Great, Unison.	
6. Swell to Great Super-Octave.	
	11. Solo to Pedals.
7. Swell to Great Sub-Octave.	12. Swell to Pedals.
	13. Great to Pedals.
8. Choir to Great.	14. Choir to Pedals.

The compass of the manuals is C C to A, 58 notes; and of the pedal, C C C to F, 2½ octaves, 30 notes. There are 6 pneumatic pistons to each clavier, which arrange, in fixed selections, the stops of each organ by the pressure of the finger. There are also several pedals which control the admission of wind to the various organs. The wind is derived from bellows placed in the basement; two of these are blown by a steam-engine of twelve horse-power, and supply ordinary pressures of wind. Another bellows is of prodigious strength, and blown, in connection with a vacuum apparatus, by another engine of eight horse-power. From these bellows the wind passes to 24 reservoirs placed in close proximity to the organs they are to supply. The pneumatic-lever is applied both to the manuals and pedal, as also, upon a new principle, to the draw-stop action. —E. F. CONRATH.

[10616.]—**Oleate of Soda.**—In reply to "E. W. B., Peckham," I beg to inform him I have at last found a chemist who professes to keep it in stock. I think upon analysis it will prove to be olive oil soap. Many thanks to "E. W. B." for his kindness.—SOAP BUBBLE.

[10646.]—**Cream of Tartar (U. Q.).**—Take grape juice and let it ferment, and cream of tartar will be left in the form of an argol. Dissolve the argol in hot water, to which add charcoal to take up the colouring matter, then by boiling and filtering a clear colourless solution is obtained, from which, on cooling, the cream of tartar separates in the form of crystals.—GIG-LAMPS.

[10675.]—**Colouring for Outside Work (U. Q.).** —To mix stone colour for outside work, grind whitelead with raw oil, and add umber as stain. Thin the colour with turps, and put patent dryers to it.—H. B. E.

[10684.]—**Lacquering Brasswork (U. Q.).**—Seeing that this is in the "unanswered" column, I reply: 1st. Why doesn't "C. H. R." follow out the directions already given? 2nd. Carriage work is not lacquered, with the exception of a few occasional armorial bearings, such as hammer-cloth crests, &c.—J. A.

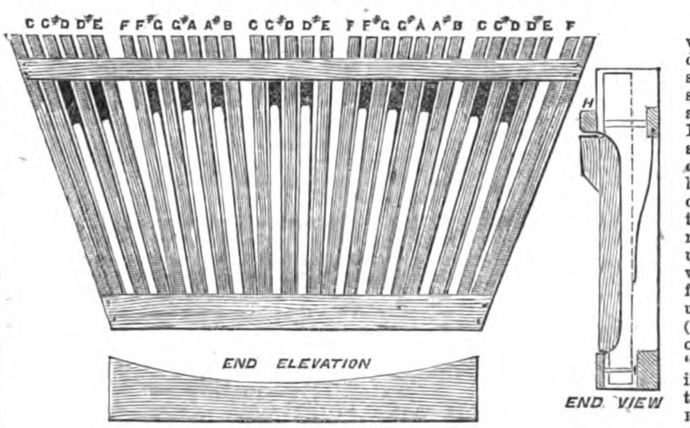
[10692.]—**Terra-Cotta (U. Q.).**—The first process in ordinary preparation is that of grinding the clay used for the purpose, for which the best are the clays of Devonshire, and the brown and blue clays of Dorsetshire; it is then submitted to the mill in the same condition as taken from the pit. From the mill it is removed and placed in vessels, where it is subjected to the action of water, after which it is baked. It may then be mixed with silica in various proportions according to the articles it is intended to form. This silica is made by grinding flint or coprolites, or it may be a mixture of sand used. If the preparation be required for fine work, it is then that washing and evaporation are necessary, but if only for common articles, the proportions of the compound may be mixed in the shape of dry powder, after which a small quantity of water is added, and then the whole may be kneaded or pugged in a mill. As different clays contract in the kiln, the mixture must be complete, or from shrinkage the article will certainly crack. After the clay, be it fine or coarse, has been taken from the slip, kiln, or the mill, it should not be used for four days. It has now two more operations to undergo before it is perfectly ready for use. The first is to beat it with an iron bar. The second is undertaken for the purpose of expelling the air that may have formed a lodgement. This is called wedging, and is performed by cutting the clay in pieces by means of a wire, and then throwing the several portions with force on the mass. Any sculptor might now model a figure in this clay. The greatest risk to terra-cotta compositions is drying. If an ornamental work be distorted in drying, it is destroyed, but this is not so with very common articles, which may be dressed by a carver so as still to be available. The shrinkage in drying is about three-quarters of an inch to a foot, in firing three-eighths of an inch to half an inch in the foot. The consumption of coal is enormous, averaging one ton and a half to each ton of ware to be fired, some of which require three days at a white heat. The revival of terra-cotta manufacture in England is due to the energy, enterprise, and intelligence of two of the "fair sex," the Misses Coade, of Lyme Regis, who, nearly ninety years ago, constructed an establishment in the vicinity of Lambeth, which by their perseverance and good management attained a degree of celebrity. I have seen some remarkable designs in terra-cotta, such as the ornamented columns in the refreshment-rooms at South Kensington. They, I believe, were executed by Messrs. Blanchard, who have carried terra-cotta manufacture to a degree of excellence never dreamed of by early terra-cotta workers. They patented a fire-proof staircase, the great merit of which is that it does not crack and break like stone under the combined ordeal of fire and water.—H. B. E.

[10754.]—**Velocipedes.**—I am now working out one of the thousand and one designs for motive carriages, which I planned when the "veloce mania" was raging, and I thought, on reading "W. R. S.'s" reply to this query, on page 648, that, perhaps, we are both working upon the same principle; mine is a tricycle, devoid of cranks, embodying both power and speed, and just the thing to meet the requirements of Mr. Browett's friend. "A. A. M.," page 619, states that he finds the forward push with the leg to be the best motion for velocipedes; this I rather doubt, it may be superior to that used on the common bicycle; but has he ever tried the old-fashioned vertical tread? I think if he does try it, he will find it superior as regards power, if not so easy a motion for the legs. I remember, when a youngster at school, not half a score years ago, in that locality four-wheelers with vertical tread were in general use, and I have no doubt they are so now, which for speed would put to shame the modern two-wheeler; and, indeed, I have seen its ancestor the "dandy-horse" propelled at a greater speed, which affair, with its rupture-producing and awkward kicking motion, I could never manage nor appreciate. If Mr. Browett's friend wishes to have a crank velocipede, or rather manumotive carriage, allow me to tell him that for ease and power combined a rowing motion is far the best. Both the steering and propulsion of the machine can be done with the hands, and a much longer crank can be used, if necessary, than by any other motion. By a forward push, I suppose "A. A. M." means a horizontal motion, the same as recommended by Mr. H. Reveley in one of the back volumes of "ours." If so, I should like to see his offered sketch.—FREDERIC W. SHEARING.

[10769.]—**Food for Rabbits.**—If "Rusticus" will take the trouble to well dig and manure a few square yards of land, and sow chicory in drills about a foot apart, he will not want for green meat for his rabbits. It may be cut every month or six weeks during the summer.—QUERCUS.

[10807.]—**Gearing Waggon Wheels.**—Many thanks to "Wheelwright" for answering my query; but I have one more question to ask him, and that is—if he had a wooden armed axle to put in, how would he line it out—by one line, as some do it, and get the hollow and length by same line? Does the height of wheels make any difference to hollow and length of bed? Supposing he had to put two new axles to a waggon, would he have the front axle the same length as the hind ones, to make them look straight on the fronts and track the same? A sketch would oblige.—YOUNG WHEELWRIGHT.

[10841.]—**Radius of Surface of Object-Glass.** —I am much obliged to Mr. H. T. Vivian (p. 670, Vol. XIV.), and for his former letter as to finding the two interior surfaces, which was just the formulæ I was short of. He has kindly given me in his last letter all the four surfaces, but I would have been glad if he had just stated the intended focus: is it for 70in., or less? I believe now that the finding of the dispersive ratio would not have been a doubtful matter if I had used a properly corrected eyepiece, not a simple lens. Would Mr. H. T. Vivian advise me to go over this all important matter again, or is he satisfied, with what I have stated, the refractive index is correct? I am in doubt about another matter. Sir J. Herschel says the foci of the lenses in the achromatic eyepiece ought to be as 3 to 2. A book I have seen says 3 to 1. Which may be right? There is a great difference in these proportions.—W. H. CASH.



[10855.]—**Pedal.**—I herewith inclose sketches of radiating and concave pedals, scale ¾in. to the foot; they should be made of 1in. birch, and the sharps should rise 1½in. at the highest point above the naturals. The pins on which the pedals work can be made of ¼in. round wire or old stair rods about that size; two will be required for each note, one at the back and under the stool, and one working in a mortice in the front end of the pedal, just under the thumping rail (marked H); the springs are of ⅛in. iron spring wire. If "Pedal" requires further information, I will endeavour to send it.—E. F. CONRATH.

[10863.] — **Sulphuric Acid.**—ERRATUM. — To make 7 tons of vitriol per week, 2 tons of sulphur (not 20) must be burnt weekly.—GEORGE E. DAVIS.

[10871.]—**Past Transits of Venus.**—In further reply to Mr. Lowdon's inquiry as to the transit of Venus on June 6, 1761, I find from the second vol. of Brewster's "Ferguson's Astronomy," that the sun's place was about 15° 36' of Gemini. The transit was observed at Greenwich by the then Astronomer Royal, Dr. Bliss; in London by Mr. Short; at Hackney by Messrs. Ellicot & Dollond; in Spital-square, London, by Mr. Canton; at Liskeard, in Cornwall, by the Rev. Richard Haydon, and by other persons at various places. It appears that Mr. Short took "an incredible deal of pains in deducing the quantity of the sun's parallax from the best of those observations which were made both in Britain and abroad; and finds it to have been 8·52″ on the day of the transit, when the sun was very nearly at his greatest distance from the earth; and consequently 8·65″ when the sun is at his mean distance from the earth." (P. 115.) "At Stockholm Observatory, latitude 59° 20½′ north, and longitude 1h. 12m. east from Greenwich, the whole of the transit was visible; the total ingress was observed by Mr. Wargentin to be at 8h. 39m. 23s. in the morning, and the beginning of egress at 9h. 30m. 8s.: so that the whole duration between the two internal contacts, as seen at that place, was 5h. 50m. 45s." (Pages 112 and 113.) Elements are given for projecting the transit, but as they would occupy a large space, and probably be interesting to but few of the readers of the ENGLISH MECHANIC, I do not now send them, but should Mr. Lowdon wish for them, and his address be communicated to me, I shall have pleasure in forwarding them to him. This transit appears to have been the second only which has been observed. The first one known to have been observed took place in December, 1639, when Mr. Horrox observed it at Hool, near Liverpool, and his friend Mr. Crabtree at or near Manchester.—C. W. M.

[10873.]—**Tooth Stopping.**—Your correspondent "Dentiste" is at fault in stating that a good amalgam for the above purpose should consist of equal parts of silver and tin. The proportion should be fine silver 4½ parts, tin leaf 2½ parts, but the superior amalgams contain gold. Chemically pure mercury should be used; that which is commonly sold as pure is known to contain lead, antimony, &c., which impurities cannot be separated by distillation, and if used quite alter the compound, and cause it to become discoloured in the mouth.—F. GRAHAM YOUNG, Surgeon-Dentist.

[10897.]—**Boilers.** — It is impossible to answer "Comjee" exactly in the manner he desires. Which is the *best* boiler depends entirely on what it is required to do; but "Comjee" cannot go wrong if he uses the ordinary "saddle-back" for moderate lengths of piping, and the "tubular" where the piping is reckoned by "miles." There are as many boilers as quack pills, and their advantages as described by the vendors require to be taken with a large grain of salt.—SAUL RYMEA.

[10927.]—**Sealskin.**—"Watts" must get some mahogany sawdust from the steam saw-mills, and with plenty of this sifted fine, and perfectly dry, he must soundly rub his sealskin for two or three hours in a tub or pan, working hard with sleeves up; then beat out the dust with a light cane, when he will find it clean probably sweet; but if not, he must take charcoal, reduce it to powder, and put the skin in a box with a layer of this an inch or more thick, under and over it on both sides of skin; put it by for six weeks, then take it out and clean it off with sawdust as before. This latter was till now my own secret for deodorising skins.—PRACTICAL FURRIER.

[10939.]—**Sealskin.**—How to distinguish, quotha? Not so easy! But *nil desperandum*. The skins you may know by their size, 3ft. to 4ft. long, and two fin-holes in the sides. In pieces it may be known by its soft velvety feel under the hand, but best by the shining silky appearance and golden brown colour of the fur under the dyed surface, to be seen by blowing into it; all other furs excepting sea-otter having a dull woolly look underneath. The furs most like seal are dyed plucked otter, and sea-otter pups, both more valuable. Dyed nutria and beaver look rougher, are longer in the fur, and brown and blue underneath. Dyed musquash is too shining on surface, blue under; it also springs back when rubbed the wrong way. Dyed sheared rabbit is much too harsh to be mistaken for seal, and dyed mole, though beautifully soft, may be known by its small size and the blue underneath.—PRACTICAL FURRIER.

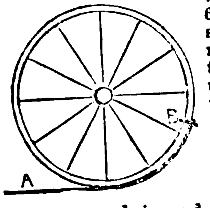
[10956.]—**Musical Box.**—If "Il Trovatore's" musical-box is a large one, he must get some watch hairspring wire, and pin a small length under the tooth, and bend it to form a curve of half-circle like a D laid thus ᗜ, but do not let it quite touch the point of tooth nor stand further out, or it may be drawn up with the pin, but so that the pin in roller will touch damper first. If a small box (and for lesser notes in large ones) he must use a quill split no broader than the tooth point scraped thin, and cemented to the tooth with shellac, dissolved in spirits of wine or wood naphtha, but do not cement it to the extreme point, but let it have a little spring.—H. B. B.

[10966.]—**Doubling Frames.**—I quite agree with "A New Correspondent" in what he says on p. 646, Vol. XIV., about doubling 40 and 60 from the cop, but I am doubling 80 and 100, and they are continually breaking at the nose of the cop. The rollers are 1⅜in. diameter, and they make nineteen revolutions per minute. The spindle makes 4,080 per minute, and there is a great deal of snarling between the rollers and the spindle. I have plenty of drag on the bobbins. When the first layer is going on the bobbins and gets nearly to the bottom, and when the travise is turning, two-thirds of the end snarls and breaks down. Any information respecting the same would oblige—A FAITHFUL WORKMAN.

[10982.]—**Rock Inscriptions.**—A few years ago Mr. F. Good, the well-known publisher in the Minories, went to Syria, and amongst other places visited the district of Sinai, and photographed the Wady Mokattab (the Written Valley). Those photographs are remarkable, not alone for the peculiar interest of the locality and objects they are transcripts of, but even for their artistic beauty, sharpness, and general excellence. It is rarely that we see photographs taken of English scenery, where the manipulator has or can have every help and convenience of chemicals and mechanical appliance, equalling those views from the remote, sterile wilderness of Syria, in definition, purity, and brilliancy. They have been issued as stereograms by Mr. Good; amongst them are slides of the written rocks, and the most remarkable of the "wadys" (valleys or dry watercourses). I suggested to Mr. Good to employ his valuable negatives for the production of lantern transparencies, and although I have not seen them, I have reason to think he has adopted my recommendation.—EDWARD B. FENNESSY.

[10996.]—**How to use a Book without Hands.**—The misfortune that has happened to our friend may result in his becoming very handy with his other limbs happily spared—not that I am going to suggest that he should make an exhibition as I have seen—viz., writing, firing off a gun, and shaving himself with his remaining limbs. But for his sake I fancied myself minus hands and arms, and thought, now what shall I do? The ENGLISH MECHANIC lay before me, and I managed to turn over the leaves quite easily with my lips, using the upper lip for the upper corner, and the lower lip for the lower corner of the sheet. Here no machine is required, or would get out of order, and it is the most natural way as far as I can see, for he can carry his paper or book quite independent of his friends, and he will find many other things that he can do probably much quicker than could be suggested to him; for is not necessity the mother of invention?—FIDDLER.

[11009.]—**Bending Tires.**—Machines for bending tires have appeared in back volumes. (See pp. 560 and 681, Vol. X.) The sketch sent is a plan I saw used by my pater's workmen, when the machine they generally used was out of repair. It is very simple and light—tires can be bent very quick by it. A is the tire, C is an old carriage wheel (if less than the size required it is no disadvantage), B is a horse-shoe put round rim and tire, holding them together. By turning the wheel the tire is bent.—F. W. SHEARING.



[11026.]—**Defective Plating Solution.**—No plating solution is really useful without a separate battery. Dissolve nitrate of silver (1oz.) in clean rain water (half a gallon). Precipitate with solution of cyanide of potassium (do not add more cyanide than is necessary to precipitate; the process must be slowly and carefully performed); wash precipitate four or five times; take up with solution of cyanide, add water to make one gallon, add about 2oz. more cyanide. Set resulting solution aside for two or three days to settle, which is better than filtering. I shall be very glad to give more minute directions for making solution, and also for working it, if desired. I have obtained more help from Gore than from Watts, but find *experientia docet* the best guide.—J. A.

[11028.]—**Pocket Aneroid Barometer.**—Many thanks for the replies given. In reply to "J. A.," the thing wanted is one convenient for the pocket, and able to give, within a yard, the height of cliffs or hills, &c. I should much like some of the results of his tests that he speaks of.—CAMPANILE.

[11031.]—**Model of Church.**—I heartily thank Henry Newman for his kind offer, and shall be glad to avail myself of it. I want to have eight bells to play five minutes. I should like them to play both tunes and chimes, any or as many tunes as you like will do. If not possible for both, I prefer chimes. Height of steeple, 19in.—MODELLER.

[11037.]—**Weight of Metals per Foot.**—As a cubic foot of water weighs 62·34lb. = 997·44oz., or nearly 1,000oz., the weight in pounds of a cubic foot of any substance may be known very nearly by dividing its specific gravity (water being taken at 1,000) by 16, a rule very easy to remember, and sufficiently accurate for most purposes, but so well known that it has probably been already published in your pages.—PHILO.

[11044.]—**Removing Powder and Shot from the Skin.**—If "Abby" has any running wounds from gun-shot, apply milk, or if healed, milk, pricked into the coloured parts the same as ink is used for tatooing, will, I have been informed, perfectly eradicate all colour, it taking the place of the ink, coal, or powder which colours the flesh. A schoolmate of mine has perfectly got rid of marks on his arm in this way.—W. H. M.

[11048.]—**Magic Lantern Sheet.**—It is very presumptuous to speak after a correspondent like Mr. Tonkes, but if the querist is going to perform in a room, he will find a sheet dipped in water will make a "mess;" it drops on the carpet and wets it through. I should advise simply to sprinkle the sheet, leaving no part untouched. If he doesn't warm his lenses, he will, even with a wet sheet, get a cloudy picture at first.—HEDERA.

[11052.]—**Rising and Setting of the Moon.**—Have not your correspondents forgotten that the moon's horizontal parallax enters as an element in the computation of her rising and setting? A table of lunar semi-diurnal arcs, including the effect of refraction, is necessary.—W. R. BIRT.

[11057.]—**Watchmaking.**—Would "Independent Chronometer" please say why is there oil put on the escape wheel of a Geneva lever, seeing that the friction is the same in regard to the ruby pin and fork? The friction in both cases works between steel and ruby stone. He might just as well say "J. O." would do well not to oil the staff holes if the pivots were well polished. It is a well-known fact to every practical man that when oil thickens on many parts of a watch it interferes with its correct time. The best remedy, I find, for that is to have it removed and renewed with fresh oil.—C. CAMPBELL.

[11068.]—**Moth v. Fur.**—As some replies have appeared, allow me to affirm that I often take in furs with moths in, although protected by pepper, camphor, Russian leather, colocynth, or bitter apple, cayenne, cedar, Keating's powder, &c. Now preventives to moth must be either powerful poisons or pungent volatile oils, or spirits, and these, though answering very well in a small way in private houses, would never do in a shop, for if one uses the former, as arsenic or corrosive sublimate, in sufficient quantity to be effective, it will as certainly destroy him as my little friends the moths: and if the latter, as paraffin, creosote, turpentine, or camphor, the smell will drive every one out of the shop, and make the furs unsaleable. Furriers keep their stock by sheer hard work, as follows:—The furs are laid on a table, and rapidly beaten over with a cane in each hand, until neither dust nor hair is seen to fly, the hair is then combed straight, and they are put away. This is repeated every fortnight during the summer, and the hotter the weather, the harder we work. But practice brings dexterity (blisters on hands first), and stock well kept is always half sold. In this way, and in this way only, I can assure "One" I do, and he may keep a stock worth £3,000 always ready for immediate sale.—PRACTICAL FURRIER.

[11093.] — **Champagne Stains.**—Try benzine collas, which may be bought at any druggist's for a trifle.—H. B. E.

[11107.]—**Table of Dates.**—What Mr. W. R. Birt (p. 674, Vol. XIV.) wants could easily be supplied on the same principle as the table I gave before—that is, for the number of days from any time of one year to the same time in any other year, whilst the first table would supplement the other for finding the number of days from any one day to any other.—H. G. M.

[11113.]—**Weights of Wind in the Organ.**—The usual method of obtaining various pressures of wind from one pair of feeders is by making the feeders to supply the heaviest pressure reservoir, and this reservoir feed the several lighter weights, which will, of course, be first inflated in the order of pressure from light to heavy. In each of the lighter reservoirs there is a self-acting valve connected to the top board, so that when the bellows is fully distended, this valve is closed so that no more wind can enter from the heavy pressure until some of lighter are used. Thus, the lightest reservoir is kept full so long as there is any wind in the heavier. It is not absolutely necessary to use expanding wind trunks, but they are preferable, if the bellows lay exactly over one another as the wind can go direct from the top of one reservoir to the bottom of the other. I hope that this explanation will be understood by "W.," if not, I will send him a sketch of the arrangement.—E. F. CONRATH.

[11120.]—**A Question of Sight.**—I am no astronomer, and therefore, perhaps, I do not understand the "A. J. V. G.'s" supposition on p. 674, Vol. XIV., of the sun being equivalent to a luminous point, but to my mind it would seem, on the contrary, that the sun, being considerably larger than the earth, would naturally throw a shadow in the form of a convergent cone surrounded by a penumbra.—H. G. M.

[11120.]—**A Question of Sight.**—We are told that Charles II. put a catch question to the Royal Society in its early days, and "E. L. G." recently came to grief over quoting that event erroneously. I am inclined to give "Fiddler" the credit of imitating the royal scamp, and of putting an absurd question for the purpose of seeing how much wisdom would be exercised about it. At all events he has succeeded in illustrating the fact that there are a number of people always ready to discuss any nonsense seriously, and to take a joke or ironical expression as an argument worthy of serious demolition. Two columns of close print contributed by ten people (including one diagram) over a question which would be reasonable if asked by a child six years of age! The astute "E. L. G." even falls into the trap, and proceeds to demolish poor "A. J. V. G." in pure unconsciousness of the obvious fact that the latter was laughing at the question. And then J. Barwick, who knows all about the space between the stars, and can tell us whether the atom of hydrogen is round, and that of carbon square, now informs us that the moon casts the earth's shadow on the sun! Well, we live and learn. I have seen the electric light cast a shadow from the flame of a candle, and as "action and reaction are equal" it may be that the candle also produced a shadow of the electric light—certainly I did not see it, but that is nothing. However, we may disregard such a mere detail as the relative photometric energies of sun and moon; but as it is now obvious, as Mr. Barwick says so, that "light can hardly be deemed vibration," it will be interesting to learn the process by which the earth's shadow is "cast by the moon on the sun during the eclipse." I really wish the printer's devil would append a note instructing me how to laugh in type.—SIGMA.

[11128.]—**Lantern Pinions.**—"Tubal Kain" is not right (see his answer p. 21, Vol. XV.) in saying that the pitch of the "pins or trundles" is the distance of their centres: though he is right in saying that the pitch should be the same as that of the wheel into which they gear. Take a pinion of 6 pins for simplicity; if their pitch were the distance of their centres, then the circumference of the pitch line would be six times that distance; whereas it should be 3·1416 × 2 or 6·2832, or about 5 per cent. more for such a small pinion. For larger ones the discrepancy would be less; but then lanterns are made commonly with only 6 pins, and not frequently with more than 10, so that the error must not be overlooked, particularly as they tend to act before the line of centres, or to jam, if put too close together.—J. K. P.

[11128.]—**Making Swimming Bath.**—If it is really clay in which you are to cut, you could not be in better case. Throw out the clay the size you want, let the sides have an inclination of 1 to 1; then, with any kind of penn stick, which is heavy enough, well beat the sides and bottom, a piece of rain water pipe with the end filled up will do; it must be thoroughly rammed, never mind the roughness, for the next operation is to cast in some of the excavated clay, which has been cut into small pieces with the spade, having gravel and stones picked out, and, if very compact, watered, and trod down till you get a thickness of 9in., ramming it in 3in. layers. This method will succeed in any soil. 1½in. or 2in. paving stones nicely jointed, and simply laid on the clay will keep the water clear; the joints can be pointed with cement. Flooring tiles which are from 8in. to 12in. square would also do, or the rammed clay can be faced with hard burned bricks set in hydraulic lime, or any good cement; if rough bricks are used they could be plastered with ground Southam lime, which would make a clean white water-tight lining.—S. H.

[11138.] — **Violin.**—It is impossible to answer "J. W. L." in toto; and as for notations he had better begin as he intends to end, or rather must end—viz., in the old notation. By all means get a good violin, and never change it, but make it your friend. To be short, I advise the purchase of "Campagneli's School for the Violin;" it is divided into four parts, 7s. each, and the system contains all that is necessary to know.—FIDDLER.

[11154.]—**Whellaw's New Medical Discovery.**—This is, no doubt, the work called "Whitlaw's New Medical Discovery," and if so, is a description of a new method of treating disease by portable vapour baths, medicated with different herbs, of which it has likewise a copious description, along with some account of the Linnæan system of botany. I read it twenty-five years ago, and it appeared to me to be an adaptation of the Thompsonian or botanic practice of medicine, in which herbs and vapour baths held so important a place. The author professed to have travelled much in America, the birthplace of the Thompsonian practice; the supposition is, therefore, not without probability.—F. P.

[11158.]—**Ermine Fur.**—You cannot entirely remove the colour. To clean, rub it well with dry plaster of Paris and flour or fine white saw-dust; the longer it is cleaned the better it will look. You may further improve it by damping the surface with benzine, and dusting on plenty of plaster of Paris (previously well washed and dried). Allow it to dry, then beat out the dust with a light cane.—PRACTICAL FURRIER.

[11168.]—**Wood Rods.**—If "Joiner" lives near a lead pencil manufactory, the machine used for rounding the pencils before cutting into lengths would suit his purpose, I think. It consists of a small lathe head having a cutter and a hollow mandril. The rod is passed through the mandril, and coming into contact with the rapidly revolving cutter is rounded with rapidity and ease.—RHO SIGMA.

[11175.]—**Cutting Mounts.**—The metal guides are made of steel, about ⅛in. thick, and at least 1in. broad, one side is bevelled off. The knife is passed along the bevel, while the guide is held down firm. Straight guides for straight lines, and an outer segment of an oval for oval mounts, but for different sizes of ovals different guides are wanted; always cut the mount from the body—*i.e.*, lay the guide upon that portion of the mount which you are going to use.—THE WELSH SHEPHERD.

[11179.]—**Covered Wire.**—"Magpie" can get silk and cotton covered wire at any good philosophical instrument dealer's, of many colours, and of various thicknesses, too numerous to mention.—RHO SIGMA.

[11183.]—**Road Material.**—It depends entirely upon the quality of the bottom—if hard, ashes will do; if soft, a layer of handpacked stones 4in. thick, having an area on the bed of 36in. at least; fill in the gaps with gravel, and over that a layer of stone 4in. thick, broken in plan to 3in. cubes, and blind with coarse sand, and on that another course of stone broken to 2in. cubes and filled in with sand. If this is to be "pitched" or paved with granite blocks, it may be of soft stone and 4in. thick; but if the surface of road is not to be block paved, the hardest granite should be used and blinded with gravel, and the thickness from 6in. to 9in. for heavy traffic. Care must be used to prevent ruts and unequal wear.—J. H.

[11186.]—**Length of Sidereal Day.**—"T. H. M." is quite right. See *Nautical Almanac*, 1872, p. 528.—W. R. BIRT.

[11188.]—**Arithmetic.**—£19 19s. 11¾d. being only a farthing off £20—

Say £20 × £20 =	£400	0	0
Less 39 farthings			9¾
	£399	19	2¼

Upon the same principle, £19 × £19—

Say £20 × £20 =	£400	
Less £39		39
	£361	

Am I right?—C. R. F., Shrewsbury.

[11191.]—**Radius and Weight of Fly-wheel.**—Multiply the number of horse-power of engine by 2,000, and divide the product by the square of the velocity of the circumference of the wheel in feet per second, the quotient is the weight of the fly-wheel in hundred-weights. There is no fixed rule for finding the diameter, as with large engines the diameter in feet is more than the number of horse-power, and in small engines, more.—P. W. H. J.

[11191.]—**Radius and Weight of Fly-Wheel.**—Let V = velocity of the periphery of the wheel in feet per second; H = horse-power; D = mean diameter of rim in feet; N = number of revolutions per minute; P = the total average pressure on piston in pounds avoirdupois; and S = stroke in feet. W = weight of rim in cwts. $= \frac{P\,S}{45\,D} = \frac{1344\,H}{D\,N}$. D = stroke, multiplied by 3½ or 4 generally. Sectional area of rim in inches $= \frac{11{\cdot}42\;W}{D}$. In corn-mills, the velocity of the periphery of the fly-wheel must exceed the velocity of the periphery of the stones, in order to prevent back-lash. If your correspondent does not understand algebra, he will require a little more information. For instance, $\frac{P\,S}{45\,D}$ means $\frac{P \times S}{45 \times D}$; $\frac{1344\,H}{D\,N}$ means $\frac{1344 \times H}{D \times N}$; and $\frac{11{\cdot}42\;W}{D}$ means $\frac{11{\cdot}42 \times W}{D}$.—W. AIREY.

[11191.]—**Radius and Weight of Fly-Wheel.**—Rennie's rule for fly-wheel:—

r = radius of wheel.
p = pressure on cylinder.
c = capacity of boiler.
v = velocity of crank-pin.
s = empirical constant, varying from ·002 to ·0015.

$\frac{r}{p} = \frac{c}{v} = s$; this gives the required radius.

Weight = 409 × r^3 × τ; this gives the weight in pounds.—S. TREMAYNE, Cantab.

[11191.]—**Radius and Weight of Fly-Wheel.**—There are many considerations to be examined into in determining these proportions, viz.:—(1) The kind of machinery to be impelled; (2) the regularity of motion required; (3) the rate of expansion of the steam in the cylinder. The radius of fly-wheel is usually from 3 to 5 that of the crank. The weight of the rim is generally 100lb. to 300lb. for each actual horse-power, varying with the rate of expansion used. The larger the diameter the less will be dead weight on the journals. The diameter must not exceed the limit of the tensional strength of the material of which the rim is made (usually cast iron), that it should not be ruptured by the centrifugal force. No engine-maker of any standing would put a fly-wheel with a rim of the same weight to any two engines he would build of one power and size, if they were intended for different purposes. For instance, if for pumping, a light (comparatively) fly-wheel only is necessary, just sufficient to turn the engine over the dead centres; for driving corn-mills and spinning fine threads, a much heavier one, and for rolling mills, a very much heavier one, wherein should be accumulated sufficient force, that the engine or the rolls may not be retarded when the material is being passed through.—TUBAL KAIN.

[11192.]—**Chemical.**—The nitrate of potash will crystallise at a temperature of 490° Fahr.; the carbonate at 499·5°; so, by keeping the temperature of the liquid between 490° and 499·5°. You will be able to crystallise out the whole of the nitrate.—S. TREMAYNE, Cantab.

[11193.]—**Pumps of Portable Engine.**—The reason why the pump won't act is because it has no back pressure valve, which is another valve fixed between the pump and boiler. Even then the valve will sometimes want cleaning out if the water is at all muddy. We have got a small engine drawing water from tanks by siphons, and up these siphons it drew a piece of indiarubber which passed the pump-valves, and lodged in the back-pressure valve, so that we had to run steam down, because the pump valves would not act. You see, in this instance, the pump with three valves would not act. A boiler pump with two valves is not to be trusted at all, if the workmanship is at all defective. The valves should be examined and cleaned every two or three months. A pump with two valves can be generally started with a head of clean water, but not always. The difficulty increases as the pump becomes smaller. I don't see the need of two hose pipes, except he wants to draw from two separate tanks, which is unlikely. One would both cost less and answer better.—P. W. H. J.

[11193.]—**Pumps of Portable Engine.**—Let "A. C. T." get a small wood mallet and give the valve-box a rap or two, and the valves will again work; they have got dry and expanded, which has caused them to stick a little. Do not make mountains of mole hills.—C. A. M.

[11193.] —**Pumps of Portable Engine.** —From the description given the delivery valve leading from the pump to the boiler is leaky, thereby allowing hot water to pass back from the boiler to the pump. The pumps with three valves really are only two. The third valve is a stop back, and serves to retain the water in the boiler when the relief-cock is opened to prevent the feed-pump injecting water into the boiler. It is a much better plan than a pump without the stop back-valve, as the pump is, so to say, constantly at work, and any surplus water that is not required in the boiler is allowed to escape by the relief-cock, and return through the second or small hose back again to the feed-water tank. Any pump can have this auxiliary stop back valve and relief-cock attached to it and the boiler.—TUBAL KAIN.

[11195.]—**McCarter's Improvements in Condensation.**—This improvement consists principally in using oil instead of water for injection; the condensed steam sinks to the bottom of the oil, and is forced from a hole at the bottom of the condenser by the steam from the cylinder at each stroke.—S. TREMAYNE, Cantab.

[11197.]—**Sharpening Steel Scraper.**—Should be held vertically over "oil stone," and rubbed to and fro, the broad way of the blade. This will cause the face to be at right angles with the sides, and slightly convex on the face, so that it will be most prominent in the centre, and work better than if flat. A little tuition and practice in a regular shop will soon instruct "Excelsior."—TUBAL KAIN.

[11197.]—**Sharpening Steel Scraper.**—First file the scraper on the edge straight lengthways with a fine flat file; then lay it flat on the bench, and with a stout bradawl kept flat on the scraper rub hard from one end to the other on both sides, and then the edges.—ELECTRO.

[11197.]—**Sharpening Steel Scraper.**—Rub the edge of the scraper perfectly square on the oil stone, then lay it flat on the bench, and with the scraper sharpener, burnish the flat side near the cutting edge, but holding the sharpener quite flat; then set it up on its end with the cutting edge to the right, and give one stroke up, bearing a little towards the edge you wish to make cut, turn it over and repeat the process on the other angle.—M. O.

[11198.]—**Birch Wood.**—American birch is more likely to warp than, I think, any other wood, and it will be extremely difficult to bore such small pieces without splitting. I have used birch every week (more or less) for above forty years, the only way ⅛in. pieces could be bored with safety is with a sharp drill in the lathe.—M. O.

[11198.]—**Birch.**—Some of it is straight and easily worked; some of it curly and beautiful; it is easily worked. To bore it use a clean cutting carpenter's pin bit in the lengths before cutting them up short.—ELECTRO.

[11200.]—**Horizontal Engine.**—Cylinder 1¼in. diameter by 3in. stroke, diameter of crank-shaft ⅝in., diameter of piston-rod ¼in., diameter of fly-wheel 12in. to 15in. Use either "gun metal" or cast iron. Neither can be melted in a kitchen fire, to be used for that purpose. Better make your pattern, and go to a founder to have it cast for you. The rim of fly-wheel may be of lead.—TUBAL KAIN.

[11201.]—**Lias Insect Beds.**—What better work can "W. F." require than the one named by the Rev. P. B. Brodie, M.A.? It contains eleven plates and one hundred and thirty pages of letter-press, with much information upon the subject. Plate 11 gives a section of the Vale of Bristol; Bedminster Down is one locality named—there are four beds of insect limestone separated by clays, total thickness 1ft. 9in.; these are under the lias and 17ft. 9in. from the surface. This quarry is two miles south-east of Bristol. This may not be the best for the purpose of study, being one of the first which presented itself to my notice; there may be many others far better; but a note addressed to the Rev. Mr. Brodie, Rowington Vicarage, Warwickshire, I doubt not, will receive every attention, having myself experienced his kindness in a liberal supply of specimens of the insects, with his views upon other matters connected with this subject. Perhaps it may be unnecessary to enter more fully into Mr. Brodie's work, since "W. F." appears acquainted with it. Should that not be so, I will gladly assist him as far as possible.
W. PALING, Newark.

[11201.]—**Lias Insect Beds.**—In reply to "W. F.," the insect limestone of the lias crops out at various parts of a tract of country comprising portions of Worcester, Warwickshire, and Gloucestershire. It is also found in parts of Somerset and Monmouth. Insect remains have been found both in the upper and lower lias, but the true "insect limestone" occurs near the base of the lower lias. I believe the finest section to be at Clust Cliff, on the Severn, but the cliff is almost inaccessible. The Garden Cliff, at Westbury-on-Severn, and Wainlode Cliff, a few miles above Gloucester, also present good sections. Throughout this district, wherever the lower lias occurs, it is sure to be accompanied by the insect limestone more or less fully developed. I shall be happy to give "W. F." more detailed and local information if he will favour me with his address.—OSA.

[11213.]—**Carat.** — The carat used in weighing precious stones is four grains, rather lighter than troy grains ($74\frac{1}{16}$ carat grains are equal to 72 troy grains). When quoted in relation to gold alloy it is not an absolute weight, but means the twenty-fourth part of any weight. Thus 12 carats signifies that half the material is pure gold; *i.e.*, 12 parts out of 24, the other 12 being alloy. The seed referred to is a bean, the fruit of an Abyssinian tree called "Kuara."—J. A.

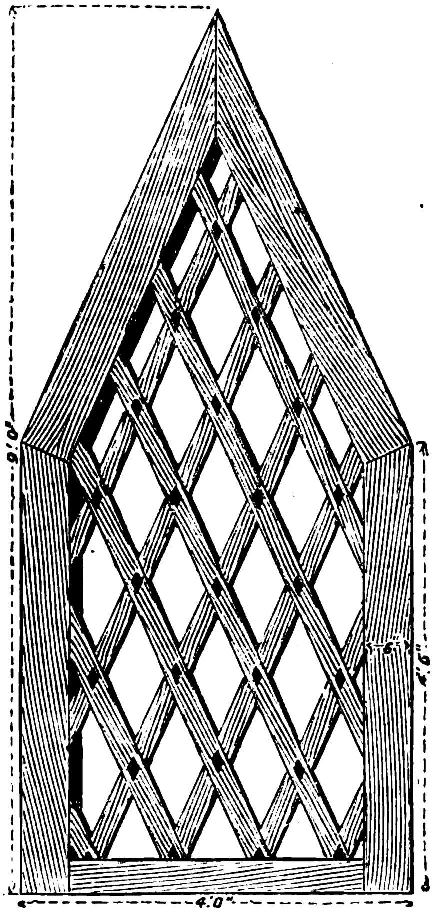
[11213.]—**Carat.**—The exact weight of a j... or goldsmith's carat used for weighing pr...

and pearls is four grains. 2. The weight which expresses the fineness of gold. The whole mass of gold is divided into 24 equal parts, and as many 24th parts as it contains of pure metal is called gold of so many carats. Thus gold of 18 parts of pure metal is called gold of 18 carats. Carat from the Greek, a little horn or pod, and the berry of a pod. From the Greeks it is thought the Arabians borrowed their karat, a weight used in Mecca equal to the twenty-fourth of a denarius or dernier. The carat in Great Britain is divided into 4 grains, among the Germans into 12 parts, and among the French into 32 parts.—Hermes.

[11213.]—**Carat.**—Originally it was the name given to the seeds of the Abyssinian coral flower, and likewise to the carob-tree seeds. Goldsmiths and assayers divide the troy pound, ounce, or any other weight, into 24 parts, and call each a carat, as means of stating the proportions of pure gold contained in any alloy of gold with other metals.—Gig-Lamps.

[11215.]—**Divi-Divi.**—The amount of divi-divi imported into England for 1869 was 22,006¾ tons; in 1870, 29,193¼; and in 1871, first half-year, 15,103.—S. Tremayne, Cantab.

[11216.] — **Garden Gate.**—The accompanying drawing is of a lattice work gate or door of timber. It looks exceedingly well executed in oak and varnished, and especially if kept as massive as possible. If made of



red deal or pitch pine, &c., a good colour to paint is Indian red. I recommend imitation nail heads of wood in preference to iron, on account of rust. By means of a movable sheet of zinc the gate may be made either an open-work or a close one.—Jannifred.

[11218.] — **Smee's Battery.**—Platinised copper will act in a Smee's arrangement, but is not so effective as platinised silver. In electro-plating works where batteries are used (Wilde's Magneto is now being largely adopted) the negative element is generally copper, not platinised; in fact a "Wollaston" with "Smee" arrangement. This battery has many defects, however. I presume T. H. Somerville only wants a small affair, and I should advise him to use either the usual Smee, or Daniell's. Relative to platinising: In outer cell your platinum solution; in porous cell water about 14 parts; sulphuric acid 1 part; into porous cell immerse rod of amalgamated zinc; into outer vessel, and bent round porous cell, your silver or copper to be platinised. Connect the two metals by a wire, and in a short time a good black deposit will be formed, and the job is done. Platinised iron would be attacked. Iron is a nuisance in batteries. I don't except even the Maynooth.—J. A.

[11219].—**Silicate of Soda or Soluble Glass.**—You have taken too much silicate. The white chalk, in fine powder, is laid upon a hard substance. Work chalk and silicate with a table-knife into a very stiff paste, it will set quick; but if anything is cemented with it, the joint should be tied with a string, as it takes a few days to harden. Exposed to air, it will harden in a few hours. Clean your knife with hot water directly afterwards.—The Welsh Shepherd.

[11219.]—**Silicate of Soda or Soluble Glass.**—There is something wrong in your method of preparation. It ought not to dissolve in cold water. See answer to query 11244; prepare a fresh quantity from those directions. Substitute calcined bones, or a mixture of clay and whiting for the chalk, and report progress.—William H. Hey.

[11220.]—**Wheel Tires.**—"Un Jeune Forgeron" gives 14 threads to the inch for the ½in. and ¾in. gas-pipes, which is wrong. It is 13·75 = 55 threads in 4in. I trust "Un Jeune Forgeron" is not one of those gentlemen that think anything is near enough. But remember, if a job is worth doing, do it well. Does E. Fardon wish to cut them in a lathe? If so, he must use compound wheels. Say A into B, and D into C. Here we have A and D drivers. It will not matter whether A is geared into B or C; place them to suit yourself. For a lathe with leading-screw of two threads the wheels are drivers (20 and 80), driven 100 and 110. For a lathe with 4 threads to the leading-screw, drivers 20 and 80, driven 50 and 110. The way to prove if given wheels will cut a given thread is 4 × 4 = 16, the number of threads in the leading-screw. 13·75, the number of threads to cut.

13·75
4
———
5500
20 and 80 drivers.
———
1100
80
———
4) 88000
———
4) 22000
———
50) 5500
———
110

50 and the 110 are driven.—C. A. M.

[11221.]—**Fowling Punt.**—Living many years ago close to the Thames at a part where the water was in some places very shallow, I found it necessary to procure a boat for my fishing excursions drawing little water, and which should be stiff and light. I had seen a description of a fowling punt which I thought would answer the purpose in Col. Hawker's work, so set to work and built one, which I will describe as well as my memory serves me. She was about 15ft. long by 2ft. 6in. wide, pointed at both ends, with a flat floor rising about an inch at each end. The bottom was made of three deal planks ¾in. thick, dowelled together at the edges with iron pins; the sides were each of one plank, also deal, 11in. wide in the middle and 10in. at each end. Across the bottom inside were floor timbers of elm, 1in. square and 1ft. apart. The stem and stern posts were also of stout elm, each about 13in. high. The sides, which were upright, except just at the ends, were then fitted and nailed on, after which they were strengthened by elm knees which also formed ribs. About 18in. were covered in at each end, forming air-tight compartments; there were three thwarts, one forward for the mast, one midships for rowing, and one aft; the two first were firmly fixed by elm knees, the last was movable. She was fitted with a sprit mainsail, small staysail and rudder. In putting the planks together a strip of old blanket, soaked in a mixture of tar, pitch, and indiarubber solution, was placed in every joint, another similar strip being laid over it, which again was covered by a strip of tin, 1½in. wide, fastened by two rows of tin tacks. The same plan was adopted where the sides were nailed to the bottom, the tin being 2½in. wide, half on the bottom, half up the side. This plan was so effectual that there was not the least leakage, the tin did not rot away as might be supposed, but lasted several years. The floor was covered with thin boards, and the whole well painted inside and out. This boat was very stiff and handy, would go anywhere, but was not fast. If I were to build another I should alter the shape aft, as a pointed stern is a mistake in a flat bottomed-craft. When forcing her along under sail in a strong wind I have been nearly swamped by the water curling over the stern. The boat I should now recommend would be one built in the above manner, about 15ft. long, 2ft. to 2ft. 6in. wide, pointed at the stem, but with a stern turned up like a punt, and about 2ft. wide, to be fitted with two fixed and one shifting thwarts; the latter is very convenient, as it leaves the whole after part of the boat unincumbered. There should be swivel tholes, and if any sail be fitted it should be a small working lug. No rudder is necessary, but an extra socket may be fitted on each quarter to ship the tholes in and steer with a paddle. I omitted to state that the sides may be built with two or three strakes, as in ordinary boat building instead of using a single plank. In the former case of course they must be riveted together with the usual copper nails and roves.—A Barrister.

[11224.]—**Books on Ceylon.**—"Damon" should apply to Mudie, Librarian, New Oxford-street, London, for Sir James Emerson Tennant's account of the island, 2 Vols., 8vo., 50s.; also his Natural History, illustrated, 1 Vol. 8vo., 12s. 6d. Sir James was for some years governor, and a more vigilant observer or pleasant writer is seldom met with; his work is the universally accepted authority now. I feel proud to be able to tender a little volunteer but reliable information derived from some personal friends who have been out in Ceylon, coffee planting, for some ten years. Avoid spirits as poison. Clothing should be of the very best light Scotch tweed. Presuming his military friend is a knight of the trigger, his battery should consist of a strong plain No. 12 double-barrel gun, with bullet moulds; a muzzle loader I would suggest for economy. One of W. Greener's, of Birmingham, sporting Snider carbines, with loops to sling; flush sights up to 800 yards, a prettier tool I never handled; at 100 yards you ought to be able to put your shots where you please. Being a military man he will know how to get ammunition economically. The last item, a good belt to carry a revolver that throws a largish ball, and a couteau de chasse, or hunting-knife in case; this latter could be best got at home in the shape of a heavy butcher's knife, such as is used for splitting up a sheep. The country abounds in large game, especially deer, so a large knife is necessary to do the cutting up. A bottle of quinine and a few other medicines would be useful. With these few hints, and Tennant in his hands, he need not fear to embark. Bachelors generally reside in boarding houses, like a colony, but each having his private room; and dine, &c., at table d'hôte. Plenty of good male society at Colombo; female society scarce, and very select, principally married.—Joe.

[11227.]—**Duckweed.**—There are four species of duckweed in England; the flowers are monœcious—that is, male and female flowers on the same plant, and in this case they are inclosed in a spatha or kind of enveloping bract. The flowers are rarely to be met with, but when found it will be in June or July.—Cuprum.

[11227.]—**Duckweed.**—The flowers are very rarely seen, but they spread rapidly by new fronds, budding out from their margins. I watched some duckweed last summer, hoping to see them, but failed. But I am going to watch some this year, and I hope I shall be able to see them, and then will let you know.—Gig-Lamps.

[11229.] — **Ammoniac Chloride.**—NH_4Cl, ammonium chloride, may be made for laboratory purposes by neutralising pure hydrochloric acid with pure ammonia, or by passing a stream of the gas through a solution of the pure acid until saturated, and then evaporating and crystallising the salt. $NH_3 + HCl = NH_4Cl$. This salt, for analytical use, should volatilise completely when ignited on platinum foil. The solution ought to be neutral to test paper, and it should give no precipitate or coloration on the addition of $(NH_4)_2S$.—Hermes.

[11235.]—**Eels in Paste.**—(1.) Flour-and-water paste needs only to be made thin and damp, and allowed to get sour, when it will produce paste eels. Bookbinders' paste is the best. It should be exposed to the air, but not allowed to get dry. A drop or two of vinegar may now and then be poured on it with advantage, or vinegar and water, to prevent its becoming dry. (2.) Bruise black pepper, put some in a galley-pot or tea-cup about ¼in. in depth, pour on it rain or river water to cover it about an inch deep. Stir it well together, and let it stand for two or three days in the open air, when a thin skin will be found upon the top, which reflects the prismatic colours. Put a minute portion of this skin under the microscope, and it will be found to hold animalcula by millions. These living organisms will increase in numbers and in size until the whole of the fluid will seem an animated mass. About half a dozen different and fantastically-shaped creatures may be distinguished, comprising tape-worms, thread-worms, cork-screws, globules, &c. (3.) Cut a wisp of new-made hay into small pieces, and soak it in rain or river water. After a few days a whitish scum will be visible on the surface, which will be found on examination to contain myriads of living creatures of a vast variety of shapes and forms and kinds. Here will be found some of our acquaintance seen in the pepper water; but the majority of these take an oval form, and are in continual motion, darting about with amazing velocity, spinning and performing all sorts of strange gyrations. (4.) Vinegar left uncovered for a few days in warm weather will generate eels, which may sometimes be visible to the naked eye. (5.) The water that drains from dung-hills is so thronged with animalcula as to seem all alive; it must be diluted with water before they can be distinguished. (6.) An infusion of any herb, grain, fruit, or flower in common water will, after a few days, contain animalcula peculiar to the herb, &c., used. (7.) In the spring of the year almost every river, pond, ditch, or puddle will afford subjects for microscopic investigation.—H. G. W.

[11235.]—**Eels in Paste.**—To get them, make white paste, not thick, and let it be until it turns sour; but it does not always succeed. If once got they can be kept for years by occasionally making fresh and adding a drop or two of the old. I have had them about nine years, originally from a single drop on a slide, from which I have bred quarts. I mostly keep about half a pint in a gallipot, with a tin cover with holes to admit air, which keeps the paste clean and white for observation. If "Microscope" will advertise his address, I will send him some. To get animalcula, put any vegetable or animal matter in water exposed to the air for a few days, and you will have plenty; the warmer the weather the better. Hay will produce them as soon as anything: many large enough to be seen by the naked eye as minute specks.—C. Bentley.

[11236.]—**Coins.**—Florins, shillings, sixpences, and threepences are the only silver coins now struck for general currency. The last issue of crowns was in the year 1851, and no halfcrowns have been issued since 1851. No groats (or fourpenny pieces) have been coined since 1856.—Henry W. Henfrey, F.H.S., M.N.S., &c.

[11239.]—**Photography.** — This question is so vague that my answer must be necessarily of the same nature. 1. Before entering the photographic profession, it is absolutely necessary that he should be able to produce really successful results, both in landscape and portrait photography. 2. The apparatus should be of the best modern construction. 3. The lenses should be by one of the best English opticians. 4. The studio for portraiture should be of the form known as ridged-roof. 5. The chemicals should be of absolute purity, and such can be obtained from any respectable photographic chemist. 6. The work sent out should be the best that can possibly be obtained under the then existing circumstances, as a really good photograph is a lasting honour, and an indifferent or bad one a lasting disgrace to the producer. 7. If really good pictures are sent out, always have a good price, and never undersell a neighbour.—R. TUDOR WILLIAMS.

[11239.]—**Photography.**—I would advise "Caswallon-ab-Davies" to get one of F. Coxe's (of Ludgate-hill, London) books called "Compendium of Photography," which will give him every information he requires. At the end of the book is a catalogue, with prices, attached to every article required in the trade. The price of the book is 6d., and is well worth notice. —A. C.

[11243.]—**Deaf and Blind.**—About twelve years ago I saw in the Institution for the Deaf and Dumb, at Manchester, a girl who was also blind, with whom the master conversed with ease by touching her fingers and elbows. I should think this gentleman (or if he has left, his successor) would gladly advise "X. X." as to the best mode of teaching the alphabet to one similarly afflicted.—R. S.

[11243.]—**Deaf and Blind.**—There are many institutions where such afflicted persons are received and taught—the blind by reading raised letters and signs on stout paper. No doubt, by advertisement, the information of the whereabouts of these establishments can be obtained.—TUBAL KAIN.

[11243.]—**Deaf and Blind.**—The use of the Morse telegraph alphabet would be a ready means of communication by means of touch on the hand or arm. After some practice the communication would become rapid by the use of abbreviations and contractions. See single needle dial in No. 361.—WATERMAN.

[11244.]—**Silicate of Soda.**—Preparation: Soluble glass may be obtained by dissolving pure silica in a boiling solution of caustic potassa or soda; but this process is both costly and inconvenient to practise on a large scale. If sand and carbonate of potassa or soda are heated together, the carbonic acid is never entirely driven off, excepting when the sand is in excess; but the whole may be expelled by the addition of powdered charcoal, in such proportion that the carbonic acid which is not decomposed, may mix with a sufficient quantity of carbon to convert it into carbonic oxide. In this way the silica first forms a silicate in the proportions contained in common glass, and drives off the appropriate equivalent of carbonic acid; then, at a high heat, the rest of the carbonate of potassa or soda is decomposed by the carbon, the carbonic oxide escapes, and the alkali, thus freed, either sublimes or combines with the glass already formed. The sand (free from any trace of lime or alumina) and alkali are taken, ten parts of the latter to fifteen of sand and four parts of charcoal; no less quantity of charcoal will suffice. If the alkali is not very pure, another proportion of charcoal may be used with advantage; this accelerates the fusion, and separates all carbonic acid, which would otherwise remain, and have a very injurious effect upon the glass. In other respects the same precautions are to be observed as in the manufacture of common glass. The materials must be first well mixed, then fritted, and finally melted in a glass pot, until the mass becomes liquid and homogeneous. The melted matter is taken out of the pot with an iron ladle, and the pot is then filled with fresh "frit." Thirty pounds of alkali, forty-five pounds of sand, and twelve pounds of charcoal is the average charge. The crude glass, thus obtained, is usually full of air bubbles; it is as hard as common glass, of a blackish-gray colour, and transparent at the edges; sometimes it has a colour approaching to whiteness, and at others it is yellowish or reddish; these are indications that the quantity of charcoal has been insufficient. If it is exposed to the air for several weeks, it undergoes some slight changes, which rather improve it than otherwise. To prepare it for solution it is reduced to a coarse powder. One part of glass requires four or five of water for its solution. The water is first heated to ebullition in an open boiler, the powdered silicate is then added to it by degrees, and must be continually stirred to prevent it falling to the bottom. The ebullition must be continued for three and a half to four hours, until no more glass is dissolved; the liquor will then have acquired the proper degree of concentration. If the ebullition is checked before, carbonic acid will be absorbed from the air, so will too great a quantity of water, for during long evaporation, which is then necessary, the carbonic acid of the water will readily combine with the alkali, and the silica will be precipitated. If the liquor thickens too much before the glass is dissolved, boiling water must be added. When the solution has the consistency of syrup, and a density of 1·24 or 1·25, it is sufficiently concentrated and fit for use. It is then set aside to cool; and also to allow the insoluble portions to settle; while cooling a skin forms upon its surface, which, after a time disappears of itself, or may be re-dissolved by depressing it in the liquor. When the crude glass is of a proper composition, it contains but few saline impurities, and no sulphuret, it may be treated as above, but if any considerable amount of impurities exist, it must be treated as follows:—The powdered glass is exposed to the action of the air for three or four weeks, during which it must be frequently stirred, and if it runs into lumps, as it will in moist weather, they must be broken up. The glass, as stated before, attracts moisture, and the foreign substances either separate or effloresce. It is then easy to remove them. The mass is frequently sprinkled with water and stirred. After three or four hours the liquor is removed; it then contains a part of all the saline impurities, and a trace of silica; the process is to be again repeated. Soluble glass thus treated readily dissolves in boiling water, and leaves nothing to be desired. To preserve it in the liquid no particular care is necessary; even after a long space of time it undergoes no perceptible change, if the solution has been properly prepared. It is well to keep the mixture from contact with the atmosphere. Silicate of soda forms a viscid solution, which when concentrated becomes turbid and opalescent; it has an alkaline taste and reaction. When it has a density of 1·26, it contains nearly 28 per cent. of glass; if the concentration is carried beyond this it becomes so viscid that it may be drawn out in threads like molten glass. When the solution is applied to bodies it dries rapidly at common temperatures, and forms a coat like a varnish. Soluble glass when dried does not undergo any perceptible change when exposed to the air, nor does it attract from it either moisture or carbonic acid; neither has the carbonic acid of the atmosphere any effect upon the concentrated solution; but when a current of carbonic acid is passed through the solution, the glass is decomposed, and hydrate of silica deposited. Soluble glass dissolves readily in boiling water, but in cold water so slowly as to lead to the belief that it does not dissolve it at all. It is, however, never entirely insoluble except when it contains a much larger proportion of silica, or when it is mixed with other bodies, such as the earth's metallic oxides, &c., with which double or triple salts are formed, as in the case with the common glasses. Soluble glass, after being exposed to the air, and afterwards to the action of heat, swells and cracks at first, and melts with difficulty; it then loses about 12 per cent. of its weight. Alcohol precipitates it unaltered from its solution in water. When the solution is concentrated but little alcohol is required to precipitate it. Pure soluble glass may be easily obtained from an impure solution by the use of alcohol. The alcohol being added the gelatinous precipitate is permitted to settle: the supernatant liquor is decanted, the precipitate collected, rapidly stirred after the addition of a little cold water and subjected to pressure. The acids act upon and decompose the solution of glass; they also act upon it when solid, separating the silica in the form of powder.—WILLIAM H. HEY.

[11245.]—**Felspar.**—This mineral is obtained in Cornwall, Devonshire, Scotland, France, Norway, and other localities—in primitive rocks, and of various colours, fusible by itself. "Beudant":—Red common F., Silica, 65·03; alumina, 17·96; potassa, 16·21; lime, 0·35; per oxide of iron, 0·47. Chapman's "Mining":—Silica, 64·2; alumina, 18.4; potash, 16·95; soda a trace. Form, $KOS_1O_3Al_2O_33S_1O_3$, or KO3SiO, 3 (AlO3SiO). Specific gravity, 2·394 to 2.581, H6.—W. P. W.

[11247.]—**Jacketed Cylinder Engine.**—If the present steam pipe is now only sufficient to supply the engine properly, put a new and separate steam pipe and cock of at least 2in. bore, with a condensed water trap (self-acting) to take off the accumulated water from the jacketed surface.—TUBAL KAIN.

[11249.]—**Concrete Walls and Buildings.**—The information your correspondent seeks would necessitate probably more space than could be afforded in the querists' column, but briefly I would state that after three years' impartial trial, not only in erecting buildings with, and in other ways using concrete, Portland cement, but by occupying a house constructed with it, I am satisfied that it is for very many purposes, but not for all, far superior to most other building materials, and that as a rule it is less costly than brickwork construction. But it is evident the cost must depend entirely on the facility for obtaining the necessary materials. The best for the purpose besides Portland cement are broken Portland, Bath, or almost any stone chippings—crushed flints, slag, river ballast, or old bricks and tiles, any of which should be sufficiently small to pass through a 1½in. mesh screen, and also have a due proportion of sand or finely broken material mixed therewith. Although the process of construction is simple, yet great care and discrimination is necessary. The proper proportion of cement should be not less than one part out of eight by measure; the cement should be the best quality, finely ground, and weigh not less than 112lb. per bushel. Walls constructed thus, I estimate to be three or four times the strength of brick walls of the same thickness; and from experience I am able to say that 9in. walls are virtually impregnable against damp and drifting rains. If your correspondent contemplates building with concrete, if only a cottage, he should visit buildings that may be in the course of erection with that material, and by so doing he would gain much more practical information than can be given here, and it would pay him to do so, even had he a hundred miles to travel for that purpose. I am just now completing a building of three floors, almost entirely (roof excepted) constructed with concrete, and which has been tested for strength, the result far exceeding the most sanguine anticipation.—F. P.

[11250.]—**Mr. Stanistreet's Astronomical Clock.**—A reply to this query appears among the letters in this number.—ED.

[11251.]—**Iron Stains in Oak.**—Spirits of salts will remove iron stains in oak.—T. R. B.

[11251.]—**Iron Stains in Oak.**—Oxalic acid will remove iron stains from oak or any other wood.—M. O.

[11252.]—**Illuminated Sign.**—The cloth should be white holland, and the parts that are to appear white left without colour, and if your varnish is good the white will not change.—M. O.

[11252.]—**Illuminated Sign.**—Lead and gas are not cousins, use white zinc.—C. A. M.

[11256.]—**Holly Walking-Sticks.**—I expect W. Hughes cut his sticks in summer, while the sap was high, if so they are sure to split at the knots. They should be cut in winter, and in trimming off the side-shoots be careful to leave half an inch on the stick; tie them together in a bundle and put them away in a dry place for a few months, then pare the knots to "fancy." Scrape off the rind. Sand-paper and varnish them, and they will look well, and be nearly as tough as leather.—R. LANGDON.

[11258.]—**Rollers of Wringing Machines.**—"T. W. R." must use well seasoned sycamore for his rollers, and turn a recess in each end to hold a wrought-iron hoop, which should be shrunk in so as to grip the wood tightly. I have a wringing machine which I treated in this way some time ago, and have not been annoyed by the rollers splitting since, although before putting in the hoops this was a common occurrence.—RHO SIGMA.

[11260.]—**Cutlers' Wheels.**—These have a tire of leather, which is thinly coated with glue and rubbed in emery powder before the glue has set. The emery, of course, adheres, and forms the grinding surface.—EXCELSIOR.

[11263.]—**Gas Tank.**—"A C. S." has not stated the proportions of his tank, or the number of burners or lights supplied from the said tank. The tank requires a cock at the bottom to allow the escape of atmospheric air when charging. Make your connections at the top of your tank for your burners. You will want a cock there so that you can regulate your pressure. A few inches from your cock screw a short piece of ¼in. or ½in pipe into your main or supply pipe; fasten on the other end of the pipe a small piece of flexible tube, and on the other end of your tube place a small pressure gauge (procure a piece of glass tube about a foot long, make it hot in the centre over a flame and bend it in the shape of a U; then half fill with water and you have a gauge). Not knowing the illuminating power of your gas cannot tell you what pressure to give: that you will soon find out by your lights, say about 15 tenths (gas is measured by tenths of an inch). Open your cock and let your water rise 1½in. = 15 tenths if that will do. As your gas is consumed you will have to open your cock to keep the pressure up to 15 tenths. Gas companies have to keep men day and night to look after the valves so as to regulate the pressure. If that pressure will do, and your tank is charged to 30lb. on the square inch, 27in. of water indicate a pound pressure 27 × 30 = 810 × 10 = 8100 ÷ 15 = 547·6, or you have compressed 546·6 cubic feet of gas into the space of one at 15 tenths pressure.—C. A. M.

[11265.]—**Drawing a Boundary Line.**—Field-book:—

30	198	
	260	60
24	248	
	240	30
20	220	
	0	

Total base 1166

260 × 60 ÷ 2	=	7800
240 × 30 ÷ 2	=	3600
		11400
198 × 30 ÷ 2	= 2970	
248 × 24 ÷ 2	= 2976	
220 × 20 ÷ 2	= 2200	
		8146

1166) 3245

Answer $2\frac{461}{583} = \frac{p}{2}$.

—THETAMU, Horsham.

[11265.]—**Lifting Water.**—"Ignoramus" has not stated where he wishes to pump the water from, neither if it is nominal or actual horse-power. An indicated horse-power performs 33,000 units of work in a minute; a unit of work is the force required to move 1lb. through a space of 1ft. in any direction in a minute, 33,000 ÷ 7ft. = 4714·286 units of work per minute ÷ 1,000oz., or 63·5lb. = cubic feet, or by 10lb. equal gallons. Should think a lift pump would answer "I.'s" wants.—C. A. M.

[11266.]—**Lifting Water.**—I take it in the first place that the power of your engine is the nominal horse-power. This is usually allowed to be the power capable of lifting 33,000lb. 1ft. high per minute = 4,714lb. 7ft. high per minute; and as the gallon = 10lb., 471gals. may be lifted 7ft. high per minute by your engine.—EXCELSIOR.

[11266.]—**Lifting Water.**—1 horse-power raises 33,000lb. 1ft. in one minute, and one cubic foot of water weighs 62·5lb. Number of pounds of water = $\frac{33,000}{62·5}$ = 528 cubic feet.—P. W. H. J.

[11271.]—**Naval Architecture.**—There is no connection between the water line and the water way of a ship. The water lines are the parallel lines formed along a ship's hull by the tops and bottoms of the plates, or the sheets of copper; and the water way is the speed of the ship in knots per hour. A ship is said to be water-borne when her double bottom is full of water. 2. The tonnage of a ship cannot be determined from the metacentre evolute, but the centre of effort can; also, the variation of the compass, if the evolute is made of copper instead of iron, as it generally is. 3. I think "dead water" must be a misprint for "head water." If this is so, the head water is never retained in the ship, but is allowed to pass freely overboard. 4. The screw race is only formed when a ship is going out of a narrow harbour or a dock. It is concrete for twin screws, one screw annihilating the screw race of the other. It is abstract for a single screw and for Colman's jet propeller. 5. Marine glue is but sparingly used, principally for fastening the engines and boilers in their places in the ship. 6. The longitudinal bulkhead is always in a line with the double bottom, and is screwed to it. The transverse bulkhead is never abaft the double bottom, and is seldom fastened to the bilge pieces. 7. The run of a ship is connected with the wing passages by water-tight doors. 8. The deck-stringers went out when iron ships were introduced; there are few books on naval architecture that make any mention of them.—S. Tremayne, Cantab.

[11273.]—**Cement for Water.**—"Goethe" should paint (red) the edges and bottom where they go together, and pack with red and white lead (mixed). Let the cistern remain three or four days before letting the water in, and that will make a perfect cure. I have fixed many the same way, and always found them to answer.—Blacking.

[11273.]—**Cement for Water.**—"Goethe" should pour melted brimstone in the joints. Proved.—W. G.

[11276.]—**Extracting Glass Stopper.**—I once got one out by attaching the end of a stick of sealing-wax to the broken stump, and when it was quite cold, warming the neck of bottle by friction with a piece of string taken a "round turn" and see-sawed. Other tight stoppers, not broken, but cemented in by the stuff that was in the bottle, I have got out by putting a drop of rangoon or paraffin oil to the neck, and warming it over a small taper or wax-vesta till you see the oil run in. I have drawn wine-corks by sticking another cork on with wax as above described. A stopper of a varnish bottle, but not a gum bottle, will be released directly by warming the neck. If the broken stopper is very tight in, it must be drilled out. A fiddle-drill with oil of turpentine and elbow-grease will do it. When you have a hole once through, you may chip or file most of the stopper away, or, perhaps, hook it out with a bent wire.—J. K. P.

[11276.] — **Extracting Glass-Stopper.**—Let "A. H." try if immersing the neck of the bottle in moderately hot water will cause sufficient expansion to allow the stopper to fall out.—W. H. W. T.

[11276.]—**Extracting Glass Stopper.**—Stand the bottle upside down in a little sweet oil for a few days, then immerse it for about half a minute in moderately hot water, and give it a few taps.—J. King Harris.

[11276.] — **Extracting Glass Stopper.** — If "A. H." puts the neck of the bottle in hot water the neck will expand and the stopper will fall out.—W. Bright.

[11278.]—**Steam.**—The flow of steam through a long pipe is given by Professor Rankine in his essay on the "Flow of Gases," as follows:—

$$c = \left\{\frac{d^2 \times l \times q}{p - q}\right\} \times \cdot 7854.$$

where d = diameter of pipe.
and l = length of pipe (both in square feet).
q = hydraulic gradient.
p = pressure in pounds per foot.
c = quantity in pints per minute.

"Vulcan" will be able to apply this formula to any numerical example.—C. W. Henwood.

[11279.]—**Fire-Damp.**—I would inform "Vulcan" that I have often observed the drops he mentions in both copper and tin mines, but never in lead mines. Now, as sulphuretted hydrogen never occurs in copper or tin mines, I am under the impression that they are only condensed fire-damp.—C. W. Henwood.

[11284.]—**Holtz's Induction Machine.**—I have not sufficient acquaintance with this apparatus to give the information asked of me, but if the querist resides in London, I may tell him that I saw one of these machines the other day in the window of Mr. Cox, the scientific instrument dealer, Ludgate-hill. Looking at this might furnish the required information; the discs are of window-glass.—Sigma.

[11285.]—**Chemist's Certificate.**—"Phœnix" does not give sufficient information of his position before the coming into force of the Act of 1868, to enable me to give him all particulars which he desires. I should advise him to get the calendar of the Pharmaceutical Society, or write to the secretary of that society (17, Bloomsbury-square, London), and he will then have every information on the subject.—Sidcot.

[11285.]—**Chemist's Certificate.** — "Phœnix" will be required to pass an examination at the Pharmaceutical Society, Bloomsbury-square. Write there to E. Bremridge, Esq., sec., who would, no doubt, return necessary information.—J. King Harris.

[11287.]—**Annuals.**—It is not easy to make a long list of annuals remaining in bloom "at least three or four months;" but it is very easy, by successional sowing, to have any annual in bloom all summer and autumn. I presume "Aster" understands this, but means that he has not time to devote to their successful cultivation in this manner. If so, here is a list of long-blooming annuals, each of which will last a month—some three. Asters and stocks to begin with; Phlox Drummondi, Zinnia, Calliopsis (or Coreopsis), Helichrysum (everlasting), Ageratum, and Linum—all of which may be treated as "half-hardy." Candytuft is an annual which remains in bloom for a considerable time; but the list above given will furnish a garden very fairly, especially if the flowers are cut freely and all the seed pods removed as soon as the bloom decays. "Aster" should buy these in "mixed" packets. A slight hot-bed and plenty of air at all favourable times when the seeds are up will enable him to plant out in May if he starts now.—Saul Rymea.

[11287.]—**Annuals.**—The rocket, the sweet William, the wallflower, columbine, larkspur, double daisy, white and pink, and lupins.—W. Bright.

[11292.]—**Linseed.**—Linseed is only used in medicine for poultices. Boiled in water, it makes a nourishing drink; by many esteemed a specific for consumption.—J. King Harris.

[11294.]—**Dividing Metal Disc.**—To "Disc."—Your disc of 12in. diameter is to be cut into four equal parts, hence the middle piece (which will be a circle) will be one-fourth the area of the whole, and the outside diameters of the intermediate rings will be those circles of half and three-quarters the area of the whole. Now, as circular areas are as the squares of their diameters, we need only consider the diameters which conversely are in proportion to the square roots of the areas; and as the whole area is 12^2, therefore the diameter of the middle piece will be the square root of $\frac{144}{4} = \sqrt{36}$ or 6, and of the two intermediate rings, the square roots of half and three-quarters of 144 respectively, or $\sqrt{72} = 8{\cdot}485$ and $\sqrt{108} = 10{\cdot}392$.—J. K. P.

[11294.]—**Dividing Metal Disc.**—As the disc is homogeneous, the weights of the parts into which it is to be divided will be as their areas:—

Let D = diameter of whole disc = 12in.
,, d = diameter of inner disc.
,, d_1 = outer diameter of smallest ring.
,, d_2 = outer diameter of second ring.
,, d_3 = outer diameter of largest ring.

First, as regards the central disc. Its area is to be ¼ of the area of the whole disc, and as the areas of circles are as the squares of their diameters, the diameter of the small disc must be half the diameter of the larger one—viz., 6in.:—

$$\therefore d = 6\text{in.} \quad (1)$$

The thickness of the smallest ring will be, of course, $= \frac{1}{2}(d_1 - d)$, and its area $= (d_1^2 - d^2)\frac{\pi}{4}$. This area (by the conditions of the problem) is equal to ¼ of the area of the whole disc, and therefore to find d_1 we have the equation—

$$(d_1^2 - d^2)\frac{\pi}{4} = \tfrac{1}{4}.\ D^2\frac{\pi}{4};$$

$$\text{whence } d_1^2 = \frac{D^2 + 4d^2}{4}.$$

Substituting the known values of D and d, we get—

$$d_1^2 = \frac{144 + 144}{4} = 72.$$

$$\therefore d_1 = \sqrt{72} = 8{\cdot}4853. \quad (2)$$

Similarly, we have for the second ring—

$$d_2^2 = \frac{D^2 + 4d_1^2}{4} = \frac{144 + 288}{4} = 180$$

$$\therefore d_2 = \sqrt{108} = 10{\cdot}3923. \quad (3)$$

Treating the outer ring in the same manner, we get—

$$d_3^2 = \frac{D^2 + 4d_2^2}{4} = \frac{144 + 432}{4} = 144.$$

And $d_3 = 12 = D$: which evidently is as it ought to be.—V. B.

[11294.]—**Dividing Metal Disc.**—General solution, applicable to any number of rings and discs:—

Let r = radius of metal plate.
a, b, c, d, &c. = radii of concentric rings.
t = thickness of plate.
ρ = density.

Then, by the binomial theorem, we have—

$$(a + b + c + d + \&c.)t = r\rho.$$

In the example given, take t = 1in., and ρ = 400lb. per cubic foot. Then we find—

a = 3·79 inches.
b = 2·78 ,,
c = 2·50 ,,
r = 12 ,,

—C. W. Henwood.

[11298.]—**Four-inch Centre Lathe.**—The use of a hole up the mandril will be found if you are making (say) a lot of small screws, which may be cut off successively from the end of a rod of metal which is held in some grip chuck, and gradually drawn forward, the tail end passing up the hole in the mandril, and not only being out of the way, but effecting a saving of material. My mandril is drilled right through for another purpose—viz., centreing work that is held in the grip chuck, while the drill is passed through the mandril from the rear end as described in answer to query 10299, p. 441, Vol. XIV.—J. K. P.

[11301.]—**Limits of Resistance in Telegraph Wire.**—The result of the researches of Professor Damerel Stokes in this direction was, that the number of B.A. units in 1 mile of 19 wire gauge copper wire 1,216,750. In one mile of 24 wire gauge, which is the most used size, the number was, 1,723,800.—C. W. Henwood.

[11301.]—**Limits of Resistance of Telegraph Wires.**—Clarke gives the resistance of the iron wires as 7·8 Ohms per statute mile, and 13·5 for number 8. The Ohm is the B. A. unit. I am not quite clear whether these figures refer to plain or galvanised wire.—Sigma.

[11304.]—**Nessler's Ammonia Test.**—This reagent is an aqueous solution of iodide of potassium saturated with perchloride of mercury, and made strongly alkaline by soda or potash. It is a very delicate test, for it is capable of indicating 1 part of ammonia in 20,000,000 parts of water. The indication is an amber-yellow tint in weak solutions, but a heavy-yellow precipitate when the ammonia is in a larger quantity. To prepare it, proceed as follows:—Dissolve 50grm. of iodide of potassium in about 150 cubic centimetres of hot distilled water. Keep the whole in the water bath at a boiling heat, while you add a hot saturated aqueous solution of perchloride of mercury until the red precipitate which forms ceases to be dissolved by active stirring. This point being reached, stop the addition of the precipitant, filter, add 150grm. of caustic soda (or 200grm. of caustic potash), dissolved in water. Add distilled water till the whole equals 1 litre; finally add about 5 cubic centimetres of the perchloride of mercury solution, allow to subside and decant the clear solution for use. The last addition of perchloride of mercury is to promote clearing, and to give sensitiveness.—Sidcot.

[11308.]—**Geocentric Longitude and Latitude.**—I should imagine that the reason why the *Nautical Almanac* is not incumbered with geocentric latitudes and longitudes required, is that they are only wanted by such persons as Zadkiel, Sagittarius, Old Moore, and other persons who profitably combine the occupations of astrologer and quack doctor. The method of conversion is fully described in every elementary treatise, and has been often explained in "our" Mechanic. However, again, tan. $\theta = \frac{\text{tan. dec.}}{\text{sin. R.A.}}$ ω = obliquity, tan. long. $= \frac{\cos(\theta - \omega)\ \text{tan. R.A.}}{\cos.\ \theta.}$ tan. lat. = sin. long. tan. $(\theta - \omega)$.—Chronos.

[11309.]—**Breaking-Strain of Hollow Iron Columns.**—Hodgskinson's formula for cast iron:—

$$P = \frac{R^3 - r^3}{R^3 + r^3} \times \frac{f}{2E} \times \text{cosecant } \theta.$$

Where R and r are the external and internal radii, $\frac{f}{2E}$ = modulus of resilience, and θ = slope or deflection. In the case of the plumb column, $\theta = 90°$.—C. W. Henwood.

[11311.]—**Electric Bell.**—(1.) One cell of the battery named would scarcely be strong enough, but two would be sufficient. (2.) A cylinder of zinc would answer as well as a "wedge" or "bar," but little, if any extra force would be gained. (3.) No. 16 cotton or guttapercha covered wire will be best if to be hung indoors, either copper or galvanised if outdoors. (4.) Gas or water pipes are more suitable for earth connections than the plan suggested by the querist, but as the distance is so short, a return wire would be better.—W. Golding.

[11313.]—**Setting Lathe.**—I don't know, as I never made or even used a shifting head. I fancied they are always made to be quite true when screwed home in one direction, and only to have the power of moving away from the centre in the other direction. For turning taper I use a centre point screwed into a plate, bolted to the collar-plate itself, or else to the collar-plate headstock: which arrangement I consider, on the whole, a better one, and certainly less expensive than making the head to shift. I don't think taper screws are ever wanted to be cut this way; but I may as well say that if they were they would be drunk, owing to the unequal action of the pin of the driver chuck on the tail of the carrier when the work is out of straight with the axis of mandril. I can tell you a very easy way of setting your slide-rest parallel after you have been turning a cone, but that is not the subject of your inquiry.—J. K. P.

[11318.]—**Gravitation.**—In the case of the inverted small thermometer the mercury retains its position by reason of the adhesion between it and the tube. Bodies falling through the air experience resistance in proportion to the surfaces they present. A piece of old leaf would fall through the air considerably slower than the same amount of metal in the form of a small pellet. In a vacuum this resistance is withdrawn. The common experiment of placing a small disc of paper on the upper surface of a coin, when both, on being allowed to fall, reach the ground together, proves this. Bodies attract, and are attracted, proportionally to their masses, as may be understood by conceiving each particle attracted separately, and the sum of attractions will be the total attraction of the mass. Each particle will therefore (excluding resistance of air) fall with an equal velocity.—W. H. W. T.

[11318.]—**Gravitation.**—"C. W. H." is under the not uncommon delusion that the force of gravitation causes heavy bodies to fall to the earth faster than light ones. Galileo, I believe, demonstrated the fallacy of this theory by casting bodies of different weights off the leaning tower of Pisa, where it was seen that they all reached the ground in the same time. The theory of universal gravitation is that every particle of matter attracts every other. Consequently the earth attracts every particle of a heavy body and draws each one to its surface with a known velocity. It matters not whether the body is composed of few or of many particles. Each particle will be made to fall with the same velocity, and the collection of particles which makes up the mass of the body will, therefore, only fall with the same velocity as each particle does. In considering, therefore, the attractive force of one body on another, the elements taken into account are the mass of the attracting body and the distance between the bodies: the mass of the attracted body not affecting the question. What, however, does make the fall of some bodies to the earth slower than that of others is the resistance of the air, as in the case of the sovereign and the feather. By a simple contrivance, however, two such bodies can be made to fall in the same time without the aid of an air-pump. For this purpose a large coin, such as a crown piece, is better than a small one. The feather, moreover, should be considerably smaller than the face of the coin, and should be flat on it. Now, hold the coin with its plane horizontal; place the feather on its upper side, and on letting both bodies drop together it will be found that they will also arrive on the floor together; the coin having shielded the feather during the fall from the resisting upward action of the air. The quicksilver in the tube of the inverted thermometer is upheld by the cohesion of its particles with those of the quicksilver in the bulb.—V. B.

[11327.]—**Monster Magnetic Machine.**—There could not be the smallest difficulty in accomplishing the purpose aimed at. If I were in the business I should be very happy to meet with such a customer as M. Raudnitz; in fact, he almost tempts me to undertake the job. I know Mr. Browning's small machine, and a very good one it is, but do not think it capable of giving off anything approaching ten cubic feet of mixed gases, to say nothing of oxygen alone, per minute; if it would, the simplest plan would be at once to use ten of them, which would give 60,000ft. per ten hours. I cannot undertake to devise the required machine, as it would require certain experiments to settle a few fundamental principles, though I can see that those principles, or rather the exact results of their application, once defined, the instrument itself is a very simple matter, and would run by no means into "thousands of pounds;" and what may perhaps seem incomprehensible, its cost for working would probably not be large.—J. T. SPRAGUE.

[11334.]—**Squinting.**—If "G. W. F." takes him to the Eye Hospital, Moorfields, London, he will get advice, —W. BRIGHT.

[11334.]—**Squinting.**—"G. W. F." asks if anything can be done to cure squinting. Certainly. Surely he knows where to take his little boy for the necessary operation.—SAUL RYMEA.

[11334.]—**Squinting.** — Ascertain which eye is faulty (it is probably but one, which is weak, and requires strengthening by use) and cover the other.—J. KING HARRIS.

[11337.]—**Equation.**— "Smoothing Plane" has asked for the solution of an equation which every one who knows anything of algebra is aware cannot be solved except by Newton's "Approximations," it being the ambiguous case for the solution of an elliptic triangle.—C. W. HENWOOD.

[11337.]—**Equation.**—There appears to be an error in the statement, as S is said to be required, although it is a known quantity. However, I suppose that what are really wanted are the values of l and n. Substituting, therefore, in the second equation, the value of l as given by the first, we get—

$$S = \left\{a + (a + [n - 1]\ d)\right\} \frac{n}{2} = \frac{dn^2 + (2a - d)\,n}{2}.$$

$$\text{Whence } n = \frac{d - 2a \pm \sqrt{(2a - d)^2 + 8dS}}{2d}.$$

Putting this value of n in the first equation, we get the value of l as follows:—

$$= a + \left\{\frac{d - 2a \pm \sqrt{(2a - d)^2 + 8dS} - 2d}{2d}\right\} d.$$

$$= -\frac{d}{2} \pm \frac{\sqrt{(2a - d)^2 + 8dS.}}{4}$$

$$= -\frac{d}{2} \pm \sqrt{a^2 - ad + \frac{d^2}{4} + 2dS.}$$

$$= -\frac{d}{2} \pm \sqrt{\left(a - \frac{d}{2}\right)^2 + 2dS.}$$

—V. B.

[11341.]—**Colouring Photos.**—There are many ways of preparing the cartes for colouring; some recommend prepared ox-gall; others a weak solution of carbonate of soda; others* again a coat or two of isinglass size, with or without a slight addition of carbonate of soda. It is well to use, instead of pure water for mixing the colours, water rendered slightly alkaline by carbonate of soda, as it makes the colour run smoother. Ordinary water colours will do, they should be of the best kinds. Don't be too free with your colour, imitate nature, rather than follow any absolute rule; practice and perseverance are essential.—W. H. W. T.

[11341.]—**Colouring Photos.** — Water-colours will do tolerably well for this purpose, but it is necessary to use a little gum water afterwards by way of varnish. Colours in powder applied with a slightly moistened brush are more generally used.—J. KING HARRIS.

[11391.]—**Galvanometer.**—The question as put is rather puzzling. What galvanometer does it relate to? The common instrument there is no ready means of calculating, because there is no known law expressing the relations of the deflection? In Noad's "Text Book of Electricity," p. 250; or Miller's "Elements of Chemistry," Vol. I., p. 457; also in Tyndall's "Heat as a Mode of Motion," will be found an elaborate process devised by Melloni for the purpose of getting uniform expressions of value for high and low deflections. On this system a special set of experiments would be needed for each instrument. If "Honours" has or will obtain No. 283 (p. 530, Vol. XI.), he will find there a table in which I have shown (Column 3), the value of all the deflections of tangent galvanometers, as compared with 1°. Those of the sine galvanometer can be obtained by a similar process, which is this: dividing the natural sine or tangent of each degree by that of 1°; by logarithms it is still easier. But the only true and satisfactory process is to ascertain the actual definite value of the deflections in some standard of current, as Vebers or chemical equivalents. The practical process for this is to arrange a constant battery—a copper-depositing cell—and the tangent or sine galvanometer, so as to get a very exact deflection for some hours; weigh the copper deposited, and divide by 31·75 (grains). This gives the chemical equivalent of the current, and, divided or multiplied by the time, gives a measure which, by means of the known ratios of the deflections, will give the standard degree of deflection of the unit current, and this enables us to value every other deflection, as is done in Column 4 of the Table for my own instrument, the only one, by the bye, that I know of which is thus enabled to give at a glance all the information needed. With a tangent or sine galvanometer once thus graduated, it only needs this instrument to be used in a circuit with any other to ascertain once for all the value of all deflections of this latter, whatever its form, in fixed units. If "Honours" will look over my papers bearing on this, I think he will find all the information required. I suppose the time will come when instrument makers will sell instruments showing the current passing in Vebers, instead of dividing every instrument into mere degrees, which give no information whatever, thus rendering it impossible to compare observations made with different instruments.—SIGMA.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last E. F. Conrath has answered 10578; "Gig-Lamps," 10646; "H. B. E.," 10575, 10692; "J. A.," 10684.

10829 Electrical, p. 571
10830 Fern Printing on Wood, 571
10833 Fork and Wedge Motions, 571
10835 Re-lacquering, 571
10840 Manufacturing Sulphate of Soda, 571
10844 Chemical, 571
10846 Analysis of Beer, 571
10847 Enamelling, 571
10850 Granite Sweating Oxide of Iron, 571
10853 Textual Revision of New Testament, 571
10857 Imitation Marbles, &c., p. 572
10858 Voicing Organ Reeds, 572
10859 Wheel Cutters, 572
10861 Oil Stains in Marble, 572
10864 Bone Ash, 572
10866 Rock-boring Machinery, 572
10867 Heliostat, 572
10869 Dr. Stokes's Magneto-Electric Machine, 572
10870 Carbon Points, 572
10874 Refining Archangel Tar, 572
10875 Wilde's Machine, 572
10876 Brewing Questions, 572
10880 Essence of Drinks, 572
10884 Oxford Frames, 572
10891 Swiss Mandril, 572
10896 Glass Paper, 572
10898 Lenoir Gas Engine, 572
10903 Rules, 572
10912 Gut Strings for Musical Instruments, 572
10913 Screw Cutting, 572
10917 Power, 572

The electric light has been introduced into the lighthouse at the South Foreland. This is now the third lighthouse station in England at which the electric light is established, and the French have established one at Cape Grisnez.

Workshop Dust.—The injurious effect of exposure to the dust of various manufacturing establishments has not unfrequently been dwelt upon with more or less force; but we are hardly prepared for the result of certain specific investigations on this subject. It has long been a disputed point whether the particles of iron, silica, &c., merely lodge within the air cells of the lungs, or penetrate through their walls into the tissue between them. But Professor Zenker informs us that, on examining the lung of a woman who had been exposed to the dust of iron oxide, used in preparing books of gold-leaf, he found the powder in the tissue between the air-cells and in their walls, as well as in their cavities. From less than two ounces of this lung over twelve grains of iron oxide were obtained by chemical methods, so that, if equally distributed through both lungs, there must have been at least three-quarters of an ounce inhaled. In another case—that of a workman exposed to the dust of a mixture used in preparing ultramarine substances—he found a quantity estimated at fully an ounce.

QUERIES.

[11352.]—**Fox Skin.**—Would any fellow reader be kind enough to inform me what to use to stop the hair from falling off a fox's hide?—L. B.

[11353.]—**Distilled Water.**—What is the chemical difference between this and ordinary water, and in what does its superiority consist?—G. W. B.

[11354.]—**Fire Balloons.**—Referring to a reply to a correspondent, on the subject of fire balloons (see Vol. XIV., No. 342, page 102, Oct. 13, 1871), would you kindly inform me what kind of paper or other material is used in the construction of a balloon 20ft. in circumference, and of the means used of inflating, so that there would be a certainty of its rising?—WM. MCDONALD.

[11355.]—**Model Steamboat.**—Will some kind fellow reader inform me what is the best sort of boiler to drive a pair of marine oscillating engines, 1in. stroke, and 1¼in. bore, not to exceed 8in. in depth, 5in. in width, and 10in. in length; what gauge of copper to stand 80lb. pressure, and the best means of heating same?—N. G. H.

[11356.]—**Candied Peel.**—Will any brother correspondent oblige by informing me of the method of manufacturing candied peel, as sold by the grocers?—RAGUS.

[11357.]—**Berlin Black.**—Would some correspondent give us some information how Berlin black is made, and how it is applied to register grates, to give them that nice black appearance?—REGISTER.

[11358.]—**Pressure of Water.**—Will some kind reader please to give me rule for finding the pressure of water upon a vessel? For instance, say a tank on the ground floor supplied from one on the top of the house, the top tank 25ft. higher than the bottom one, and supplied by a pipe 1in. in diameter. Please give it in plain figures, as unfortunately I do not understand algebra.—R. IRONS.

[11359.]—**Casting Brass Solid.**—Will any kind correspondent give me what reliable information he can on the following subject?—Living in the country, and never having had the advantage of seeing a practical man perform the operation, my castings are generally honeycombed. What is the reason of this? Has running the metal hot or cold, or the way the moulds are made, anything to do with it? Also in what proportion should the metals be mixed for bearings?—DUFFER.

[11360.]—**Sun's Declination.**—I should esteem it a great favour if any of your astronomical contributors could tell me how I can get the correct declination of the sun for an intermediate time, between the apparent noon of each day. The term "diff. for one hour," on page 1 of our *Nautical Almanac* seems to be a very incorrect one. I have always been told the way to find the sun's declination for an intermediate time is to multiply the number of hours elapsed since the preceding noon by the so-called "diff. for one hour" (regardless of second difference), and then add or subtract accordingly. Certainly, in some observations of the sun, a second or two is not of much importance, but would it not be better if our *Nautical Almanac* published a table of second differences, so that you could get a correct declination? There could surely be no objection on account of space, although I see in the later editions of the almanac a gradual decrease in the number of pages, and I suppose a corresponding decrease in the computing staff, but if the almanac is to be confined to a certain number of pages, why not omit the trashy explanation, and insert one or two useful tables?—HENRY WOOD.

[11361.] — **Preserved Meat.** — Would any correspondent explain the modus operandi as conducted in Australia, with regard to the filling, boiling, and soldering up of the tins. The reason why the ends are concave, and what is the use of the bent strips of tin soldered inside the lid?—CURIO.

[11362.]—**Silver Tubes for Meerschaum Pipes.**—Could any of the readers of the MECHANIC inform me how to make bent silver tubes for meerschaum pipes? I can do the straight ones, but often lose a job through not being able to do the bent ones. An answer will oblige—A YEAR'S SUBSCRIBER.

[11363.]—**Hankey's Comet.**—Anxious as "F.R.A.S." always is to assist any one desirous of information, can he give me the method for calculating the next places of Hankey's comet, which, when completed, I would gladly communicate to our MECHANIC. I have De Morgan's well-known sheet of logarithms, a slide rule (by Smith), a sextant and a Gunter's scale, and a very accurately divided triangulator. Should I not have sufficient materials, perhaps "F.R.A.S." will kindly inform me what other articles are required.—YOUNG ASTRONOMER.

[11364.]—**Lettering the Backs of Books.**—Will some reader kindly tell me how the gilt lettering on the backs of books is done, or on slips of leather?—W. STEAD.

[11365.]—**The Wind.**—Will any of your readers inform me from which quarter the wind blows mostly during the year in London?—ANEMOMETER.

[11366.]—**Blankets.**—Will any fellow reader inform me of the best method of washing and whitening blankets that have become yellow? Should any chemical be used?—HOUSEKEEPER.

[11367.]—**Magnesium Lights.**—Can any one tell me how to make magnesium lights? I suppose the addition of magnesium filings to an ordinary blue light would answer; but as the filings are expensive, I wish to avoid experimenting.—T. T.

[11368.]—**Precious Stones.**—Will some of your correspondents kindly inform me what relation in value do the cheaper precious stones, such as garnet, emerald, blood-stone, &c., bear to their settings of nine carat gold? Or if information in this form be not convenient, a reference to a work on the subject will be thankfully received by—CARBON.

[11369.]—**Etching Steel.**—What acid will eat steel quickly? I want it for making a hole into a that I do not wish to soften.—H. D. B.

[11370.]—**Electrical.**—How is it that in the following combination current can be detected? A strip of copper and of zinc, with a piece of cloth between them, are joined together at the ends: then upon exciting this compound strip and bending it round till the ends nearly meet, the current can be plainly felt with the tongue. Now, I should have thought that joining both ends of copper and zinc would have destroyed all current whatever. Which is the negative pole in such a combination? —H. D. B.

[11371.]—**Steel for Lathe Tools.**—As I live a great distance from any town where I can procure steel for slide-rest, eccentric, vertical and horizontal cutter tools and drills, I want to order some useful-sized steel to have by me when required. Would "J. K. P." kindly let me know the most useful sizes and names of best steel? The centre of my 4in. lathe is ½in. above slide-rest. Would he also give me his advice how to mend a piece of the cast-iron frame that the mandril runs in, which is broken out by one of the screws of cross-bar (that keeps the front bearing of mandril in its place) being too tight?—L. S.

[11372.]—**Oval Chuck.**—Would "Jack of All Trades" kindly help me in constructing his oval chuck (Vol. XII., No. 293), as I do not understand B², the micrometer screw and head with divided and sub-divided rings, nor the figures K R R and plan C and section C? If he would give me a few measurements I should be greatly obliged. My face-plate is seven inches and fifteen-sixteenths in diameter.—L. S.

[11373.]—**History of England.**—Can any of "our" correspondents inform me of a good cheap History of England for boys of ten and eleven? I have had Little Arthur's, John's, and McLaurie's, and require one now between the latter and Dickens's. Mrs. Markham's is too lengthy, and Collier's too difficult.—Beta.

[11374.]—**Fixing Belts on Tires.**—I wish to know the proper way to put the belts on Barnard & Bishop's lawn mower tires, and if they can be repaired when broken, and by what process.—Blacking.

[11375.]—**Brickmaking in Canada.**—I should feel obliged if any one of "our" readers who may have knowledge of Canada could inform me of the part wherein soil might be dug suitable for making bricks—sand, clay, and chalks are the necessary materials for composition. If the plant is situated adjacent to some rising neighbourhood the advantages would be more profitable. —Gillem.

[11376.]—**Marble Busts.**—I have several marble busts which are considerably blackened and soiled from exposure to the influence of dust and smoke. Can any one instruct me how to clean (without injuring) them readily?—M. B.

[11377.]—**Pocket Umbilicus.**—I have a small 6in. pocket umbilicus, the internal mechanism of which has become deranged, in consequence of the geodesic having become entangled with the escapement wheel on the indicatrix; in addition to which, I am afraid some teeth of the skew bevils on the permanent axis of rotation have become bent, producing non-isochronous movements in the parabolic governor. Can any of your mechanical readers advise me how to remedy these defects without breaking the air-tight joints in the covers, and so vitiating the vacuum? The cylindrical case of the umbilicus is made of plate-glass, and not of the usual alloy of sheet tin and cast iron.—R. Macmichael.

[11378.]—**Killing Beetles.**—How can I kill the larger kinds of beetles for mounting in a collection without destroying their colour, and in the quickest manner, so as not to cause unnecessary pain?—Sempervivo.

[11379.]—**Wardian Case.**—Will some kind reader furnish some practical hints to a young amateur mechanic who is ambitious of constructing a wardian case, about 3½ft. long, at the minimum cost consistent with completeness and a certain amount of chasteness?— Y. A. M.

[11380.]—**Sand for Casting.**—Could any of your subscribers inform me of the method of preparation of the sand which is applied to the purposes of moulding and casting iron and brasswork?—Leonidas.

[11381.]—**Rhumkorf's Coil.**—Would "Sigma" or some one else kindly tell me how many pint Bunsen cells I could use with safety for working a Rhumkorf's coil, consisting of three layers of No. 18 copper wire for primary; also, how they are to be arranged?—J. S. W.

[11382.]—**Parrot.**—Can any one tell me the cause of and cure for a parrot picking the feathers off one of his wings and his red tail? I have altered his diet, giving no hempseed, and keeping him almost on bread and milk, but it makes no difference. It is a gray bird, and never has meat or bones.—Cygnus.

[11383.]—**Sulphur Soap.** — How is sulphur soap made? What is the quantity of flowers of sulphur used in a pound of the soap, and how is it worked in?— Peronelle.

[11384.]—**Small-Pox: Its Prevention and Cure.** —In No. 333, p. 514, of the Mechanic, phenic acid is mentioned as a cure and preventive of small-pox. Can any one give me any information concerning it? I have tried to obtain it, but have been unsuccessful. Has carbolic acid the same virtues?—F. W. Shearing.

[11385.]—**Salt.**—Will any of your correspondents inform me what are the tests for salt? 1. For purity. 2. For strength. 3. What changes does salt undergo by lying in stock (say) from four to six months? 4. Is there any difference in the quality (chemical or otherwise) of the salts made in different parts of England?—Chloride of Sodium.

[11386.]—**Crystals in Gas Tar.**—About nine months since I had occasion to use some gas tar from the gas works. I procured some in a tin quart can. After I had used what I wanted I put the lid on the can and laid it by in the cellar. Some time after I wanted a little more tar, and to my surprise, when I moved the lid off the can, I saw some beautiful white crystals projecting from the tar on the sides of the can. Now, I should feel obliged if our chemical correspondents would extend their favours and explain the chemical action; also, the equations worked out, so as to explain the formula of these crystals.—Atomic.

[11387.]—**Sundials.**—Will one of your astronomical correspondents kindly inform me whether a sundial might be made to give correct indications by mounting it on a pivot, so as to admit of its rotation in a horizontal plane, and setting it from time to time by a graduated circle divided into days or weeks, according to the degree of accuracy required? Or would it be also necessary to have the gnomon capable of adjustment vertically? Could a similar arrangement be applied to other forms of dial, such as the vertical?—L. C. E.

[11388.]—**To Mr. Fennell.**—Will Mr. Fennell be good enough to state whether the organ shown in section on p. 665 of the last volume is the same as the one of which he formerly sent a drawing? Also, whether he ever made the instrument, or merely designed the case, which was an extremely elaborate one?—L. C. E.

[11389.]—**On Fortifications.**—Will some reader inform me of the plan of the late Earl of Dundonald on fortification? I have a plan of a fortification on hand, and wish to know if they are anything like mine. My plan rises out of the earth, and when down the enemy might stand on the top of it and not be aware of its presence.—J. T.

[11390.]—**Brown Hat.**—Will somebody kindly tell me how to dye my straw hat brown? It used to be an easy matter to get done, but now both general dyers and milliners refuse the work. Having an old fashioned fancy for a brown hat, I tried to do my own, and got a sixpenny bottle of dye for the purpose, but as it was barely enough to cover the crown I thought it dear, so finished it off by adding a bit of one chemical and a bit of another, until the hat was presentable and even wearable; but having no idea of the quantities of the things I used, I am unable to do the same again, so must submit to being another woman guided by "rule of thumb." —Sarah.

[11391.]—**Insulating Coil.**—Will any kind reader inform me whether it is absolutely necessary to insulate each separate coil with ebonite, or is there anything else that would do as well? If properly insulated what is the average length of spark a ½lb. of No. 32 silk covered wire ought to give?—H. Corbett.

[11392.]—**Scent from Violets and Roses.**—Can any one inform me the way to extract the scent from violets or roses?—H. Corbett.

[11393.]—**Metallic Harmonicon.**—Having lately seen a drawing of a metallic harmonicon, would some kind reader give me some particulars about it? What are the breadth and thickness of the ribs upon which the notes rest, the kind of wood best suited for them, and are the pins which keep the notes in their places driven down through the heart of the cord into the ribs? and is it, after all, an instrument that is of much practical value to the musician, or is it only a musical toy?— Valve.

[11394.]—**Opera Glass.**—I wish one of your correspondents would inform me how to make an opera-glass of great power—for one eye would do, and it need not slide.—Inquirer.

[11395.] — **Foreign Wood.** — Can any of your numerous readers inform me what kind of wood it is that is bound outside the cases that cocoa fibre comes in? It is a very dark and heavy wood, and comes in small pieces about 1in. square?—C. C.

[11396.]—**Ivory Handles for Whips.**—I have seen ivory handles for driving whips, apparently turned, but having at irregular intervals knots in imitation of those in holly and other woods? How is this done? I think the result might be produced by turning beads at intervals, and filing same away to form the knots; but a careful examination of one of the handles makes me think it is not done so.—Jannifred.

[11397.]—**Sting-proof Gloves.**—Could any one tell me how I could make a pair of sting-proof gloves, to be proof against the stinging of bees?—Apiarian.

[11398.] — **Stinging of Bees, Hornets, and Wasps.**—What is the best remedy for the stinging of the above to prevent swelling?—Apiarian.

[11399.] — **Water Power Wanted.** — Will some brother reader inform me what size turbine wheel I should require to work a cylinder which is now worked by a man and lad? I have a cistern which I think will supply sufficient water, holding about 400 gallons. I can get 18in. fall from bottom of cistern to top of wheel; will 1½in. pipe be large enough? If not please state what size will be necessary. Of course I can always have that quantity of water in cistern, as I have a good supply. Please state the depth of wheel and size of buckets. A sketch of one will greatly oblige.—E. Tappin.

[11400.]—**Pedals for Pianoforte.**—Would some kind reader give a plan of a set of 29 pedals for practice for the piano, and how to connect them with the keyboard of a 6 octave piano?—J. W. S.

[11401.]—**Electric Formula.**—I have had some years' practical work in the engineering department of a telegraph company—chiefly in construction work. I have purchased Culley's "Handbook of Practical Telegraphy," but cannot understand the scientific instructions for testing, &c. Will some brother reader kindly say if I can acquire this information without a master, and if so what books I must purchase?—Bladud.

[11402.]—**Water Power to Work Saw Bench.**— On page 671 of last vol., your obliging correspondent "Tubal Kain" estimates 7,206lb. of water, having a fall of 6½ft., will give an effective power about equal to 1 horse. I wish to know the size of an opening from a head of water that would allow the escape of that quantity. Would a 3ft. opening, with 6in. of water flowing over the cill, be near that weight? "Tubal Kain" is better at figures than I am, and I hope he will not smile at ignorance. We receive much instruction from the writers in "our" journal. Are the paddles of water-wheel set at right angles from drum, or inclined to receive the flowing water? I hope to turn the above query to some advantage in the western country.— Gillem.

[11403.]—**Gas.**—Will some one tell me where the gas burned in the carriages on the Underground Railway is supplied from?—W. Bright.

[11404.]—**Analysis of Albite.**—Will Mr. Da kindly indicate how I must proceed in making quantitative analysis of albite (Si_6 Oz Nao_2 Al_2 O_6)? an inform me if ZCy_2 is soluble in water, if ferrous sulphate is oxidised into the higher sulphate by passing chlorine through its aqueous solution, if $MnCl_2$ is converted into $MnCl_4$ under the same circumstances, and if potassic nitrite in like condition is converted into the chloride? —W. J.

[11405.]—**Purifying Zinc Wire.**—Will you or any of your readers be kind enough to inform me of any other means of purifying zinc wire for a battery, other than using mercury?—John S. Darton.

[11406.]—**Steam Pump.**—What kind of steam pump is best to try an artesian bearing from a bore hole forty yards deep, which stands thirty-three yards in water?—John Hartley.

[11407.]—**Magic and Conjuring.**—I want to give a lecture on magic, and wish to give as many startling experiments as I can. I should like to make the stage as attractive as a conjuror's. What I mean by magic is those tricks that are done by natural causes; for instance, the double funnel where you pretend to pump water out of a person's arm, the water being kept in the funnel by the pressure of the atmosphere, and is allowed to run out on lifting the finger from a little hole in the handle of the funnel. This is magic. Cooking plum puddings in gentlemen's hats is conjuring. Can any of your numerous readers tell me of any magical tricks?— Mark.

[11408.]—**Sewing Machine.**—Being about to purchase a sewing machine, and reading up the subject, I find those instruments are divided into two classes, such as form the stitch with a revolving hook, and those which do so by means of a reciprocating shuttle Now I wish to know which of those methods is the simplest or the least liable to get out of order, presuming that either make the sewing with similar excellence. I want the instrument for general use in a private family, and for a lady who does not appear to have more than mediocre mechanical ability.—E. B. F.

[11409.]—**Canine.**—Can any brother reader of this very valuable journal put me in possession of a remedy for the falling off of the hair of a retriever pup? I may just state that it is black and three months old, and up to about a month ago had a fair coat of curly hair; since that time it has gradually fallen off until it is almost bare. I have washed it frequently with dog soap to destroy fleas, and have also administered areca nut for worms, both these articles having had the desired effect. I may also state that it is full of mischief and as hearty as it can be, but the hair coming off completely spoils this otherwise promising and valuable pup; therefore, if any of my brother readers can tell me what will cure this failing, he will confer a great favour on—J. A. H.

[11410.]—**Geometrical Question.**—AB is the base of a triangle, of which the sides AC and CB are equal to one another; also D is a point in BC, or in BC produced, where a line drawn from A makes a right angle with DB. It is required to show that the angle DAB is equal to half of the angle ACB at the vertex of the isosceles triangle.—Thetamu, Horsham.

[11411.]—**Line Shaft.**—Will some one give a quick and correct mode of fixing a line shaft, say 160ft. long? —Tyro.

[11412.]—**Painting.**—I have seen an oil painting by M. Zadorecki which very much takes my fancy. Will some one kindly inform me if he is considered a good painter, and if his works are much sought after?— Flactem.

[11413.]—**Lathe Chuck.**—Would "Goat" kindly give a more minute description of the lathe chuck he refers to, in his reply to query 10883, as I do not quite understand him? A detail drawing would greatly oblige—Lilly.

[11414.]—**Unripe Seeds.**—If seeds are gathered before fully ripe will they germinate when sown, and if so is the plant degenerate?—Z.

[11415.]—**Scarlet Runners.**—Will some reader tell me which is the best sort for sowing, and how I can prevent the flowers dropping off, which happened to me last year instead of growing to be beans? Also a few hints for the successful cultivation of this delicious vegetable.—Z.

[11416.]—**Crossbow.**—Would some brother reader inform me how I could make a good crossbow, one that will carry well?—Turner.

[11417.]—**White Polish.**—Will any of your readers direct me how to polish white woods, such as lime and apple? and also give me the recipe of a good white varnish?—Stilton Cheese.

[11418.] — **Absorbing Quality of Printing Paper.**—Can any of your correspondents inform me if the absorbing quality of paper of foreign books can be obviated? I should feel obliged if some one would state a handy method of doing this.—E. W. P. Edwin.

[11419.]—**Half-Horse Power Turbine.**—Would a brother reader of "ours" kindly inform me if it is possible to get, say, ½-horse power (or less would do) from a turbine erected in conjunction with a common house water tap, through which runs a good supply of water through a 1in. diameter pipe, supplied by a main of (say) 6in. diameter?—Aqua.

[11420.]—**Sewing Machine Extras.**—I want to make a few extras for sewing machines. Will "Jack of All Trades" kindly inform me whether the ones in common use are silvered, or are they white metal, polished?—Cleos.

[11421.]—**Photography.**—I am just commencing the practice (or study) of photography, and am, to the best of my knowledge, strictly following the instructions given in all works on the subject. I think I have succeeded in coating the plate with collodion. I immerse it in silver bath for four or five minutes, develop with iron developing solution, fix by plunging in hypo. bath for about ten minutes; the picture looks well till I wash it, and as soon as I flood it with water the picture nearly disappears, leaving little more than the upper part of background, which looks muddled and blotchy. If some experienced hand will kindly come to the rescue I shall be very grateful.—Camera.

[11422.]—**Night and Day Temperature, &c.**—How is it we often hear it said it is never so cold by night as by day, when we know very well, from the readings of the thermometer, that the reverse is the case? Are our bodies less sensible to the influence of cold at night? Again, I have often heard it affirmed by sailors that it never blows so hard by night as by day. Is there any truth in this?—A. E. S.

[11423.]—**Surgery.**—Can any one give me information on this case? Three months ago a person of my family got about a quarter of an inch of the point of a needle in her finger. As it is exactly in the middle joint, no surgeon has been willing to answer for the result of an operation. The finger, at first much swollen and extremely painful, has now, for the last two weeks, resumed its former state, except a little white tumour where the needle went in, and a soft red swelling on the opposite side; it is still painful when bent. Is there any danger?—A COUNTRY SUBSCRIBER. [We hope no one will answer this question who is not qualified to speak with authority.—ED.]

[11424.]—**Botany.**—Wanted, information about a good "Flora," partial or complete, of Wiltshire, or of South of England. Are there any with analytical keys for young beginners?—AME EN PEINE.

[11425.]—**Fitting New Roller and Lever to Watch.**—Will one of our watchmaking subscribers kindly inform me how to put a new roller and lever to a watch, also how measure them?—JOBBER.

[11426.]—**Screw Cutting.**—Will any kind reader of "our" MECHANIC inform me what pitch of screw I want for a 4in. centre lathe, and what size? and what distance from centre of lathe mandril to centre of screw?—DIGBY.

[11427.]—**Degrees in Chemistry.**—Will some subscriber kindly inform me of the best way of preparing myself to take a degree in chemistry? Also what would be the first degree to be taken, and the best place to take it at? Will some one kindly give me a few examples of questions that have been set in the examinations?—AMBITIOUS CHEMIST.

[11428.]—**Violin.**—Can any of your correspondents learned on the subject of violins inform me if a violin having inside the following inscription is likely to be genuine: "Made by Thomas Smith, at the Harp and Hautboy in Piccadilly, London, 1756;" and if genuine would it be valuable?—W. P. D.

[11429.]—**Ferns.**—Will some reader kindly tell me how to get rid of and prevent mildew to ferns kept under a glass shade?—E. T. S.

[11430.]—**Lapidaries' Tools.**—Will some brother reader kindly tell me the way lapidaries cut the pebbles found on the sea-shore, and what tools are required, and how they are polished? Any information on the above will oblige.—J. CHAMBERLAIN.

[11431.]—**Tinned Water Bottles.**—Our corps have been ordered to carry water bottles, and they are tinned inside, but we find that wine, &c., dissolves the tin and causes the iron to rust. I wish to know whether they can be easily plated with silver inside, and how?—if with battery which, and what size will be required? They are black japanned outside.—LONDON RIFLE.

[11432.]—**Tuttle's Comet.**—No one has given the places for every day of Tuttle's comet in "ours," beyond what our friend "F. R. A. S." wrote in the leading article of the ENGLISH MECHANIC for Feb. 23. Would some one oblige me by giving the places for the early part of April?—W. H. SKELTON.

[11433.]—**Porous Charcoal.**—Will any reader inform me how the porous charcoal blocks are made, and what are the ingredients for filters?—J. WALTON.

[11434.]—**Salmon Spawn as Bait.**—Would any reader inform me how to mix salmon spawn as a bait for fishing. I have a book for fishing which says, "Salmon spawn is a good bait for all kinds of fish when mixed in a peculiar manner."—KING FISHER.

[11435.]—**Bootmaking.**—Is it necessary to soak leather in water before using it for the soles of boots? If so, does that not damage the leather, and render it less durable than when worked dry?—CRISPIN.

[11436.]—**Harmonium.**—Is it absolutely necessary that the channels should be all the same width in a harmonium pan?—K. T. L.

A Shower of Stones.—A shower of stones is reported from Rosario, in December. A great tempest was felt, ending in a shower of stones from N.W. to S.W., and doing much damage. The shower lasted ten minutes, and the stones were abundant and large, weighing from a nut in size to a pigeon's egg. The cornfields have severely suffered. It is remarked the like occurrence had not been seen for many years, so it is to be inferred such a phenomenon is not unknown. As the Bernstadt colony was affected some European observations may be received.

The Healthiest Sites for Dwelling-Houses.—The healthiest sites for dwelling-houses (said Dr. Hime, in a paper recently read before the Sheffield Architectural and Archæological Society) are known to be those on trap, granite, and other metamorphic rocks, where water readily escapes, and the soil, and consequently the air, is dry. Cholera is rare in houses on such sites. Permeable sandstone, gravel, and chalk, if unmixed with clay, are also healthy. Sands which contain organic matter, clay, and alluvial soil are always to be suspected. Thorough draining, both subsoil and surface, is a necessary preliminary to building. Dampness of ground necessitates dampness of the air and of the walls. Houses should never be built on ground filled up with ashes and other *debris*. The large amount of organic matter contained in it, which is freely exposed to the action of the air and moisture, becoming decomposed, must cause poisonous emanations destructive to those who, living above, must breathe it.

DOMESTIC RECIPES.

From the *Food Journal*.

PUREE DE LEGUMES.—Boil in some stock with a bundle of sweet herbs, pepper, salt, and spices to taste, any combination you like of such vegetables as carrots, turnips, potatoes, parsnips, leeks, onions, peas, Jerusalem artichokes, etc. When thoroughly done, pass the whole through a fine hair sieve. Mix in a saucepan a piece of butter and a little flour, then add a little of the purée, and when this is well mixed add the rest. Finish by stirring in, off the fire, a couple of yolks of eggs strained and beaten up with a little milk. Serve with or without any sippets fried in butter. N.B.—The above is one way of making use of the trimmings of vegetables produced by cutting them up with fancy cutters.

FILETS DE VEAU A L'ITALIENNE.—Cut from a piece of leg of veal some nice fillets, three-eighths of an inch thick, sprinkle them on both sides with pepper and salt, and lay them flat in a tin, with plenty of salad oil. Put the tin in the oven just long enough to cook the fillets, then drain and arrange them in a circle on the dish, with the following sauce in the middle:—Fry in a little salad oil a couple of shallots, minced fine; when they are a pale straw colour add two or three mushrooms and a little parsley, minced in the same manner; then moisten with enough stock and white wine in equal parts to make the sauce; add pepper and salt to taste, a clove of garlic, some sweet herbs, and a bay leaf tied up in a bundle. Let the sauce boil half an hour, and remove the bundle. Melt a piece of butter, add a very little flour to it, then the sauce, stir it well on the fire, and it is ready.

CRAPPIT HEADS.—A Scottish dish, of which the name signifies stuffed heads. It consists of the heads of haddocks, stuffed with a mixture of oatmeal and suet, flavoured with onions chopped small, and pepper, to which the roes of the haddocks are sometimes added. The heads are then placed in a pudding dish with a little suet, sprinkled with oatmeal, and baked in an oven. This was formerly a favourite supper dish in Scotland, and is mentioned in "Guy Mannering" as one of the good things prepared by the landlady of a village inn for a guest to whom she wished to show particular attention. Although a very pleasant dish, it has, however, fallen much into disuse.

OMELETTE AU PARMESAN.—Beat up three eggs with pepper and salt to taste, and a tablespoonful of grated Parmesan cheese; fry a light colour, and serve with plenty of grated Parmesan stewed over the omelet.

USEFUL AND SCIENTIFIC NOTES.

A Cosmopolitan Move.—It is asserted, and, we believe, on good authority, that Prince Bismarck is about to summon to Berlin an International Congress, to discuss the present postal arrangements of the world; and that he is prepared to lay before the members the following proposals, as a basis for negotiation:—1. That all the States of Europe, Russia in Asia, Turkey in Asia, Canada, the United States, Algeria, &c., shall form one postal union. 2. That throughout this union there shall be adopted a uniform rate of postage of twopence per half ounce. 3. That throughout the union, newspapers, printed matter, patterns, &c., shall be conveyed at the rate of one penny for every two ounces. 4. That to all countries not included in the Postal Union double the above rates shall be charged. 5. The uniform registration fee for all parts of the world shall be twopence.

A Wave of Cold.—The meteorological observations now made and telegraphed daily in America disclosed, in February, the path of a great atmospheric wave of cold across that continent. The *Chicago Tribune* states that on the night of the 11th the telegram to that city announced that at Fort Benton the thermometer had suddenly fallen to 15° below zero, but none of the other signal stations exhibited any marked change of temperature. On the 12th, the thermometer fell 35° at Omaha. At Chicago it stood at about 43° until midnight, with a very light movement of the atmosphere; the icy wind then arrived, and the mercury dropped 33° in ten hours, and fell still lower in the evening, the wave passing on towards the south-east. It traversed the distance from Fort Benton to Chicago at the rate of 25 to 30 miles per hour, and it is stated extended at least 100 miles north of the line from Fort Benton to Omaha, but not so far to the south. The barometer rose as rapidly as the thermometer fell.

Copper Gas-Pipes.—The *Journal de l'Eclairage* notices an accident which once more proves the danger of using copper gas-pipes. A workman having, with a three square file, cut almost through half the diameter of a gas-pipe of red copper of ⅜in. internal diameter, which supplied the Liége station, was removing the tool when an explosion similar to the report of a rifle ensued, and the workman was much burnt. Some gas-pipes having been taken down, they were found covered with a blackish coating, and showed evident signs of corrosion from ammoniacal condensation. The black matter was analysed, and was found to consist of an acetate of copper, which exploded between 203°-248°, producing water, copper, carbon, carbonic acid, and traces of carbonic oxide.

Pearls.—Mr. R. Garner lately read a paper before the Linnean Society, in which he referred to the theory, now generally adopted, that the production of pearls in oysters and other molluscs is caused by the irritation produced by the attacks of the minute parasite known as *Distoma*, and believed that, by artificial means, this parasite might be greatly increased. British pearls are obtained mostly from species of *Unio*, *Anodon*, and *Mytilis*, but it is probable that all molluscs, whether bivalve or univalve, with a nacreous lining to the shell, might be made to produce pearls.

Coating Oxidisable Metals.—A process devised by M. Nagel, of Hamburg, for coating iron, steel, and other oxidisable metals with an electro deposit of nickel or cobalt, consists in taking 400 parts, by weight, of pure sulphate of the protoxide of nickel by crystallisation, and 200 parts, by weight, of pure ammonia, so as to form a double salt, which is dissolved in 6,000 parts of distilled water, and 1,200 parts of ammoniacal solution, of the specific gravity of 0·909, added. The electro deposit is affected by an ordinary galvanic current, using a platinum positive pole, the solution being heated to about 100° Fahr. The strength of the galvanic current is regulated according to the number of objects to be coated. For coating with cobalt 138 parts, by weight, of pure sulphate of cobalt are combined with 69 parts of pure ammonia, to form a double salt, which is then dissolved in 1,000 parts of distilled water, and 120 parts of ammoniacal solution, of the same specific gravity as before, are added. The process of deposition with cobalt is the same as with nickel.—*Iron Age*.

Liquid Glue.—An excellent liquid glue is made by dissolving glue in nitric ether. The ether will only dissolve a certain amount of glue, consequently the solution cannot be made too thick. The glue thus made is about the consistency of molasses, and is doubly as tenacious as that made with hot water. If a few bits of indiarubber, cut into scraps the size of a buck shot, be added, and the solution allowed to stand a few days, being stirred frequently, it will be all the better, and will resist the dampness twice as well as glue made with water.

Insanity in France.—History teaches us, says the *Lancet*, that when a nation passes through great political storms, that period is always followed by an increased development of insanity, which generally takes a suicidal form. The throes through which France has lately passed have already materially increased the number of lunatics in that country. The inmates of the various asylums and maisons de santé have more than doubled in the course of the last eighteen months, and the Morgue in Paris is barely large enough to contain the bodies which are daily found in the Seine. Among the Communist prisoners who are now in durance at Brest, Cherbourg, Lorient, and elsewhere, the tendency to insanity is very marked, two per cent. having become deranged since their imprisonment. The appointment of a medical commission to inquire into and report upon this question would be both wise and humane.

The Productions of Florida.—White oak, live and water oak, gum, bay, hickory, magnolia, palm, dwarf palmetto, pine of several varieties, Indian corn, cotton, sugar cane—which, unlike the Louisiana cane, reaches a full maturity—sweet and Irish potatoes, celery, radishes, rice, tobacco, indigo—the principal production under the British occupation of Florida; Sisal hemp, the magney plant or Agave Americana, castor bean, the mulberry, peas, pea-nuts, wild arrowroot, rye and oats, tomatoes, cucumbers, melons, beans, cabbages, turnips, beets, oranges, lemons, limes, citrons, peaches, grapes, figs, pomegranates, plums, blackberries, olives, bananas, pine-apples, guava, tamarind, plantain, cocoanuts, &c. Wheat does not succeed; but flour may, of course, be readily procured by the immigrant who is not willing to live on Indian corn, sweet and Irish potatoes, rice, or the almost countless fruits, added to his meats and fish. As for cattle, they may live on outdoor supplies, and range for ten months of the year in Northern Florida, and for the whole year in Southern.

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Amount previously acknowledged	£332 5 6
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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, March 26, and unacknowledged elsewhere :—

W. H. Cuell.—G. R. Hallane.—Philip P. Hanson.—L. Michals.—Geo. E. Jee.—Young Moulder.—George Lampbard.—Wm. Moore, jun.—John Ridgway.—R. G. Kent.—P. W. Mayor.—C. Scopas.—Greybeard.—S. Bottone.—R. A. Proctor.—Cameo.—Old Dog Tray.—The Harmonious Blacksmith.—W. Pengelly.—Sigma.—W. R. Birt.—Fred. Harrison.—A Shipbuilder.—Eureka.—J. C. M.—Moneta.—O. W.—G. H. S.—John Clegg.—Zoo Andra.—F. T. S. S. D.—Interrogator.—Fond of Singing.—E. Naylor.—A New Subscriber.—Samuel Davis.—S. G.—Wm. Hutchins.—N. Du Fai.—J. Walton.—M. Paris.—J. B.—Jack of All Trades.—R. S. T.—Screw.—Photo.—M. R. C. S.—Hy. Newman.—A. Z.—E. H. W.—H. D.—R. Langdon.—A. W. C. Price.—W. H. Harris.—W. C. Hughes.—G. H. Hurst.—A. J. White.—G. F. H.—W. G. Clarke.—An Anxious Mechanic.—Rosse.—G. A. D.—Rata.—Semaj.—Full Stop.—W. J. H.—H. F.—A. J. V. G.—R. Tervet.—Samuel Smither.—J. R. Proctor.—E. B. Fennessy.—Experior.—C. B. B.—Iriosal.—Archer.—Touchstone.—Country Tinker.—W. Bright.—Matthew Berth.—A., Liverpool.—Ultima Thule.—Lyons.—Anxious.—W. W.—Bed of Stone.—Champagne Charlie.—Geo. Knott.—B. H. Harris.—Henry White.—King Fisher.—Ralph Lowdon.—F. R. A. S.—E. R. E. A.—T. Leith.—Ambitious Chemist.—R. D. D. Masey.—Excelsior.—W. R.—H. Sheppard.—A. J.—S. Pearce.—Vega.—L. W. D.—B. H. Rochdale.—Æneas.—Digby.—G. D.—Zeta.—Youngster.—A Chemical Student.—F. B. T.—R. G. A.—A Subscriber.—S. W. Dudley.—J. Westwood.—Wm. Richardson.—R. O.—W. H. Skelton.—Old Coin.—Barbaros.—F. T. C.—Geo. N. Dobson.—A Young Student.—C. N. Abbett.—L. C. E.—W. H. Hey.—W. P. D.—Philadelphus.—E. T. S.—A Young Reader.—J. Chamberlain.—Khoda Bux.—Jobber.—Thetamu.—Telescopic.—W. E. Henning.—F. A. Edwards.—Welshman.—J. W.—J. W. Card.—Northern.—J. D. Hardy.—Galashiels.—Fletcher and Sinclair.—Coastguard.—E. A. Hansom.—J. H. H.—Detritus.—Sharp and Good.—Boatswain.—Social Reformer.

JOHN SHAW.—Yes.

B. BUDD.—Your letter is not forwarded, because it is our rule not to forward such letters.

Education, Labour, L. Langdon, Youngster, and C. P. E. Your queries are advertisements.

L.—Monthly, price one shilling, and a poor shilling's worth it is. Judge for yourself.

S. SMITHER.—Ornamental Turning, No. 7, next number.

FRAZER HALLE, LL.D.—Scientific Education next week.

J. K. P.—Your other answers next week.

E. L. G.—The P.S. to "Save Us from Decimalism" came too late for this number. It will appear as a separate letter next week. The answers will also appear then.

V. C. B.—Don't ask silly questions.

J. D.—The Organ Built, No. 6, next week.

CERVUS.—Though you doubtlessly disclaim with truth that you have no interest in the books you recommend, still the insertion of your letter would look like an advertisement, and would certainly have the effect of one.

FIDDLER.—You have wandered rather too distantly into the regions of speculation in your letter on "A Question of Sight," to render it suitable for our columns. Please see our answer to "Phœbus" in last number, p. 26.

PNEUMATIC LEVER.—Please send the draught of "the novel arrangement from Germany."

R. IRONS.—We should be glad of the particulars of galvanising iron works in general.

ONE WHO CONSIDERS DARWIN A FOOL.—You are more emphatic than you are polite or truthful. Darwin, in all probability, if he considered you worth consideration at all, would prefer that *you* should entertain such an opinion of him.

SENEX.—Your answer about combing hair smoothly over the head being the cause of baldness cannot be correct, as women would then become bald sooner than men.

JAMES SMITH.—Your query, if inserted and answered, would have no general value, as it would only be useful or interesting to *one* person—yourself. We desire our space to be occupied with information useful or interesting to the largest number.

Correspondents whose communications are not inserted for reasons given in "Hints to Correspondents."—Vermilion, E. Barber (1st reply), Alpha (University Club), Peronello (first query), J. H., F. B., Clock Fancier, Semperviva (first query), Thomas Marshall, Manxman, Thomas Stone, Reed Maker, C. Williams, Samuel Hill.

W. T.—It is unreasonable that you should ask "F.R.A.S." to give you the desired information. Your letter is not forwarded because it is contrary to our rules, and if it were not "F.R.A.S." would not comply with your request.

A COUNTRY SUBSCRIBER.—Ask a surgeon. It is astonishing how complacently some of our subscribers submit serious medical questions to a host of people whom they have never seen, and who will never see them; and of whose qualifications they are entirely ignorant. We expect one of these days to receive a query asking for information on the best and easiest way of amputating one's own leg.

JOSEPH DAVIES.—We should be glad to receive a short series of letters on the subject of nail making.

MILLER.—See indices to back vols.

G. W.—For information on tinning see pp. 91, 141, 164, Vol. XII.; 649, Vol. XIII.

TRUEFITT.—Too frivolous. Write to some of the "Penny Dreadfuls."

EDMUND W. COCKE.—For paint for engine, see pp. 318, 366, 368, and 417, Vol. XIII.

J. L. REILLY (Boston, U.S.A.)—We cannot send volumes by post at all, nor back numbers, except at greatly increased postage rates. For the same reason we had better not send you monthly parts. Any instructions should be given through the agency by means of which you subscribe. Back numbers are 5d. each including postage.

H. B. E.—In No. 367.

LIVERPOOL SUBSCRIBER.—See reply to "Country Subscriber."

BATTLE.—See indices to back vols., and the next six queries you send try and let *one* of them be about something that has not been answered in back numbers.

CYFEACH.—For information on galvanising iron, &c., see pp. 432, 478, 623, 576, and 622, Vol. XII., 343 and 546, Vol. XIII.

G. WHITTLE.—For directions to make collodion balloons, see p. 332, Vol. XII.

A NOVICE IN THE ART.—An illustration and description of Cantelo's apparatus for egg-hatching, was given in reply 6503, No. 310, Vol. XII.

C. J. RECORDON.—We have no space for any more replies to the query.

J. RAE (Sydney, N.S.W.)—The photos. with your second letter are quite clear, and will appear in our next number. We cannot send the vols. to you for M. Tornaghi, as recent regulations of the English Post Office prevent their transmission by post. We therefore have commenced his subscription with the last number, which begins Vol. XV., and await your further instructions. We have never sent duplicates of your vols., and trust the original parcel has by this time reached you. We shall send weekly numbers, and not monthly parts, as the postage for the latter is so heavy.

A WATCHMAKER.—Your question is too vague. You had better send the battery to the makers to be repaired.

BOOTS.—Badness of leather, or a habit of buying boots too narrow for your feet.

ADAM.—"Traditions of Pre-Adamite Races," are matters of too vague a nature for our pages. Never mind about your "decent," but pay more attention to your spelling.

ADVERTISEMENT.—We will not help you to disfigure the streets.

W. D. T.—Yes; apply at the Patent Office.

EXCELSIOR.—We shall be glad if one of the correspondents using this nom de plume will change it.

R.—Try poison. If your dogs are good for anything they will not interfere with a kitten if brought into the house young, and care taken to familiarise them with it.

UN ECOSSE.—The "editor is *not* agreeable." It is unreasonable of you to ask Mr. Tonkes to repeat information after he has referred you to page and volume, and when you can obtain the number for twopence!

A. J. F.—For information on skeletonising leaves, see p. 566, Vol. XI.

W. F.—We do not intend reporting them this year.

JAMES CUNLIFFE.—See back numbers.

CYPHER.—There is a difficulty in reproducing music in our pages, especially of other than the established notation. We were enabled to illustrate "H. T. W.'s" letter by the kindness of the Rev. Jno. Curwen, who voluntarily offered to supply the necessary stereos. If the supporters of your system will do the same, we will print yours. We do not see, however, that it is at all necessary, as the principle of the cypher system is apparent to any one who has seen the tonic sol-fa notation; neither do we see how the printing of your first letter would have prevented what you call the "extraordinary assertions" of "A Schoolmaster." "H. T. W.," in a letter to us, expressed a wish to know more of the cypher system. We have therefore made an exception to our rule, and forwarded your letter to him, and advised him to communicate with you by advertisement in these pages.

J. A. WILSON.—Similar answers preceded yours.

INQUIRER.—Between freezing and boiling temperature, rods of glass expand 85in. in 100,000; of copper, 171in.; of cast iron, 109in.; of brass, 188in.; and of steel, 114in.

R. H.—Yes; you will easily understand how—though the principle is somewhat differently applied—by reference to an article on the magic box, on p. 350, Vol. X.

ROBERT HARRISON.—For information on vulcanising indiarubber, see p. 415, Vol. XIV.

A. LUFFKIN (Iowa, U.S.A.)—See reply to J. L. Reilly for reason why back numbers are not forwarded.

W. D.—What *do* you mean?

E. TOYE.—See "Sable's" articles on painting magic-lantern slides, and his occasional answers.

C. T. C.—Beckwith's sewing-machine is an American invention many correspondents have been inquiring about.

T. STINGER.—Your reply is an advertisement. See notice to advertisers on first page.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MARCH 19, 1872.

750 J. H. Johnson, Lincoln's Inn, for improvements in machinery or apparatus for separating or sorting various substances. A communication.

751 W. Rose, Halesowen, Worcestershire, for improvements in treating waste boiler plates and other similar plates for the manufacture of gun barrels and nail rods.

752 E. Watteeu, Middlesbro'-on-Tees, for improvements in explosive compounds. A communication.

753 S. Gibson and J. Gibson, Hebdenbridge, Halifax, for improvements in sewing machines.

754 J. Simpson, Wortley, Yorkshire, for a new or improved device for protecting growing celery and cardoons.

755 S. Barton, jun., Cannon-street, City, for an improved rose and nozzle or jet to be used in connection with syringes and other apparatus for distributing water.

756 W. L. Anderson, Limehouse, for an improved mode of fastening gaiters, leggings, and other articles, and in the fastenings employed therefor.

757 A. M. Clark, Chancery-lane, for improved mechanism for changing the shuttles in looms. A communication.

758 R. A. Browne, Richmond-hill, Surrey, for an improved utensil for poaching eggs and other culinary purposes.

759 W. A. Smith, Princes-street, Hanover-square, for an improved purse-glove.

760 W. R. Lake, Southampton-buildings, for improvements in the manufacture of boots and shoes, and in apparatus therefor. A communication.

761 S. Deards, Harlow, Essex, for an improved apparatus for heating water for warming conservatories and other buildings.

762 A. M. Clark, Chancery-lane, for an improved battery gun. A communication.

763 T. Bradford, Fleet-street, for improvements in the means of heating cylindrical or other surfaces used for mangling, calendering, or ironing textile or other fabrics.

764 W. R. Lake, Southampton-buildings, for improvements in machinery employed in the manufacture of leather. A communication.

765 C. W. Heaton and E. E. H. Francis, Charing-cross Hospital, for improvements in apparatus for filtering oil and other liquids.

766 S. J. Beaman and J. Onions, Wednesbury, for an improved puddling furnace.

767 A. Schanschieff, Taunton-terrace, Middlesex, for improvements in apparatus for facilitating telegraphic signalling upon railways. A communication.

768 T. J. Smith, Fleet-street, for improvements in apparatus for the production of gases for heating and other purposes. A communication.

769 A. Schanschieff, Taunton-terrace, Middlesex, for improvements in apparatus for receiving telegraphic signals and despatches. A communication.

770 W. R. Lake, Southampton-buildings, for an improved apparatus for preventing injury to railway carriages by the displacement or removal of the rails, the slipping of the wheels therefrom, or other like accidents. A communication.

771 S. R. Gregg, Lombard street, City, and D. Evans, Cassland-road, South Hackney, for improvements in the method of forming the surfaces of roads, railways, footpaths, platforms, and other roadways, which improvements are applicable to the construction of bridges, pillars, and other buildings.

772 J. Bavin, Lambeth-walk, Lambeth, for improvements in steam engines and in generating steam.

773 W. R. Lake, Southampton-buildings, for an improved roll for spinning machines. A communication.

774 W. J. Lockyer, Bristol, for improvements in the preparation of artificial manures.

775 W. Palliser, Cromwell-place, South Kensington, for improvements in boots and shoes.

776 J. Somerville, Dublin, for improvements in gas retort lids and mouthpieces, and machinery for luting the same.

777 E. Edwards, Southampton-buildings, for improvements in dial plates for calendar clock and watches. A communication.

778 W. G. James, Storey's Gate, Westminster, for improvements in the construction of traps for drains.

779 J. C. Mewburn, Fleet-street, for a new or improved safety thermometer or alarm apparatus for steam boilers and other purposes. A communication.

780 A. M. Clark, Chancery-lane, for an improved safety boat-lowering and detaching apparatus. A communication.

781 H. B. Barlow, jun., for improvements in the manufacture of healds for weaving and in heald shafts. A communication.

782 Sir J. Whitworth, Manchester, for improvements in wheels to run on railroads and common roads.

783 W. R. Lake, Southampton-buildings, for an improved electric torch for lighting gas. A communication.

784 E. Kaulbach, Warwick-street, Regent-street, for the improvement of the means of obtaining parallel motion, and of converting curvilinear into direct rectilinear motion.

785 J. Collinge, Manchester, for improvements in reaping and mowing machines.

786 W. R. Lake, Southampton-buildings, for improvements in boot and shoe heels. A communication.

787 A. Longsdon, Denmark-hill, Surrey, for improvements in ships or vessels of war, and in forts, batteries, and other armed or military structures or apparatus for use on sea and land.

788 M. Payne and C. H. Payne, Thrapston, Northampton, for improvements in brick-making machines and in apparatus connected therewith.

789 J. Kincaid, St. James's-street, Middlesex, for improvements in the permanent way of tramways.

790 R. A. Robertson, Victoria Docks, for improvements in evaporating liquids and in the apparatus to be employed therein.

791 P. Jensen, Chancery-lane, for improvements in boring through earth or other soil by means of water pressure, and in apparatus therefor. A communication.

792 R. Clachar, Glasgow, for improvements in presses for pressing cotton and other fibrous substances into bales. A communication.

793 F. S. Thomas, Baker-street, Pentonville, for improvements in the materials for making roads, ways, and floors.

794 J. Russell, Bonnyfield, Stirling, and W. R. Hutton, Stirling, N.B., for improvements in obtaining zinc.

795 W. E. Thomas and E. Taylor, Salford, for improvements in the method of and apparatus for fixing rollers on to the axles of wringing, mangling, and other machines.

796 J. Warburton, Bingley, Yorkshire, for an improved cork fastener and apparatus or machinery for making the same.

797 J. Barnett, Aberfeldy-street, Bromley-by-Bow, and W. Vokins, Mark-lane, City, for the economisation of fuels and prevention of incrustation in boilers.

798 J. Barnett, Aberfeldy-street, Bromley-by-Bow, and W. Vokins, Mark-lane, City, for improvements in furnaces.

799 M. Benson, Southampton-buildings, for improvements in washing, cleansing, and purifying petroleum and other kinds of oil, and in the apparatus for performing the same. A communication.

800 E. Laporte and C. D. Fontaine, Brussels, for improvements in the preparation of tobacco.

801 F. W. Gerhard, Wolverhampton, and J. Light, jun., Bradley Staffordshire, for improvements in the production of iron and steel.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 5, 1872.

ARTICLES.

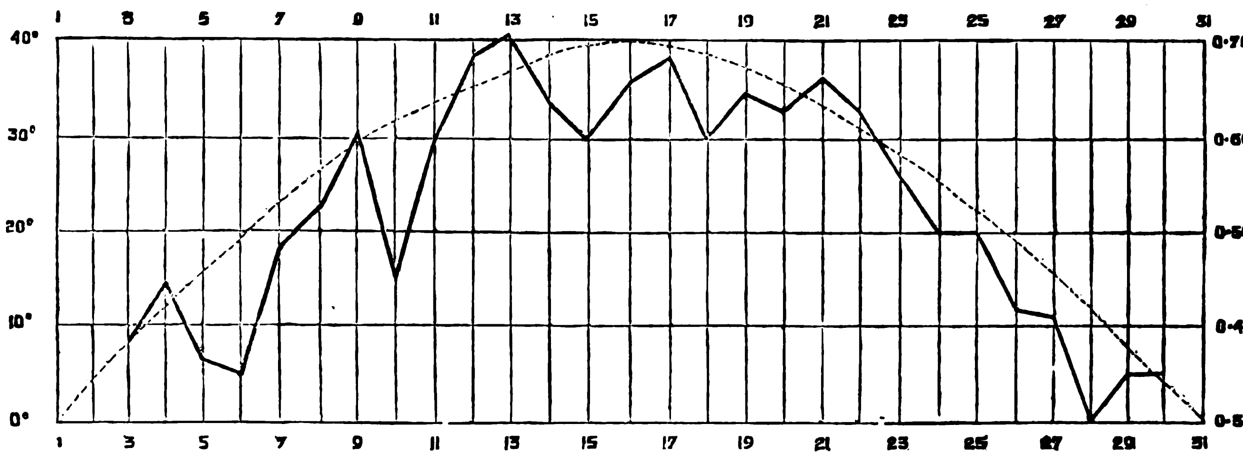
LUNAR METEOROLOGY.

By W. R. Birt, F.R.A.S., F.M.S.

ALL meteorological processes depend more or less on the sun for their existence. It is his heat that warms the surface of our planet, the earth; its atmosphere, partaking of the warmth communicated by his beams, is rendered capable of sustaining the maximum density of aqueous vapour at its then existing temperature, and all the meteorological phenomena we are acquainted with follow. As the sun affects the terrestrial surface so does he those of the other planets of his system, and it may, perhaps, contribute to a clearness of conception if the operation and effects of heat upon those planets be considered under the term planetary meteorology; and in like manner, if we are able to trace the effects of heat upon the moon's surface, and detect appearances which cannot be referred to known agencies, but which are not unlike many meteorological phenomena on the earth and planets, the classification of such effects and appearances under the designation of Lunar Meteorology—although we are unable to detect by optical methods the existence of a lunar atmosphere—may be both suitable and legitimate.

We have already hinted that heat is the agency which contributes in the greatest degree to meteorological phenomena. The development of heat on the surface of a planet or satellite is proportional to the altitude of the sun above any given spot on the surface, and we know that the diurnal and annual progressions of temperature on the earth's surface are functions of the sun's altitude and declination. Although we cannot measure the effect of heat on the moon's surface thermometrically, yet, as we know that on the earth the sun's rays are capable of effecting changes of colour in terrestrial bodies, so changes of colour of portions of the moon's surface are not unlikely to be exponents of the effect of the heating power of the sun upon them.

There are three methods by which alterations in the tints of lunar objects may be ascertained: *First* by estimation, *second* by comparison with a graduated series of tints to which a more precise numerical value can be applied than to mere estimation, and *third* by the use of an instrument so constructed that the observer may readily record the numerical value of the tint presented to his notice. In carrying out a series of observations on either of these methods the obstacles are considerable, but not insurmountable. There is nothing particularly inviting in registering night after night the colour of a small spot on the moon. What is to come of it? is a not unlikely question, and unless the observer has faith in obtaining results that will repay him for his labour, either from the discussion of his own observations, or from a combination of them with the observations of others, he is apt to grow weary, especially if he has to wait two or three years before any of his observations can be turned to account. Again, it is not improbable that his enthusiasm may be insufficient to carry him through so irksome a labour, if a thought crosses his mind that he is only one of several workers, and that somebody else may reap the benefit of his exertions, forgetting that if a few earnest observers are banded together to raise the bucket from the well, the dissemination of the truth when once obtained is of far greater importance than the *aggrandisement* of one or even of all who have sought for and found it. The present popularity, or the enduring reputation of a great discoverer, is as nothing compared with the truth found and promulgated. We revere such names as Copernicus, Kepler, Newton, Herschel, and others; but what would those names be without the great truths which the men who bore them were the instruments of *unveiling?*



The study of Lunar Meteorology must necessarily be a difficult one. The ordinary training of the astronomical mind is inadequate to grapple with it; it does not depend upon accuracy of measurement, nor can it be elucidated by instrumental methods except in one important particular. A keen eye to detect with facility minute differences of colour, a correct appreciation of definition, contrasted with a want of that necessary quality for seizing the smallest detail as manifested on neighbouring portions of the moon's surface, and a disburdening of the mind of any preconceived opinions as to the existence or non-existence of hypothetical conditions, are among the elements of successful study. These, however, are not all the requisites; it is not only exceedingly difficult, but almost impossible, for one observer to carry on the inquiry single-handed. Co-operation is necessary, and co-operation of a peculiar kind. The mere detection of differences of colour or definition in the present state of selenography is not of itself sufficient to establish the existence of Lunar Meteorology. Astronomers have been trained in a different school: they ask for *proof*, and they have a right to demand it, and proof can only be obtained by a long series of observations. Several observers must unite in a course of laborious and almost uninviting observation, and register night after night the general appearance, kind of definition, colour, and brightness of a small portion of the moon's surface. It is only after two or more years that these records can yield any fruit, and the fruit will greatly depend upon the character of the mind that undertakes the final investigation.

Discoveries of whatever nature, whether commanding the admiration of mankind or confined to the knowledge of a few, are mostly the results of laborious investigations conducted by means of weight and measure into which number necessarily enters. We have said that the progress of lunar meteorology does not depend upon accurate measurement, except in one particular: that particular we will now examine. Of the three methods alluded to for determining changes of colour on the moon's surface one only has yielded any result: it is that of *estimation*, but this would have been useless without *number*. A well-known spot on the moon, Plato, has been selected for the observations, and some half-dozen observers entered energetically into the work: mostly three gradations of tint were observed—light, medium, and dark. In the course of two years 133 estimates were made, varying from very light to very dark, and to each estimate a numerical value was attached—light 0·33, medium 0·50, and dark 0·66. The observations treated in this way have yielded a curve which unmistakably tells us that the material of the floor of Plato undergoes changes of colour immediately dependent upon the altitude of the sun above its horizon, and also that these changes of colour bear (with regard to the moon) the same relation to solar influence as the expansion of mercury in our thermometers does on the earth.

Although it has long been suspected that the *forms* of objects on the moon's surface are affected by the angle of illumination, as it is termed—*i.e.*, the angle in which light falls as dependent upon the altitude and azimuth of the sun—the apparent variations arising from changes in the illuminating angle have, so far as we are aware, never been subjected to a close comparison; and, while changes of colour, so far as regards the aspects of bodies, have been supposed to depend upon different illuminations, we believe this to be the *first* instance in which the connection has been really shown; indeed, in the curve before us we have something more than mere change of aspect, for the deepening of the tint as the sun approaches the meridian, in our opinion, arises from a temporary change effected by heat in the material of (or over?) the floor of Plato, whatever it may be. We must not, however, regard the present result as one warranting us to lay down our arms. If we desire to become really acquainted with lunar physics we must be up and doing, for it is only one, perhaps, of a long series of results conducing to this end; certain bright spots have been suspected of fading, and certain light areas, if earlier records be correct, have become permanently darker. The ocean of lunar research is before us: we have picked up one pebble, we hope many more will follow.

Passing from the consideration of the effect of solar heat upon the colours of lunar objects, as partaking of the nature of a meteorological process, we may bestow a thought or two on a few phenomena in which heat may be intimately concerned. It has been our lot on several occasions to witness simultaneously on the moon's surface two very different aspects, and we have found instances on record precisely the reverse of those which we have noticed. It would swell this article to too great a length to quote such instances, or give our own experiences, suffice it to say, that we have remarked the definition of a region—the Mare Serenitatis, for example—to be anything but clear and distinct: scarcely a crater could be detected upon it; at the same time the region to the east, including the Palus Putredinis, and the Palus Nebularum, has been so clear and well defined, that very minute objects could be readily discerned. As the manifestation of these different states, although synchronous as regards the earth view, are referred to different portions of the luni-solar day, and appear to be connected with the position of the sun in the heavens, they may be appropriately classed as meteorological phenomena.

In the foregoing remarks we are not aware that any theoretical considerations have been introduced; a connection between changes of the sun's altitude and colour has been shown, and a connection between clearness and obscurity of the moon's surface on the one hand, and the sun's altitude on the other, hinted at. So far as th… remarks may be supposed to have a theore… bearing, it would be on the vexed questi… lunar atmosphere; but whether the cont…

on this question be terminated in the negative or affirmative, the facts mentioned above, as well as their connection with and dependence upon solar influence, will remain as ascertained portions of selenographical science.

REFERENCES TO ILLUSTRATION.

Curves of solar altitudes and variations of colour at the Lunar Crater Plato.

The dotted curve is that of the sun's altitude, the continuous curve that of the variations of colour.

The horizontal lines represent intervals of 10 degrees of altitude, and 0·10 of chromatic variation.

The vertical lines represent intervals of twelve hours in the luni-solar day, from sunrise to sunset.

IRON AS AN ELECTROTYPE.

WITHIN the last ten years or so the attention of electro-metallurgists in England and on the Continent has been devoted to the attempt to discover a successful method of forming an electrotype in iron, and it was only so recently as last year that the announcement of the success of the researches of M. Klein, an official of the state paper-mills at S. Petersburg, was publicly made, and specimens of bank-note and other plates, medals, a page of printing type, and sundry other articles produced by the process were placed in the International Exhibition two or three months before its close. Although the publication of the *modus operandi* of M. Klein's process, and the exhibition of some of its most satisfactory results, are so comparatively recent, we believe that iron electrotypes have been in use in Government departments in Russia for nearly four years, especially for printing bank-notes. Most of our readers are aware of the great strides that have been made in the art of electrotyping since the time of its discovery by Mr. Spencer in England and Professor Jacobi in Russia some thirty years ago, a discovery which has developed into an important manufacture, not the least useful branch of which is the employment of electrotypes, both in letter-press and what is commonly known as copper-plate printing. Up to the present time copper is the metal which has given the most satisfactory results from all points of view, as the production of electrotypes in that metal is remarkably easy, and consequently cheap, while they are sufficiently durable to answer all ordinary purposes. As substitutes for the original wood engravings they are almost invariably employed in standard works which are likely to run through numerous editions, the wood blocks being thus preserved in as good condition as when they left the engraver's hands. The copper electrotype has also proved itself a formidable rival to the ordinary stereotype for works which are repeatedly reprinted, such as Bibles, prayer-books, &c. But copper has its disadvantages for the purpose as well as its advantages. Although far more durable than wood and the ordinary type-metal, it is yet all too soft to withstand the wear and tear of many thousands of impressions; it is liable to corrosion if put away damp; and it is utterly unsuitable for use with certain coloured inks—*e.g.*, red, which, containing vermilion, a compound of mercury and sulphur, eats away the fine lines of an engraving in a very short time, rendering the copper electro totally useless for printing purposes.

Up to the present time the only process which has been much employed in obtaining a harder and more durable surface is that of M. Jacquin, known as acierage, which consists in coating a copper plate with a thin film of iron. It has been asserted, however, that the iron electrotype plates of the new process are almost indestructible; that they are better able to withstand the inevitable accidents constantly occurring in printing-offices; and that, above all, they can be produced at a cheap rate. As a matter of fact there can be little doubt that the process of iron electrotyping, once understood and reduced to working order, would be as cheap as, if not cheaper than, the employment of copper, while, as far as the chapter of accidents is concerned, iron would not be so liable to damage as the softer metal. But with regard to indestructibility it is not so easy to draw the line, for though iron would doubtless be the most suitable material where the printing surface is always protected from damp, as in bank-note printing, the tendency to rust must be eliminated before iron can hope to supplant copper in the far more general and widely-extended developments of letter-press printing, where, from the nature of the surrounding conditions in those situations where durability would be most serviceable, the electrotypes would be subjected to frequent dampings, occasioning action of a most destructive character. Whether any means can be found to obviate this defect remains to be seen; the utility of the discovery is in other directions of so much importance that we proceed to lay before our readers what is known of its principal features and the uses to which it has hitherto been put in the arts.

The first specimens of iron electrotype were, we believe, exhibited at the Paris Exposition of 1867, and were produced by M. Feuquières, but according to Professor Jacobi, although they presented a tolerably good surface, the reverse was full of small holes, and altogether they were much inferior to those of M. Klein, produced by an entirely different method in the following year. M. Klein had previously made many experiments upon the subject, and after witnessing the results of M. Feuquières he returned home and subsequently brought the art to its present degree of perfection.

Professor Jacobi, who has written more on this special branch of electro-metallurgy than any other savant, states that the quality of the iron deposit depends almost entirely on the greater solubility of the anode, and with this fact in view, M. Klein combined the iron anode with one of copper—Professor Jacobi afterwards modifying this arrangement by substituting charcoal made from horn in place of the copper, by this means obtaining more powerful results. From the account of his experiments recorded by M. Klein in a letter to the Academy of Sciences of S. Petersburg, we learn that his first attempts were made in coating engraved copper-plates with iron, for which purpose he employed a bath of the chlorates of ammonia and iron, to which was added a small quantity of glycerine; but, in endeavouring to obtain a thicker deposit, this process was found to be unsuitable, as the iron not only cracked on the surface but fell off in brittle flakes. To remedy this M. Klein prepared three baths, the first consisting of a concentrated solution of the crystals of double salt—$FeO,\ SO_3 + NH_4O,\ SO_3 + 6\,HO$; the second was composed of the same salts, but mixed in the proportion of their equivalents; while the third was prepared from a solution of sulphate of iron by precipitating the iron with carbonate of ammonia, dissolving the precipitate with sulphuric acid, and removing excess of acid. These solutions were concentrated as much as possible; and iron plates, with a surface nearly eight times that of the copper, were used as the anode. Using a Daniell battery a deposit was obtained in about 24 hours, but this was a complete failure, being full of holes and breaking up easily. With the weaker action of a different battery slightly improved deposits were obtained, but still so far from the results desired that M. Klein cast about for the discovery of the cause and the means of remedying it. This he ultimately found to be the acid character of the bath, which he attributed to the fact that more iron was deposited than was dissolved, and in order to give the anode a greater solubility M. Klein united a plate of copper with the iron, as before mentioned—the result being that the bath composed by the first method remained in good condition after many hours' working, and the deposits became perfectly satisfactory. The process is one, however, requiring great care and attention to prevent too free a disengagement of gas, the best results being obtained by keeping the current so that neither oxygen nor hydrogen is disengaged. Prof. Jacobi found that this stage could be ascertained by means of a galvanometer, which indicates when the current is too feeble or too strong.

Such are some of the facts of probably the most important invention in electro-metallurgy since the primary discovery of that art. For the mere coating of a plate with an iron face, the process of M. Jacquin before referred to has been used with excellent results for some years. In this a solution of hydrochlorate of ammonia (1 to 10 of water) is placed in a trough lined with guttapercha, a plate of iron nearly as long and as deep as the bath is connected with the positive pole of a Bunsen battery, and another plate about half the size of the other attached to the negative pole. These are immersed in the solution, and the bath left for several days, till it arrives at the proper condition for working. The article to be coated is then substituted for the smaller iron plate attached to the negative pole, and immersed in the bath; if the article is not immediately covered with a bright coat of iron the bath is not ready, while it should not be allowed to remain in after the bright coating begins to show a black deposit around the edge. But this process is, we believe, only applicable to the coating of copper-plates or electros, or articles made of alloys of that metal.

METALLURGY OF IRON AND STEEL.

(*Continued from p. 29.*)

THE Hindoo process of extracting iron, as previously described, is in use not only in that country, but has been employed from time immemorial in India, Burmah, Borneo, Madagascar, and Africa. These people, however, do not get perfectly pure ore to operate upon, and one common impurity in it is silica (a compound of silicon and oxygen). It has the property of uniting with the oxide of iron to form a slag, and when we extract iron from ore of this sort we get, in addition to a lump of metal, a quantity of fusible glass-like stuff called "slag"—a silicate of iron. After these people get their iron out of the furnace, they cut it into two pieces (or more, according to the size of the lump) and work each part separately (*i. e.*, heat it and forge it) under the hammer, and in this way they will produce good iron, in *small pieces*, at about £8 per ton. Now, we are apt to look down on these people with boastful superiority, but let us see what they have done. They have produced a solid iron column at Delhi, between 40ft. and 50ft. high—accounts vary as to depth in the ground, according to one it is 16ft.—in circumference 5ft., and highly ornamental at top. A cast of this column is now in the South Kensington Museum, and a piece of the iron which the lecturer had had presented to him he had submitted to be tested, and it turned out to be wrought iron. It was probably forged piece by piece, end on by hammering. According to one account it was made 900 B.C., but another and more probable statement put it at 400 B.C.

Carbonic oxide (CO) is a most important agent in metallurgical operations; and its applications form one of the most valuable steps in modern times. It is a colourless, inodorous, highly poisonous gas, burning with a very hot blue flame, and forming, with the oxygen of the air, carbonic acid. Passed over red hot iron oxide it takes up an atom of oxygen and forms CO_2. It may frequently be seen burning at the top of a common fire with a blue flame, and is due to the carbonic acid produced at the bottom of the fire taking up an additional atom of carbon, and becoming two atoms of carbonic oxide. The greater part of the iron extracted in this and other countries is obtained from the oxide of iron, by the application of this carbonic oxide.

CATALAN PROCESS.—This mode of extracting iron is so called from the Province of Catalonia, in Spain, where it is extensively carried out, as also in the south of France. There is a small furnace in a corresponding forge, with a blowing machine outside, and very rude premature hammer moved by water power. Their forges are no better than mere hovels or respectable cow-houses. Their size may be imagined from the fact that the lecturer, when in the Pyrenees, being anxious to see one of these places, actually passed by it without being aware of its existence. The ore employed is the peroxide, combined with water, or, as we call it, brown iron ore, and it is very good for the purpose. In an angle of the forge is fashioned the furnace of the best material they can find to resist heat, if not fire-brick, of good igneous rock, as gneiss, &c. The furnace is nearly square, 3ft. or 4ft. deep, and 3ft. or 4ft. in section at the top; one wall is vertical, another not quite so, but leaning upwards and outwards. The left-hand side is of blocks of iron and stone; the other side is entirely of iron; the back is wholly of fire-brick or stone, while the front consists of two large plates of iron, nearly vertical, and not quite meeting down the centre. Near the bottom of this slit is a horizontal bar of iron, which serves as fulcrum for the rod used in stirring up the iron, the upper part of the opening being stopped with clay. The bottom is formed by a large stone of porphyry or anything of that kind, and on the right side there is a bank or platform.

Now for the blowing machine. Theirs is only to be resorted to in cases where water-power is available, and the mountain streams of the Pyrenees furnish this in abundance. It is called a

Trompe, and requires a fall of water about 20ft. or 30ft. At the top outside the forge is a tank, usually of wood, provided with a continuous flow of water, and containing not less than 10 tons. At the bottom nearly on level with the furnace is an airc-hest of wood; it may be made round, but it is best made trapezoidal in plan, with narrow end towards fire; this wind chest is completely closed, with the exception of four openings, two for the entrance of the water, one for its exit, and one for exit of air. This chest is put in connection with the tank above by two pump "trees," or pipes, generally trunks of pine (from the mountains) hollowed out, the upper ends being fixed in, but projecting a little above the base of tank, and lower ends in broad part of top of chest. Over the top of the pipe is a wedge-shaped body, or plug, at the end of a lever, and a chain from the other end of the lever goes down into the building close to where the workmen stand, and by means of this plug they can regulate the blast by letting a greater or less quantity of water flow down the trees. Just below the tank, oblique (downward) holes are bored in the side of the trees, or a kind of funnel arrangement is made at top, the object being to bring air into contact with the flowing water, by which a large quantity is carried down into the chest. An opening is made near the bottom of the broad end for the outflow of the water, and at top of opposite end for the air into the blast-pipe, the arrangement being made so as always to have a certain quantity of water left in the chest. A mercury or other gauge is inserted in the pipe to measure the strength of the blast. At the broad end of the chest, and underneath the opening of the trees, is placed a ledge of wood, and exactly underneath the openings are laid two stones, which effect a double purpose—namely, prevent the otherwise enormous wear of the wood, and also throw the water more forward and scatter it, and thus effect a more complete separation of the water and air. It is said, on good authority, that there is no apparatus known which gives a more uniform blast than the "trompe" if properly constructed and regulated. There is one great objection, however; the air is always very moist, saturated with water, and the smallest diminution of temperature causes it to be deposited; moreover, it carries along with it into the furnace a quantity of finely divided particles of water. With a height of about twenty or thirty feet they get a pressure of one or two pounds to a square inch.

The trompe has been used for the ventilation of mines. Its principle is seen whenever a liquid is poured from one vessel to another, like the froth on beer, &c., when poured out. An experiment was made to show how the principle might be usefully employed in the house when a continuous blast for blow-pipe, &c., is required, if water power be available. A large funnel was fixed to the top of a pipe, the lower end of which communicated with a bell jar set in a large vessel of water, as in collecting gases, &c., in water troughs. When water ran down the funnel and pipe, a strong continuous current of air was forced through a lateral pipe communicating with an opening in the neck of the jar.

The tube from the chest carrying the air passed first into blast-pipe—a rather loose leather bag—and again by a pipe into "twyer." This twyer is a sheet of copper folded over into form of tube, the upper part having its edges somewhat open, the lower part against the furnace, having the edges overlapping. By means of the trompe an air current, having a velocity of about 6ft. per second, is maintained.

While the furnace is still warm from the preceding charge, a layer of charcoal is put in, then the iron ore (previously crushed to coarse gravel), and then charcoal is piled round this ore and beaten down with spades, &c., the object being to prevent, as far as possible, the gases produced during combustion from traversing the charcoal, but to turn them amongst the ore. The hot CO formed from the charcoal as above described acts on the ore in two ways, first driving off the water, and then reducing it. Charcoal and ore are added from time to time as required. About 1,000lb. of ore are used for a charge, and 30 per cent. of metal is obtained, or a lump weighing about 3cwt. After being exposed in the furnace for about five or six hours, the melted metal falls through to the bottom, and a slag is formed precisely similar to that in the operation of puddling.

Three men are required to get out the lump, and having got it out, they at once proceed to work it. They make it hot, and then hammer it with a large hammer (worked by water-power) on a large stone for anvil, then cut it into two pieces, and work each piece separately. These pieces are again divided in halves, and the four lumps worked into bars, being heated from time to time to the right degree of temperature. The hammer is at one end of a lever, the other end being depressed by four pegs fixed on the axle of a water-wheel.

It is altogether a very simple process, the useful effect, however, is estimated at only one-tenth of the total amount of power employed. It requires a large quantity of charcoal, and a large amount of labour, and, in fact, it can only be usefully employed where the latter is cheap and abundant. Under this system the total profits of an ironmaster for a year would amount to about £150. On this account it has been generally given up, but it is still in use in some parts of the United States, as well as North Spain and South France. The iron obtained is very good for certain purposes; on examination it is found that the mass is not perfectly uniform, some parts being considerably harder than others, and more steel-like. By modifying the proportions of iron ore and charcoal used we get different degrees of hardness—*e.g.*, by increasing the quantity of charcoal the iron becomes harder and more like steel.

ERRATUM.—On p. 29 read "the Hindoos, who have no *double* bellows, properly so called," &c., instead of "who have no doubt," &c.

ON THE TREATMENT OF ASTHMA.*

IN the summer of 1870, I was summoned to a lady suffering from an acute attack of asthma. For several nights she had been restricted to the sitting posture, bent over a table, with the forehead resting on her hands. The distress was very great indeed. She was subject to frequent attacks of the kind, complicated to a very moderate extent with catarrh and bronchitic exudation. Her physician, a gentleman who holds high professional rank, was out of town. Nothing had been omitted in the treatment, which of late was simply palliative. She was recognised as constitutionally asthmatic, and little hope was entertained of permanent amendment. The asthma first occurred on the subsidence of nervous symptoms a few years previous. It had not, as far as I am aware, any marked organic basis. There was observable on the legs an eczematous eruption. Under these circumstances, I directed that the chloroform liniment of the *British Pharmacopœia* should be rubbed briskly into the chest for an hour's space, if possible; and this was done daily by a very efficient attendant, who had sufficient intelligence to comprehend and carry out the treatment. Very early much relief was experienced. On the return of her physician to town at the end of three days she was already so very much changed for the better that he directed the treatment to be continued. From that time it consisted in the daily repetition of the rubbing process for a month, or nearly so, without aid from medicine, and with little restriction as to diet. Beyond the information I received that she was daily improving, I had really little or nothing to do with her professionally after one or two visits. Under the hands of her attendant, she speedily got rid of the asthma. The patient went out of town in the autumn, and enjoyed perfect health and spirits. She took much walking exercise, with exposure, in the cold of the ensuing winter; and, what is very singular, two years have since elapsed with no return of the asthma.

I shall now make a few observations on this method of treatment. For some years, in Paris, asthmatics have been in the habit of resorting to a rubber in the Boulevard Saint Michel, a certain Widow Pau, who pursues there very much the method which I have laid down, only that her nostrum is a secret. She is resorted to by a few wealthy people from this country, and has honourable mention in some of our West End clubs. At the end of the treatment, her patients are presented with a little book or brochure containing her successes, which may be said to be fairly written for a book of its class. The cure is subject to disappoint for a few days; but generally great benefit will be found in a fortnight, or even in less time. There is a hint that it is best suited to cases with catarrhal and bronchitic complication. The instance which I have here brought forward seems exactly to correspond with those which are boasted of and detailed historically by Madame Pau.

Before giving directions as to how this treatment should be carried out, I will speak as to the rationale. Counter-irritation, especially by blister, issue, and moxa, are of such well established repute in the treatment of asthma, that I need not dwell on them; but, besides this, a jolting vehicle, anything that leads to displacement of the air stagnant in the vesicles, is proved to give relief in many instances. I should advise, then, that the frictions should be made with such roughness as the case admits. Slight blows with the palm of the hand or the end of a towel on the ribs are quite allowable; and the friction should be extended to the front of the neck at the lower part, where the vagi enter the chest. I do not think that the composition of the liniment need trouble us, provided it be warm and works easily. Anything like Roche's embrocation would answer very well.

I am not without some experience of asthma, and I am persuaded that the present method will be found a valuable addition to our therapeutic means. If proved not to be novel, it must be conceded that it has fallen into utter neglect.

* By GEORGE GASKOIN, Esq., Surgeon to the British Hospital for Diseases of the Skin.

SEA SICKNESS.

JAMES GARDNER, M.R.C.P. Ed., in a letter on this subject in the *British Medical Journal*, says:—"Old sailors have frequently told me that, although they have never suffered from sickness in sailing ships during a long voyage, yet they invariably suffered when crossing in the Channel steamers. So far as regards myself, I have never suffered from sickness, although swinging and a rotatory motion on shore always affected me so much that I never could waltz. It appears to me that the sickness arises from three causes: first, impression on the brain; secondly, on the stomach, through the sympathetic system; and thirdly, on the imagination; chiefly, however, on the stomach, as those persons who have a healthy digestion and are careful in diet are better able to withstand the attack. Much depends on the position of the person, and on that of the berth. At either end of the vessel there is, of course, in a head sea, most motion, and, therefore, the nearer the centre is the best place. I have found also that, after trying all other plans, a fixed berth placed athwart ships, or across, is preferable. Iced champagne with dry biscuit, or an effervescent draught with a few drops of sal volatile or chloric ether, I have found give the greatest relief. As a preventive, in the short passage across the Channel, I would recommend that precaution should be taken not to go on board with an empty stomach, and that something solid should be taken, either a chop or a steak, with a glass of bitter ale or cold brandy and water, no pastry, and not to overload the stomach; if the weather be fine, to keep on deck as much as possible, and to keep the attention employed. I consider it would be a great advantage and comfort to passengers if the Channel steamers were larger, giving more space above, and below better ventilated. There should be more attendants and appliances to meet emergencies. The present steamers are too sharp in the bow, not high enough in the water, and too long in proportion to breadth, so that they have a short, pitching, jerking motion, to which old sailors succumb. It would be far better and answer the purpose to have a separate class of steamers—in the summer season especially—for carrying passengers.

BELL'S PATENT FEED-WATER HEATER.

THE products of combustion seldom or never leave the flues of a Cornish boiler at a less temperature than 400°. The feed-water from the hot well has a temperature of not more than 100°, while that of the water in the boiler is probably 290°. A considerable saving in fuel may be effected by utilising the heat of the waste gases in raising the temperature of the feed-water in the case of the best set boilers, while the saving will be very considerable indeed when the boilers are so badly set that a good heater will raise the temperature of the feed to that of the water in the boiler. A large number of patents has been taken out for feed-heaters applicable to stationary boilers. One great difficulty attending their use is due to the rapid deposit of soot on the heating surface, because it is colder than the escaping products of combustion. To get rid of this difficulty various forms scraper have been adopted from time to time with varying success.

In the annexed engravings we illustrate a very ingenious feed heater, the invention of Mr. A. Bell, of Clara-street, Huddersfield, which has been for some time in successful operation at the works of Messrs. Thomas Ackroyd and Son, worsted manufacturers, Birkenshaw, near Leeds, where it has given such satisfaction that a second has been ordered.

It will be seen that the heater consists simply of three coils of cast-iron pipe. Mr. Bell has succeeded in doing that which has hitherto been regarded as almost an impossibility, namely, casting a complete coil of pipe in one piece; and we commend these coils to the attention of our readers, as likely to prove useful for many other purposes beside those for which they have been designed.

The arrangement of the heater, or "fuel economiser," as Mr. Bell calls it, will be understood at a glance. The mode of working the scrapers which keep the heaters free of soot will be gathered from the sketch, Fig. 3. There are two scrapers to each coil; these are propelled by two vertical arms, A A, which are attached to a crosshead, B B, at the top and bottom of each coil, these cross-heads being fixed to the centre shaft C by means of set screws; therefore, when the centre shaft revolves by means of the worm and wheel, Figs. 1 and 2, the crossheads are propelled round, carrying the upright arms, and thereby forcing the scrapers in their course before them round the screw until they reach the bottom of each coil, when the reversing motion, fitted to the boiler gear by its own action, reverses and propels the scrapers to the top, and so on alternately. The lower halves of the scrapers are kept up to the pipe by means of small balance weights. It will at once be perceived that the pipes cannot escape being thoroughly cleansed, which is a very important object; the simplicity of the arrangement is also so complete that there is scarcely any possibility of its getting out of order. The machine can be constructed of any number of coils, either in single or double rows, according to the number of boilers in use. Each machine is fitted with a safety-valve, stop-valve, and mud-tap. The cost is, we understand, extremely moderate, and the space occupied very small.

FIG. 3.

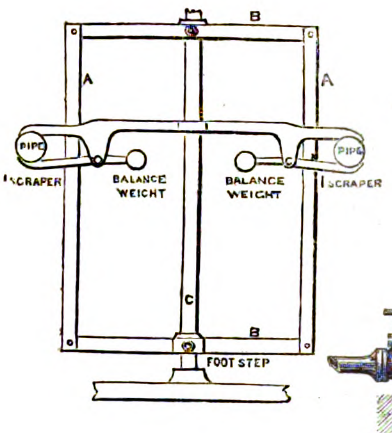


FIG. 2.

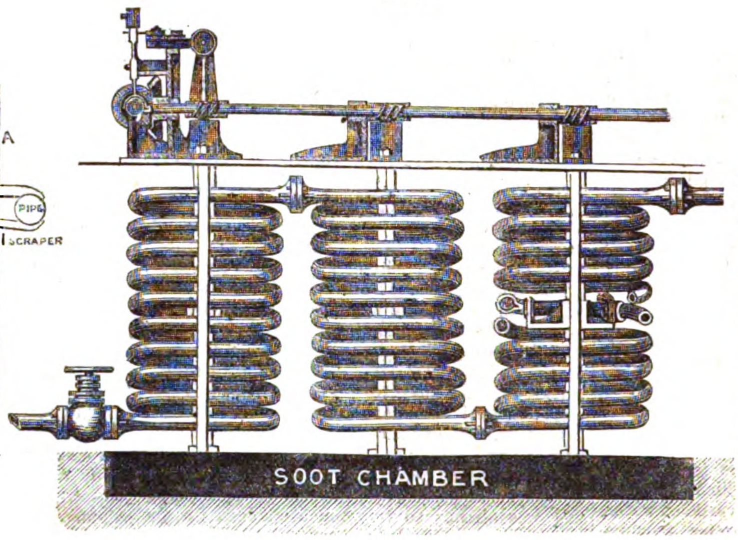
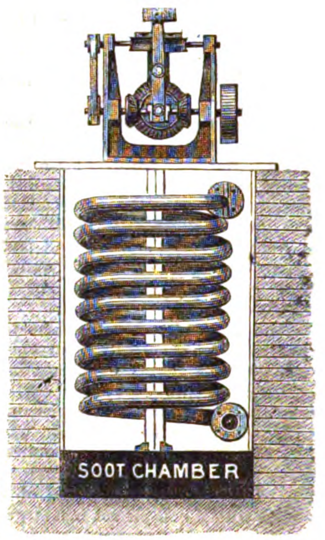


FIG. 1.



REVIEWS.

Spon's Dictionary of Engineering, Civil, Mechanical, Military, and Naval. Edited by OLIVER BYRNE. London: E. & F. N. Spon.

THE fifth division or volume of this valuable work has just been issued by the publishers, and ample opportunity is now afforded for judging of its character and scope. The editor is carefully and faithfully following out the plan laid down in the specimen part, and the work will undoubtedly be the best of its kind in the English language. Mr. Byrne was the editor of Appleton's "Dictionary of Machines, Mechanics, Engine-work, and Engineering," but since that work was published so great have been the strides made in science and in the various fields of ingenuity and industry that scarcely an article which appeared in his previous dictionary could be admitted in the present without either modification or amplification. The title of the book is in itself a very illusory guide as to its real character and scope; no subject which can possibly be said to be connected with engineering, in however indirect a manner, being omitted. The nature and properties of labour-saving machines are fully explained; useful instruments, important tools, and ingenious mechanical contrivances receiving especial attention, while such subjects as engines, hydraulic machines, bridges, embankments, mines, and the various cognate matters of which these are but generic headings, are treated in the fullest manner possible in a work not specially devoted to them. The rudiments of the arts and sciences described are not deemed unworthy of explanation, and such articles as "Algebraical Signs," and "Atomic Weights" are written in the clearest style, so as to place them within the intellectual grasp of the average mechanic. Woodcuts are supplied in abundance, from a cow-milking apparatus to a bradawl, while the machinery employed in the principal arts and manufactures is illustrated by the best and most modern examples. Altogether the work is most elaborate, and should find a place in the library of every mechanics' institute, and in the office of every engineer, civil and mechanical.

A Dictionary of Chemistry. By HENRY WATTS, B.A., F.R.S., F.C.S. London: Longmans.

WATTS' "Dictionary of Chemistry" is so well known that we need say no more than that this is the supplemental volume, bringing the record of chemical discovery and knowledge down to the commencement of 1870, with addenda of important matters up to the end of 1871. It contains nearly 1,140 pages of matter, including interesting and valuable articles on electricity, heat, chemical action of light, spectral analysis, beer, proteids, aniline and the aniline colours, analysis by flame reactions, and many others too numerous to mention.

Science Primers. Chemistry. By Prof. ROSCOE. *Physics.* By Prof. BALFOUR STEWART. London: Macmillan.

WE have received two of the series of "Science Primers" jointly edited by Profs. Huxley, Roscoe, and Balfour Stewart. They are published at a cheap rate, and are written in the simplest language, the object of the authors being to state the fundamental principles of the sciences in a manner suited to pupils of an early age. A series of simple experiments has been devised for the purpose of bringing the mind of the pupil into immediate contact with Nature, and to impress upon it indelibly the chief truths of each science. The editors consider that "the power of observation in the pupils will thus be awakened and strengthened," but they are careful to point out that "the amount and accuracy of the knowledge gained must be tested and increased by a thorough system of questioning." These little volumes are pure gold throughout; there is a total absence of the flashy experiment, but the truths enunciated are enforced and explained in a simple yet entertaining manner. We have read every word, we believe, of Balfour Stewart's "Physics," and we see no reason why it should not be adopted as an ordinary class reading-book, as well as a text-book for the acquirement of a knowledge of its special subject. Now that there is a prospect of science being taught in schools to a small extent, we hope the trustees or managers will not begrudge the money for the purchase of the necessary apparatus and materials for performing the experiments described in these "Primers." What we have said of the "Physics" primer, applies equally to the one devoted to "Chemistry;" and if the subsequent volumes of the series are as good, a want long felt will be well supplied. Science will be better—more widely—understood, and the seeds thus sown at school will, we may hope, give an abundant yield of fruit in the years to come.

Scales for the Ready Comparison of British and Metric Weights and Measures. By A. L. NEWDIGATE, M.A. London: E. & F. N. Spon.

THESE are a series of twelve slips of very stout card on which are printed, in such a manner as to be readily compared, the scale of an English weight or measure and the corresponding metric weight or measure. Thus, on the scale comparing English feet with mètres, we find that 100ft. are marked, and that they nearly correspond with 30·5 mètres; the two measures being printed close together, the feet divided to the half-foot, and the mètres to décimètres. Each mètre up to nine has its equivalent in English feet shown to six places of decimals and each 10ft. has the equivalent measure in mètres up to the same number of decimals; while on the back of the scale inches and sixteenths are given reduced to decimals of a foot. As a specimen of the utility and approximate accuracy of these useful scales we suppose a question put: The length of the tunnel at Mont Cénis is 12·291 kilomètres, how many English miles is that? By referring to the scale, we find that opposite 12·291 kilomètres is 7·64 miles, and according to the table at the back ·64 of a mile is equal to 5 furlongs 20 yards = 7 miles 5 furlongs 20 yards. If greater accuracy is desired, by making use of the equivalents for the kilomètres which are given to 6 places of decimals we readily bring the sum to 7·6374 miles, and as by the table ·6364 mile = 5 furlongs 20 yards, and ·001 = 2 yards, the correct answer is 7 miles 5 furlongs 22 yards, which is found in practice in much less time than it has taken to write the explanation. These scales must be remarkably useful to all who have to convert metric measures into English ones.

A Treatise on the Theory of Friction. By JOHN H. JELLETT, B.D., President of the Royal Irish Academy. Dublin: Hodges, Foster, & Co. London: Macmillan.

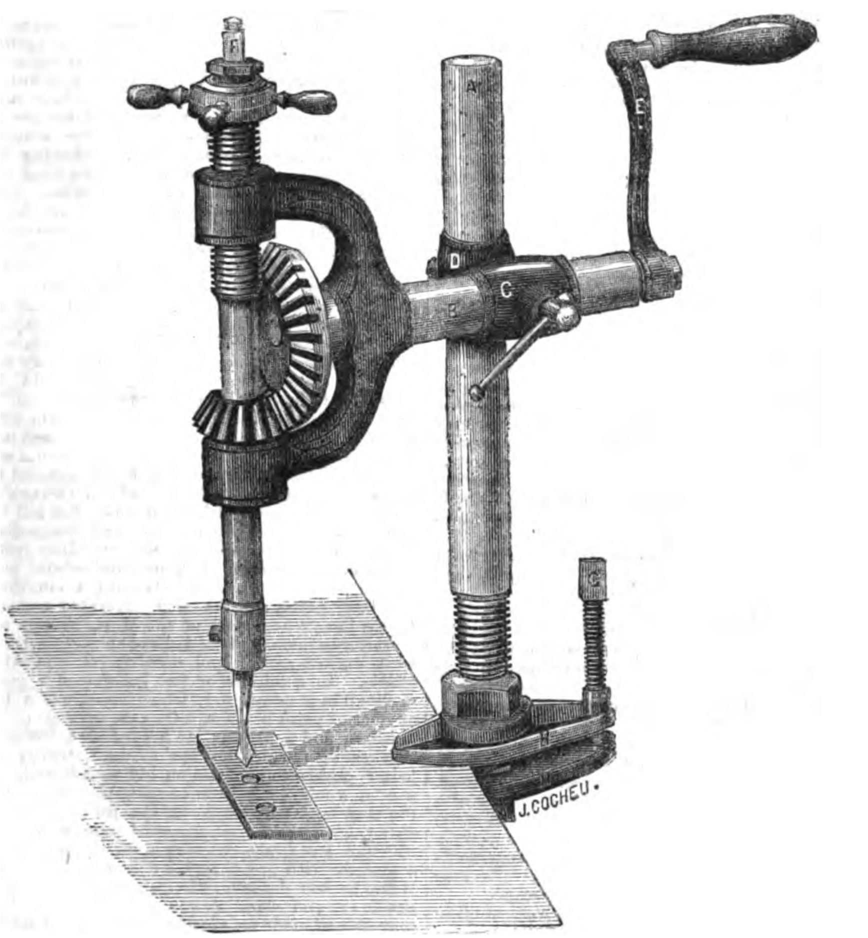
THE author of this book considers that the theory of friction, as a part of rational mechanics, has scarcely received the amount of attention it deserves, and as a consequence he has attempted to meet what he felt to be a want. It seems probable he says, that many students have been led to regard friction less as a part of rational mechanics than as a correction to be applied before the investigations of that science can be made practically useful. Such an idea is a mistake. The theory of friction is as truly a part of rational mechanics as the theory of gravitation. The force, friction, is subject to laws as definite, and as capable of mathematical expression as the force of gravity. All we can say of the book at present is that it is worthy of the attention of mathematicians, and the author, who thinks the theory is deserving of more ample discussion than has yet been bestowed upon it, will think himself repaid, for certainly a laborious work, if he succeeds in obtaining it.

An Elementary Treatise on Curve Tracing, by Percival Frost, M.A. (Macmillan), a subject which, in the words of the preface, presents so many faces pointing in directions towards which the mind of the intended mathematician has to radiate, that it would be difficult to find another which combines so many valuable hints of methods of calculations to be employed hereafter, with so much pleasure in its present use.—*A Handbook of Sewage Utilisation*, by U. R. Burke (E. & N. F. Spon), is a brief account of the various processes of deodorisation and utilisation hitherto experimented upon.—*How to Cook*, by T. L. Nichols, M.D. (Longmans), is merely another cookery book, strongly spiced with the author's crotchets. On p. 33 we are told that "swine are always unclean and often diseased, and infested with the germs of tapeworms and scrofula." Livers and kidneys should be avoided, but sweetbreads and tripe "ought to be as pure as any portion of the body."—*Popular Science, Domestic Hints, Eminent Men, Animal and Vegetable Life, Oddities of History*, and *Thoughts for Times and Seasons* (Griffin & Co.) are six manuals edited by John Timbs. They are made up of useful and scientific notes and "elegant extracts," and are generally taken from acknowledged authorities or standard works.

A Holtz electric machine, one of the largest and, probably, most effective in the world, was forwarded lately to the University of Pennsylvania. The revolving-plate is 36in. in diameter, and the machine is capable of giving an 18in. spark

A UNIVERSAL ANGULAR DRILLING MACHINE.

We illustrate in the annexed diagram one of the useful American inventions introduced by Mr. Churchill, of Wilson-street, Finsbury. This is a drilling-machine capable of being fixed in almost any position, and of drilling a hole at any angle. It is, we believe, made in two sizes, the upright shaft A being either 1¼in. or 1½in. in diameter, the whole machine weighing respectively 28lb. or 36lb., and drilling up to ⅝in. or 1in. holes. Attached to the shaft A, which is 2ft. long, by the collar or movable joint C D, is an arm, B, which is permitted by the joint to swing to any point right or left of the shaft A. The collar or ring D turning on the shaft A, and being secured by a set-screw, enables the operator to drill in a circular line, while the arm B, turning in the socket C, allows the drill to be worked at any angle from the perpendicular. The whole of these parts are also adjustable as to height on the shaft, and can be raised or lowered to suit the length of the drill or the thickness of the work. The crank E is shown in the position for drilling small holes—*i.e.*, on the spindle passing through



arm B, the gearing being 2 to 1; but for large holes the crank should be shifted to the spindle F, which is provided with a ratchet attachment for the purpose. It will be seen on examining the engraving that the screw thread on the shaft, together with the screw G, and the clamps H H, enable the workman to secure the machine on benches of any ordinary thickness, or to any support which affords a holding place within the limits of the clamps. It will also be apparent that by means of the joint and ring, C D, the drill can be worked at any conceivable angle. This is one of the handiest and most useful American inventions that have been introduced to the notice of mechanics.

DEFAULTING SOVEREIGNS.

An ingenious machine has been recently devised which threatens, in the course of a few months, to stop the career of certain sovereigns who have been travelling about under false pretences. As our readers are aware the British sovereign is a very "noble" coin. When issued from the mint the intrinsic value of the metal alone is exactly equivalent to that of the finished medal of Queen Victoria which many of us regard with so large a share of our affection. But by contact with the world this noble sovereign loses several of its glittering particles, and is looked upon with a suspicious eye by certain gentlemen who have a penchant for trying everything in the balance, and rejecting all that are found wanting—or, rather, of rating sovereigns at their proper value, for as long as they are of true metal and good they have no objection to take them in and send them to be re-formed. With a view to assist them in this labour Mr. James M. Napier, of the firm of D. Napier & Son, Engineers, Lambeth, has invented and perfected a machine to provide bankers with ready and accurate means for rejecting light gold at the counter in presence of the proprietor, "and so place them in a position to charge the user with the loss of weight and terminate the career of the large quantity of worn and fraudulently reduced coins now in circulation, as well as to maintain the integrity of our gold currency at the expense of the wearers of it." The machine referred to differs considerably from those in use at the Bank of England, constructed by Messrs. Napier. It covers a space of 8½in. by 5½in., or little more than a half-sheet of notepaper, and is worked by turning a handle. The most interesting feature in it is the employment of electricity to take note instantaneously of the action of the weighing beam, and to dispose a directing apparatus to determine the destination of the light coins. The machine is self-supplying from a reservoir; its ordinary speed is 60 per minute, and a touch sets it for sovereigns or half-sovereigns. The details are worked out with a view to simplicity, handiness, and durability, while the results combine rapid treatment and exactness.

VALUE OF AGRICULTURAL CHEMISTRY.

The following is a portion of a lecture delivered by the Rev. J. Smith, B.D., at Newhills, Aberdeenshire. Mr. Smith, responding to the wish of several farmers of the parish, that he would give a course of instruction on agricultural chemistry, has, for the last few months, been delivering lectures weekly before well-attended meetings of agriculturists. On the conclusion of the course Mr. Smith said:—Considering the season of the year, we have found it advisable to make our reading and conversation converge as much as possible to the subject of manures. When our course commenced, ammonia was selling at £80 per ton, being a rise of £8 to £10 since the previous season. At the present moment, this indispensable substance is valued at something like £100 per ton, or about 1s. per lb. This fact must surely be more powerful than any words in enforcing the adoption of the best methods of retaining the nitrogen of our manure heaps, preventing its escape by evaporation or drainage, and in showing the importance of not allowing a drop of waste liquid from dwellings and offices to be lost. The rapid increase in the cost of ammonia may be expected to stimulate the spouting of premises, the formation of tanks, the making of the bottom and sides of dung-courts impervious, and similar mechanical improvements. And these would be not merely agricultural but also sanitary improvements, which, if generally adopted, might help to ward off typhoid fever, diphtheria, and other diseases from farmsteads, where, strange to say, they are but too common. The enormous price of a main ingredient of manures may contribute more than anything else could possibly do to promote such studies as we have been engaged in, and so to intellectualise the agricultural mind—an appeal to the pocket being generally more efficacious than verbal advice. The farmer must have ammonia, and generally a great deal more ammonia than can be produced on the farm; and when this substance costs 1s. per lb., it is surely of immense pecuniary interest to him to ascertain what quantity of ammonia will be most remunerative in his circumstances, and in what form he can purchase it most cheaply. Now, how is he to satisfy himself on these points? Take, for example, the turnip crop, on which, I believe, most of you, gentlemen, are in the habit of bestowing £2 to £3 worth of fertilisers per acre over and above a dressing of farm-yard. Well, the manufacturers prepare a turnip manure, and doubtless these special mixtures are often compounded with great anxiety and skill to meet the requirements of the plant. But the experiments conducted under the superintendence of Dr. Voelcker, and reported in a late number of the *Journal* of the Royal Agricultural Society, concur with many former experiments in showing conclusively that the same turnip manure produces very different effects on different soils. And this is just what might have been expected when we consider how soils differ, both as regards the proportion of organic and inorganic matter, and also with respect to the constituents of the inorganic matter. Thus the very nature of things renders it impossible to compound a turnip manure that shall be at once effective and economical in different soils. Without going beyond our own parish, it would be very surprising indeed if the mixture that proved most remunerative on Clinterty should also prove most remunerative on Oldmill. And it is gratifying to learn on reliable evidence that a moderate dose of a fertiliser may in some circumstances be more profitable than a heavy dose; for in the experiments of the Cirencester Chamber of Agriculture, as just reported upon by Professor Wrightson, 3cwt. superphosphate per acre for swedes was found more profitable than 6cwt., a result which is the more remarkable that soluble phosphate is the specific for the turnip crop.

"ARGENTO" PICTURES.

THE following description of the manipulations for obtaining "Argento" pictures are given by Mr. Wenderoth, of Philadelphia:—

A carbon print is made by exposing a piece of carbon tissue, sensitised by bichromate of potash, under an ordinary negative, in the usual way of printing carbon prints. A metal plate with a silvered surface is taken and ribbed by rubbing it with a sanded brush, to deaden the polish and to give effect to the picture. The plate is then cleansed with spittle (nothing else answers the pupose so well), and then laid upon a sheet of paper on a table flowed with diluted alcohol. The carbon print is now laid face down upon the print, paper laid upon it, and a squeegee (made of a piece of wood and several thicknesses of ordinary bed ticking wrapped over one end) used to force out the superfluous alcohol between the picture and the plate, and to make the one adhere to the other. The alcohol also serves to prevent the occurrence of air-bubbles.

The whole is now immersed in a pan of water of about 100° temperature, and developed in the usual way, leaving on the plate a picture, the shades of which consist of the coloured gelatine and the lights, or rather, the highest lights of the surface of the plate exposed under colourless gelatine. This part of the operation, as all carbon printers know, is most fascinating and beautiful—more like the developing of a collodion plate than anything else. As soon as the superfluous colour is all washed away, the pictures (now on the metal plates) are removed from the water, and hung upon a line by clips to dry.

To render them more lasting still (though a carbon print on a metal plate seems to be as permanent as anything can be) they are, when dry, hermetically sealed to glass in the following manner:—A little stand should be provided, made of a plate of cast iron, say one quarter of an inch thick and twelve by twenty inches in size, smooth on the upper surface, riveted to a leg at each corner. This plate is heated with gas, or a coal oil stove, the heat being applied at one end, so that the end of the plate furthest from the heat will be considerably cooler than the other. Now lay the picture upon the iron plate at the warmest end. When it becomes warm, drop upon it a small piece of white wax, which will soon melt, and naturally spread over the whole surface of the picture. Now, having first heated the glass, place it upon the surface of the picture, place them under a weight on the cooler end of your iron plate, where they will gradually cool and become effectually sealed together. They are then cleaned and mounted in a case or frame, as desired.

The results are very beautiful, and are made more brilliant by the metal plate on which they are mounted. The prints are made by "cut outs," so that, when finished, the white metal plate forms the margin, which adds greatly to the effect.

HOW A MAN FEELS WHEN FREEZING.

DURING the recent cold weather, Dr. McMillan, a young dentist, while travelling from North Middletown, Ohio, to the adjoining town of Paris, was overcome by the intense cold, and came near being frozen to death. He narrates his experience, in the *Cincinnati Enquirer*, as follows:—

"After having proceeded about three miles on my journey, my feet became very cold. By stamping my feet upon the floor of the buggy I imagined I was perfectly warm, as my feet troubled me no longer, and the cold sensations through my body ceased. I, however, felt dull and sleepy, like a man who is drunk. I didn't care for anything. At this point, I believe, I began to freeze, and ought to have known it, but felt so comfortable that I did not examine my situation. After I had driven about three miles further my hat was blown off, but, being in a hurry to reach Paris, I did not stop to hunt for it. When I had proceeded perhaps a mile further, letting the reins lie in the bottom of the buggy and paying no attention to my driving, my horse shied off the side of the road and ran upon a rock pile. I then attempted to get the lines and pull him off, when I discovered I had lost the entire use of my right, and could barely use the left hand; with this one I attempted to pull him off the rocks, but the buggy wheels being locked, I could not do it. I then got out of my buggy, and in doing so struck the bridge of my nose across the wheel and cut it severely. I then went to the head of the horse, took hold of the bit and attempted to pull him around, but he would not move. I then commenced to unharness him, with the expectation of pulling the buggy off the rocks myself, feeling all the time very sleepy. When I had almost completed the task of unhitching the horse from the buggy, the desire for sleep became so great that I could bear it no longer, and I laid down upon the rocks by the side of the horse and went to sleep. I must have lain there some fifteen or thirty minutes, when I was aroused by a coloured boy who found me. Upon his asking me where he should take me, I told him to Paris, still not being aware of my critical condition. Upon arriving in Paris, my feet were put into cold water, which entirely, I think, cured them, as they do not hurt me. My left hand does not give me much pain, and I think will be all right in a few days; but my right hand was badly frozen; nothing seemed to do it any good, and I am afraid I shall lose three, if not four, of my fingers. Last night, when I arrived in Paris, I could give no account of myself, but this morning I remember every incident."

SUGGESTIONS FOR MAKING HALF-WORN-OUT IRON SHIPS PERFECTLY SEA-WORTHY AT A SMALL COST.*

THERE can be no doubt that the half-worn-out plates of iron ships may be much strengthened by the application of the cements in ordinary use, composed of silicate of lime and alumina. The plates are found covered with scales of oxide of iron, and when the cement is applied in a wet state, an imperfect chemical union is formed, consisting of silicate of iron, lime, and alumina, which hardens into an artificial stone of some strength; the plates are firmly backed up, and the ship is much strengthened throughout her structure; as long as there is little cargo in the ship, she makes but little water, and seemingly is in perfect order for the longest sea-voyages.

This, however, is delusive, for when the ship is loaded, say 20ft. deep, and her plates are a little strained by the motion of the ship, she begins to leak; for although the scales of iron, strengthened by the artificial stone, may easily resist the pressure of water where it is only 2ft. or 3ft. deep, with a pressure of 1lb. or 1½lb. on the square inch, yet they generally yield to a pressure of 10lb. on the square inch, or 1,400lb. on the square foot, in 20ft. of water. At that depth a little water oozes through some small orifice on the outside of the plate, and collects behind a strengthened scale; it gradually accumulates, and, as surely as in a Bramah press, acts with a 10lb. per inch pressure on the scale, and forces it from its place; an inward current of water is then established, which is sure to enlarge the leak. Sometimes the scales are of sufficient strength to resist this pressure, but the risk is great. It is instructive to remember that the scale of cement was found to be gone off from the lowest part of the bottom of the *Megæra* near the keel, and several bottom shales of iron andplaster were detached in the of that unfortunate ship.

By affixing cement upon the inside plates of an iron ship, a most deceptive trap is laid. In dock, under survey, the ship appears abundantly strong, and resists the strenuous and honest strokes of a wood mallet; borings may be taken which seem compact—the ship may not even leak till a small hole occurs deep in the outward surface from working in rough water; when the ship labours, the trap falls, and lucky are the sailors if they escape.

In cementing vessels it would be well to fill in solid between the frames, and flush with the lining or ceiling about the bottoms of coal bunkers, leaving a course for water in the centre of each bay by inserting a piece of iron piping; the bottom parts of the vessel, fore and aft, should be filled in to nearly the top of the floor plates, and such other parts as it is difficult to gain access to.

Should it be desirable to preserve an iron ship for future use, whose framework is of adequate strength, but where the state of the plates is precarious—this may be accomplished by lifting all platforms, and everything that covers over the inside of the plates in the hold; a sheathing then can be fixed all over the plates outside from keel to deck, of say 4in. thick, of pitch pine above and American elm under the deep water secured by means of metal screws 3in. long, turned from the inside of the plates into the wood. Where the plates happen still to be of sufficient strength, the application of an iron washer with a hole through its middle for the screw would be found enough; but where the plate is weak, a butt plate secured between the frames may be advantageously employed. I should recommend a screw, cast in Prince's metal, ¼in. in utmost diameter, with six turns in three inches. This screw will support 1,200lb. without drawing, and cost 2d. The stem, keel, and such like parts, can be sheathed, and fastened by means of metal screws and nuts, countersunk in the wood, and covered with stoppers of guttapercha and sand; the outside of the wood sheathing thus cut off from all electric communication from the iron plates and frames can be coppered, and thus the transport will sail better by far than before, but the copper should be kept at least 3in. distant from all ironwork, such as the screw propeller. If this wood sheathing be caulked with oakum, made from new tar rope (not oakum picked in gaols from old rope taken from the marine-store dealer), the ship may be safely sent out for a five years' cruise, without fear of her leaking, and if the attachment of the screws be inspected and made good, the sheathing will remain good for fifteen years, with merely re-caulking, the ship thus sailing at small cost.

* Read by William Poole King, Esq., before the Institute of Naval Architects.

MORE "PSYCHIC" MANIFESTATIONS.

THE following account of some curious psychical or spiritualistic phenomena are published by the *Edinburgh Courant*, which must be responsible for the truth of the statements contained therein. It appears that in the shop of a Mr. Nicol, Edinburgh, there are at present on view several paintings which have a peculiar interest attached to them, not so much on account of their intrinsic value as works of art as from the fact that they have been produced in the dark by a person while in an entranced or somnolent condition. The circumstances which have lead to the production of these pictures may be briefly stated. During the last visit to Edinburgh by Mr. Home, the spiritualist, his séances were attended by several gentlemen who were sceptical as to the power attributed to spiritualism, and they formed themselves into a club, which held meetings twice a week for the purpose of investigating the subject. After a number of experiments they succeeded in producing some of the so-called phenomena, but nothing that could not have been explained by natural laws. In the course of their inquiries the members of the club sought information in spiritualistic literature and from other sources; and they soon learned that a wonderful "painting medium" was to be found in the person of a Mr. D——, a journeyman cabinet maker in Glasgow. It was stated that this man, in his normal state, had no knowledge of painting, but that when he fell into a trance he painted excellent pictures in oil. In order to satisfy themselves on the point a meeting was held in a house in Edinburgh, at which the "medium" was present, a temporary easel was erected, and a piece of millboard, prepared for oil painting, was nailed on it. The "medium" then sat down on a chair, and said that the company need not refrain from conversation, as it would not hinder the manifestations. In the course of ten minutes he fell to all appearance into a deep sleep, and immediately started to his feet, his countenance being entirely changed, and bearing a more intellectual aspect than before. He shook hands with a number of imaginary persons in the room. His eyes were shut during the greater part of the time, except when he spoke to them, and the balls of the eyes appeared to be turned round, and nothing but the whites visible. In a minute or two he opened a parcel, made up in a newspaper, which contained a large number of paint brushes, a tin case with oil colours in tubes, and a pallet. He first of all selected the brushes with which he was to work, trying their points on his tongue and on his thumb nail, as a painter would do. He then selected colours from the tins, and put them on the pallet. Having changed the position of the easel from what it was when he was awake, he took a pencil and outlined a picture with great rapidity and no little skill. While he was drawing, the gas was once or twice put down, and when it was put up it was found that he had made as much progress in the dark as in the light. Some of the gentlemen present stood close to the easel, and they afterwards stated that the eyes of the medium were shut all the time. After the picture had been outlined, Mr. D—— took up the pallet, and commenced to paint, not in a slow careful manner, but in slapdash style, and the result was that in 32 minutes a picture of Loch Achray was completed. The spiritualists say that more wonderful manifestations can be obtained in Mr. D——'s presence, namely, the production of "spirit paintings," in which the medium's hand is not called into exercise at all. The production of these spirit paintings takes place (of course) in total darkness, and at the meeting which Mr. D—— attended a specimen was given. The medium took his seat at one end of a table, and the colour box was placed at the opposite end. Several gentlemen sat between him and the colours, so that he could not reach them without the company being aware of the circumstance. He took from his pocket a number of cards and rubbed them with his hands, as if feeling for a card suitable for the operation. He appeared from his manner to be asleep, but was able to answer questions and carry on a conversation. He at last chose a card the size of a carte de visite, prepared for oil painting. It was marked on the back, so that it could be checked, and laid on the top of the colour box opposite the brushes. The company were told that they would probably require to wait some time before any manifestations would be shown. The light was then put out, and in a few minutes there was a sharp sound, as if a wire was being drawn over a piece of paper, and a noise was made as if a brush was thrown on the table. That was the signal for the lighting of the gas, and the company then saw the card close to the place where it had been laid. On turning it up it was found that a picture had been painted on the under side, and was still wet. As some of the company had doubts as to the experiment, a request was made that it should be repeated. The light was again put out; and in a short time a pencil was dashed on the table. On the cards being examined, it was found that there were two subjects very cleverly drawn—a faithful portrait of Hugh Miller and a sketch of a girl! Mr. D—— was in the trance about three hours; and when he awoke he appeared to take great interest in the pictures—an interest which could not be simulated. He said that he had seen in a shop window somewhere the original of one of the pictures he had drawn. We state the above facts simply as we have ascertained them.

Our contemporary says that the greatest pains were taken to test the truth of the statements made, and that the reporters whose evidence is given are by no means to be regarded as spiritualists. Still, it is a remarkable thing that the "spirits" must have "darkness" before they can exhibit their talents, and few sensible people will believe in these supernatural paintings unless they are permitted to furnish the cards and see them painted in broad daylight, the handmaid of Truth.

THE STEAM JACKET.

THERE is a practical objection to the use of the jacket to which we have not yet referred. High-pressure steam, especially if quite dry, appears to exert a peculiar solvent effect on cast iron. Already we hear rumours in numerous directions of the rapid wear of the high-pressure cylinders of compound engines, an evil which grows in proportion with each augmentation of the weight of the casting. It appears to be fortunate that the remedy for this evil affords the best possible method of applying the true theory of the jacket in practice. In certain cases the jacket is made by putting a thin steel tube into a cast-iron cylinder bored out to receive it. The Reading Works Company have brought this system of construction to great perfection, for example, with excellent results. How far the scheme is applicable to marine engines we are unable to say. We suggest that, especially in marine engines, instead of steel—notably an uncertain material—hard brass, or more strictly speaking gun-metal, liners should be used for the high pressure cylinders. Properly made, the material is much harder than cast iron, and will take a beautiful surface; while the material, being an excellent conductor, would comply with one of the fundamental conditions of eminent success in using the jacket. The idea is a mere extension of the system of lining air pumps. We do not claim it as original, but we believe this is the first time the scheme has been mentioned in any journal; and it appears to us to be well worth the consideration of engineers engaged in the construction of large steam engines working with considerable pressure.—*Engineer*.

PRESERVING PLASTER CASTS.

A CORRESPONDENT of the *Athenæum* writes:—"In view of the approaching Royal Academy and International Exhibitions, it may be worth while to draw the attention of sculptors to the use of paraffin for saturating the surface of plaster of Paris casts, instead of employing stearine, or clogging them with coats of paint. Paraffin, from its comparatively unchangeable nature, its few chemical affinities (*parum affinis*), the variety obtained from peat or mineral tar, indeed, having been tried for ages by exposure to all sorts of cosmical vicissitudes, seems, *à priori*, more likely to be durable in colour and other qualities than stearine. It softens at 110°, melts at 130°, and is then easily applied, in one or more dressings, to casts made previously warm in an oven or on a covered stove. It imparts to the plaster an agreeable appearance of subdued transparency, combined with solidity, far preferable to the effects produced by stearine. The casts soon acquire an ivory-like tone, and their surface is destitute of any greasy feel or any unpleasant glare; unlike those dipped in stearine, they do not appear, after a trial of many months, to turn yellow—moreover, paraffin is very cheap. Of course the casts to be treated with it must be clean to begin with, and any seams should be neatly finished off. When properly saturated for half an inch or less in depth from the surface, the paraffined casts are smooth and dry to the touch, so that dust, if it gathers upon them, does not adhere to them, but may be removed by a fine brush, or may be washed off with a soft sponge and *cold* water, either with, or better, without soap. Warm or hot water makes them adhesive, melts the paraffin, exposes the pores of the plaster, and causes dirt to sink into the surface in patches or streaks. Any exposure to undue fire heat or solar heat also affects them injuriously, and, of necessity, oily dusters or greasy fingers will soil them. With care, however, they may be kept, even in London houses, without the hideous covering of a glass shade. This process of paraffining casts appears to be admirably suited for works intended for public exhibition, which are necessarily subjected to the influence of many atmospheric impurities. It not only enables them to be preserved in a comparatively clean state, but it substitutes for the dull, cold, and ghastly whiteness of the raw plaster an agreeable hue, substance, and surface. The suggestion of this use of paraffin was made by Professor Marshall, and it has been practically tested by Mr. Thornycroft and his son."

ON ECONOMY OF FUEL AND PREVENTION OF SMOKE.*

THE heating surface being in proportion to the result required, there is still in all furnaces, and particularly in those of marine engines, a loss amounting to at least 25 per cent., arising from imperfect combustion. Indeed, it has recently been stated, on the authority of a Royal Commission, that our best Cornish engines only utilise one-eighth of the coals burnt, and the majority of engines not more than one-thirteenth.

In order that I may explain the object that I have in view, and the principle of my system, by which I seek to prevent this loss, it is necessary to consider the nature of those effects which we find in operation in the furnaces of our engines.

When coal is burnt in the open or in the ordinary house grate, the principal products of combustion are carbonic acid and water; a certain portion of finely-divided carbon escapes combustion and constitutes the soot or visible smoke of a coal-fire. When the decomposition of coal is effected in retorts or vessels from which the air is excluded, the products are much more numerous and complicated, a large amount of volatile matter is expelled, partly in the form of hydrocarbon gases, and partly in the form of hydrocarbons in the state of vapour, solid coke remaining in the retort.

Now, different parts of the furnace frequently represent the conditions of the open fire and retort, also constantly varying in place and temperature. In the laboratory, if we want a smokeless gas flame, we adopt some contrivance similar to the Bunsen burner, in which a mixture of air and gas takes place (as in some varieties) through wire gauze, the particles of air and gas being thoroughly distributed through the entire volume; the molecules of each gas coming into individual contact, a condition that is essential, and the result is a smokeless flame, in which glass tubes and white porcelain capsules may be heated without becoming blackened.

This would not be the case with the ordinary gas-jet burning in the open; the supply of air in this is abundant, but it is not commingled with the flame, only coming into contact with the outer shell, producing a flame that deposits a thick soot on any other object placed in it, pointing out the absolute necessity of maintaining the conditions of combustion that we possess in the Bunsen's burner.

It would be simply ridiculous to attempt to make gunpowder by the haphazard throwing together of saltpetre, sulphur, and charcoal. The proportions of the gun and projectile might be the best, but what result should we have from an explosive so prepared? It is doubtful whether it would ever burn. Is there not a close analogy between this and the well-constructed boiler and furnace, and the condition of the combustible material represented in the latter by the imperfect mixture of air and flame?

Not only may vast quantities of unconsumed carbon pass off in a dense smoke, but also volumes of invisible and inflammable gases escape ignition, as they would from the retort of a gas factory, and at a low temperature the furnace may actually be distilling hydrocarbon oils, as in one specially built for that purpose.

It is this visible loss in smoke, and visible loss in unconsumed gases and vapours, which it is our object to save by the proper admixture of the atmospheric oxygen.

Various contrivances have been proposed for this purpose, and adopted with more or less success. Improvements at the bottom of the furnace, as in the ventilating fire bars, which make a better distribution of the air, at the lower part of the fuel. In others the air has been admitted at the fire-door, and at the back of the bridge; but the volume of air has generally been greater than necessary, chilling the gases below the point of ignition, the stream of cold air only coming into surface contact with the heated gases, as some ocean currents of hot and cold water are said to flow side by side without mingling with each other.

It is, therefore, the thorough admixture of the heated gases with air, as in the Bunsen's burner, which is the essential feature of the system which is the subject of this paper.

The object in view I seek to attain as follows:—

In each tube of an ordinary tubular boiler is inserted another of much smaller diameter, perforated at its end nearest the fire in such manner as to cause an induced draught when required, by a current of air flowing through the said tube, or being forced through by a blower or steam jet, this being under perfect control by opening or closing a valve. Each of the boiler tubes is in this manner filled by a smokeless flame of great intensity—the deposit of soot and dust is reduced to a minimum, there not being any smoke except on first lighting the fires. No obstruction is offered to cleansing the tubes, and the inner ones can be separately unscrewed, or removed in sets, when it is required to prick out the perforations or to renew the ends.

The expense is small, the air pipes costing not more than a few pence per foot, and no alteration for their introduction being required except of a most trifling nature.

The same system is applicable to locomotives and other engines.

* By Captain J. GORDON MCDAKIN, late 42nd Highlanders. Read before the Institution of Naval Architects.

WANT OF OBSERVATION IN THE FARMER.*

PERHAPS the best way of testing whether the farmer acts justly by his workman is to seek an answer to the question whether the latter does or does not generally receive a full equivalent for the value of the labour he is able to supply. Of course this point is not so easy and simple to solve as in the case of many manufacturing matters, but reasonable conclusions might be drawn by any one thoughtfully estimating the value of crops and the proportion of cost which labour represented in their production. Probably little difficulty would be found in showing that the labourer's pay, taking all the year, came fully up to, or exceeded, a fair valuation of the work he did. This being so, no rise of wages could take place under existing circumstances without a dead loss to the employer. How, then, could effort be made to improve the status and raise the income of the labouring man? The answer seems plain and inevitable—increase the value of his work. But how, again, can this be done? By making him a better workman in the matter of individual tasks. Seize systematically every method for making men dexterous at sowing a field, ploughing a furrow, mending a harness, sharpening a hoppole, foddering a bullock, and managing a yard of dung. This was not a matter of vague generality, but of hard fact. He (Dr. Monckton) had seen with his own eyes, within twelve months, important tasks so badly done that double the wages might have been paid for good work with profit to the farmer. He had seen wurtzel seed so unevenly drilled in point of depth, that five times the man's daily pay was thrown away, because he had never been taught that mere holding straight was not drilling, but that regular and shallow deposit of the seed was even more essential. He knew a hop-garden of favourable clays, and not of running sand, that had been drained three times in nine years, because of the imperfect fall secured on the earlier occasions. He had seen last season gangs engaged in hop syringing; the work accomplished by one gang would be more cheaply paid for at £1 a day than that by the others at a crown. Again, why should not every farm of reasonable extent see that some of its hands could thatch, or stack, or build a pig-sty, or paint a waggon, or shear a sheep, or mend a fence? It had been too much the custom for a whole parish to depend on one thatcher and sheep shearer, who often earned 30s. in three days, and was drunk for the rest of the week. Surely our own workpeople might be enabled to benefit by these rather better paying jobs. A great industry had sprung up in the country in the use of creosote. How many of those now listening had ever so studied the matter as to know the very best time, temperature, and method for the process? He had himself seen professors of the art, men who let out tanks, and took contracts for their neighbours, and who did not even know what a thermometer was, and yet pole-dipping could never be done to the best advantage without its aid. Many workpeople in charge of those tanks now receiving 2s. 6d. a day, would be better worth 4s. if rendered more observant, more painstaking, and better instructed.

THE DIRECTION OF LABOUR.

But this leads us to the second method of augmenting the value of the workman's toil—viz., a more skilled and studied direction of his tasks. Of course it was clear in connection with what had already been said that the master must instruct himself, and exercise increasingly his own wits as well as those of his workman, and this feature must never be blinked. Not only morally, but in business aptitude, the man will be what the master makes him. Take a clutch of pointer puppies and give four away to four different people; the value of their labour in two years will depend almost entirely upon the pains and skill with which their respective masters have set and kept them to their work. An army of soldiers may be of exemplary skill and courage, and yet see their efforts nulli[...] by unwise or insufficient planning and direc[...]

* From a paper read by Dr. MONCKTON, be[...] Maidstone Farmers' Club.

In the matter of labour a farmer must be exercising a perpetual foresight to make his operations dovetail and harmonise. The job of to-day must be habitually so done as to render more cheap and effective the work of to-morrow. Labour so directed will yield value and show a result. Without such management, men, though industrious and well enough master of each particular task, will inevitably muddle away time, and waste money —*laboriose nihil agendo*.

ORNAMENTATION OF SILVER PLATE.

ORNAMENTATION of silver plate is at the present day quite a work of art compared with the specimens handed down to us from the last century; but, by the aid of steam, a more intelligent class of workmen, and a better class of tools, added to a purer taste for the elegant, have worked wonders in this respect, and now even the commonest articles of silver plate bear the impress of beauty. One of the most striking inventions of a recent date for such ornamentation is that by Mr. J. A. Rhodes, of Sheffield, a description of which cannot fail to be interesting, and we quote the following from a recent article in *Nature*:—"A thin plate of metal perforated by punching, shows a depression of the edges of the perforations, while the surface of a plate cut by saw piercing preserves its even uniformity. It may be supposed that the figures so cut out would at times be remarkable for beauty of form, and, indeed, they are so more or less, but still it seems to have been left for Mr. Rhodes to utilise these, so as apply them to relief ornaments. It must be remarked that Mr. Rhodes is not only his own designer, but for nearly twenty years has been the designer and piercer to the principal firms in Sheffield, and his ability and taste are, therefore, well known in the trade. The idea is very simple, but, like all other ideas of value, might have remained a long while dormant, had not Mr. Rhodes, Columbus-like, put it to practical application. To give our readers a clear idea of the new method of ornamentation, we will take the tea and coffee service for example, and suppose the panels complete and ready to become the design. A plate of gold having been provided of a suitable substance, the intending design is drawn on it, and so prepared and applied that the design or ornament becomes solidified with the metal of the vessel, with an appearance of having been adapted by some curious and singularly precise method of casting, and quite excluding all supposition of parcel-gilding." After referring in detail to some engravings of spoons and a salt-cellar, which appear along with the articles, the writer adds:—"With respect to the cost of these table requisites, they are brought generally within the means of householders, unless the ornament be unusually rich. The low relief ornaments, on the less expensive products, are worked in aluminium; and for objects yet less costly it is not necessary that they be of silver. We all know the infirmity of gilding, or parcel-gilding; its existence is only a question of a few years, while, on the other hand, the substance of the superimposed gold or aluminium will, with fair treatment, last half a century, without any very conspicuous show of wear and tear. This invention, being only in its infancy, is open to amelioration in perhaps many directions. One advantage which strikes us most forcibly and directly, would be the picking out, or clearing with a sharp point those bas-relief forms which may not be sufficiently definite; and thus the invention would be raised more nearly to the level of fine art. The process, as we understand, does not limit designs to the flat bas-relief, but is susceptible of the adaptation of compositions even approaching high relief, and the latter manner of treatment would raise well-considered products into competition with the most beautiful and valuable metal works of the most celebrated producers of any time. There is nothing *repoussé* that could equal what may be conceived of the prominence of detail and delicacy of finish of such works. Their effect would resemble that of inserted ivory-carving, with, if necessary, sharper cutting. This is only an idea of the perfection to which the invention may be carried, for nothing of this kind has yet been produced. Mr. Rhodes has patented as well a method of ornamenting metals with enamel or of embellishing with enamel a superimposed metal design."

An Important Discovery.—An important discovery bearing on the antiquity of man has just taken place, Mr. Edward Charlesworth, F.G.S., one of the correspondents of the English Mechanic, having discovered in the Suffolk crag, or older Pliocene beds, teeth of the extinct shark (Carcharodon), apparently perforated by human agency, as well as many concretionary nodules with longitudinal perforations unlike those produced by the action of boring mollusca. The specimens will be exhibited and described at the meeting of the Anthropological Institute on the 8th of April. If this discovery is verified, it will carry back the existence of man in England to a period coeval with the mastodon arvernensis, and far more ancient than the mammoth age."

SCIENTIFIC SOCIETIES.

HACKNEY SCIENTIFIC ASSOCIATION.

AT the usual fortnightly meeting, held on March 12, Mr. W. R. Birt, F.R.A.S., Vice-President, read an able paper on

The Rewards of Science.

Mr. Birt said: The similes of running a race, climbing a ladder, or striving to attain the summit of a steep and rugged ascent, have very frequently been employed to indicate the earnestness of men in seeking to obtain a recognition of their labours in whatever departments their energies have been exerted. In the ancient Olympic games the successful competitor received a laurel crown, perishable in itself; yet the fact of the successful termination to him of the conflict in which he had been engaged, opened up rewards of a much higher and enduring character. The chariot of the warlike conqueror was prepared for him, and in it he was seated, to be conveyed by four horses to his own city. On his passage homewards he was received in every city with the greatest acclamations, but he was not permitted to pass through the gates of his own. He had been a conqueror in athletic games, or in the horse and chariot race, or he had excelled in poetry, in eloquence, or the Fine Arts, and his own citizens would not receive him as an ordinary citizen. He had won the crown, the symbol of the friend to humanity; he appeared before them as a conqueror, and he must enter the city as such through a breach in the walls. The painters and sculptors of his country perpetuated the game he had won. A statue commemorative of his victory was erected in the sacred wood of Jupiter, at Olympia, and his name was celebrated by poets and thus handed down to posterity.

The cultivation of science may be likened to a race, or still more to the climbing of a hill, from the summit of which, to speak hyperbolically, we obtain an unbounded prospect. Methinks I see a number of hard-working students running this race—climbing this hill. Every portion of the natural world is ransacked by them to obtain materials with which to construct their theories, or by which they hope to enlarge the boundaries of knowledge. Here and there they separate into little groups, with the object of thoroughly exploring portions of the hill in the course of their toilsome journey to the top, others give their attention to the natural productions of the hillside—the trees, the flowers, the grasses which adorn it; others, again, not content with earthly things, turn their attention to the heavenly, as night after night the earth is enveloped in darkness and the spangled sky showeth unto them knowledge. By the aid of their instruments they sound the depths of the illimitable space above them, and they put such questions as these to themselves:—How are these mighty orbs distributed in the illimitable space? What is the physical constitution of the sun shining above us? What was that wonderful shower of stars which fell a few years ago from the sky?—with others of a like nature. A partial solution of these questions urges them onwards in their researches.

Now and then I behold some little commotion among the groups; I am desirous of ascertaining to what it is due, and upon attentive consideration I find that an advance in knowledge has been made by a successful investigator, and his fellows are about to reward him by a mark of their approbation, which he receives at their hands. The award is made by a few who have themselves been rewarded by their fellows by being elevated from the mass of workers to the positions which they occupy, some having already received a similar mark of approbation, while others are still striving for it. This mark is considered as the impress of the sovereign upon the genuine coin: it gives currency to philosophical thought, the ideas worked out by the recipients are generally received as exponents of truth: they are, in fact, rendered current among philosophers.

Dropping the figure, it may not be uninteresting if we offer a few impartial remarks on the "rewards of science" given in this country. The groups of ardent workers, our scientific societies, give rewards of a minor character—the publication of papers, appointment as office bearers and members of councils, the highest reward in the gift of a society being the "medal," or in some cases "medals." In the distribution of these rewards the greatest care should be, and generally is, exercised in the appointment of officers and members of councils, for on them depends the award of the medal which is to stamp in the eyes of the general public the philosophical value of the work of the medallist. In most societies the appointment of office bearers and members of council is by ballot, a list having been presented by the retiring council of fellows recommended by it as suitable for the various offices to be filled. To the vote by ballot or the recommendation of the retiring council there cannot be the least objection, for it is presumed that a body of gentlemen forming the élite of the society are above prejudice, and, besides, it is a guarantee that none but gentlemen duly qualified by a practical acquaintance with the branch of science cultivated by the society will be recommended to fill the offices.

There can be no question that in our larger scientific societies the appointment of a fellow as member of council carries with it a prestige equivalent to a reward for services rendered to science, and to give an opportunity for rewarding a labourer in the field which it is the province of any particular society to cultivate, provisions exist in some by which no fellow can serve in any office for a longer period than two years, at the expiration of which a member of council may be advanced to a higher post, as secretary or vice-president, and a successor recommended from among the fellows, and as the society should be presided over by a gentleman well versed in the branch of science cultivated by it, the greatest care is generally exercised by the retiring council in recommending a gentleman qualified in every respect for filling the chair at the expiration of the then president's period of office. The rewards, therefore, in the gift of a society are—publication of papers, appointments to the various offices, the highest being the presidency; beyond this is the medal.

A consideration of the rewards given by the Universities and the State will not occupy us long: a mention of them will be sufficient for our present purpose. Honorary degrees, appointments in the gift of the Government, honours conferred upon the most distinguished cultivators of science, and pensions granted to those who have made remarkable discoveries, are the principal. As may be readily imagined, the attainment of these rewards depends more or less upon the recommendations to the Government of the recipients by influential men who are personally acquainted with them.

The "Rewards of Science," as we have thus sketched them, are emphatically external. They are marks of the estimates which men make of the labours of their fellows. They are by no means to be despised, yet it is exceedingly important that they should not be overvalued. From the very nature of things, especially when every field of inquiry is literally crowded with labourers, a small minority can only hope to succeed in obtaining the 'crowns" of the various societies, and a still smaller the more substantial rewards of the State. And are no other rewards within the reach of the student? Must he depend entirely upon his fellow-man for the recognition of his labours? Most assuredly, if he undertake the cultivation of science only with the hope of one day becoming great and eminent, the probability is that he will fail in the attainment of his object. There are rewards superior to any that man can bestow. We know that ability for scientific research is not confined to the rich and great, and many a student who has occupied his leisure in the acquirement of knowledge has also contributed to its extension without even attaining a position beyond a worker; also many a student has undervalued the results which he has obtained, and for want of sufficient energy in making them known, they have slumbered, until some one, having obtained similar results and remarked their bearing on our present knowledge, has given them to the public, who has reaped the advantage. The real source of satisfaction to the student is a love of science for its own sake, or rather, for the sake of the Bestower of every good and perfect gift. We have heard of "Nature's Aristocracy," a better expression would be, "God's Aristocracy" consisting of men on whom such gifts are bestowed. In the employment of his gift, each step the student takes is accompanied with its own reward. "For there is nothing better than that a man should rejoice in his own works, for that is his portion." The pleasure experienced in every advance which to a student is really a discovery, is the highest, the greatest the purest reward, because he regards it as the result of a gift bestowed upon him.

There is another source of pleasure to the scientific worker, which consists in the publication of the results of his labours. While deriving satisfaction from these labours, he would not add to the stock of knowledge unless he were to communicate the results to his fellows. From the very birth of science a communication of the results of the labours of its votaries, either orally or in writing, has been the means of increasing and perpetuating knowledge. In the present day the channels are numerous through which information may be communicated to mankind. Publication in the transactions of societies implies a supervision on the part of councils or editors, and must be regarded in the light of a reward. There are, however, channels of a different kind through which students may communicate their views to their fellow workers, and in which such views are freely and impartially discussed. Other channels are also open which need not be specified here. It is the press that gives stability to works of science. A thought embodying a fact brought for the first time to light is committed by its author to this general repository of all knowledge; it may, from a variety of circumstances—its non-acceptance by those who are looked up to as the leaders of the scientific thought—its being in advance of the age, and the general body of scientific men being unable to appreciate it—lay dormant and buried, but there it is, not only to spring forth at some future time and bear fruit in due season, but to testify that the author had not laboured in vain. Many are the cases that might be cited of fresh discoveries which the press had already chronicled, but little notice had been taken of them at the time, the discoverers were little known until some striking phenomenon was observed and great publicity given to it, when the earlier publication was thought of and the original account disinterred to the honour of the pioneer who thus received his due reward, if living, and if removed from this state of existence, the press bore testimony to a successful result of his labours.

The members of this association are cultivators of true science in a true scientific spirit, and seeking their reward only in their work. Such need not be disheartened if their labours are not readily appreciated. In the great majority of instances in which real knowledge has been communicated to mankind it has always been so, the first announcement of a fact is received with caution, often with distrust, the general recognition of it may be long deferred, but truth can never alter, and the highest reward a man can have is the satisfaction of knowing that in communicating to his fellow man a new truth he is a benefactor to his race.

Mr. Birt concluded by presenting to the library a valuable series of works on the subject of lunar changes, and a cordial vote of thanks was accorded to the eminent lecturer by the assembled members.

USEFUL AND SCIENTIFIC NOTES.

Cochineal Insects.—It takes, says the *Virginia State Journal*, sixty-five thousand cochineal insects to make one pound in weight, and the amount imported into America during last year was 1,849,842lb. The annual slaughter of these harmless insects, therefore, to supply carmine for American ladies' toilets, and the various dyes and tints for their ribbons, feathers, and dresses, actually reaches 120,239,780,000 in number! These figures are perfectly awful, but some of the uses of carmine are worse.

Syrup of Coffee.—This preparation is of great use to those who have long journeys to make. Take half a pound of the best ground coffee; put it into a saucepan, containing three pints of water, and boil it down to one pint. Cool the liquor, put it into another saucepan, well scoured, and boil it again. As it boils, add white sugar enough to give it the consistency of syrup. Take it from the fire, and when it is cold put it into a bottle and seal. When travelling, if you wish for a cup of good coffee, you have only to put two teaspoonfuls of the syrup into an ordinary coffee-pot, and fill with boiling water. Add milk to taste, if you can get it.

The Artesian Well in Boston, U.S.—The work of boring this well was begun in the latter part of the month of March, 1871, and has been going steadily forward up to the present time, the progress made being from 1ft. to 15ft. each day, at a cost of 15 dollars per foot. The well had reached a depth of 1,000ft. when we last heard of it. When the work was first commenced, a drill would last thirty-six hours without sharpening; now the same kind of drill will only last one hour. The diameter of the bore is 5in.; the drill is 4in. across. The drill and iron shafting which connects it weigh now 1,200lb., and the rope by which it is lowered weighs 900lb. The power is furnished by a 16in. horse-power engine, with a walking-beam of 36in. stroke, at the rate of about thirty strokes per minute. It is said to be the intention of the company to keep the drill at work until they obtain a sufficient volume of water for their use, unless their money gives out, or the drill goes through on the other side.

Level and Angle Indicator.—We have received from Messrs. Fletcher and Sinclair, of Liverpool, a handy instrument bearing the above title, which combines in a portable form the properties of a level, an angle indicator, a mariner's compass, a simple form of theodolite, and a sundial, together with a handy table for ascertaining the height of distant objects. All these are contained in a flat compact mahogany case, which is only 10in. long by about 4in. broad, and which itself contributes to the formation of the level and angle indicator.

Copying Drawings by Electricity.—A method of rapidly copying drawings or engravings is suggested by M. Chanderay, who uses the induction coil for this purpose. The method adopted by draughtsmen consists in puncturing holes through the design, and thus obtaining an outline, which is subsequently transferred by sifting plumbago or other powder through the holes—a very laborious task where the drawing is large or has much detail. In the plan proposed, a table covered with tin foil is connected with the negative pole of the inductorium, and on it are placed as many sheets of paper as the spark will penetrate. A metal bar, insulated with guttapercha, serves as the positive pole, and as a pencil for copying the tracings. This point is moved about on the outline of the engraving, and sparks pass through the paper to the tin sheet underlying it every time connection is made, puncturing four holes through the tissue at each passage. It is said that but little skill is required to guide the pencil, as the ink tracings, being ...ed conductors, carry the pencil easily along.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

CONGRATULATORY — CRITICAL — OPTICAL — ASTRONOMICAL — COSMICAL — ARITHMETICAL—SOLARIOLOGICAL—AND COMETIC.

[3870.]—BEFORE entering upon the more immediate object of this letter, that of replying to various queries which, directly or indirectly, have been put to me, I would refer to two or three communications which appear in No. 365.

Let me, then, commence by saying that it was with sincere pleasure that I read (in letter 3804, p. 11) the gratifying account by the Messrs. Lambert and Taylor, of their pursuit of the most sublime of all the sciences, under circumstances of considerable difficulty and discouragement, so many thousand miles from where I write; and ask them to accept my assurance that (under whatever lack of appreciation they may carry on the study of astronomy in Auckland) they will certainly not want sympathisers among the numerous astronomers who are numbered among their brother readers of the ENGLISH MECHANIC.

And next, I would ask "E. L. G." whether he seriously regards his reply (10091, p. 19) to a question as to the formation of turret-shaped hills, as a *scientific* one? Because, if so, I would commend to his attention Mr. Scrope's "Volcanoes of Central France" (notably p. 206), Hugh Miller's "Testimony of the Rocks," and Lyell's "Antiquity of Man," as three among a score of books which will show the utter fallacy of his answer. If he will further supplement the theoretical knowledge thus acquired by some field practice under the guidance of a competent practical geologist, I think I may venture to hope that he will never again drag in the quasi-mythical Noachian Deluge to account for phenomena of which it neither does nor can afford any explanation whatever.

Admirable as is the suggestion of Mr. M. Paris (letter 3807, p. 12), it occurs to me that his scheme would break down in a point of detail. I fear that there are scarcely enough departed men of science to stand as godfathers to every "bright particular star" in the heavens; while it would be obviously invidious to seek our "lights" among the livers.

In compliance with the request preferred by "E. J. D." (letter 3823, p. 16), I have turned back to his original question (contained in letter 3493, p. 516, Vol. XIV.), and, after having carefully perused it three times, confess my entire inability to make head or tail of it. I utterly fail to picture to myself the relative positions of his "hole in the shutter," "screen" (the screen is peculiarly unintelligible) "tables," and "camera;" and am therefore reduced to the necessity of questioning my querist. Firstly, then, has he ever himself tried the experiment whose explanation he is desirous of obtaining? And, next, should he have done so, would he mind rendering it apprehensible to my very limited capacity by the aid of a diagram?

Pending the result of the observations of the transit of Venus in 1874, "A Young Astronomer" (query 11281, p. 24) may take the "lineal value of one second of arc as the mean distance of the sun," at 450 miles, without much chance of error.

Will Mr. H. Ellis (query 11308, p. 24) permit me to point out that the *Nautical Almanac* is not a treatise on practical astronomy, and that, therefore, nothing more can reasonably be demanded than that it should contain a full and complete explanation of the tables of which it is composed. This, to give it its due, it does. I may add that, inasmuch as there is internal evidence in Mr. Ellis's question that he is not unfamiliar with computation, it will, perhaps, suffice for his purpose if I give him the formula for calculating the longitude and latitude of a heavenly body, from its right ascension and declination. Let us call L the longitude of the star, l its latitude, and ϖ the obliquity of the ecliptic. Then say sin. R.A. cot. dec. = tan α. This being so,

$$\text{Tan. L} = \text{sin.}\ (\alpha + \varpi)\ \text{tan. R.A.}\ \textit{cosec}\ \alpha.$$
$$\text{Tan.}\ l = \text{cot.}\ (\alpha + \varpi)\ \text{sin. L.}$$
$$\text{Sin.}\ l = \text{cos.}\ (\alpha + \varpi)\ \text{sin. Dec. sec.}\ \alpha.$$
$$\text{Sin. L} = \text{tan.}\ (\alpha + \varpi)\ \text{tan.}\ l.$$

If Mr. John Taylor (query 11323, p. 24) had looked at the Moon herself, instead of "in several astronomical works," I think that he might have answered his own question. I assume, *in limine*, that he is aware that a fixed star rises, souths, and sets every day 3m. 56s. sooner (by ordinary clock time) than it did on the preceding one. Very well, then, if the Moon were coincident with such a star, and apparently immovable like it on the face of the celestial vault, she would do the same. But if Mr. Taylor will notice the Moon's position in the heavens with reference to any bright star on a given night, and repeat his observation at the same hour on the next one, he will see that she has travelled many times her own diameter towards the *East*; in fact, she goes right round the Earth, from West to East, in the course of a lunar month. Without, then, puzzling Mr. Taylor with any consideration of the Earth's diurnal rotation, it may suffice to point out that as all the heavenly bodies rise in the East, the farther the Moon travels towards that region the later she will rise. I suppose that this is what your correspondent means by "retardation."

Let me try to clear up the wonderful difficulty of W. W. J. Porter (query 11339, p. 25), by the intimation that there is nothing in existence answering to a sidereal *day of the month!* Owing to a cause which I despair of here explaining to him, the face of the night sky *does* alter in the course of ages; but this has nothing to do with the condition of things, in consequence of which Mr. Porter predicts the occurrence of so eccentric a result 188 years hence. Perhaps, in this connection, he would not mind turning back to some articles on Time, by the present writer, in your tenth and eleventh volumes? As for the second part of his query, it will probably be enough to observe that the Earth's axis remains parallel to itself (so to speak) during its entire orbit round the sun; and that—owing to the (practically) infinite distance of the Pole star—that orbit, 184,000,000 miles in diameter! shrivels up into a mathematical point as viewed from it.

I think that a perusal of Whiston's vagaries would satisfy Mr. J. Songest (query 11348, p. 25) that Mr. M. Paris was in error in supposing that the ex-Lucasian Professor and Editor of "Josephus," held the "origin of the solar system" to have been cometic. What Whiston really did say was, that the great comet of 1680 was in our part of the universe at the time of the creation of the world; and that, happening to "collide" with us (as our American cousins say) it sent the earth spinning on its axis. Subsequently (and this I commend to "E. L. G.") we got into its tail, and the "deluge" was the result. I ought, perhaps, further to state that Whiston goes on to predict that this identical comet is to cause the general and final conflagration of all things mundane. It strikes me though, that in such event the watery tail might possibly play upon us. In which case we should, doubtless, merely be very much put out.

It only shows to what little purpose many people read their MECHANIC, when we find the subject of multiplication by concrete quantities (qy. 11188) again cropping up in there columns. Once for all, multiplication by a concrete quantity is IMPOSSIBLE. How can we conceivably say 20 *pounds* times anything? What would be the numerical result of 17 vibrations × 11 cheeses? Inasmuch, however, as this has all been previously set forth in former volumes with no apparent result, perhaps the most conclusive way of dealing with those, who, like "C. R. F." (p. 45), gravely give directions for performing an impossibility, will be to select one of their own examples and see what their wild notion leads to. I assume that it will be admitted that £20 = 19,200 farthings. Let "C. R. F.," then, square each of these quantities, according to his method, and compare the results. If it be true, as he asserts, that £20 × £20 = £400; then assuredly 19,200 farthings × 19,200 farthings ought to be = £400 too. Is this so?

It was from no forgetfulness—as far as I am concerned—that I omitted any reference to the moon's parallax in the reply touching her rising and setting at Melbourne, in my letter (3795, p. 9). I imagined—merely as a matter of course—that my querist knew that her R. A. and Dec., as given in the *Nautical Almanac*, were geocentric.

I am, of course, ignorant for what purpose Mr. Henry Wood (query 11360, p. 49) requires the sun's declination with such extraordinary accuracy; but I think he must be almost, if not quite, unique in his wish that (what he calls) "the trashy explanation" of the contents of the *Nautical Almanac* should be omitted, merely to make room for a table of second differences in connection with the sun's declination! Why can he not make such a one for himself? If he will honour me by turning to a letter of mine (2087) on p. 305 of your thirteenth volume, he will find directions how to proceed. To refine, however (for any practical purpose), upon the method exemplified on p. 539 of the *Nautical Almanac* for this year, seems to me a little like standing upon half a sheet of note-paper in order to see better over the heads of a crowd.

It would be futile even to attempt to answer the query (11363) of "A Young Astronomer," on page 49; inasmuch as it contains internal evidence that the mathematical acquirements of my brother correspondent are of infinitely too rudimentary a character to permit him to deal with the computation of the ephemeris of a comet. The calculation of its path by the aid of "a slide rule (by Smith), a sextant, a Gunter's scale, and a very accurately divided triangulator" would be "Hankey" (panky) work indeed; amounting, in fact, to legitimate conjuring. I must entreat our "Young Astronomer" not to imagine that I wish to discourage or be unkind to him; but the determination of a cometary orbit is really a matter of considerable difficulty. Certain geometrical relations are represented by equations, and these equations have to be solved by successive approximations. I only know that it is a task that I would not face, except under compulsion. I assume, by the way, that it is *Encke's* comet which my querist refers to.

It is on record that a patient, going to the famous surgeon Abernethy, and commencing the detail of his symptoms with "Oh, Doctor! if I lift up my arm like this, such a frightful pain runs through my shoulder," was summarily extinguished by the coarse rejoinder, "Then what the devil do you lift it up for?" Proceeding upon something of the same principle as the brusque old doctor, I would venture to ask "L. C. E." (query 11887, p. 50) if a sundial will give correct indications when immovably fixed, what in the world can he want to mount it on a pivot, and rotate it in a horizontal plane for?

I am unable to give Mr. Skelton (query 11482, p. 51) any further information with reference to the comet of which he speaks. It has not, that I am aware of, been yet observed in these latitudes.

A Fellow of the Royal Astronomical Society.

JUPITER'S SATELLITES AND "F. R. A. S."

[3871.]—I am glad that "Philo" did not mean what he seemed to imply anent "F. R. A. S.;" for the latter has so long and so ably contributed to the columns of the English Mechanic that few of your readers can bear patiently to read unpleasant remarks respecting him. "Philo" speaks of the freedom of "F.R.A.S.'s" comments; but I have never seen a line in any letter from "F.R A.S." which could be regarded as unpleasant, save when he has had occasion to castigate a rude correspondent. I must admit that once or twice when this has happened he has "lashed out" in a manner commanding my hearty sympathies.

I quite readily concede that the passages quoted by "Philo," taken apart from the context, seem to indicate that Sir John Herschel entertained an erroneous opinion about the accuracy of prediction respecting Jupiter's satellites. But when the omitted sentences are supplied (as in my letter), Sir John Herschel's opinion assumes a different aspect. It may be that in the edition of 1833 those sentences are wanting. In that case, we learn that Herschel entertained erroneous views in 1833, and corrected them subsequently. In any case, Airy's statement on this subject is decisive of the matter. If "Philo" wants further evidence, let him hear what Hind (from whom the "predictions" are received) has to say respecting them. "Independently," he remarks, "of defects in the tables, there are difficulties attending the observation of these phenomena which unfit them for *accurate* determinations of longitude."—*Explanation of Nautical Almanac.*

I should be sorry to deprive "Philo" of the satisfaction he seems to derive from having "erred in good company;" though I have yet to learn that Sir J. Herschel actually made the mistake imputed to him.

A word as to the Astronomical Society. In that society, as in all scientific bodies, there are individual members who are not authorities in the branch of science to whose cultivation the society is devoted. Yet I imagine that there are few societies in which the percentage of such members is smaller than in the Astronomical Society. Speaking for myself, I must say that in addressing communications to the Fellows of the Astronomical Society, I always feel that it behoves me to exercise exceptional care, because of the large proportion of first-class critics in an average audience at any of our monthly meetings. It must always be a source of gratification to our Fellows, that a man like the late Professor De Morgan, whose special views would not permit him to put himself in nomination for the Royal Society, accepted and retained a Fellowship in the Astronomical Society; and that Sir John Herschel, who declined the presidentship of the former society, held four times (that is, during eight years) the chair of the latter. Richard A. Proctor.

HOW TO USE A BOOK WITHOUT HANDS.

[3872.]—Our desideratum, kindly inserted in No. 361, query 10996, has brought many admirable replies, and we shall be proud indeed if a perfect solution be arrived at through the active intelligence of your right-hearted contributors, whom so many readers of "our" English Mechanic have learnt to respect and esteem. There are, no doubt, many cases besides that of our disabled engine driver where it would be hailed as a real Godsend; many military men and officers, mechanics, miners, and others have to endure this terrible affliction. The helplessness is bad enough where the man cares little for mental pursuits, but is tenfold distressing when the intellect is healthy and vigorous. For every response we tender our best thanks—that of "M. O." has been read with genuine emotion, and if he will refer to "Addresses Advertised" we shall gladly put him in direct communication with this case. We have seen "Dominy's" plan, but fear it is too expensive, complicated, and limited; it never came into much practical use, and we do not know the present makers; the patent must have run out. The suggestion of "W. R. S." seems good, but the beads being so much below the eyes, the tongue has to pick out the right one, and will often miss. We have not the means handy of testing that of "Philanthropist," but a neighbour (Mr. Tenz, the ingenious Swiss carver and modeller to the Palestine Exploration Commission) saw something like it in Paris and considers it quite practicable. "Philo," and all your readers, shall certainly hear of our success, with the editor's permission. "Cireb's" suggestion, with the little cut, is excellent: the plate is improved by a cross form, which gives firmness to the cane or stick; it requires more practice than one would think, as the action of "a wet finger" (no dummy) is both peculiar and heavier than one is conscious of. The plan of "Carolus" has the qualities of great merit—accessible, light, simple, general, and at once practicable. Guttapercha for the tube is the pleasantest, and the little instrument stands in a glass ready for use, leaving the head and eyes free.

Our first idea was to mount the pages upon something like a long towel, reviving the ancient "tench," the rollers to be moved by a pedal, but we wished to see what could be found applicable to an ordinary book. Any opening of the English Mechanic to an armless intelligent man must be a real treat; but to be able, without troubling others, to read the whole number weekly would be an inexpressible boon, and if "M. O." can invent such a revolving desk as to accomplish this, he ought to be crowned!

The writer could not see our armless engine driver yesterday as he was thirty miles off again with the limb-maker, who, after ten weeks' painful anxiety, is still pursuing the needful experiments. The stumps are extremely short, not more than three inches. Still, we hope on. T. M. W.

A METHOD OF MULTIPLICATION.

[3873.]—"E. L. G.," in replying to query 11054, reproduces a very neat method of multiplying by ·78539, &c. The following, which (to save space) I have illustrated by the same example, is much shorter, easier remembered, and more correct:—

	13·78125	
	9·646875	given number, but 1 place out.
	9646875	repeat, but another place out.
	19293750	ditto, × 2 another place out.
	1929375	repeat, another place out.
Sum	10·82379375	
Less	275625	{given number, × 2, six places out.
	10·8237661875	

Screw.

TO MR. DAVIS AND "CHEMICAL STUDENT."

[3874.]—Mr. Davis in his reply (p. 18) asserts that a portion of my method for the practical separation of the metals in the hydric-ammonic sulphide group is incorrect, or, as he styles it, a *lapsus calami*, with which he seems perfectly familiar. As the matter stands his assertion is more or less correct, but his deductions do not appear to be exactly the same. The method given by myself is quite correct, with this simple addition, that the acetic acid solution must be treated with $(NH_4)_2S$, and the zinc from this precipitate dissolved out with acetic acid. This clause was left out by misadventure. Even had it not, however, no trouble would have been found, as both the zinc and the manganese would have given their respective reactions. As the matter stands Mr. Davis is not quite correct, as the precipitate would not, as stated, contain CaC_2O_4, $BaSO_4$, MnO, Mn_2O_3, and ZnO, but simply $BaSO_4$ and CaC_2O_4, and, as on adding acetic acid, nothing but a mere trace would have been precipitated, the filtrate would, of course, then have been treated for zinc and manganese, and at once found. As in the case in point zinc, magnesium, and manganese not being precipitated under the circumstances, and unless with very bad manipulation, would not be thrown down by sodium phosphate in testing for Mg, but would remain in the filtrate from the precipitate. In conclusion, I hope that Mr. Davis will be so kind as to point out in this way any more such mistakes that he may detect in my correspondence. J. B.

ALLINGHAM'S PROPELLER.

[3875.]—Since forwarding the description (let. 3843, p. 39) of my propeller to you, I have been trying the model in the Mersey, and find that the speed is increased considerably by making the blades 1⅞in. broad each, instead of ¼in., and so reducing the number on each side to 10 instead of 32, which, of course, simplifies the construction still more.

John James Allingham.

ELECTRIC SPARKS.

[3876.]—I should not think it worth while to say anything about "Philo's" remarks (3866, p. 42) had he not put a distinct question; and as he seems to have so very limited a power of comprehension I will endeavour to bring my reply within his range. I do *not* "deny the possibility of gas being lighted by a spark from the finger, the electricity being unintentionally excited." I do not claim to be infallible, or to know anything except from experiment and deductions therefrom. On the other hand I do not believe that such an occurrence ever took place, because no experiment or deduction therefrom within my cognisance justifies the belief. I trust "Philo" is able to distinguish between the two mental conditions of not denying, yet not believing, though he has some extraordinary notions as to what constitutes evidence; he really is the first person I have heard of who would admit that he would decide a scientific question according to whether an opinion came from "a pretty young lady" or "a crusty old bachelor." I know juries are influenced in that way, but the jurors do not usually give that for a reason. At the same time it may be satisfactory to "Philo" to learn that I am neither crusty, nor old, nor bachelor, and certainly not a pretty young lady. Further, I assure him I am not "mistaken in thinking sarcasm to be my forte," for I do not think so, and should be sorry if it were. Sarcasm is like pepper—a useful seasoning, but not a main element of diet. As an intellectual cook I consider it useful when making up a hash ent of scraps of pretentious ignorance, and things of similar nature. If "Philo" has received a sprinkling he has to thank himself only; he took upon himself to write very strongly on matters that he knew nothing about; he was further pleased to speak very offensively and personally, and to falsify what I did say very plainly, whether he is able to understand it or no. Any one who takes that line with me stands a very fair chance of a sharp return, just as any one who courteously disputes any proposition or argument is secure of an immediate and kindly discussion, as "Philo" ought to know, if he is not a very recent reader. I think he is a recent contributor, as I do not remember his signature, and in the few recent letters I have observed there are so many errors of fact and deduction that it is scarcely probable they would have long escaped attention, to say nothing of the spirit some of them display; even this last letter, where, instead of apologising for his misconception, he again attributes motives to me that he has no sort of right to assume, he implies that I am angry with him because he did not give my remarks the attention I think they deserve. It is a matter of the smallest moment to me what attention he gives them, but before he or any one else presumes to remark upon anything said either by me or any one else, it is their duty to give the matter honest attention, not to falsify; and if from either some real obscurity or from their own incapacity there is a misapprehension, when that is pointed out it is the duty of an honourable man to apologise, not to exercise his powers of casuistry and repeat the offence.

Sigma.

AUSTRALIAN MEAT.

[3877.]—You have, Mr. Editor, lately inserted several letters—pro and con—on Australian meat, and I was somewhat surprised to see the manner in which some correspondents gave their opinions, on what I thought insufficient foundation, as to the comparative non-nutritious properties of this meat. I am afraid prejudice in such matters with some people goes a long way. Besides, many people who have been eaters of English beef and mutton all their lives, make a meal or two off Australian meat, and because they don't feel as well, or fancy they don't, after the first meal or two, they jump to the conclusion that English beef and mutton are cheapest. My opinion, founded on my own experience is, they are mistaken; and I also beg to give the following corroborative testimony:—

Some careful calculations have been made at St. Cuthbert's Parochial Board, Edinburgh, as to the cost of feeding the 424 inmates of the establishment, and it was found that the quantity of meat used in the ordinary soup was 51lb., which cost, at 6d. per lb., £1 5s. 9d. Less Australian meat, viz., 38½lb. was used to obtain the same amount of soup, and the cost was only 19s. 11½d., showing a saving in the day's food of 5s. 9½d. By varying the cooking of the colonial meat, and making it into a potato hash, 8½d. a day more was spent; but even with this extravagance the saving over fresh meat was 5s. 1½d. It is in such comparative results as these that the real value of the meat is to be found.

It should be noted that both home and colonial meat was estimated at 6d. per lb. When it is borne in mind that colonial meat can be had at two-thirds of the cost of home meat, the difference will be still more striking. Economical.

CURIOUS PHENOMENON.

[3878.]—Has any photographic reader of the English Mechanic noticed the curious result of dropping a semi-congealed particle of collodion from the corner of a plate into a pan of water, or, better still, a tub? Owing probably to the repulsion of the ether and the water, it immediately gyrates, sometimes with great regularity and surprising speed, and at other times slowly and eccentrically. The appearance often is exactly that of a comet flying through "space," as depicted in our astronomical primers.

Cornubiensis.

THE PROPOSED BRIDGE CONNECTING ENGLAND AND FRANCE.

[3879.]—The object of this publication is to show the practicability of constructing a safe and durable bridge between England and France that would meet the requirements of both nations, for we may rest assured that the capitalists of Europe would not risk their money to complete such a gigantic undertaking, except something more practicable in detail can be brought to bear upon the subject than the plans and schemes which have hitherto been proposed and brought before the public.

If we are by any means to connect the two nations a bridge should be constructed of sufficient dimensions to allow of three separate lines for railway traffic. The horse and carriage way should at least be 30ft. in breath, and the side paths for foot passengers not less than 10ft. or 12ft. each.

Like Mr. Hawkshaw and others I had long thought of a tunnel, but when I considered the many difficulties required to be overcome, and the faults that would in all probability be met with in the chalk formation, even at hundreds of feet below the bottom, I consider the work of a tunnel an absolute impracticability, as no shields could be employed with any degree of safety to render a rush of water impossible.

On the other hand, the difficulties connected with a bridge to span some twenty miles of a sea whose maximum depth is about 168ft., or say 170ft., and this part the water is never still (it is that of a rapid tideway running at the rate of three miles per hour for about six hours of every spring tide, and with strong and long continued up or down channel gales), a still greater surface velocity is imparted, reaching, probably, to the bottom, across the entire channel; and to construct a bridge this bottom must be reached, and strong massive stone piers or abutments brought up from a vertical depth of 170ft. to the surface, sufficiently strong to resist the greatest storms which are known to occur in this part of the channel. We have no experience of diving at this depth either with bell or helmet; and to construct shields or cofferdams of sufficient dimensions and strength, the expense becomes discouraging, as the pressure of sea water at a depth of 170ft. is nearly 76lb. per square inch, so that if circular shields or cofferdams were employed only 32ft. in diameter, or 1,206in. in the circumference, the average pressure on the first 2ft. in height from the bottom would be nearly 76lb. per square inch, or 2,199,744lb. on that portion of the circumference alone, which is only the 85th part of the total height to the surface of the water. It will be observed that this pressure is equal to a crushing force of 982 tons, which every part at that depth would have to resist; the next succeeding 2ft., would have in like manner to resist 969 tons; the pressure, of course, diminishing in proportion, as the surface is approached; therefore, the total force that such a shield or cofferdam would have to resist would amount to nearly 41,736 tons.

It is easy to imagine it to be within the limits of a mechanical possibility to construct them sufficiently strong to resist this pressure, and some plan might be found to connect them together in parts and sink them to the bottom at the place required for the foundations, but when it is considered the risk of water bursting up from the bottom, and the enormous expense and labour required in raising and resinking them for each pier or abutment in that vast structure, I have no confidence in the use of shields or cofferdams at such a depth in sea-water.

The plan by which I propose to overcome these difficulties will be best explained in the general description of the bridge, which, according to my plan, would consist of a huge wrought iron tube, similar to those used in the Britannia Bridge over the Menai Straits, resting upon stone piers or abutments brought up from the bottom at a clear distance from each other of about 459ft., and carried up to a height sufficiently above high water so as not to interfere in any respect with the shipping.

The tube would be divided into three separate compartments running through the entire length; and to allow sufficient space for the treble set of rails within the outer shell would require to measure about 45ft. in breadth; and to obtain the greatest strength the sides should be about 30ft. deep, or, between the top and bottom cells, nearly 26ft.

Under every circumstance, I would propose that the tube should be made sufficiently strong to sustain not only its own weight, but in addition to that load 3,000 tons, equally distributed over each length between the supports, a load many times greater than it will ever be required to carry.

Fig. 1 will give an idea of the general construction of the great combined tube, showing the three separate sets of rails within. It will be observed that the top cell projects 2ft. 6in. over each side, making a breadth of 50ft. on the top available for a roadway. The side railings should not be less than 6ft. in height from the footways or paths to the iron cope plates. The railings can be either plain or ornamental, and should be put up after the lengths of the great tube are set in their places.

Fig. 2 is a plan of a portion of the piers or bottom towers, extending in two parallel rows in a direct line from shore to shore, except at the union towers, each 32ft. in diameter, set in pairs 56ft. apart from their centres, and 469ft. from centre to centre of each pair. It will be observed that this length is reduced to about 250ft. at the union towers and shore abutments. The object of this is to balance the tension on every part of the combined tube extending across the channel. The expansion and contraction that would take place in a continuous stretch of this length will be further explained in fixing the lengths.

Fig. 3 is partly plan and partly section of one of the piers or abutments 8ft. above the water line, where the circular towers, coming up in pairs from the bottom, are united into one oblong tower or pier 84ft. over the extremes by 32ft., where it curves in at this height to 26ft., then running up with a straight batter on all sides, except in the recesses, where the tubes are raised. The seats or beds for receiving the cylinders of the 8 hydraulic presses that are required in raising the tubes should be provided with cast-iron plates to prevent the pressure of the cylinders from injuring the stone work.

I will now endeavour to explain the plan of erecting the circular towers, or abutments, and in preparing them for their deep foundations. It is to be understood that a careful survey of the various depths has been taken where the bridge is intended to cross, and the nature of the deposit resting at the bottom on the chalk formation ascertained. This will serve as a guide in constructing the circular shrouds wherein the foundations are laid upon the surface of the water, and gradually sunk down inch by inch, as course after course of the finished mason-work progresses.

A plan so novel and so convenient cannot fail to recommend itself as the best means of erecting buildings of this class in deep water, as the workmen can at all times continue their work either at the surface or at as many feet above it as may be found convenient.

The first thing required in this process is a hollow cylinder or shroud 32ft. in diameter, constructed of wrought-iron plates, with butt joints well riveted together. All the lap plates are put on the outside.

The rivet-holes in the shroud plates are countersunk on the inside, so that the interior presents a plain and smooth surface.

Fig. 4 is a sectional elevation of the shroud, showing the angle irons for fixing the timbers B and C of the foundation. The upper course of timbers B are well jointed together, and made to fit accurately into the shroud, so as to be perfectly water-tight; but the timbers C are kept a little apart from each other, so that a free passage is left at the ends of each, communicating with the groove E cut round the circumference of the timbers. This groove communicates with a pump fixed on the outside of the shroud not shown in the Fig. There is also a valve opening outwards or upwards on a line at P that can be opened and shut at pleasure.

The top timbers T are all well jointed together and fixed to a circular guide of plate iron H, made to slide freely through the whole length of the shroud to the bottom timbers B and C.

The leathers A are for securing a water-tight joint, and are, in addition to the water, pressed out against the interior of the shroud by indiarubber bands.

All the shrouds should be constructed on shore, and the bottom timbers B and C securely fixed in their places. The timbers T require only to be temporarily fixed to prevent the water from forcing them inwards during the time that they are being floated out to their places.

This is accomplished by means of a steam tug taking two of them in tow and proceeding out with them to where two pontoons are securely moored, having on board, and in readiness, all the appliances for letting them down where the towers are required to be brought up; and as they approach, the water is allowed to flow into them until their bottom ends sink considerably, bringing them nearly to a vertical position in the water; and whenever they are cast off from the tug the valves should be regulated, so as just to keep them from touching the bottom, while the ends of the guide ropes are passed round the windlasses, so that they can be correctly guided to their places; and when they are correctly set, the pumps should be put in motion; but sooner as the inclosed water under the timbers B and C escapes through the pump valves, keeping them open so long as any sinking takes place—that is to say, it freely escapes through the valves when the pumps are at rest, as it is evident that if no provision was made for an escape to take place, the water would be forced down under the bottom edges of the shrouds, and would burst up on the outside, tearing and cutting away the beds surrounding them. The proper time that should be chosen for this operation should be when the tide is near the turn, so that before it again begins to flow the pumps are put in motion, and a vacuum, so to speak, speedily formed amongst the particles of matter under the timbers B and C, thus bringing not only the weight of the shrouds to bear on the bottom, but, in addition to that of their own weight, the weight also of the whole quantity of water inclosed within them. Thence, including their own weight, it will be found that they are thus each securely bound or fixed to the bottom with a load, not including the pressure of the atmosphere, equal to about 4,000 tons—a weight which neither gales nor tides will be able to disturb.

The time required to secure them thus from the time that they are cast off from the tug need not occupy more than fifteen or twenty minutes. The bottom valves are then shut by means of the side rods, and the temporary fixings of the timbers T of the great pistons removed; and if it is found that the water does not raise them to the required height, they can be raised by forcing in an additional supply of water through the feed valves from the pumps. The stability of the shrouds are further secured by strong timber frames uniting each pair together at their upper extremities.

These frames are for carrying the travelling cranes required in lifting the stones, &c., from the boats and placing them on their beds. When this is completed, the erecting of the permanent towers can be immediately proceeded with.

The stones should all be prepared on shore, and accurately fitted, so as to shorten, as much as possible, the labour of setting them in their places.

The foundation courses are carried up perpendicular and in a solid form for about 6ft. or 7ft. from bottom, to where the inverted dome X starts and intersects the surrounding walls at a height of about 17ft. from the base, thus forming a hollow space within each tower 22ft. in diameter, and extending up to W, as shown by the dotted lines R, Fig. 5.

The object of the bottom dome X is to distribute the weight equally over every part of the foundation, and as each course of the stonework is completed, the person in charge of the bottom valves regulates the sinking, so that the underbeds of the finished course are lowered only the depth of themselves, thus bringing the upper-beds for the next course to the same height from the scaffold on which the workmen stand when engaged in laying the courses in their proper places.

The scaffolds are suspended by iron rods from the frame-work above that carries the cranes, &c., and should be placed or arranged convenient, as it is desirable at this stage that the mason work should make rapid progress, and whenever it is found that they have reached the bottom, the scaffolds should be removed, and the interior of the towers filled in with concrete, or if not, it is desirable that they should be filled up with water to the surface level, which can be done by means of a siphon, thus bringing a weight to bear on each, in addition to that of the stonework, equal to nearly 1,600 tons. The upper domes W (Fig. 5) should be completed, and the space surrounding them left as a clearance of the shroud, filled in with a durable composition of cement, thus completing them, so far as the deep sea buildings are concerned. They should be left to stand over the winter months before commencing the surface towers that are to support the tube.

Before leaving this part of the subject, I may state that the weight of stonework in each tower just immediately before they reach the bottom amounts to 4,600 tons. The iron shrouds have to resist the internal pressure, as the stone-work is about 800 tons heavier than the water displaced—that is to say, the specific gravity of the stonework at the depth of 170ft. is that much heavier than the water, so that the pressure under the timbers or piston T before reaching the bottom amounts to nearly 90lb. per square inch, whereas, at full tide the shrouds are pressed only by the surrounding water to 76lb., and at low water may not exceed 60lb. per square inch; therefore, the shrouds should be made sufficiently strong to resist the difference of this pressure, otherwise they would burst.

The bilge water at E, before having been filled in with cement as mentioned above, is kept constantly at the same level as the water on the outside by means of a siphon, so that the pressure is balancing equally in all directions except under the timbers. This, being understood, it will be observed that the shrouds should increase in strength towards the bottom.

The thickness of the plates and the pressure at the various depths may be expressed as follows:—

Depth in feet.	Pressure in pounds per sq. in.	Thickness of plates in inches.
10	4·4	half.
20	8·9	,,
30	13·3	nine-sixteenths.
40	17·8	,,
50	22·2	five-eighths.
60	26·7	,,
70	31·1	eleven-sixteenths.
80	35·6	,,
90	40	three-quarters.
100	44·4	,,
110	48·9	thirteen-sixteenths.
120	53·4	,,
130	57·9	seven-eighths.
140	62·3	,,
150	66·8	fifteen-sixteenths.
160	71·2	,,
170	75·7	one
180	80·1	,,

Before commencing the surface towers the framework and the upper portion of the shrouds at the flange joint should be removed, so that the arch connecting each pair of the under towers can be bridged over with the stonework at the desired height, as shown in the drawings Fig. 5.

During the time the buildings are in progress the erecting of the tubes on shore should not be neglected, and as they are completed they should be floated out to their destinations in precisely the same way as that adopted with the tubes of the Britannia Bridge; but I would strongly advise a different plan to be taken in the raising of them, as they are nearly double the weight of the Britannia tubes; it would be very unsafe to trust to any combination of chains, as the snapping of a single link would cause considerable delay. The friction also to be overcome in such a combination of chains as would be required to raise a weight nearly 3,000 tons would be very great.

The plan by which I propose to raise them is from below, as it is safe and more expeditious, as when they are brought in between the towers they are immediately rested upon the temporary timbers shown by the dotted lines Fig. 5. The pontoons are then withdrawn, and the pumps for raising the presses are put in motion by means of a steam-engine placed with the pumps on the timbers at the opposite side of each tower.

The pressure pipes leading from the pumps to the hydraulic presses pass through ports left in the stonework at K; the four presses in combination for raising each end of the tubes should have a clear lift or range of 8ft. 3in., so that the 8ft. lengths of packings have a sufficient clearance to be put in as each lift is completed, and in addition to the cast-iron packings the tubes are further secured by following them up with wood packings. During each lift the tubes are raised about 3in. per minute, so that in one day, from the time that they are rested upon the temporary supports or beams, they can be raised to their permanent places.

The number of hydraulic presses employed should not be less than 24, as the first set—viz., 8, are required to remain in their places before the tubes are riveted; the second set can be in operation raising the next length while the third set are fitting up to be in readiness for the next succeeding length, and so on.

The short lengths passing through the towers should be fitted up in their places, and should rest upon cast-iron frames which project down a few inches on the edges of the stonework. Each of the 459ft. lengths are raised 2ft. 6in. at one end above the level, while the lower end is riveted to the tower length. The raised end is then lowered to the same level as the length passing through the next tower, and then riveted to it; so that by this process, instead of any deflection taking place in the tube with its own weight, it can be made to raise itself upwards in the centre between the supports, but this should not be carried too far; if the proper limit be observed it will greatly add to the strength and rigidity of the tube, as the tension of wrought [illegible] is greater than the force required to crush it; [illegible] reason the tower lengths should be well secu[illegible] cast-iron frames, as the greatest compression [illegible] lengthways at this point.

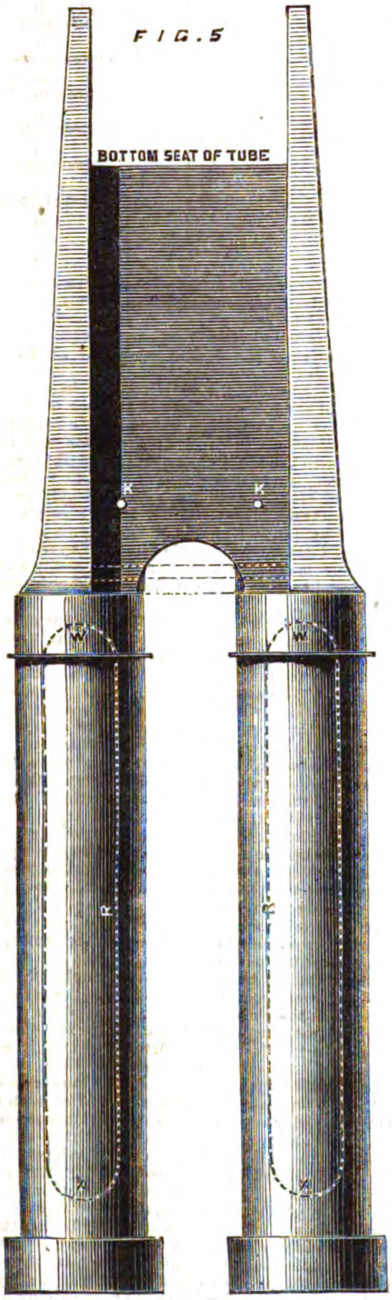
It will be observed that no provision [illegible] supporting the tubes on rollers, as they [illegible] the towers and abutments, whereas the

Britannia Bridge are supported on 32 sets of nicely adjusted rollers, set in pairs consisting of 22 rollers each, and with this adjust the greatest expansion that takes place in the entire length of 1,513ft. does not exceed 3in. or 10½in. per mile.

In a length of 20 miles at this rate the expansion would not exceed 17ft. 4in. From this statement it may be inferred that nearly one half of the expansion must be resisted by the friction of the rollers caused by the weight of the tubes they are supporting; for it is found that the expansion of wrought iron between 32° and 212° is ·0012, or for every increase of 15° from 32° up to 212° it expands ·0001 part of its own length. Therefore a tube 1513ft. long, exposed to the rays of the sun during the heat of summer, would undoubtedly at times reach 82°; the expansion at this temperature (if not partly resisted) ought to be 6·052in., and as the combined or treble-way tube when finished would consist of an entire length stretching from shore to shore, I would propose that the expansion and contraction that would take place in its length, from 32° up to 92°, or say 100°, should be overcome simply by its own weight and the strength or weight of the land or shore abutments.

FIG. 2

FIG. 5



This at first sight may be thought impossible, but from what is known of the properties of iron it will be found to be the only safe and practical plan that can be adopted in any iron structure of such vast dimensions, as the expansion from 32° to 90° on a length of twenty miles would amount to 42·24ft. All the lengths composing the tube should be set and riveted together in their places at a temperature of about 52°, maintained by artificial means during the whole time of uniting the lengths together, and securing the ends of the tube to the land or shore abutments. It will be observed that the expansion between 52° and 92° would be 28·16ft., this would have to be resisted by a force or weight equal to what would compress or shorten the tube to the same extent.

The contraction between 52° and 32° would be 14·08ft.; the force or tension to resist or overcome the contraction must act in a contrary direction. To find the force required to resist the expansion of any length of wrought-iron tube, multiply the number of square inches contained in the cross section by 2,492, the sum found will express the number of pounds required to compress any length of the same tube ·0001 part of its own length.

Example.—Although the plates, angle irons, &c., of the great tube vary in thickness between the supports they should be arranged so that the section is the same in all parts of the length—viz., 3,600 square inches. This, multiplied by 2,492 is equal to 8,971,200lb., or 4,005 tons. The force required to compress it ·0001 of its own length, or 10·56ft., therefore, to resist or compress it 28·16ft., it would require 10,680 tons.

To prevent dispute I may mention that the number 2,492 is the 10,000th part of the force in pounds corresponding with the modulus elasticity of wrought iron; 1in. being the unit, 17,800lb. per square inch would compress or extend it the 1,400 part of its own length, or 75,428ft., which is equal to the expansion or contraction that would take place between 32° and 139°, a temperature or atmospheric heat unknown, even at the equator.

I am not sufficiently acquainted with the formation of the shores to state the dimensions and the precise form the land abutments should have. This and the approaches leading to the bridge can be modified according to circumstances. The double set of union towers are further intended to facilitate the progress required to be made in raising the lengths of the main tube, and to give time for connecting their ends to the short lengths passing through the towers; as many as six lengths of the great tube can be in progress at the same time, raising fixing, &c., as they divide the bridge into three sections of 6⅔ miles each, so that by beginning the work of setting the tubes at

FIG. 1

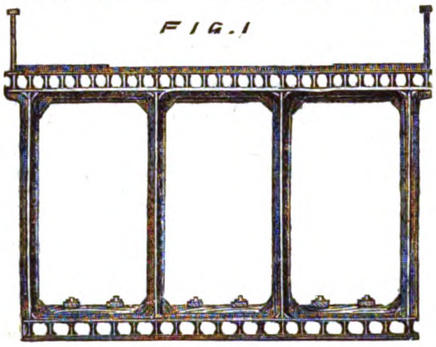
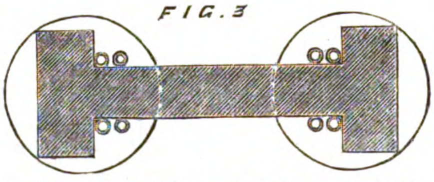


FIG. 3



the centre of each section and working from right and left of each starting point, they can be completed much sooner than otherwise.

The side tubes, as will be observed at the above named towers, should be constructed similar to the corresponding lengths of the main tube, and are for supporting the station-houses, &c., that should be erected for the comfort and convenience of passengers besides those who are required in connection with the great structure, and during the winter the tubes should be lighted up with gas, and the method of ventilating them so adjusted that the atmosphere at all times could be kept free from the obnoxious gases that are generally found to accumulate in railway tunnels. The following items will furnish sufficient data for calculating the costs, &c., of the entire structure.

Column 1 gives the number of tubes, &c., required to complete the bridge.

Remarks.	Number of tubes, &c.	Length in feet.	Weight in tons.
Wrought iron...	222	459	743700
	6	240	10500
"	227*	10	16344
"	8*	240	9300
"	462†	85	45000
Total			824844

* Side lengths at union towers.
† Shrouds average length.

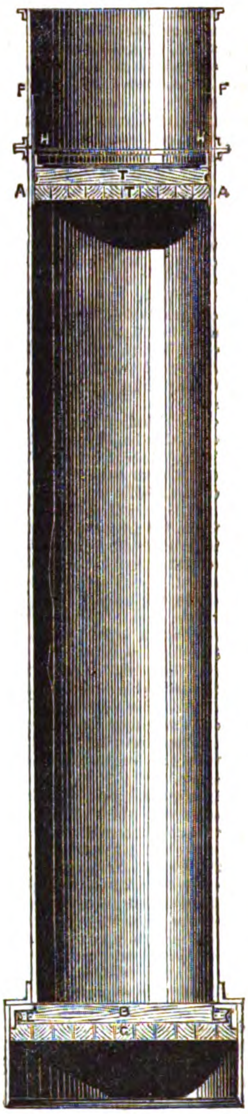
		Height in feet.	
Cast iron			37000
Stone work	227 *	104	1623050
"	2 †	85	4200
"	462 ‡		119160
Total			2857010

* Surface towers. † Shore abutments.
‡ Bottom towers' average height.

Concrete or composition for footpaths, carriage-ways, &c.	87500
Timbers for foundation, &c., 1,593,700 cubic feet, or	39842
Total	3846196
Or, including station-houses, side railings, water, gas-pipes, &c., say about	4000000

And by employing suitable machinery for constructing the various parts of the ironwork, &c., the whole might be completed and opened for traffic within four years from the time of commencing the work, at a cost not exceeding £18,000,000, as it would be found, by adopting the plans I have given of building the bottom towers and resisting the expansion and contraction of the tube, that a considerable saving of time and money would be effected; and in conclusion, I would further

FIG. 4



propose that my plan of constructing a roadway on the top of the great tube should receive due consideration, as such a mode of communication would undoubtedly be preferable to any class of underground tunnels, and if carried out would serve as a useful monument to illustrate the enterprise and wisdom of the age in spanning the waters of the channel with a stupendous bridge worthy of the nations it would unite together in friendly intercourse with each other.

The experiments, so far as have been made with the circular shrouds, have been perfectly successful in every respect. Sholto Douglas.

PIANO CONSTRUCTION.—TO MR. SCHUCHT AND HIS FELLOWS.

[3880.]—Is Mr. Schucht again poking his fun at the remarkably serious individual the unpractical "Harmonious Blacksmith"? After enumerating some of the difficulties of increasing the power of the sounds of piano trebles, he very coolly suggests that I, the unpractical blacksmith, of all men, should give such eminently practical man as himself a hint or two how to get over those difficulties. Verily, as Mr. William Shakespeare hath it, some men (the blacksmith to wit) have honours thrust upon them.

With regard to giving hints, I might say, "Would that I could." It does seem rather presumptuous for an unpractical blacksmith even to hint at (much more to attempt to specify, to practical pianoforte-makers) the probable means of improvement; besides which Mr. Schucht *estopps* me to some extent by refusing me the privilege of proposing certain "little dodges," some of which I may remark, *en passant*, are generally supposed by pianoforte-makers to greatly influence results.

In my subjoined observations on this subject, I have purposely avoided merely theoretical—which are but too commonly synonymous with controversal—matters; but I do feel compelled, in reply to Mr. Schucht's assertion, that "when we hear the deepest bass note we also hear all the notes in the piano," to exercise the free Briton's privilege of becoming like most of my neighbours, a dissenter. Very possibly all the notes of the piano may be then and there present among the "obertones" of the said lowest bass strings, especially if we hypothetically include all the theoretically possible "obertones of those obertones," but to say we hear them all is simply saying the thing which is not. Possibly, were our ears as cultivated as those of the angels, who are popularly supposed to listen continuously to the heavenly music of the spheres, whatever that music may be, we might hear all those sounds; but the writer's ears, however musical they may be, are not, he is happy to aver, quite long enough to enable him to imagine he does hear all of them. Seldom, indeed, does he hear, in a well-made piano, more than one or two of the said obertones, *alias* harmonics, of the said open string, especially if it be as tight as it ought to be, which, by the way, it seldom is.

Mr. Schucht says we cannot make a piano treble, the mass of whose materials shall equal that of those of the bass; quite true. We can't make a fiddle as big as a double bass; perhaps, if we could, it might be inconvenient to "chin" it, excepting by the Anakim. We can't make a piccolo as big as a pedal-pipe; a trumpet as big as a bombardon; a free reed which sounds C, three octaves about pitch C, quite so large as the one which sounds the so-called 32ft. C C C C of the bass; neither can we make a pipe in unison with the first of these reeds quite so big as the huge pedal-pipe whose sound is unisonous with the latter. There are, however, a few things we can do to compensate to some extent for the differences in their masses, or of the masses of air contained in such pipes. One of these things is blowing the small pipe or reed with air at greater pressure, something like which it is possible to do with piano strings—but of this more anon. Another thing is employing more little pipes than big ones, and this is the very course indicated by Nature, who endows a dozen little children with voices quite capable of out-squalling any one man—or woman either. N.B. The latter is saying something; in fact a good deal.

Mr. Schucht also says, "If a pianoforte-maker discovered a method of making a treble equal in power to the bass, he would at once apply the same means to the tenor and bass, which would leave the treble as relatively weak to them as at first;" this seems to me very doubtful. Not to mention that organ-builders do not commit such an absurdity, for they no more use as many pedal-pipes as they do treble ones than a wise harmonium-maker uses as many reeds of 16ft. tone as he does of 4ft.; the "unwise" harmonium-makers do, hence the relative weakness of the trebles of their vile, coarse-toned instruments. I think Mr. Schucht pays but an ill compliment to the taste and judgment of his fellows in assuming they would act so absurdly, besides which, it is just possible the means employed to augment the power of the treble might be inapplicable (or, at least, not desirable to apply) to the tenor and bass. One such means, hereinafter described, certainly is not, for its application to the bass would induce a very bad and "harmonicky" quality of tone. Keeping down the power of the bass that it may not overpower the treble is no novelty; in fact, we practically do it daily by covering the bass hammers more thickly than those which strike the treble strings. Possibly Mr. Schucht has read Messrs. Broadwood's little book, printed for private circulation in 1862, and will remember they distinctly state that in addition to using softer hammers to improve the quality of and keep down the power of the sounds of the bass strings, they also purposely avoided treating that portion of the soundboard which was under the bass strings in the same manner as they treated that portion beneath the treble strings, lest the sounds of the former should overpower those of the latter. Probably Messrs. Broadwoods are not the only makers of horizontal grand pianos who have done the same or similar things, for the practice is very common in some other musical instruments, and is universal in those collections of them, designed to be performed on together, which we call orchestras.

When we design an orchestra we usually employ more fiddles than contra basses, more cornets and flutes, than trombones, ophicleides, and bombardons. When we build an organ or harmonium we don't put quite so many C C C C pipes or reeds into it as we do of those which produce treble sounds; and we ordinarily do something very like this in the piano, for we use more unisonous strings for its treble than for its lowest notes. May I guess even Mr. Schucht himself employs but single strings for the latter, and two or three strings for his trebles, notwithstanding he has estopped me from suggesting the use of three strings instead of two, forgetting that it is a practical fact that many mickle strings, if not equal to are at least more suitable than only one to be used along with his single but muckle bass string.

Probably no other unpractical individual ever experimented further in the multiplication of unisonous strings in piano trebles than I have done. On C, two octaves above pitch C, I have tried no less than seven No. 14 strings 3in. long, but the honest truth is that I found little or no increase of loudness when the number exceeded five. Probably the failure resulted from the weakness of the action, I being then unable to strike seven strings more forcibly than five. In the orchestra seven fiddles have not one bow common to all, but seven bows, one to each. Let me add, each of these seven bows has a separate fiddler, one to each, to "saw" with them in every instance I ever "sawed," in other words, seven times the motive force when needed which one fiddler could apply to one bow. Now my seven strings were all struck by one hammer, certainly somewhat heavier, about a fourth, than usual. Seven strings mean more than twice the resistance to the hammer's blow that three strings can have, and as I had not then learned how to increase the force of the blow in proportion to the increased resistance of so many strings (at least not without increasing the weight of the touch, until it became too great for pleasant performance). For I then only had the means of experimenting with the common horizontal grand action, Der "English Mechanic" of Mr. Schucht and his countrymen, which, in common with all other actions, however excellent, cannot, without too much increasing the weight of touch, be made to strike so powerful a blow when its hammer is horizontal as when it is inserted in the top of the butt, as it must be for upright strings; hence, we need hardly be surprised to find if I produced powerful sounds from three, considerably more powerful sounds from four, and yet more powerful strings from five strings, that after that number were used, but little if any increase of loudness resulted, probably because the same force of impact (being distributed over so many) each string was not moved so far, and consequently they did not lift the soundboard so high, and the aërial wave generated by its motion, was less ample than it would have been had the seven strings been raised by the hammer as far as five strings were. It is, however, hardly worth while theorising about the matter, because I have since learned that three No. 17 wires 4in. long, properly struck, yield a louder sound than five No. 14 wires, whose length is only 3in.

However unpractical I may be deemed I have far too keen a sense of commercial considerations, and, let me add, of business responsibility, to recommend Mr. Schucht and his fellow manufacturers to make pianos with five strings in the treble for each note. Some of the very best trebles I have yet heard had but two unisons, and not to mention the increased cost of construction resulting were five strings used, which after all would not be so very heavy, I greatly fear the tuning of such instruments would be found rather costly. Besides this merely pecuniary consideration, which I for one would be quite willing to pay the additional cost of if proportionate excellence resulted, I (although I have but little faith that my future life could be largely influenced by human maledictions) would rather not (for his sake) desire the tuner should wish me located in a region whose temperature is popularly supposed to be unpleasantly high every time he doth his office, for, after all, I have written in disparagement of their class. I do acknowledge that tuners are "men and brothers." Now I much desire to be at peace and brotherly love with all men, yea, even with tuners.

Had not Mr. Schucht estopped me, I would also have suggested that those hammers which are what he terms pointed at their striking faces, are generally believed to cause treble strings, not only to produce louder sounds, but also sounds of more "penetrating" quality, especially if the said hammers be rather thinly covered. Now this "penetrating" really is worth something in musical instruments—in fact, but for it the trebles of pianos would be almost inaudible. I have not the slightest desire to inflict on Mr. Schucht and my other fellow readers a long tedious disquisition on timbre, and the probable (query hypothetical) causes of the great differences thereof, which may, or may not be, caused by the predominance of the different "obertones" we hear, but I will simply appeal to notorious facts within our daily experience. A familiar example of this penetrating quality of tone is heard in the sounds of the common military fife, which may be heard above all the other instruments in an orchestra, but no flute, or stopped diapason pipe, in unison with the fife, would be audible under the same circumstances. Without pretending to verbal scientific accuracy—a thing not to be expected from ignorant blacksmiths—we commonly say the sound of the fife penetrates through those of all the other instruments. I am sorry to add it doth also "penetrate" my poor ears very unpleasantly indeed, but, nevertheless some people do really like it, just as the "Sans-Culottes" of North Briton are said to like the bagpipes. Well, *De gustibus*, &c.

Besides the ordinary practice of increasing the penetrating quality, and, therefore, the apparent power, of piano trebles by employing thinner coverings for the treble hammers than are used for the bass hammers, which practice is now probably carried as far, especially by the English makers of horizontal grand pianos, as is compatible with the production of sounds of pleasing quality—perhaps in some instances even yet further—although I think if their bass hammers were made heavier and covered yet more thickly, which latter is the practice of most continental makers, the quality, at least, of their bass tones would be greatly improved. There is another simple and old fashioned way of increasing the power of the trebles—viz., to go back to that exemplification of the wisdom of our ancestors which is shown by giving hard knocks. This obvious and time-honoured method seems to have totally escaped the penetration of modern pianoforte makers, at least, I have seen no modern examples of its carrying out. Like all "ancient" men whose education belongs to the period when Windham wrote "Pugilism is the Salvation of England," I have great faith in hard knocks, if not for the civilisation of mankind, at least for the production of loud sounds in the treble of pianos, for when this process is applied to their strings it induces much the same consequences which result from its aplication to juvenile humans—to wit, it causes them to "cry aloud."

Hard hitting in pianos may be carried out by two methods, we may either make our hammers double the weight they were without increasing their velocity, which, however much it would improve the bass would greatly deteriorate the treble, in fact, although doubling the total force of the blow, it would also render it what Mr. Eavestaff termed "thuddy," which is just what we don't want it to become; to confess the truth, it often is far too much so already. Thuddy blows answer very well for driving piles or forging red hot iron, in both of which cases the long continued contact of the ram or hammer does no harm, but for inducing the musical vibrations of short strings the sooner the hammer rebounds from them after it strikes them the better, because their vibrations must be at least sensibly impeded, not to say damped, by the continuance of contact between the hammer and strings; in a word their tones, never anything too long, become yet shorter and more "blocky" the more time elapses before the hammer rebounds. I think it follows that heavy hammers, which strike thuddy blows, "arent" exactly what we want for piano trebles, so, as we don't desire to damp our strings before the hammers have time to rebound from them, we shall have to copy the wisdom of our ancestors, who made grands before the first quarter of this century expired, in so far as making light hammers strike hard by moving them at a high velocity when they do strike is an example thereof.

Strange to say, ye modern practical men (who probably elevate their nasal organs at the name of the blacksmith, and piously thank heaven they are not as that unpractical sinner is—well, happily, like Thomas Ingoldsby's celebrated jackdaw, he don't feel one penny the worse) seem never to have perceived the advantages of this system. Indeed, so far from increasing the velocity of their treble hammers, they have, in most of the actions they employ, actually reduced their velocity about one-third, driving them no faster—sometimes a trifle slower—than they do those in the bass. In the old grands, whose touch was what we should now term very shallow—only about ¼in. deep—the hammer was moved eight or nine times as fast as the key, in modern actions they seldom move more than six times faster, and its weight is about double that of the old hammer. Such being the facts, need we wonder that modern hammers, especially when heavy loaded strikers are hung to them, strike "thuddy" blows? Probably their blows are rather more powerful than those of old grand trebles. Additional weight, however, is but a bad means of obtaining additional force, although its evil consequences may be to some extent compensated for in modern pianos by employing No. 14 to 16 wire in lieu of No. 10 and 12 wire for their treble strings.

I will say something more on "Piano Construction" in another letter.

THE HARMONIOUS BLACKSMITH.

KING-NUMBERS.

[3881.]—MAY I ask "E. L. G." (let. 3654, p. 607) to publish in the columns of the ENGLISH MECHANIC his demonstration that there are no other king-numbers than those he gives in the letter I refer to, and also the method of ascertaining each step in the series of "noble" numbers there given, which method he there says he "may explain in another paper"? I have noticed a fact in connection with the table he gives, which I should be glad to publish in these columns, but should like to see his demonstration of what he asserts before I do so. May I be allowed to point out what appears to me to be an error in his letter? He says, "the two lowest king-numbers, two and six, are the only ones that, multiplied, produce a third king-number." Surely, 6 times 60 is 360.

ALFRED M. BOX.

COLLIERY EXPLOSIONS AND THEIR PREVENTION.

[3882.]—ALLOW me to express my gratification that "King Coal's" opinion (letter 3816, p. 14) does not materially differ from my own as to the best. I think the only effective method of diminishing the frequency of explosions—*i.e.*, by ample supplies of air well distributed, and insuring attention to that by rendering it more costly to neglect than to observe the conditions essential to safety. I quite agree that as a rule accidents are most frequent in the smaller collieries, but, on the other hand, when explosions do occur most lives are endangered in large ones. To limit this exposure of very many lives to one risk, the select committee of the House of Commons recommend that large fiery mines should be divided into sections or pa[...] so that not more than 100 miners should work [...]

same section. Such division would cause both cost and inconvenience possibly greater even than the additional security to life would compensate for; that, however, should not be assumed without careful consideration. My impression is that if the lives of colliers were insured, as they ought to be, it would be found cheaper to adopt the precaution than to pay for the risks, and unless the precaution would cost very much more it ought to be adopted, for the lives of our countrymen, especially if they be husbands and fathers, are of extreme value.

I do not see any probability of the cost of compensating for lives lost by explosion being greater than I assumed, for, wreckless as the pitmen often are, they will not be more but less so, when greater carefulness by others becomes common, and my calculation is based upon the assumption that fatal accidents will not increase, while they will most certainly diminish, if danger be made more costly than safety to those who can most effectually enforce precautions. PHILO.

EXTINCT VOLCANOES.—VI.

[3883.]—There are a good many traces of extinct volcanoes in Italy, besides those of the Phlegrean fields. In general character they resemble those previously described. The chief localities are certain lakes near Volterra in Tuscany, which give forth very hot and sulphurous and boracic acid vapours; a small sulphurous lake near Viterbo, continually giving forth bubbles of gas; and the lake of Vico, between Viterbo and Rome; Mount Vultum, in the Apennines in the province of the Basilicata; and Lake Agnano near Naples. Of these the Lakes of Vico and Agnano are the most interesting—the former, as the ancient Lacus Cimini. Old authors state that its site was once occupied by a town, whose ruins used to be visible at the bottom of the lake when the water was clear. The ground where the town is said to have stood is supposed to have been engulfed during a volcanic eruption, when the said lake was formed. The Lake Agnano is the site of an ancient volcanic crater, and on its margin is situated the Grotto del Cane, so famous for the deadly vapours it exhales—these consist of carbonic acid gas, in combination with watery vapour. This celebrated grotto is thus described in his work on volcanoes by Dr. Daubeny:—"The mouth of the cavern being somewhat more elevated than its interior, a stratum of carbonic acid goes on constantly accumulating at the bottom, but upon rising above the level of the mouth, flows, like so much water, over the brim, hence the upper part of the cavern is free from any noxious vapour, but the air of that below is so fully impregnated that it proves speedily fatal to any animal that is immersed in it. Also it is impossible to fire a pistol at the bottom of the cavern, for although gunpowder may be exploded even in carbonic acid by the application of a heat sufficient to decompose the nitre, and consequently to envelop the mass in an atmosphere of oxygen gas, yet the mere influence of a spark from steel produces too slight an augmentation of temperature for this purpose." Similar phenomena, but on a grander scale, are presented by the extinct crater on the Island of Java, called Guevo Upas, "the poison valley." It is level, about half a mile in circumference, surrounded by precipitous rocks. From various parts of its soil carbonic acid gas is discharged in such quantities as to prove fatal to any animal venturing nigh. This valley gave rise to the celebrated figment about the upas tree which once obtained such general belief in Europe that it was credited even by Dr. Darwin.

There is another extinct crater in Java where are exhaled vapours equally deadly, but which exert a most peculiar effect on the dead carcases subjected to their influences. Instead of their being, as in the Guevo Upas, reduced to skeletons, the carcases have all their bones dissolved by the vapours, while the flesh, skin, hair, and nails are preserved from decay.

To the westward of the town of Le Puy there are a number of small volcanic craters, of which the two largest are the Lake De Bouchet and the crater of Bar, which also appears to have been at one time a lake, but is now dry; the former has its greatest diameter about 2,300ft., with a depth of about 90ft.; and the latter is on the top of a mountain which is composed entirely of such substances as are ejected from volcanoes. Its diameter is about 1,660ft., and its depth about 130ft., while it is almost perfect in its form. The mountains near Vienna exhibit streams of lava which accommodate themselves to the existing valleys near Agde, also on the shores of Gulf of Lyons, on the top of a hill—viz., St. Loup, there is an extinct volcano whence have descended two streams of lava, apparently of recent origin. On one of them the town of Agle has been built—the other projects into the ocean.

The district of Eyfel, on the borders of the Rhine, is another in which extinct volcanoes abound; they occur mostly in the form of circular craters, which are now filled with water, their borders consisting of volcanic ejections; they also exhibit various superficial streams of lava. One of the most remarkable of these round craters lies near Andernuch, a little west of the Rhine. It is named the Lake of Laach, and is nearly two miles in circumference; on its margin are found numerous volcanic ejections exactly resembling those of Mount Vesuvius. Notwithstanding these evidences that the extinct volcanoes of Eyfel have been in activity since the country acquired its present formation, there are no historical records of their operations. There is, indeed, a passage in Tacitus referring to fires that issued from the earth near Cologne, but his description does not warrant the conclusion that the event to which he alludes was of the nature of volcanic eruption. The Drachenfels, on the eastern bank of the Rhine, and the other mountains in its neighbourhood, belong to the more ancient volcanic formation. The same may be affirmed of the other mountains scattered throughout Germany and Central Europe generally, in which rocks of volcanic origin occur.

But of all the extinct volcanoes in the world none is so remarkable as the Dead Sea. This singular collection of salt and bitter water has the level of its surface depressed 1,312 feet below that of the Mediterranean, thus indicating an enormous subsidence. The Dead Sea occupies the site of what was formerly the plain of Jordan, described as having been well watered everywhere, like the land of Egypt. One part of it, called Sheddem, was full of slime pits, the only indications of volcanic action. When the cities of Sodom and Gomorrah, which stood in the plain were destroyed, it is said it rained upon them fire and brimstone from Heaven, but it appears that they must have been primarily discharged from the earth, for the smoke of the country went up as the smoke of a furnace. The phenomena, therefore, most likely resembled in the first instance those of Jorullo, but the catastrophe seems to have ended like the great eruption of Timor—the whole of the plain having been ingulfed and replaced by the salt lake, whose depressed level so clearly indicates the nature of its origin. RALPH LOWDON.

NOMENCLATURE, &c.

[3884.]—I was a few days ago working my way slowly and laboriously through an old manuscript book on alchemy written in 1608, and as I read page after page about "aurum potabile," "the elixir," the "white blood of the green dragon," and so forth, I could not help thinking that there was a strong resemblance between the jargon of the seventeenth century and the nomenclature used in the science of the nineteenth, and wondering whether it was necessary to involve matters in extra obscurity by the use of terms that are almost unintelligible except to the initiated, especially when each writer seems to invent whole sets of new ones, or, worse still, employs old ones in a new sense. Far be it from me to say anything against our talented and obliging friend "Sigma," but he is an instance in point, and has employed several names—Farads, Vebers, &c.—that are, I think, quite new, in his recent papers in the English Mechanic.

It is, however, in chemistry that the most outrageous names occur: even the "white blood of the green dragon" is a joke compared to the polysyllabic combination of Greek and Latin that occur in organic chemistry, and in inorganic too, for that matter. Then, too, what a grammatical barbarism is such a compound as Platinic Chloride. True, it may be a syllable shorter than, but is it so easy to pronounce as, its old name chloride of platinum. As for zincic chloride, I can make nothing of it; if the "c" is hard, the word borders on the ludicrous, if it is soft the name of the metal is lost.

Just now we are having a battle about valencies; and atoms and molecules are flying about pentads and hexads in a most alarming manner. In connection with this, I remember in some book on chemistry a remark that it was scarcely an explanation of a fact to say that "substances combine because they have an affinity, and they have an affinity because they combine," yet all this discussion about "valencies" seems to my feeble comprehension to be very much in the same style.

Another thing that often strikes me in my discursive reading (I am a Jack of all Trades in reading, and I fear I must add a master of none in understanding); is the tendency to dwell on minutiæ rather than on broad facts.

Take astronomy as exemplified in our pages; look at those straggling sketches intended to represent some mountain or crater of the moon, and then read the long discussion as to whether a little crooked mark is a cleft or a rill. What on earth does it matter which it is? moreover, no two observers ever seem to agree in their sketches.

Again, read Secchi's papers on sun flames, divided by him into a hundred different kinds, yet who would dream of classifying the shapes of the flames that flicker up and down in our grates? Is the one of more real use than the other?

Then take microscopy: what pages have been written, what a paper war rages as to (say) Eozoön canadense! What hours have been spent over infinitesimal differences in the markings on the Diatomaceæ or the specks in a tadpole's tail!

I might dwell also on microscopical anatomy: has medicine or surgery been sensibly benefited by all the thousands of observations on blood corpuscles, striated muscle, and so forth? Has cancer been checked by means of knowledge gained from the examination of its cells? Has tubercle been arrested? Has any practical result followed from all this prying into the laboratory of life? Some trifling knowledge may have been gained, but I much fear that the true answer to the question must be—Very, very little. L. C. E.

BEES AND BEE-KEEPING.

[3885.]—The weather anticipated in my last letter has come upon us with a vengeance, and wind and rain, sleet and snow, with the temperature below freezing-point, have stopped all bee operations, and confined the bees to their homes. The immediate effect of it will be that the queen will cease to deposit eggs in the cells, and the bees will huddle together for mutual warmth. In a strong stock little harm will arise beyond loss of time, as there would at no time be more brood in the hive than could be covered and cared for by the nursing bees, and, although the temperature outside the hive is so much lower than it was, it has happily caused the foragers to keep within the hive and so to keep up the temperature within; but with weak stocks the effect will be very severe. When stocks are reduced by sudden stress of weather to the verge of starvation, the bees cease feeding the queen on prepared food and allow her honey only; they consume all the eggs, and as the pressure increases the larvæ also, and all the prepared food stored in the cells, with the larvæ for its sustenance. As time goes on, and the pressure becomes greater, they unseal the cells of the full-grown nymphs and eat all the soft parts of their bodies, throwing out at the mouth of the hive only the bony formation of the head and thorax, and after that sheer starvation induces them to swarm out, which they often do, and pitching on the ground close by, perish in a heap. Amateur bee-keepers hardly ought to need reminding that a little help would prevent so dire a catastrophe. C. N. ABBOTT.

DUST IN THE SPECTROSCOPE.

[3886.]—I have great pleasure in replying to the courteous request of your correspondent, "A Fellow of the Royal Astronomical Society," as to the best method of cleaning the slit of a spectroscope. I fear, however, that I shall not be able to render him much assistance. When a spectroscope is of considerable dispersive power the slit may be opened for such a distance that particles of dust will not fill up the space between the jaws, and still the instrument will give a tolerably pure spectrum. But when the instrument has a very low dispersive power, the slit can scarcely be wider open than the three-thousandth part of an inch, and it is, of course, exceedingly difficult to prevent particles of dust of this diameter from lodging between the jaws of the slit: this causes the spectra to be striped with the longitudinal lines which so much annoy observers.

All this is, no doubt, well known to your correspondent; my object in writing it is not for his information but for many other readers in whose interest he evidently writes. As your correspondent says, a camel's-hair pencil is of no use—generally I have found it make matters much worse—but a freshly cut splinter of dog-wood should have been useful. I have found any small piece of soft wood, cut carefully round, and rubbed on a cloth, so as to free it from all small particles, effectual, if used in the following manner:—First blow on the slit, allow time for any slight amount of moisture which may have condensed to evaporate, close the slit by means of the screw motion, open it a tolerable width, and wipe the edges of the jaws with a splinter of wood; blow on the slit again, close the jaws of the slit completely by means of the screw motion, and on re-opening the jaws will generally be found free from dust. Though this method is not always successful on the first trial, it is the best method I have yet been able to find, and after some practice your correspondent, who I have good reasons for thinking is a most expert manipulator, will be certain to succeed at any time. JOHN BROWNING.

ATMOSPHERIC DUST.

[3887.]—It may interest your readers to learn that Dr. Tyndall's cotton respirator has been anticipated by the inhabitants of some parts of South America. "The fact, which seems well authenticated (Boussingault), that the inhabitants of South America are enabled in some localities to withstand the attacks of endemic diseases by mechanical application, such as veils placed before the organs of respiration, so as to sift the air from morbid solid particles, supports the organic nature of malarious poison. Absorbent porous bodies used instead of veils, such as charcoal, have been long disused in manufactories from their power of condensing gases, which are replaced by the inspired air in its passage through them, and are thereby carried into the circulation."—Dr. R. D. Thomson, in "Cholera Report," 1854.

Dr. Thomson holds the opinion, which I some time ago stated to be mine, that putrefying bodies are not to be dreaded, but living matter. I believe fresh sewage to be far more dangerous than old. Putrefaction gases may kill, but do not give contagious or infectious diseases. And, I may add that what we require in a disinfectant is something to kill the living germ, not an agent to prevent comparatively harmless putrefaction. It must also be remembered that the cilia in the lungs enable them to free themselves from germs and dust for the most part. We have always some ridiculous bugbear which pays to keep alive. M. PARIS.

POTATO CULTURE.

[3888.]—Having seen various articles on the above subject in your paper, I venture to send a few remarks. For some years I have paid considerable attention to the subject, and I will state what I believe to be the best means for insuring a good crop. 1. Wide setting, about 25in. between rows, and 15in. between the potatoes, liberal manuring, and large sets (whole). 2. As soon as the tops are 3in. or 4in. above ground, I pull out all the sprouts, except three of the strongest. This is a certain means of insuring large potatoes, and though fewer in number, a better sample and greater weight of crop. I earth up very high. If disease appears I mow off the haulm close to the ground, as soon as any spots are seen on the leaves; by this means I saved, last season, a splendid crop of "lapstones" when my neighbours lost most of theirs. I cannot agree with your correspondent who blames manuring for the disease—it is quite the contrary in my experience, and without manure planting potatoes is waste of time and ground. INQUIRING [illegible]

SCIENTIFIC EDUCATION.

[3889.]—IN my communication to you of November 10, 1871, I reported the last contributions towards an exact science of mind in support and extension of the soul-theory of Plato. Permit me to report progress in relation to the exact science of reasoning or exact logic. A. Jiram Row, in his lecture at St. George's Hall, reported in the ENGLISH MECHANIC of the 9th ult., takes us back to and endeavours to resuscitate lower forms of barbaric thought which some of our own naturalists have also attempted unsuccessfully to render again fashionable. They are attempting vainly to turn the dial of the world backward at least six centuries. There are few things more difficult than the exact observation of facts. The exact interpretation of their natural language is a rare achievement. To the man of average capacity, who has toiled long and painfully, and has at last been able to exhibit a few hitherto unobserved and unexciting particulars, the result is most disappointing. His is no master-mind, and he is unable to so grapple with the groups of particulars as to generalise subtly and reach discovery. So he abandons the straight and narrow path of fame to gather Olympic dust in the broadway of sensation. The last public rebuke of Huxley appeared in the *Morning Post*, then reporting his lectures at Kensington. The writer then quoted against him the "Brancassine criteria," "Man cannot reason by means of uncertainties," "The recognitions of man cannot extend beyond the limits of certainty," "Certainties must spring from an exact experience," "Superstition, scientific, is the acknowledgment of uncertainty as certainty," "Exact logic must have as its basis an initial certainty." These criteria, part of the "Doctrine of Logical Limits," first published, the writer states, in 1842, are obviously a further development of the English school of philosophy founded by Roger and Francis Bacon, as opposed to the metaphysical schools both of the Continent and India. Let us contrast the really scientific education of the English school, according to its last development, with the Indian substitute. "Man," says the former ("Exact Philosophy," Book 1) "is certainly a part of nature. He is physically carbon, oxygen, hydrogen, nitrogen, chlorine, iron, lime," &c. "The chief elements of the external world are constantly becoming physical humanity." Now, mind is also a part of man—his chief part. What any one may imagine mind to be is a quantity outside critical logic, which acknowledges the existence of certainties only. Certain it is that mind is a part of man; therefore of nature. It is impossible for an exact thinker to take any known quality of mind and attach it to inanimate entities. It is impossible to dislocate one quality of mind without dislocating at the same time all its other qualities or congeners. To infer that a brickbat has a soul is an impossible inference. Logical inference, strictly so-called, is an entity altogether beyond mere human volition. So soon as an inference is exposed as having the fatal quality of uncertainty it becomes extinct. It is destroyed by the first criterion, or first law, just quoted. Exact logic is limited to facts or certainties; it sweeps away into nothingness all mere sayings, as the "Modern Oracular" ("Exact Philosophy," Book 2.) It annihilates the use of all inexact terms, especially those which are often applied to inanimate objects, and which, according to exact experience, are never known save as mental entities. To say that a "stone endeavours," or that any object known to be senseless acts, operates, contrives, arranges, &c., is to use spurious terms. These belong to the follies of fable, and are mythic verbiage, belonging not to mythology, but to the "hyper-supernatural." Mythology usually assumes the presence of some form of mind. The mythos of monstrosity assigns all its marvels to the absence of it. It, in fact, ignores its very existence. Now, when A. Jiram Row talks to the higher class of educated Englishmen about "concrete existence in all its varieties" as only the expression of a principle of an unconscious self-existence, they think it wholly unnecessary to exhibit any law of exact logic, any "Brancassine criteria" for the extinction of this rare bit of the modern and ancient oracular. It is a self-annihilator. It is plainly metaphysic jargon. Its author shut out mind from his mental collection, and his saying merely signifies exactly that exclusion.

There are those amongst us who would drag us back to the mythic teaching of the middle ages. We have not the stone of transmutation, the alkahest, the elixir vitæ, upheld as searchworthy; but we hear occasionally of something infinitely more marvellous—unconscious—protoplasm; natural selection, that, unmentally, selects; and psychic force; all ultra-miraculous agencies. All these new discoveries teach us that, since more can be achieved without mind than with it, a lunatic asylum is the place wherein to find a master-statesman, the most skilful administrator, a sovereign, or even a god!

Professor Huxley did not reply directly to his critic, but he replied indirectly; as may be seen in the ENGLISH MECHANIC, No. 343, p. 112. There, at Owen's College, he complained that scientific men were reproached for departing from the Baconian or scientific method, and for not being allowed to guess, or imagine, or speculate, or invent hypotheses. "Nine-tenths of what scientific men dealt with were," he adds, "only probable conclusions, and that we must wait more than a century for real evidence of the truth of Darwin's hypothesis!" Now we have a good answer to this complaint. Newton obtained his grand results by rigorously observing and interpreting natural facts, and not by speculating. Of the speculative method he speaks with colossal disdain:—"Philosophia naturalis id revera præcipuum sit et officium et finis," he affirmed (Opt. 28, Qu.) "ut ex phænomenis sine fictis hypothesibus arguamus et ab effectis ratiocinatione, progrediamur ad causas." "We make clear or prove by reasoning from results and without fictive hypotheses," was the Newtonian method. What would he have said to the century-to-come Darwinian possible?

FRASER HALLE.

SAVE US FROM DECIMALISM!

[3890.]—WHAT we sorely need of "Philo" (p. 12) is fewer words, indeed; though I will not say, as he does of me, "in proportion to his ideas"—ideas of a sort being, with him and most of us, enough to spare, but far better ones even than his being by no means the things wanted, especially in this metric matter; but judgment and real thought, of a kind he never betrays a trace of—thinking out some one thing, however small, to its end.

To adopt one of his last ideas, he must have a very low estimate of expected readers to set up gravely a parallel between the new French measures and an *invention*; moreover, such an invention as logarithms! as if this crude expedient (dashed off in the hurry of the most furious revolution, to supersede a chaotic host of local and trade standards) involved any invention at all! But above all, a brother to logarithms! Why, it is not half so comparable as the man of Wagga-Wagga is "just like Roger!" They were both men, at least, and had both been in England and Chili; but all the parallel we can find here is that both things were once new, or, rather, new to Europe! It is suited to the same order of mind as Mr. Bottone's comparison on p. 588, of two sums which, because they are stated, in different notations, each by a 7, an 8, and a 5, are to be taken for one question! and when offered the choice which of the two he will state in both notations, so as to work one identical question in both (p. 608), declares off, with the falsehood* that I proposed he "should first reduce English notation to decimal," and flatly refuses to compare the two methods on any one sum at all.

And, by the way, what clap-trap and hocus-pocus are all these comparative calculations hitherto? We are shown long multiplications, reductions, and the rule of three, involving long division; as if any of these were practically used. They must necessarily be taught to school-boys, to ground them in the theory of the matter; but who in England uses them in real accounts? They are avoided, and in commercial reckoning can be totally so, and even short multiplication used as little as possible, and all else is done on the principle of the rule the school-books call "Practice." This form or application of short division, not merely the most valuable and used rule, but the very cream and practically *sole* used portion of the school arithmetic, arguers like "Sigma" and Mr. Bottone simply ignore, the fact being that its whole value and prevalence that so well earn its name, are one great protest against and evidence against decimalism! It all hangs simply on that superiority I have been pointing out, of the truly *metric* numbers, those *artfully-chosen* ones that connect the units of our ancestral weight and measure systems (that "Sigma" ascribes to *accident!*) over the mere denary powers that arise from the accident of counting by fingers. The rule of "Practice" in the school-books is prefaced by lists or tables of all the "aliquot parts," as they are called, of £, a ton, &c. Systems formed by "accident," or any such as Mr. Bottone imagines were what he calls "consistent," repeating the same multiplier step after step, would never have had large units, like the £ or ton, with these numerous submultiples, or sufficiently divisible, *i.e.*, sufficiently *metric*, to lead to this most useful and rapid method, so well-named "Practice." The miserable Gallo-Chinese pseudo-system in question miscalling itself "metric," in which alone, of all systems, *accident* really has a chief part, scarcely admits of any such method, only of its barest rudiments, as dividing by 2 and 4 instead of multiplying by 5 and 25, and I suppose French school arithmetics have no such chapter; but few people can have any idea—I had none myself till yesterday—of the height to which you must carry the powers of ten before they will compare, in number of divisors, with the upper numbers of my "eumetric" list, on p. 607. Reckoning the number of divisors exclusive of unity, it will be found that

In 1,000 are	14, or no more than in	120
In 10,000 are	23, but 1 more than in	360
In 100,000 are	34, or no more than in	1,260
In 1,000,000 are	47, but 1 more than in	2,520
In 10,000,000 are	62, or no more than in	7,560
In 1 milliard are	98, or no more than in	45,360
In 100 ditto are	142, or no more than in	110,880
In 1,000 billion are	254, or no more than in	1,081,080
In 10 trillions are	391, or no more than in	6,486,480

Thus we find it would take 20 decimal places to make a denary unit divisible by merely *as many* divisors (and not near as common or convenient ones) as a unit of only 7 figures derived from the "noble number" system yields. And observe that the highest prime factor in this 6,486,480 is but 13, so that supposing a metric table having this for the ratio of its highest and lowest units, there need be no step larger than 13, and children could as well learn to carry thirteens as they now do twelves from pence to shillings. But such a table, instead of the three steps 7, 11, and 13, might embody them in the single step 1001; it being actually easier to carry 1001's, or to divide (in our denary arithmetic) by 1001 in one line, than by 13. Now, considering that 13 has a place in our time system, being the number of weeks in a quarter of a year, I (having more faith than "Sigma" in the "survival of the fittest") can by no means venture to predict that we shall always be Chinese enough to perpetuate even a system following the noble numbers no farther than those whose largest prime factors are 5, 7, or 11. We already have all these (the 7 in avordupois weight, and the 11 in long and land measure), and we might by combining them with the next prime (13) make the largest unit in any table the noble number 720,720, the most divisible under a million. Thus if we had, for the poor's sake, like most of our neighbour nations, a unit, mite, or lept (λεπτον) as small as the tenth of our penny, we could keep accounts by:—

60 lepts	= 1 tanner.		
360 ,,	= 6 tanners	= 1 deniar (*denarius*).	
2,520 ,,	= 7 deniars	= 1 guinea.	
55,440 ,,	= 22 guineas	= 1 min (*mina*).	
720,720 ,,	= 13 mins	= 1 talent.	

And each unit would have the most numerous *aliquot parti* or "practice-table" possible in its range, and the talent be the lowest sum having 237, two talents the lowest having 287, three talents the lowest having more, four the lowest having more, five the lowest having more, six the lowest having more, nine the lowest having more, ten the lowest having more, twelve the lowest having more, fifteen the lowest having more, twenty the lowest having more, and then 24, 30, 45, and 60, each a noble number of lepts. Only above this last do the numbers begin to involve the factor 17. Such a system (which need involve the calling in of no coin but the farthing) would lead to exactly parallel tables of weight and all kinds of measure, and be carrying out the ancient and truly scientific metric principle that gave us the arithmetic of "*Practice*," as far as I think it likely to be carried, whether under our rude denary notation, or the superior Chaldean sexagintal, that is certain (if there be "survival of the fittest") some day to displace ours. But supposing the fact of 2,520, being the highest of what I term "king numbers" (the highest that must be doubled to become more divisible), be taken as a sort of natural reason for stopping thereat as the highest unit, and so having no carryings of more than tens and sixes (as at present) and sevens, then it is somewhat notable that the largest English coin yet struck was for exactly this number of our commonest and practically lowest coin, the halfpenny (which has so long been so notoriously our copper unit that our name for coppers is neither farthings nor the short word pence, but "*halfpence*"). The *five-guinea piece* was exactly 2,520 "ha'pence," and (supposing we revived this fine coin (our present sovereign being, for a rich nation, one of the lowest maximum ones), and replaced the present two gold ones by its third and seventh (they might be called terce or bezant and sept or mark), and restored for the awkward "ha'penny" the name obol, we should have—

60 obols	= 1 deniar (half-crown)	
360 obols	= 6 deniars	= 1 mark (or sept)
2,520 obols	= 7 septs	= 1 min (*mina*)

And pounds would be reduced to these mins by simply adding a cipher, and the half of them, and halving the sum. Nor would any present coin become superfluous but the gold ones and the florin. The "practice-table," or list of divisors of this min, would be 47, that of the pound being but 19.

In the matter of names there is vastly more consideration required than projectors like "Philo" dream of, and I will explain, if you grant me a future column, the grounds for wishing the above names, especially "deniar," min (and talent perhaps) thus revived.

The most amusing thing is that "Philo" himself says he is "not convinced that a decimal division of days and hours will be better than that now in use"!!! Then, how on earth can he have discovered a decimal division to be better than sexagintal of anything else? Is not division division? He might as well say the decimals are best for weighing meat, but he is "not convinced they are best" for cheese! And does he not begin his next paragraph by telling us "of course the full advantages will not be obtained unless all weights and measures of things *to be bought* or *sold*, as well as money, are divided decimally"? Are weeks, days, hours, then, things not either bought or sold? That "money, value," and time ought to be divided "in like manner," he says I assert, "which is easier than proving." If, "in like manner" means commensurably, and proof is wanted that they ought to be so related, I shall certainly not deign to give more than "Philo" himself has. Moreover, so unlucky is he, that even the reason he offers me for use against decades of days is fallacious, and cuts exactly the other way! That 7 divides natural years better than 10, is the reverse of the fact. One year exceeds 52 weeks more than twice as much as 2 years differs from 73 decades, and more than the four (with their bissextile) differ from 146, and these make the nearest group of true years to a whole number of days under a century. The week (like the Bhuddist 60-day cycle) is purely *artificial* (which word does not necessarily imply *human*) and as for "a feeling" of anything "right as well as expedient," in the weekly rest, I challenge him to produce, apart from the Bible, one shadow of ground for either more right or more expediency in leaving a seventh of days for rest than a third or a three-thousandth.

On one point I will readily take "Philo's" word that, speaking out of book, my general denial of civilised decimalists before Marat was against a fact, and that "every one knows" the Chinese have remained so from "before history." He is entirely welcome to th[e] sapient example, which adds to the analogies I kn[ow] exist between the two wisest in their own conc[eit]

* Is this "parliamentary" or ordinarily civil? We think not. A correspondent may be in error without knowing it, but "a falsehood" involves intentional dishonesty. "E. L. G." is well able to defend his positions without the free use of offensive epithets, and we trust, for his sake and our own, that he will cultivate the temper which becomes the true philosopher.—ED.

nations. But having returned to that opening of his letter, I wish to know where is the "bad taste," of which he "will say nothing," in my quoting the glorious system's own originators? If anything be ushered into our world in an extraordinary way, with unique pomp—a birth, say, proclaimed by angels, or as this was, by most remarkable men, with unparalleled trumpet flourish, as pre-eminently this or that, or in the name of one or the other—in short, if a goddess brings us a glorious system, is she not to have the credit? Does good taste require the authors of a good thing to be ignored, and all their most vaunted reasons and views of its why and its connections? If you are advocating, say weekly rest, or trial by jury, do you keep Moses or Alfred out of view? Or if I am explaining gravitation, must I avoid the bad taste of either quoting or naming Newton more than once or at all? If the "metric system" be good, I repeat, glory to Marat and the Goddess of Reason. E. L. G.

DECIMAL COINAGE.

[3891.]—I have read with much interest the correspondence on the proposed change in our currency to a decimal system. I am strongly in favour of such a change. But if the change be made, so that 1,000 farthings equal one pound, and we reckon either by pounds and farthings or by pounds, florins, and farthings, why is there any necessity for giving any other name to the new 10-farthing piece than 10 farthings? A new name would be a useless element of confusion. In America, where they reckon by dollars and cents, the 10-cent piece, though called a dime, is yet in practice never named in calculations, or but rarely in retail transactions. I would suggest the following as the series of coins for the new decimal system:—Farthing; halfpenny equal 2 farthings; penny equal 4 farthings; 10-farthing piece equal 10 farthings; 20-farthing piece equal 20 farthings; shilling equal 50 farthings; florin equal 100 farthings; crown equal 250 farthings; half-sovereign equal 500 farthings; sovereign equal 1,000 farthings. The following method to be adopted for making the change:—First, withdraw all the half-crowns, and issue more florins; after that is done, and not until after, issue the new 10 and 20-farthing pieces; call in all the sixpences, fourpenny, and threepenny pieces, and enact the new scale of values. The new silver 10 and 20-farthing pieces to be respectively by weight a tenth and a fifth of the florin. When the people have got used to a decimal currency, they will very soon wish for a decimal system of weights and measures. To attempt to decimalise our weights and measures before decimalising the coinage is putting the cart before the horse. Moneta.

[3892.] — The remarks of your correspondent, "Philo," at the close of his letter (3806), being in purport very similar to mine inserted in your paper of the 22nd February, perhaps you will allow me to say a few words on one or two exceptions.

"Philo" proposes to call in the threepenny and fourpenny pieces, and to issue no more halfcrowns or sixpences. I should say it would be very inconvenient to have no silver coin between the shilling or half-florin and the cent. or chequer (which "Philo" proposes calling it, but which I fancy it would be better to designate a piastre, being about the value of the Egyptian and not very far from that of a Turkish piastre); and I would suggest that a quarter florin should still be issued. Half-crowns might be allowed to die out or wear out, but while in circulation would, of course, be 12½ cents. (piastres), or 125 mils (farthings); and the same might apply to the fourpenny pieces (of which there are few now in circulation, and those well worn), which might be used as one-half piastre pieces, or they might be withdrawn. The threepenny pieces must, of course, be withdrawn. A Subscriber.

COSTLESS VENTILATION.

[3893.]—A constant supply of fresh air is so important to our well-being, and in the prevention and cure of disease, that the subject needs no comment; an attendance, however, at any public meeting, is only necessary to convince how much this axiom is ignored —or if admitted, how unsuccessfully met; "crowded to suffocation" indeed, being the conventional term used to express a full assemblage.

For some time I recommended to my patients the plan of opening the window-sash at the top, and stretching out on a frame a corresponding depth of tarlatan, to intercept blacks and prevent draught; but the principle is wrong and the result unsatisfactory, as the draught is directed downwards on the sitter, and not upwards towards the ceiling; the screen, too, is anything but ornamental, and becomes clogged with blacks, so as to require removal and repair.

The method I now use is simple, economical, quite free from draught, and does not get out of order. Raise the lower sash of the window, and place in front of the opening at the bottom rail a piece of wood of any approved depth—from two to three inches is sufficient: this leaves a corresponding space between the meeting rails in the middle of the window, through which the current of air is directed towards the ceiling; heavy blacks cannot ascend with the air, which is driven so high as to be warmed before it descends; light blacks are not admitted in ordinary conditions of the atmosphere, though doubtless they are in cases of violent commotion caused by very high wind—the more the lower sash is raised, the more the difficulty of blacks entering between the meeting rails is increased. The principle may be modified in various ways, making the bottom frame of wire blinds supersede the strip of wood, or if this be placed above, and the top sash drawn down to a corresponding depth, the same result will obtain; in a word, open the lower sash of the window two or three inches, and block it up anyhow, and the air enters the space in the middle and is carried to the ceiling.

The opening between the meeting rails will doubtless be found to admit more air than the various patented plans so erroneously applied to the top of the sash, whether of wire gauze, perforated zinc, or glass louvres; and while I am satisfied of a constant current of fresh air inwards, I am disposed to believe that occasionally there is a passage of heated air outwards, in which case the latter is always at the sides of the window, the fresh air rushing in at the centre;—however, provision should always be made for the escape of heated foul air from the ceiling, through a large valvular opening in the flue or elsewhere.

It will be seen that this simple plan is adapted for the cottages of the poor and the mansions of the rich; in the latter, however, the draperies must be arranged so as not to interfere with the current of air towards the ceiling: it may be used in any weather, day and night, summer and winter; indeed, in the house of a medical friend, to whom I had demonstrated the plan, to insure constant action, the window of his reception-room has been nailed open, and the same is the case in several rooms in my own house during the milder months of the year; a modification of this plan may be adapted to French casements, by allowing the upper portion, generally fixed, to fall inwards on hinges.

But, although the above plan answers for ordinary daily ventilation for windows without overhanging drapery—at night, with gas in crowded rooms, it is not at all equal to the occasion; in these cases I adopt the following, also costless, very efficacious, and which may be used with overhanging draperies:—

At 9in. above the height of an ordinary person, say 6ft. 6in., place a small hook in moulding of shutter case farthest from the window on each side, and another 9in. below the moulding on each side, in front of window-sill; tightly stretch across the window a length of linen or calico, with small loops or rings to attach to the four hooks, leaving the calico 9in. larger than required to hang down loosely on each side; this forms, what is, I believe, technically called by architects a "hopper." Throw up the lower sash as required, and draw the blind down to the lower rail of the window-sash, wherever it may be. The air enters in full volume, strikes against the broad surface of the calico, and is directed upwards towards the ceiling. Here is the advantage of a window more or less open, with privacy, and without draught. When not in use this calico can be rolled up into a very small compass.

Costless Filter.—Take a flower-pot and plug the hole, not too tightly with a piece of sponge; add a layer of powdered charcoal about 1in. thick, then the same quantity of clean sand, and on that some coarse gravel. P. Hinckes Bird, M.D., F.R.C.S., F.L.S.

1, Norfolk-square, Sussex-gardens, W., London.

METAL MINES REGULATION BILL.

[3894.]—It is proposed to enact by this bill that an adequate amount of ventilation shall be constantly produced in every mine, so that the air shall be in a fit state for working therein. No attempt is made to define how bad air may be to be deemed fit to work in, nor how its state is to be tested; and perhaps in a first attempt it is expedient to leave this indefinite, and to be content with enacting that there shall be some ventilation, leaving it to the justices in case of complaint to decide if it be adequate. It would, however, be far more satisfactory if it were possible to enact that the proportion of carbonic acid shall not exceed a certain ratio, and perhaps some of your numerous readers can suggest an easy method of showing in a mine when such proportion is reached or approached.

Two methods have been proposed, assuming that the maximum proportion of carbonic acid should never be allowed to exceed ten times its usual proportion in the open air of about 4 parts in 10,000, which would be ·4 per cent.

Dr. Angus Smith suggested that half an ounce of limewater be shaken in a 7½oz. bottle, filled with air containing 4 per cent. of carbonic acid; as much carbonate of lime will be formed as if the same quantity of limewater were shaken in ten times as much air containing ·04 as much carbonic acid—*i.e.*, the same quantity of CO_2 in ten times as much air, and this quantity would render the limewater perceptibly turbid. The plan is as simple as possible, and the only objection to it is, that a mine, being a nasty dirty place, it is difficult to keep the bottles used clear, so as to render the turbidness of the limewater equally visible, a difficulty easy to overcome by those who wish to overcome it, but formidable if those who have to use the method do not wish it to be successful. Another plan: I have tried also to estimate the impurity of air by the length of time a candle will burn in a limited quantity of it, but without obtaining consistent results, chiefly, I think, because the flame differed in size, and, therefore, burnt up the air confined at different rates. Moreover, when the oxygen was nearly all burnt, the flame, instead of going out, became gradually smaller but still continued to burn, and the exact moment at which it began to fade could not be distinctly marked, but I do not despair of the difficulty being overcome or avoided.

I shall be very grateful, and the poor miners will be greatly benefited, if any one can devise a method by which the quality of mine air can be tested with approximate correctness, by some instrument, not too costly, which can be easily carried into and used in the level of a mine.

I have tried, but with only partial success, that of a lamp with only a limited supply of air, enough to burn brightly if the air be pure, but dimly if it be impure. The difficulty with this is to estimate by the eye the diminution of light of a lamp where there is no undiminished light to compare with it; moreover, other causes than diminution of oxygen affect the brightness of the light, and it is difficult to exclude all such sources of error—such as the exact length and quality of the wick, the condition of the tallow or oil, the temperature, and other circumstances unknown to me. Philo.

ATOMICITIES.

[3895.]—With Mr. Bottone's kind permission, I will take upon myself to answer "Mercuric's" letter (3801, page 11). To do so effectually I must ask "Mercuric" a few questions. 1. Has he obtained the vapour density of ammonium to enable him to affirm, *ex cathedra*, that its formula is $\begin{cases} NH_4 \\ NH_4 \end{cases}$ instead of NH_4? 2. Does not Mr. Bottone, in his table, refer the valencies of the elements to that of hydrogen, and has "Mercuric" ever prepared NH_5 PH_5, &c., that he lays down as law that nitrogen and phosphorus are pentavalent. 3. If, as "Mercuric" has been "led to believe," the five atoms of chlorine are directly combined with one atom of phosphorus, in phosphorus pentachloride, how does it happen that its vapour density is 104·25, instead of being 208·5? 4. Can "Mercuric" make the vapour densities of ammonium chloride NH_4Cl, cyanide NH_4CN, sulphydrate NH_5S, agree with their calculated molecular weights? Until he can do this, I fear he is much more astray than Mr. Bottone, who at least honestly tells us not to place too much trust in any of the existing hypotheses. N. Du Fai.

CONTACT OF COMETS WITH THE EARTH.

[3896.]—Some numbers back remarks were exchanged on the question whether the earth had increased in bulk by extraneous deposits since the creation, the result of which was an assertion from "E. L. G." that there was clear proof of comets having come into contact with the earth in former times; and what still more surprised me was the apparent certainty with which he looked upon a flood as at least one of the results of such contact. That comets should at times come in contact with the earth might have been expected; but what of the supposed result? I write this because the correspondence has ceased without any explanation, or any remarks on the subject by other correspondents. I venture, therefore, to call "E. L. G.'s" attention to it, and request him to favour us with all the information on this interesting subject which he is able to furnish. J. C.

REMARKABLE ELECTRICAL PHENOMENON—LIFE IN DARKNESS.

[3897.]—I think Mr. Highton (letter 3808, p. 13) will find in Faraday's researches that Faraday paid a good deal of attention to this matter, and came to the conclusion that a wire so circumstanced acts as a Leyden jar. In fact, all partially insulated wires behave more or less in this way.

I would call the attention of those of your readers interested in this curious subject, life in darkness (letter 3821, p. 15) to the fauna and flora of our cellars. There are many cellars to which not a ray of daylight ever penetrates, and rarely illuminated by lamp or candle, yet inhabited by numerous spiders, which cannot live by eating one another. In one cellar I visited I never could find anything caught by their webs. The water mains in London are said to contain enormous quantities of some species of polype, and in them there must be absolute darkness. The spiders I mention appear to be of the kind forming cobwebs elsewhere inlight but what flies into their nets is a mystery to me. M. Paris.

BOILER CONSTRUCTION AND MANAGEMENT.

[3898.]—I have much pleasure in offering "T. L. F." (letter 3813, p. 13) my advice, assuring him that it is practical, and for the most part based upon experience. In the first place, I think his variable eccentric may be very ingenious, and might answer his purpose, but I think the matter may be very much simplified by putting a valve close to the boiler and having a return pipe (between that and the pump valve), with a tap in it, so that by partly opening the tap the surplus water may be returned to the feed water cistern; after a few trials you will be able to set the tap so as to just supply the waste, and it will require very little attention.

With regard to the boiler I certainly should not advise a copper one, as the cost would be very considerable, and unless he is very young, and means to live to be very old, I think a good iron boiler would last as long as he is likely to need one.

If "T. L. F." means to have a self-contained boiler I should think a vertical one would suit him, as they take very little room, and make steam rapidly; he might have a valve in the chimney (like a throttle valve), which could be worked at the lathe by the aid of a little cord and a few pulleys.

I am daily using an engine (for driving an 8in. centre screw-cutting lathe) that I believe would just suit him; it is a horizontal engine, the cylinder is 11in. long and 3¾in. diameter, and with the steam at 50lb. is capable of driving two or three lathes. If you only want to drive one lathe, of course something smaller would do. Screw-cutter.

DUST IN SPECTROSCOPE.

[3899.]—The longitudinal lines referred to by "A Fellow of the Royal Astronomical Society" (letter 3796), as seen in the spectroscope when the slit is nearly closed, are due, I think, not to particles of dust adhering to the edges of the slit, but to imperfect polishing of one or more of the prisms. The surface of the glass evidently retains traces of the emery cuts, which, although exceedingly fine, are quite perceptible when viewed with the least possible quantity of light admitted through the slit. Having seen these lines repeatedly in one of Mr. Browning's star-spectroscopes, I came to the above conclusion, which is, I think, the true solution. Mr. Browning will perhaps tell us.

F. Bird.

THE METRIC SYSTEM.

[3900.]—Having waded through the three or four columns contributed to this subject by "E.L.G.," pages 36 and 37, it seems to me they can be resolved into the expression of some few mathematic crotchets, and the very compact assertion as to the metric system, that "its vaunts are ludicrously false, its failure more than remarkable, unique, ironical, almost supernatural." "E.L.G." is really a very clever fellow, and one of wide if rather superficial information; but I must submit that his style of scientific argument is only fitted for a circle of ancient maidens enjoying their tea flavoured with brandy instead of milk.

It is pure childishness to rave and foam in this fashion, and to suppose that mere contemptuous reviling will prove a system to be absurd which has gained the approval of the great majority of scientific men, and is steadily forcing its way into practical adoption in commerce, notwithstanding the serious objections to a change which must cause great temporary inconvenience.

There are only two modes of treating the subject—viz., the scientific and the practical, and these two must be connected together. If we were commencing the world anew, and arranging a perfect system to be employed by new created man, such arguments as are employed by "E.L.G." might be worthy discussion, and we might weigh the relative merits of decimal, duodecimal, sexagesimal, &c., notations; but the world counts by tens, and we may pretty safely assume that the world will count by tens for a good many ages yet to come, if not as long as man himself endures. It is, therefore, utter waste of time to discuss the advantages any other system of notation might have. Therefore we need not discuss any more whether the duodecimal notation which "E.L.G." calls a "preposterous mare's nest" is any better or worse than his favourite Assyrian double notation by 6 and 10, which appears to me to be a preposterous complication. One thing is perfectly certain, whichever may be better or whichever worse, the world will have nothing to say to either of them.

All we have to do, then, is to settle how we can make the best use of our ten figures and the arithmetic based upon them. Men of science have answered that by reducing all measures they use to some decimal system. They either adopt the French system, or they use a grain or a pound as their unit and decimalise from it, ignoring all other weights; or if they try to adopt the English system, they use Griffin's septem (7 grains), referred to by Mr. Allen (p. 37), as the unit, being a decimal division of the pound and gallon, and therefore convertible into common measures; but they entirely ignore those measures themselves, that is to say, they are unanimous as to the necessity for a decimal system. Practical men would be equally unanimous if they once tried such a system—that is to say, no human being would ever think (except some occasional fantastic dreamer) of changing from a decimalised system to any other. The one only reason against adopting a decimal system now is that the change would involve great inconvenience, and this applies to any change whatever, equally to any of "E. L. G.'s" fads, to any decimalising of existing weights and measures, and to the French system.

If this be so (and few will dispute it), the base of a new system, the unit, is perfectly indifferent; we may with equal advantage adopt the metre, the foot, the cubit. All we have to care for is to establish a standard unit; so also whether that unit is a rod of platinum carefully preserved from injury, or the width of the doorway of St. Paul's Cathedral, or the length of a pendulum at a given spot, is equally a matter of mere detail, argument about which is only scattering dust about the true object of any importance. Let us suppose we have to decide whether the English foot shall be used or the French metre. We know the foot very well; but when we divide it into tenths instead of inches, or when we multiply it by 10 or 100, will not the new denominations be equally strange, the change of calculations equally great as though the metre and its consequences had been substituted for the foot? If we take the cubic foot for our base of capacity, will our market women be less puzzled over the loss of their familiar bushels and pecks than if they were asked to use the litre.

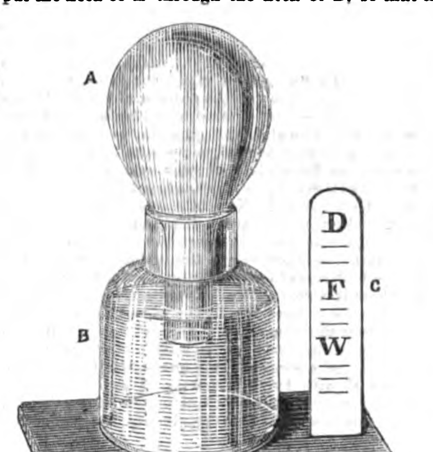
The foot, we are told, is common to England, Russia, and some other nations, and we are invited to use this for their convenience. What results? We go through all the nuisance of a change, retaining only one familiar link to the past, and after enduring all the nuisance we have a system in only limited use, unless we can persuade all the rest of the world to go through a similar trouble by changing their whole system. The rest of the world would say: No, gentlemen, we have shown you the way, we have already the decimal system you intend to use, we are satisfied with our unit, take it and the system together, and follow our example; don't suppose we will again go through the heavy annoyance of a change, in order to enable you to gratify your pride by forcing the English foot upon the world; you had much better follow the good example set you, and adopt the French metre, already adopted by many nations and by scientific men all over the word.

There might be plenty of units devised far superior to the French metre, and for scientific purposes a new modification of some parts of the system will probably be employed in order to correlate the measures of force as well as matter to the atomic system of nature, but the practical considerations I have set forth entirely dispose of all such questions. We must take the metre or stay where we are.

Sigma.

SIMPLE WEATHER-GLASS.

[3901.]—I have had a weather-glass like sketch in use for twelve months. It acts very correctly; A, Florence flask; B, pickle bottle. Well wash the grease out of both glasses. Now pour clean cold water into B, put the neck of A through the neck of B, so that the



end of A is 1in. below the surface of the water. That done, the weather-glass is complete. Directions for reading:—Let it stand for a day. When the water is half-way up the tube it denotes fair weather, when at the top dry, when at the bottom wet. For the other points you must notice its movements. C is the scale. The best place for it is in an out-house.

W. Bright.

ORNAMENTAL TURNING.—VII.

[3902.]—Next to the spiral twist for ornamental purposes, fluting has a very neat appearance. The work to be fluted must be finished off in the lathe as for plain turning. The article should also be turned lighter than work that has to be twisted, for the reason that only a small quantity of the wood is removed by fluting. The best tool for the purpose is a ⅜ or ¼ turning, or some may prefer carving, gouge; but it must be borne in mind that the gouge should be ground somewhat different to that for turning purposes (I am now stating what I deem to be the most workmanlike manner). To the general turner, who is oftentimes pushed for a moment, certain makeshifts are made which should not be tolerated by an amateur. I have myself frequently turned a column and fluted the same at one operation with the same small gouge; but no doubt I could have done the job in a more workmanlike manner with proper tools.

A

The best mode of proceeding is this:—Having prepared the work by turning, papering, &c., mark out one, two, or three strands, same as for twist (the tool described a few numbers back will be the best for those unused to marking out; to the general turner in common work marking is not required); when marked, the only skill required is to remove the lines so marked with a sharp gouge, ground so that it presents more of a square face than for turning. It is chiefly at the top and corners where it cuts. Care should be taken that the cut is of equal depth from top to bottom. The pulley should be held in the left hand, the gouge in the right hand, resting on the T rest a trifle above the centre of the work. The handle of the gouge should pass under the right arm; by so doing it helps to steady the gouge and facilitates the cut of the flute. The gouge should be held at the same angle as the mark on the work, the gouge held firm, the pulley gently moved round at the same time cutting the work with the gouge. Afterwards finish off with glass-paper and a piece of deal cut in the shape of a wedge, called in the trade a burnisher; it will cause the work to shine; with a little practice, fluting can be easily acquired. In a future number of the Mechanic I will send sketches of a few chucks for different purposes, with the use of the same. I have spent a deal of time since I had first to do with the trade of turning upon different chucks. My idea, always prominent, was to do as much as possible in the lathe, thereby saving an amount of hand labour. To tell of my failures would amuse some of "our" mechanical readers no doubt, but as that would not instruct, I shall only state what I know to answer. It behoves all of us to moot any new plan, but at the same time it should be stated that it has not been tried, thereby saving inexperienced persons both time and money.

I send for the editor's approval a sketch of an aquarium stand. I turned hundreds of them for the trade some eighteen months ago; they are very simple, and any person at all used to the lathe can manufacture one. Materials required: Square piece of wood (mahogany has the best appearance) about 6in. square on the face, by 4in. deep, a piece of board 10in. square, 1in. thick; turn as pattern, the top A should be hollow, same as a saucer, with a 2in. hole in the centre 2in. deep; the bottom of the piece should be turned with a rabbet to be fixed in a hollow turned in the bottom. When finished, taken out of the lathe, and fastened together by means of two screws underneath. A common bell-glass, to be purchased at most glass warehouses, makes a very neat aquarium, with a little shingle and a few weeds—a pretty window ornament for the summer months. I may here state for our readers' information that a 12in. bell-glass can be purchased for about 2s. or 2s. 6d., and will hold a pail or more of water.

My attention has been called to your remarks in "Answers to Correspondents" in favour of a Practical Amateur Turners' Society in London; being a cockney myself, and having acquired a knowledge of wood-turning, and its intermediate branches, I would have no objection to forward such movement in London. If "March" has a few friends of the same mind, who will advertise their address, I will communicate with them with a view to form such society as required. At present I am connected with the sawing trade, being proprietor of a Band and Circular Sawing Mill. I have had also considerable experience with societies in general, being secretary to four societies at the present time.

Samuel Smither.

LIGHTNING CONDUCTORS.

[3903.]—Referring to "Philo's" letter (3846, p. 39), King's Norton, called commonly Norton-by-Galby, or simply Norton, is 6¾ miles E.S.E. from the centre of Leicester town. The spire was totally thrown down, and, I believe, every stone split from dowel to dowel: these were copper. The tower was split in front as far as the clock, which was about on the level of the roof. In my letter (No. 3793, p. 668), I used the word steeple for tower incorrectly. The repairs, without re-building the spire, cost, I think, over £400.

"Philo" should recollect, when he says that I used a common but inaccurate expression, that the actual words I used, see letter 3793, and used intentionally were "the fluid or whatever you call it" made a hole. Now, though ignorant I am meek. I did not presume to say that the lightning was a fluid and made the hole, nor that the expansion of steam produced from the water of crystallisation in the hydrate of the mortar by the action of electricity did it; not yet that a repulsion of particles, produced no one knows how (for "Philo" admits he does not, see p. 39), did it. I merely stated that there was lightning (so-called) and a hole, evidently due to its action. I remember the hole was much bigger inside than outside the tower. If "Sigma," who knows well at least what is the opinion held at the present day about electricity and its action, were to tell me that it is a fluid and does the work of a solid, I should bow to his authority without arguing; and, *mutatis mutandis*, do not intend to argue it with "Philo," nor bow to his authority either. As he has omitted to give any answer to my question in letter 3793, first line, I will observe that I have an impression that Ferguson in his "Electricity" makes the statement that surfaces conduct, or else that the power of conducting is proportional to the surface: I think the former, but it is thirty years at least since I read the passage. I doubted it then, and disbelieve it now. If he were speaking of something very thin, like tinfoil; then the surface and section would vary together, which might account for the statement being made, even if it is not true generally. I should like to know whether it is or not. I will give "Philo" another chance of answering a question—viz., this: Is he quite sure that under any ordinary circumstances an electrical discharge (including lightning) through water, produces steam enough to do any damage? Or, putting it another way, does he mean to stand by the statement made in lines 6, 7, 8 of his letter 3846, which includes substances only partly charged with moisture, or saturated therewith?

J. K. P.

WHAT HAS BECOME OF THE PSYCHIC

[3904.]—Some
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As these gentlemen expended a large number of words, and no small amount of temper without agreeing, you suggested that similar experiments should be made in the presence of competent and reliable witnesses, when no mistake could be made as to what did or did not take place. You also offered this meeting of scientific gentlemen a room free of expense, and every opportunity of eliciting the truth. The only condition you insisted on was that the experiments, whatever they might be, should be performed in the light. I have been anxiously watching our World of Science from that time to the present to know the result of the offer. I fully expected that Messrs. Crookes and Varley would have met you on your own terms, but I have looked, and looked in vain. I suppose that negotiations must have commenced and been broken through because you could not agree upon terms. If so, I for one would like to know wherein you differed, or what is the cause of the experiments not having been made, or if made, what is the result. I cannot believe that the spiritualistic or "psychic force" party so lacked courage or confidence in their newly-discovered principle as not to come up to the scratch. But whatever the cause of the silence, I think an explanation of some sort is due to your readers all over the world, and I hope, Mr. Editor, you will vouchsafe to enlighten us at your very earliest convenience.

A Member of the Society of Arts.

[The truth of the matter is we have no information to impart, and no explanation to give beyond the fact that Mr. Varley and his friends never accepted the challenge, and we have heard nothing of them in any sense. We suppose they considered "discretion the better part of valour."—Ed.]

SUN'S DECLINATION.

[3905.]—Henry Wood (qy. 11360) can scarcely have read the "trashy explanation" to the *Nautical Almanac* with sufficient care. However, the following will, perhaps, be sufficient guide for him. Should he require the sun's declination for transit over any meridian other than Greenwich, he must first find the variation in one hour of longitude for a time midway between the meridian required and that of Greenwich, and multiply this variation by the difference of longitude, and apply it with the proper sign to the sun's declination at Greenwich transit, which will give him the correct declination for the meridian required.

Example. Required the sun's declination at transit at Quebec (long. 4h. 44m. 49·02s. W.) on April 8, 1872. The long. being W., take the difference betwen the variations in one hour for April 8, and succeeding day—viz., 0·32", the proportional part of which for 2h. 22m. 24·51s. (*i.e.*, midway between Greenwich and Quebec) is 0·03", which, subtracted (because the variations are decreasing) from 55·89", the variation for April 8 gives 55·86" for the variation required. This quantity, multiplied by the difference of longitudes, gives 265·2", which, added (because the declinations are increasing and the long. is W.) to the sun's declinations on April 8) gives N 7° 30′ 9·9" for transit at Quebec. Should the declination be required for any other time than at transit, find the corresponding Greenwich mean time, and proceed as before, taking care to apply the correction found to the sun's declination given on p. 2 of the almanac, which is for Greenwich mean noon, the variations being assumed the same for mean as apparent noon. Henry Wood will perceive that the variations given in the almanac are for the instant of apparent noon, and represent the sun's motion in declination through the period, a half-hour before to a half-hour after transit, and by finding the variation midway between Greenwich noon and the time required he is virtually correcting for second differences, and his results are obtained to the utmost nicety.

If our querist will take the trouble to look at the later *Nautical Almanacs*, he will find instead of less information being given a much larger amount is now contained in them, notwithstanding the actual number of pages is less, which has apparently been achieved by a closer arrangement of some of its details. For instance, I am now looking at the almanac for 1875 (the last published), and observe that the list of the Elements of Occultations has been given for all stars down to magnitude 6½ instead of magnitude 6, and the consequent number of stars increased from about 500 to above 1,500 per annum, also that the variation in 10 minutes is given for the moon's R.A. in addition to the variation in declination previously given, which will enable the astronomer to calculate the moon's position at any intermediate time with the greatest precision, and including the effect of second differences by the same method as that explained above for the sun's declination. Also, that the independent star constants (as they are termed) for correcting the places of stars, are given for each midnight throughout the year, instead of each fifth as formerly, a very great boon to professional astronomers who wish to get the mean place of an uncatalogued star. The positions are given daily for five circumpolar stars instead of two, and are, moreover, fully corrected for nutation, and in the moon culminating division the moon's semi-diameter and horizontal parallax is given at transit, thus avoiding the trouble of interpolation from the noon and midnight values given at p. 3 of each month. I think that Henry Wood will see that he has been rather rash with his statements respecting the quantity of information given in the almanac, and will likewise inform him that I have understood that the explanation he terms "trashy" was compiled by the highest professional and nautical astronomers for the use of seamen, and has been universally praised for its clearness, and pronounced adapted to the meanest capacity.

Altair.

THE ORGAN BUILT.—NO. VII.

[3906.]—After carefully getting the whole of the top fold finished, as directed in my last letter, proceed with the lower fold; begin by fastening the ribs to the middle frame with the tape, then put the leather on over the tape, and allow it to dry; now lay the middle board of the bellows on the bench with the trunk band upwards, and fasten the ribs to the tape in the same way, and put the leather on over; when dry, turn the bellows up again, and begin with the feeder; get two battens 2ft. 8in. long, 3in. wide, and the same thickness as the ribs, fix one firmly on the feeder board at the end where it is to be hinged to the middle board; the other is to be fixed to the middle board, but under it in shallow grooves fix four pieces of webbing; nail the webbing to the middle board, then glue and screw the batten over it; the webbing must be left long enough to turn down to the feeder board, to which it must be firmly attached, as shown in Fig. 1; then along the joint glue a piece of leather both inside and outside; now proceed to fix the ribs in the same way as directed for the lower fold of the reservoir; when dry open the reservoir to its full height, and cut out a pattern in paper of the four corner pieces for the lower fold; then, when you have got the pattern nicely to fit, cut your corner pieces out of unstrained leather, pare the edges all round neatly, and glue on, well working it down at the corners and edges; a small cut will have to be made in the middle of each side of the leather where the two ribs are joined, so as to get the corner piece to lay flat on the rib. Now take one of the strips of leather, such as the ribs are fastened together with, and cut sixteen pieces 2in. long; pare the edges neatly, and glue a piece over each cut in the middle of the corner pieces on both folds to prevent any leakage there; when neatly done it gives a nice finished appearance to the work; when dry, open the feeder wide and put on the corner pieces the same way. Now get a piece of inch board 10in. × 8in., and in the middle of it cut a hole 5in. × 4in.; get a piece of three-quarter stuff 6in. × 5in. and cover it with two thicknesses of leather, leaving the leather projecting an inch at one end for a hinge; now fix this over the hole by glueing the projecting

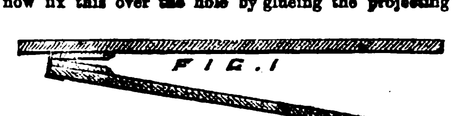
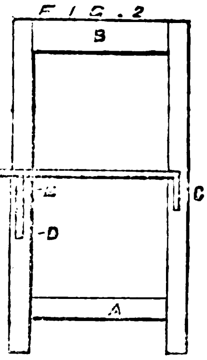


FIG. 2



leather firmly down, and over it nail a thin piece of wood; bore a hole in the middle of the valve large enough to let a piece of tape go through; fasten one end of the tape to the middle board of the bellows, put the other end through the hole in the valve, then firmly screw the valve board with the valve to the inside of the bellows down on to the top board of the bellows over the hole left for it, a thickness of leather being placed between the boards to make it air tight. Now try the bellows; having closed the holes for the wind trunk, place a weight of thirty or forty pounds on the top, and if your work is good the bellows will be nearly a quarter of an hour going down; ascertain what height you want the bellows to rise, and tie a knot in the tape at that height, so that the valve may be pulled open if the bellows rises beyond that point. While the bellows is inflated, carefully examine it to see if there are any leaks, and stop them, as afterwards it will be difficult to do so. Now proceed to get out the stuff for the frame. For this purpose you will require four pieces of stuff 3in. × 3in. and 4ft. 4in. high, two rails of inch stuff 4ft. 9in. long and 4in. deep, also two rails of inch stuff 4ft. long and 4in. deep, and two more the same length, but 6in. deep. Plane all up true, and tenon two short rails into the posts, the top of the bottom rail being eleven inches from the ground, and the other being level with the top of the posts. Be careful to place the deep rail at the top for the windchests to lay upon; these two pair of rails and posts make the ends of the frame. Next tenon the long rails into the posts, the rail at the back to be 2ft. 5in. from the ground, the front one to be 2ft. only. Get out two pieces of ¾in. stuff, 4ft. 8in. long and 7in. wide, lay one end on the back rail, and to keep it level, fix a block (the same width as the board and 5in. deep) on to the front rail. Screw these two pieces down to the rails exactly 2ft. 6¼in. apart, which is the width of the keyboard, so that the frame of the keyboard will rest on these boards, and the keys will be between. Fig. 2 shows how the frame is put together. A, bottom rail for bellows to lay on; B, top rail for the windchests; C, back rail to support keyboard, &c.; D, front rail; E, block to keep key rail level.

With regard to the feeders described by "A Young Organist" (3746), they are well known, only in his drawing he shows springs to close the valves, which will not answer; but as in my letter I am describing one specific instrument, I do not think it wise or necessary to show in how many ways it may be made. In all probability, if six organ-builders should build such an organ as I am describing, we should find six different patterns. The French feeders are powerful and good, but cannot be blown by the foot.

J. D.

SPONTANEOUS COMBUSTION, ELECTRICAL, MAGNETIC, &c.

[3907.]—(10941.)—Spontaneous Combustion.—I will readily grant "Manus" the excuse he asks for, on condition that he will equally excuse me for informing him that he has introduced two elements tending to assist spontaneous combustion (if such a thing really exists), which did not enter into the original query, and were not, therefore, taken into account in my reply—viz., the immediate presence if not absolute contact between the oily waste and a metallic substance, and secondly both exposed to an Indian sun. Neither of these conditions were presupposed by the querist, nor would they be suspected by the general reader; but had they been so, and as I have never been at Poonah, and therefore knew nothing of the habits and eccentricities of the men who are employed in the gun factory there, I am not in a position to deny either of the statements made by "Manus" of the two cases coming under his cognisance.

But I must record the implied facts that "Manus" is not in a position to contradict me, as in the first place it was the man who used the oily waste, and not "Manus," who witnessed the phenomenon, if it really occurred, and "Manus" could not have been present in the second instance, or he would not have given £5 to a man for giving the alarm of fire! I presume, in my ignorance of the customs of Poohnees and other Indian tribes (with whom "Manus" is familiar), that they never indulge in the vile habit of smoking, indigenous to the barbarian practices of European or American workmen; and, therefore, a stray spark from a contraband pipe could neither have assisted the sun in the case of the oily waste nor the linseed oil in that of the saturated sawdust? For my own part, I have never seen nor heard of a true case from a competent eyewitness that would lead me to believe in what "Rube Rawlings" calls "Spuntainyas Kumbuxshun," either in the arid wastes of the "Praiaree" or the handful of cotton waste exposed as the original querist indicates.

(11188.)—Arithmetic.—Sir,—The circle squarers, lunarian rotatists, and Parallaxians have been driven ignominiously from your pages into Lethe. Spare us then, oh! spare us from a re-inundation of nonsense-mongers — worse if possible than any or all of these—viz., the "multipliers" of £19 19s. 11¾d. by £19 19s. 11¾d. Never did Phœnix rise from its ashes with greater certitude and perseverance than does this nonsensical evidence of untrained mathematical reasoning. "Ours" has already in earlier numbers teemed with it—and what scientific journal has not been bored with it *ad nauseum*? For the love of those who would "live and learn," in mercy place a *veto* upon it.

(11295.)—Electrical.—I do not think I misunderstood "Forked Lightning," since by desiring to exhibit 12in. sparks he is evidently more desirous of showing the more glaring effects of electricity than communicating the principles upon which the science is based. All the phenomena necessary to be exhibited to an audience, say of 300 persons, in order to convince their eyes as well as their ears in a lecture, can be as well produced by a disc of ebonite 12in. diameter giving a ½in. spark under favourable circumstances, as by the largest machine yet manufactured, and with the additional advantage of the lecturer running no personal risk, even by misadventure. When the London Panopticon was in its glory in Leicester-square (shame to the metropolis that allowed such an institution to be degraded to its present level), it possessed, I believe, the largest plate machine ever made and the phenomena produced by it were truly striking and magnificent, and great and earnest was the applause drawn from adult and juvenile spectators at every new effect produced. Yet I dare venture to aver that vastly more real knowledge of the science of electricity was not only communicated to but instilled into the minds of his large audiences by the six so-called "Lectures to Juveniles," given by Professor Tyndall a few years ago at the Royal Institution's Lecture Hall, and if I remember rightly, the most costly and elaborate instrument he used was a large glass tube and a thick stick of sealing-wax—more real knowledge, I say, was communicated than the monster machine ever afforded from the day of its construction to the present date. The Winter machine was fully illustrated and described in an early volume of the English Mechanic, but I have not time just now to refer to it.

(11311.)—Electric Bell.—One "Lelanche" should work a bell if properly constructed—that is, the arms of magnet wound with a large number of fine wire helices. 2. A cylinder would be preferable to a wedge of zinc, as offering greater surface, if the other conditions of construction admit its use. 3. No. 16 wire would be ample, or ordinary iron telegraph wire, if more readily obtainable, insulated would do equally well, but would be less pliable for indoor fixing. 4. For indoor work, and only such a short circuit, a return wire would be far preferable and more reliable than an earth plate; I have recently seen some triple coated cotton wires admirably suited for indoor work, as the two wires can be twisted together where they pass through a wall, requiring but a very small orifice through the wall, and yet giving very fair insulation.

(11327.)—MONSTER MAGNETIC MACHINE.—Although addressed directly to Mr. Sprague, I feel that gentleman will forgive me for saying a few words in reply to this query. In the first place, I think, Siegm. Raudnitz, of Bohemia, ought, when such large sums of money were at his disposal, to have ascertained as a fact beyond doubt that a small machine of Browning's was "capable of producing ten cubic feet of oxygen per minute," and in a case where such a sum as the monster would require, the purchase of one of these small machines would not involve an unnecessary outlay in order to determine the fact. The principle thus once proven, over a fair space of time and not by got up séances, would be worth all the opinions of all the electricians the earth has given birth to, and nothing more than a mere question in simple proportion or two would be required to guide "S. R." safely as to whether he should speculate his thousands in a single monster or a given number of small machines of definite capacity tending towards the effects he desired to attain. These data settled definitively in his own mind, I scarcely think it credible that a nation who have supplied a Britannia tube over Menai, a bridge across Niagara, a Great Eastern steamship, or even that trifling little matter called the Atlantic Telegraph, would fail in utilising the proferred capital (under good security), so that all "S. R.'s" wishes might be fully realised. There is surely a link wanting somewhere that "S. R.," of Bohemia, must supply before "any fellah can understand" his axioms.

(11835.)—TO MR. TONKES.—It is not only my opinion, but my absolute belief, that $\frac{1}{0}$ is a true mathematical representation of infinity in so far as a finite mind can form a conception of infinity. I am not inclined, and much less is it my intention, to be drawn into the metaphysical inquiry of "infinite divisibility," to which the query of "S. J." evidently tends. If he wishes for a full development of the expression used, I must refer him to Liebnitz or De Morgan's "Differential Calculus," or, better still, to E. A. Poe's "Eureka"—in either of which he will find ample room for study for his genius instead of wasting it in playing bagatelle with symbols, which have neither definite nor defineable meaning. I can believe in one infinity! of two I know nothing, and believe less if possible. "Infinity within, infinity without, below creation," vide P. B. Shelley for details of demonstration. He wrote metaphysically, I tried to do so mathematically.

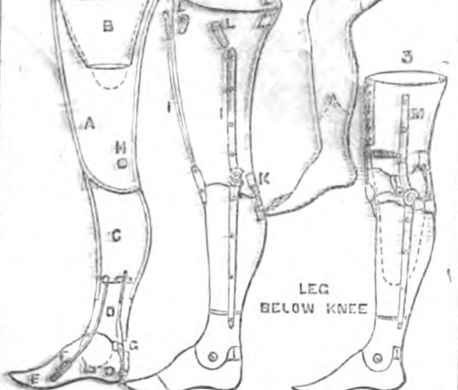
(11846.)—I am sorry that my time is so limited just now that I cannot comply with the request of "T. H.," especially as I have in one of the early volumes given full details and drawing of Siemen's coil, which was, I believe, the first practical development of Poggendorff's theoretical view of how a coil should be made; he certainly hit the right nail on the head, and Messrs. Siemen drove it home. The use of the discs is simply to divide the secondary into as many separate compartments as you desire, which will depend upon the length of wire used and the effects supposed to be obtainable at the terminals. Their position is transverse to the axis of the fasciculum and primary coil, so that they form, in fact, a series of secondary coils, each insulated by the discs from its neighbour, thereby avoiding the danger too often experienced in coils (as ordinarily wound in successive layers) of the static inductive charge, set up in the secondary, flashing back to the primary or the fasciculum, instead of becoming developed through the extremities or poles of the secondary, electricity always choosing, by "natural selection," the shortest path to equilibrium or a state of quiescence; the natural result being either destruction to your insulation, or quite probably disruption and melting of the secondary wire itself; whereas, if your secondary is divided into a series of coils by ebonite discs, the disruptive discharge would only affect seriously one or two, at most, of the coils, leaving the rest uninjured; and as I before stated the injured ones can be readily replaced, as compared with rewinding and insulating a whole coil. I mention the disruptive discharge incidentally, but I do not think it possible for any such phenomenon to take place in a coil with the secondary so divided; and the facility of cure is equally easy, let the fault arise how it may—therein lies the advantage.

(11818.)—GRAVITATION.—A vacuum, per se, does not affect the force of gravitation, it simply removes the opposing resistance of the atmosphere, which in some cases, such as the light down of feathers, soap bubbles, balloons, &c., is so great as not only to counterbalance gravitation, but to give the appearance of the existence of an opposing force (repulsion) even greater than attraction itself, causing such matter to rise from the earth instead of falling toward it. Take away the resistance of the atmosphere (that is, form a vacuum), and down plumps any or all these buoyant substances with the same velocity as the heaviest metal—viz., that due to the unresisted force of gravitation. "C. W. H." must remember that the same sovereign can be drawn out into such a state of tenuity that it would fall even in the open air no more rapidly than the feather. Well now, that is just what nature has done with the material of which the feather is composed, for a very wise and apparent purpose. The whole rationale of this subject was fully discussed, and all the difficulties attending it explained away, in one of the early volumes of "ours;" the discussion was, however, somewhat ludicrously brought to a termination by the original querist (being unable to comprehend the arguments adduced) naively inquiring "how is it, then, that a plank loaded with bullets does not rise up through them as the same plank would through water, it being specifically lighter than either the water or the bullets?" It was supposed the querist had been "raised" in Mobile.

WM. TONKES.

ARTIFICIAL LEGS.

[3908.]—THE subject of artificial limbs has more than once been referred to in the ENGLISH MECHANIC. I was invited a short time since by a poor man, whose son had the misfortune to lose his leg, to contribute through the medium of its columns some information on the subject. "S. H.," in his query of March 8, says:—"I suppose it is too much to expect manufacturers to give instructions," &c. There are some, no doubt, who would be reluctant to do so. As a subscriber, and one who has benefited by the information imparted by others, who have been always ready to answer any query I have sent, I feel pleased to give you my experience on this subject without feeling that I shall sacrifice anything by so doing. In writing this article, if I may call it one, for the better understanding the subject, I will divide it into the following sections:—1. The human leg and its principle of construction. 2. How and by what rules an artificial leg should be made. 3. Amputations, and the points at which to amputate when the surgeon has the option. 4. The construction of legs. And lastly, the fitting and adapting them to individual cases. First—the human leg. The legs of the body correspond to two pillars, the heads of which are secured in their sockets at the pelvis or large basin which takes the abdomen. Upon the pelvis is reared the spinal column and head. This upper structure is supported by the legs or pillars beneath. Now, these two pillars do not run down vertically from their head or socket; if they did the feet would be as wide apart as the hips, but the thighs from the hip joints diverge in towards the knees, so that the knees almost touch. This divergence or incline inwards is more in women than in men, as the pelvis is wider on account of the extra weight they have sometimes to carry. From the knees the legs run down vertically, almost to the feet, so that when a man stands properly erect his feet stand pretty close together, but to make the base firm the feet turn outwards to widen the base of standing. If you stand erect and bend the knee forward and look over it at your toes, you will find that the great toe is almost in a line with the outside of the knee, leaving the foot its width outside of the knee. These, then, are just the curves given to the natural leg



that the gravity of the body may be well sustained. I would next say a few words about the joints in the leg. The knee joint is a simple hinge joint, the centre of which is eccentric—that is to say, the centre of the knee joint is not in the centre, but extends back towards the back of the leg. Thus, when a man is standing erect the swell of the thighs stands almost in a line with the toes (see dotted line No. 1). Thus the gravity of the body falls in front of the knee centre, and the knee, so to speak, becomes locked; thus he stands at ease in perfect comfort and safety. The ankle joint is a simple hinge joint with a little lateral motion; the toes also are a simple joint. The foot in construction resembles an arch, on the centre of which the leg bone rests. Thus the leg bone does not come down in a line with the heel; if it did the foot would fall every time with a thump, and jar the whole upper structure; but the heel, which is one of the abutments of the arch, projects back; thus in walking the point of the heel touches the ground first and pitches at an angle; thus the foot falls gently down, and the jar is broken as soon as the foot is flat, the tendon Achilles draws the heel up and throws the body on the great toe, which becomes the pivot on which the body moves and turns. I have given just in this simple way the construction of the human leg—what I may call its mechanical part, in which points an artificial leg is materially affected, and the closer we keep to the natural limb the more perfect we become in constructing an artificial limb.

2. How and by what rules an artificial limb should be made. An artificial leg for amputation above the knee should not be made almost straight, as many are, but from hip to knee it should diverge inwards, and take the same lines as the natural limb. The foot, instead of being straight with the leg, should turn out, so that when the knee is bent, the foot should be nearly its whole width outside the knee; if made straight with the leg the toes will turn in in walking when they should turn out; the knee centre should not be in the centre, but extend back to the back, so that when standing erect the gravity of the body may fall in front of the centre to lock the joint and enable the wearer to stand in safety (see dotted line H, sketch No. 1). If the centre of the knee be put in the centre of the knee the wearer cannot stand in safety, because the moment the gravity of the body falls behind the knee centre the knee gives out, and down he comes, because there is no natural rectus muscle to help the knee. A patent leg was represented in the columns of the MECHANIC a few years ago for amputation above and below knee. The mechanism and workmanship was all that was desired, but the knee-centre of the leg for above the knee was in the centre, thus it was a matter impossible to wear the leg in safety. The inventor had lost his leg below the knee, and made a leg that answered his purpose well; and he set to work to make one above the knee, but it was wanting in principle. If the knee-centre had extended back another inch or inch and a half, the leg would have been perfect, but it was not my place to correct the defect as a manufacturer. The ankle-joint of the leg should give just simple flexion and extension, and all lateral motion avoided; any lateral motion, of which there has been so much ado about, gives an unsteady motion to the foot (as the will has no power to control), and is more liable to get out of repair. As a limb maker gets every makers' limbs to repair in the course of a few years he can see their construction, and see which answers best; and the greater number from experience would say simple flexion and extension is best: it is all that is necessary, and when makers of limbs sometimes pretend they have some wonderful internal mechanical contrivance, I say, without hesitation, it is all moonshine; you can have nothing simpler in construction than the sketches represent.

3. Amputations, and the points at which a leg should be amputated. The success of an artificial limb in a great measure depends upon the nature of the operation. Bad operations and badly-fitted legs are bad indeed—a man may as well be out of existence as without his legs he is in constant misery and pain. The best place to amputate when the surgeon has the option is at the lower part of the middle third downwards from the joint (see cut No. 4). This leaves a good lever and stump for the patient to use the limb, and it makes a good stump for the mechanic to adapt his limb to. A stump too long or too short presents difficulties to the mechanic, and is always an annoyance to the loser of a limb. Long stumps come in the way of the mechanism; in short ones you cannot get sufficient grip; other stumps have not much muscle, and the edges of the bone seem to be protruding through the skin. The bones in operating should be cut up so as to have a good cushion of muscle under end of the bone. The edges of the bone should also be filed or nipped off to prevent the round edges cutting through the muscle and skin. The nerves should be drawn down with forceps, and cut off so as not to be brought up with the flap. The best flap is the posterior and anterior flap, as it brings a good cushion of muscle up under the bone; but should not be cut up too high laterally. Some legs are amputated from disease, often scrofula; the disease sometimes lingers in the stump, which makes the wearing of a leg tedious.

4. I now come to the manufacturing of the legs. Different makers employ different material and different plans of construction; but the principal, with knee, ankle, and toe joints, are much the same. Legs in general are made of wood, willow, nominally called cork, because of its lightness, the sockets of which are hollowed to fit the stump. But to the construction of my own manufactory I shall confine myself. No. 1 represents a section of my leather leg. A and C are leather buckets made of the best light ox-hide. The foot and shank D D are made of wood—willow. As my original business was working in leather, I have a process whereby I can mould the hardest butt leather to the anatomy of the leg. The shank D is secured in the leather calf bucket C. The tendon at the back G is made of metal hinge, and is regulated by screw nuts. F is a spring of vulcanite rubber, or a spiral spring, secured by gut to flex the foot. Thus, when the foot pitches at the heel, the foot falls flat; the pressure on the heel extends the foot; when the pressure is off, the foot flexes, and the tendon Achilles supports the ankle and helps the heel up when standing on the toes. E the toes, a leather sheath to shape, stuffed with horse hair. This gives the crease in the boot and takes away the woody appearance of the foot. J is the outside of the leg. The thigh and calf bucket are secured together by the lateral steels J. Jointed at the knee with catch joints, K is a laced tendon to save the strain on the knee joint, and prevent the click of the same. I is a spring which is regulated to bring the leg forward in walking, and acts as the rectus muscle. L L L L are where the straps are secured for fixing the leg.

8 represents a leg for amputation below knee, the bearing being taken in the taper or cone of the thigh, leaving the knee free to act without bearing under it, and the stump free from pressure. The lower part is the same in construction as leg above knee.

For a working-man an artificial leg is expensive in the wear and tear of the ankle joint. He cannot afford two legs, so by securing the peg in the shank he can knock about to work; but when dressed for church, can take out his peg and put in his foot. This can be applied to a leg above or below knee.

Lastly comes the fitting. A leg for [illegible] mechanism may be well executed, but if [illegible] is useless. For amputation above knee [illegible] the stump without pressing the muscle [illegible] make a socket on the cast of leather [illegible] into the top of the leg, No. 1 B. Great [illegible] fixing this, or it will throw the leg [illegible] thus transferring the fac-simile [illegible] leg, leaving the end from pressure.

tain amount of bearing. On setting the bone the leg is bound to fit. Till within this last month I have fitted a leg a week for four months in succession to all kinds of operations. I have not had a single case where the patient has not been enabled in one hour after the leg is on to walk with and without a stick, and walk up and down stairs, which is the drill they have all to go through. The boy represented in the MECHANIC some time back with both legs off, one close under the knee and the other in the middle of the thigh, thinks nothing of walking five miles; in fact, as he walks the streets he is taken no more notice of than an ordinary individual. I fear I have taken too much of your space, and the chances are that you will not be able to find room for this article.

JAMES GILLINGHAM.

WARMING AND VENTILATING.

[3909.]—NOTHING can be more mischievous in every sanitary point of view, than the admission of a room's supply of fresh air warmed to the extreme degrees named by "An Architect" (letter 3848), or indeed, to any degree above the external temperature when that is higher than 56° Fahrenheit. For either the room is self-ventilating (like a lantern or the House of Commons), or it is (like English architects' rooms) non-ventilative, preventing by its malformed ceiling all possible escape of the immediately breathed air, and fouling the whole contents as speedily and permanently as possibly. Now, in the former rare case, the heated fresh air will simply rise straight to the outlets and pass away, instead of the foul, which is less light, wasting all the heat it has received, and leaving the room fouler than if it had not passed through. But in the other case, the common one, it will rise as quickly to the mischievous ceiling, displace thence the breathed air that is always there, collecting and cooling, and send it down to be rebreathed even quicker and more perpetually than the successive supplies of more and warmer breath would have done. If our dwellings admit of being made more wantonly pestilent, "An Architect's" treatment (p. 40) makes them so.

E. L. G.

PROTOPLASMIC LIFE.

[3910.]—IF the pages of the ENGLISH MECHANIC are familiar to the eyes of Dr. Crace-Calvert, perhaps he will kindly favour us with an explanation how happens it that he—having succeeded in preparing water so that it will keep for months without life appearing—asks 'why did not life appear in the liquid contained in the flask as well as in the tubes which had been exposed to the air?" (Vide p. 33 ante.) Now granting that, by the means described in the *Chemical News* of July 14th, 1871, Dr. Calvert is enabled to prepare water so nearly optically and chemically pure as to be absolutely free from all "germs" (an attainment which Professor Huxley once ridiculed, as one utterly hopeless to strive for), then the question naturally arises, why should Dr. Calvert put the above interrogatory? For from what possible source, contained in the flask in question, were living things to derive their origin? Whence were they to get their nitrogen? Surely Dr. Calvert does not impliedly accuse Abiogenists of entertaining an idea—obviously too absurd—that living things arise spontaneously in a flask containing chemically pure water. What Abiogenists really contend for is, that living things may and do arise *de novo*, in solutions in which all pre-existing life had been destroyed; that as regards the paucity of life observed in one result and the abundance of life in another result, much depends upon the nature of the solution employed; and, that when living things are said to come into being *de novo* they are only supposed to originate from the re-arrangement of non-living matter which previously existed in a state of solution. If, out of the many writers on the subject of "Spontaneous Generation," there be one individual who has expressed his belief to be that it is possible for organisms to arise in fluids similar in condition to the contents of Dr. Calvert's flask, then, perhaps, Dr. Calvert will be so kind as to acquaint us with name of writer and title of work. I do not suppose that Dr. Calvert has examined the contents of his flask in order to ascertain whether crystals of any particular salt have appeared therein, but why not? As well might he expect crystals to appear as living organisms.

A. J. V. G.

ARE ANTS PIRATES.

[3911.]—"SAUL RYMEA" (letter 3778, p. 667, Vol. XIV.) quotes a "popular authority," in which it is stated that ants eat the centres of flowers. He does not state the name of the authority; and I would remind him that popular authorities are not by any means authorities in regard to reliability. All I can say is, that the ants whose acquaintance I have made have to all appearance been almost exclusively animal feeders—sweet articles, whether animal or vegetable, coming in for a share of their attention. The argument that the ants are blameable for part of the mischief wrought by the aphides on account of their consumption of the honeydew seems to me new and curious; but supposing it to be a fact that the ants in consuming the honeydew actually do cause the aphides to produce more of it than they otherwise would, it would only be an additional cause for the destruction of the aphides; thus sending the ants elsewhere to procure food, resulting in more profit to the gardener and horticulturist. I may say more on this subject at some future time.

J. C.

THE LATHE AND ITS ACCESSORIES.

[3912.]—I SEND you photographs of an epicycloidal chuck which I have just constructed. From the photographs it will be seen that I have not departed from the principle of Bergeron, the father of the chuck, for all the others are but modifications of the one figured in the "Manuel de Tourneur." I mean giving eccentricity by the flange movement of the radial arm carrying the change wheels. I have done this after a careful consideration of the admirable though complicated chuck of Mr. Plant, because I think the flange movement is the simpler. It avoids the necessity of the eccentric chuck movement, the radial arms, and link motions, all rather difficult for an amateur to construct, and it is equally efficient, as whatever amount of eccentricity is given, the wheels are always in gear.

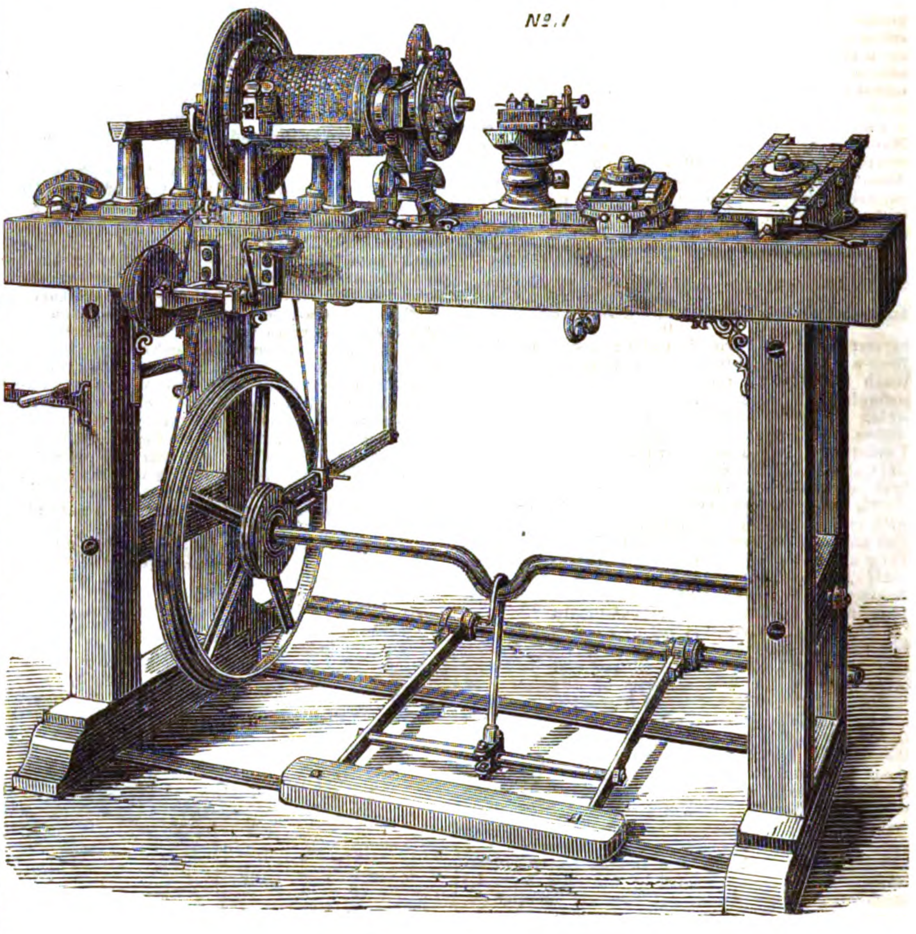
In my old chuck the reversing motion was obtained by an intermediate wheel slipped on when required. In the new one I employ what I call the sun and planet motion. The steel bracket (see 6, No. 4) carrying the planet wheel is pierced at one end (*a*) to receive the spindle of the wheel (8, No. 4), the centre of motion of the radial arm, and at the other end has a slot concentric with the centre of No. 8, so that the sun and planet wheels are always in gear, and the motion is direct or inverse, according as the pinion on the axle of the driving wheel (13) gears with the one or the other.

So much for the principle of the chuck, now for its construction. To return to the photographs. No. 1, of which I now inclose a better proof, shows the chuck screwed on the nose of the rose engine. It will be seen that the lathe can be worked either by the hand or the foot. To the right of the slide-rest is a double eccentric and oval chuck, and farther to the right a straight line chuck, both belonging to the rose engine. By using a magnifying glass, the whole details may be seen at a glance.

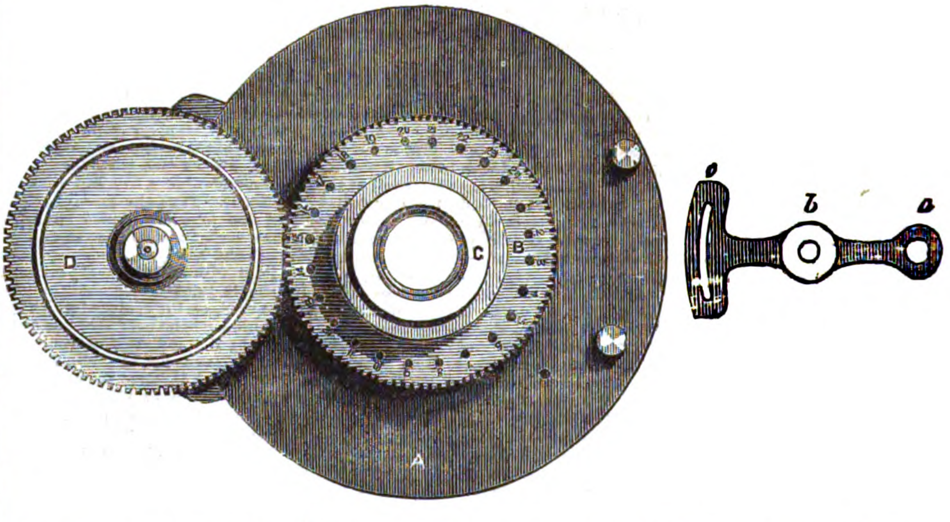
No. 2 shows the back of the chuck, the foundation plate A, which is merely a face plate, very true on both faces, with boss C to screw on the nose of the lathe. On this boss the wheel B revolves, except when held fast by the pointer placed in one of the holes shown. It then remains stationary, and gives motion to the driving wheel D, which, in its turn communicates motion to the wheels in the front of the chuck. This arrangement is the same as that adopted by Mr. Plant.

No. 3 is a front view of the chuck, showing all the wheels in gear, a combination which gives 180 loops in one continuous line.

No. 4 will give a better idea of the construction of the different parts, as the driving wheel (13), the main wheel (14), and the division wheel (15), are removed to show the position of the radial arm (2), and the central stud (5), on which 14 and 15 turn. Both are countersunk to turn on the bosses, which gives steadiness to their motion. These wheels are fixed on the stud by



No. 2



the washer 19, having a key way to fit a pin on the stud and the screw 18, which allows them to turn without a shake.

Instead of the slot in the foundation-plate, concentric with the centre of the lathe mandril adopted by Bergeron, I employ a bracket, seen at 12, whose inner surface beds truly on the periphery of the foundation-plate, with slots to allow of lateral motion for different sizes of pinions, and two capstan-headed screws to fix it in place. This is a better arrangement, as the screws do not interfere with the pinions, whatever their size.

When the mill-headed pin 4 is in place, as here, the chuck is all at centre, and would make dots or circles, according as the slide-rest is central or not.

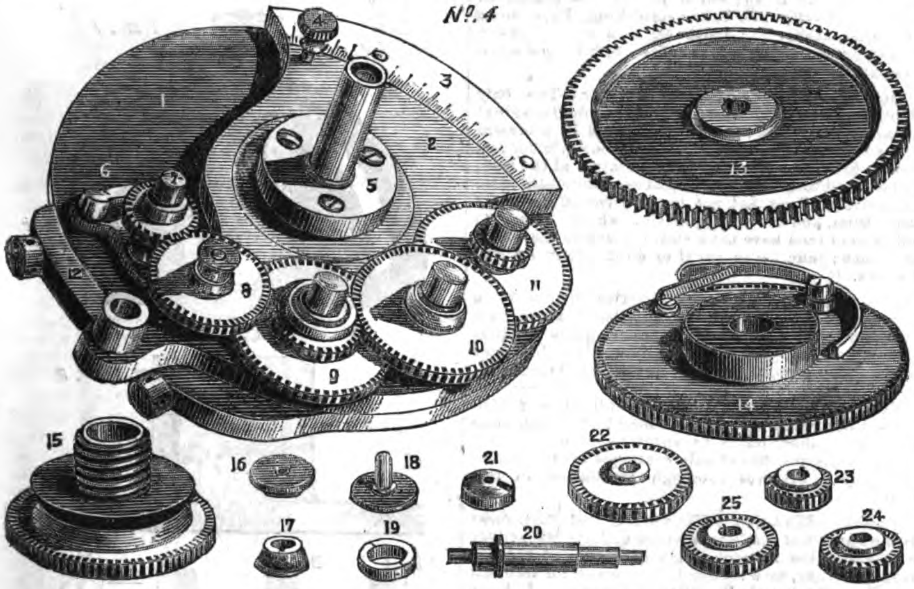
The boss of the main wheel, which I originally intended to make the depth of one of the change wheels, I subsequently made the depth of two, and ultimately I extended it to the depth of three, for a reason which I will immediately explain. The bracket 6 for carrying the planet wheel 7, and the bracket 12 for the axle of No. 13, are made of the same height as the upper surface of the radial arm carrying the change wheels.

addition of a division plate. It is not quite completed; but I do not consider it a part of the chuck, any more than the rose engine, though both may be combined to give variety to the figures. It is merely a combination of the eccentric with the epicycloidal chuck.

I should have noticed the rest of the disjecta membra of the chuck in No. 4. The part 3 is rebated and kept in position by two capstan-headed screws, which are loosened to allow the radial arm 2 to be moved to the right for eccentricity. 3 is graduated for the purpose. 20 is the axle of 13, passing through 12. The wheel 13 is keyed on the flanged end, and the nut 21 retains it in place. 22, 23, 24, 25, are the change pinions keyed on the other end of the axle. 17 is a washer of the thickness of the wheel, which is placed above or below the pinion to correspond with the level of 8 when in gear or out of gear with the main wheel, and 16 is a mill-headed nut for retaining the pinions in place.

I have not had sufficient time to try the powers of the chuck. The few trials I have made have been satisfactory; but I shall, no doubt, find several alterations necessary as I proceed. I am not foolish enough to

No. 4.



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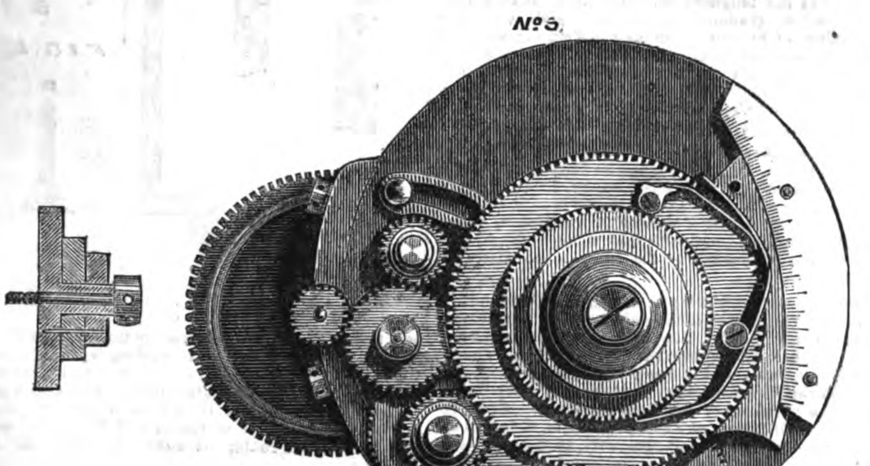


The sizes of the wheels may easily be calculated, as the main wheel of 120 teeth is 4in. diameter. In the number of teeth I was restricted by the number on the division plate of my lathe. The numbers adopted are as follows: The fixed and driving wheels on the back of the chuck 96 each; on the front the planet wheel 7 has 24, gearing with No. 8 of 40, attached to one of 20 below, which moves No. 9 of 60 teeth, carrying one above of 30, which gears into No. 10 of 60 teeth, having one of 24 below, which turns No. 11 of 60 teeth, which has one of 20 on a level with the main wheel, and gearing with it.

The advantage of the depth of the boss of the main wheel will now be perceived. The whole of the pins on which the change wheels revolve are of the same height as that of No. 11. In plate No. 3 it will be seen that the whole of the wheels are on a lower level than the main wheel, except the last, which gears with it; but the position of the pins is so arranged that any one of the series may be made to gear with the main wheel by inserting a washer of the thickness of the wheel, and raising it to the level required.

The arrangement for placing the figures on any part of the plate is the same as in my old chuck, with the

compare the workmanship of an unpractised amateur like myself, working by gaslight for amusement, with that of an experienced mechanic, such as Mr. Plant; but I have studied the action of the epicycloidal chuck for years, and believe the principle I have adopted is simpler and fully as efficient as that of the single geometric chuck, which, however, I have never seen but on paper. Of one thing, at least, I feel assured, that the amateur who may wish to construct one for himself will have no difficulty in deciding to which to give the preference.

I could send you some specimens on wood and metal, but they are rather heavy for the post, or rather for the pocket; but I may find an opportunity of forwarding some soon by a private hand. I need hardly add that nothing will afford me greater pleasure than explaining any portion of the work that may have been overlooked to any one who has the curiosity to ask for information.

I may state that the depth of the boss of the main wheel is ten-sixteenths of an inch. The wheels and washers are each three-sixteenths, which leaves one-sixteenth for clearance. To insure centrality in the wheels and washers on the same axle the larger wheel is cast with a boss on one or on both sides. On this boss the smaller wheels and washers are fitted, and soldered in some cases, and in others fixed with a pin screwed into the larger wheel.

The axles of the wheels, the bracket carrying the planet wheel, the screws, spring and catch, are all of steel, burnished and tempered blue. The rest of the chuck is of gun metal polished and lacquered. It is a handsome instrument when mounted on the lathe, and if it works as well as it looks I shall be quite satisfied.

Sydney, N.S.W. JOHN RAE.

COMPETITIVE EXAMINATIONS.

[3913.]—I FEAR that some little misconception has arisen in "Hedera's" mind with regard to my design in pointing out the paragraphs in Professor Barff's admirable little work. My intention was not to criticise Professor Barff, for he is, evidently, a thorough master of his subject; and what is more important, a truth-seeking and unbiased writer. Nor did I propose entering into the merits of the terms "anhydride" or "acid," as "Hedera's" reference to the preface and p. 174 would lead one to infer. My only purpose was to show that although Williamson and others have demonstrated that when sulphur is burned at high temperatures a compound (call it what you will) containing one equivalent of sulphur united to three equivalents of oxygen, is formed, yet this *fact* is to be ignored by candidates under examination, and something else substituted. Professor Barff, like a conscientious man, teaches the *truth*, for in the text he quotes Professor Williamson to prove that the above compound *is* formed. Like a conscientious adviser, in the fly-note he tells the reader that to meet the wishes of the examiners the intending candidate had better not say *that*, but something else. Is comment necessary? I believe not; but should "Hedera" feel disposed to make any I will read it with great pleasure. The stricture which I threw out does not apply to chemical examinations only; for while under examination, some time back, by the Civil Service Examiners, I ventured to correct an error in a dictation, in which a verb in the past and present tenses, both referring to the same time and action, was made use of in the same sentence; but the examiner politely told me to mind my business, telling me that I was expected to write exactly as he dictated, whether correctly or otherwise.

S. BOTTONE.

TELESCOPE WORK FOR MOONLIGHT NIGHTS.

[3914.]—PERMIT me, if you please, as one who is greatly attached to the pursuit of observational astronomy, very sincerely to thank your valued correspondent, Mr. Birt, for his communication (letter 3856), entitled "Lunar Objects for Observation, April, 1872;" and also to express a hope, in which I feel quite sure that I shall be joined by many other subscribers to the ENGLISH MECHANIC AND WORLD OF SCIENCE, that Mr. Birt will kindly continue to give a similar list for each successive month, so that henceforth we may anticipate that gentleman's working catalogue of lunar objects for examination and research, with much the same feelings of interest and pleasure as we have long been accustomed to regard the "Astronomical Notes" of "our" obliging guide "F. R. A. S." ROGANS.

AIR-BLADDER IN FISHES.

[3915.]—"LATRATOR" (let. 3810, p. 31), if an old dog, must have had his sensitive feelings very often hurt by persons either not quite up to the last new thing in science, or else tenaciously clinging to an old creed. I may in this case comfort him with the assurance that there are no signs of anybody's "advocating" the Borellian theory. I put forward the view generally held by writers on natural history and comparative physiology, and if I am not mistaken one still to be found in Müller. I wear my scientific creeds very loosely, and am quite willing to adopt the one chosen by "Latrator," to whom I owe particular thanks for the correction. M. PARIS.

The Speed of Bicycles.—Some idea of the speed at which bicycles may be made to travel can be gathered from the exploits of the proficient riders at the recent amateur champion meeting of athletes in London. The four-miles bicycle championship drew five entries, but F. V. Honeywell (Surbiton) had no difficulty in proving himself the swiftest, his times for the miles being—first, 4m. 35s.; second, 8m. 49s.; third, 13m. 9s.; fourth, 17m. 21s. The pace was slow at first, but it warmed up in the last mile, and he came in very fast. Keen, the bicycle builder, and said to be the most accomplished bicyclist out, started on a 52in.-wheel to do two miles under seven minutes, which he accomplished with $2\frac{1}{2}$ seconds to spare—the first mile being travelled in 3m. 29s., quite good enough to show the great pace which can be obtained on a large-wheeled bicycle.

A BRUTE of a man, says the *Farmer*, has been rightly served by an Edinburgh magistrate for cruelly ill-using a horse injudiciously intrusted to his charge. He belaboured the poor dumb animal until it fell on its knees, and then beat it again more savagely for falling. It was only after half an hour's "exercise" of this nature that the wretch cried "enough." For this fiendish gratification the magistrate, Bailie Cousin (all honour to him), gave him—heaven save the word!—thirty days, without the option of a fine. We should like to see all of the same kidney served in a similar manner.

REPLIES TO QUERIES.

₊ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[7182.]—**Time in England and New Zealand.**—The difference of time between two places is according to the relative difference in longitude, measured in degrees. Greenwich longitude is 0° 0′ 0″, and consequently a vessel sailing from the Thames, say to Wellington, New Zealand, goes east (via Cape of Good Hope) 174°32″. The earth revolving from west to east, we New Zealanders see the sun sooner than you do in England by 11h. 30m., so that when you are at church on a Sunday morning, we are going to bed the same evening. For public convenience a mean time is calculated, this is deduced from the mean meridian of longitude of the islands, which is 172°30″ east; this gives New Zealand time 11h. 30m. in advance of English time.—RATA, Wellington, New Zealand.

[9846.]—**New Zealand.** — For £ read lb. The following is from statistics published annually by the General Government of New Zealand:—Export value of wool during the year 1861, 7,855,920lb., value £523,728; 1865, 19,180,500lb., value £1,141,761; 1869, 27,765,636lb., value £1,871,280. 1861 and 1865 are valued at 1s. 4d. per lb. 1869 is the value declared by shippers, statistics for 1870 not yet published. The wool of 1869 exported to the United Kingdom was 26,360,152lb.; New South Wales, 882,404lb.; Victoria, 1,023,080. I will send 1870 when published, which will answer another correspondent, as to quantity shipped to America.—RATA, Wellington, New Zealand.

[10702.]—**Terrestrial Gravitation.**—From the reply to my query on p. 18, I fancy "Philo" cannot have read my letter on p. 406, nor Mr. Proctor's remark thereon in letter 3386, or, even at the risk of being somewhat tedious, he would have given the easy proof mentioned on p. 18, "that the joint attractive force of all the particles of a homogeneous sphere is the same as it would be if the attraction of all of them were exerted at the centre," because it is exactly what is required to show that the attraction at the equator of an oblate spheroid is less than at the poles. At present I am of opinion it is greater, and that if $\frac{R^3}{R^2} = R$, then $\frac{R + E^3}{R + E^2} = R + E$, and $\frac{R - E^3}{R - E^2} = R - E$, these equations shewing it to be so. Perhaps, before working out his easy proof, it would be as well if "Philo" ascertained the results of a few experiments upon the behaviour of liquid matter.—T. A.

[10739.]—**Centre Drill Chuck.**—This is no more than a piece of good round iron, ¾in., fitted to the ordinary round drill socket. A hole is bored up the back for clearance, considerably larger than the wire used for the drills within ⅜in. from the point, which is drilled the size of wire, a nut is tapped half way in with a thread, the other half a cone. The end of chuck is chased or screwed, and cone turned to fit the nut. The cone of chuck is then split from the point up, about ⅜in., in three places, into the central holes, which allow it to act like a spring forceps, and when the wire is put into its place and the nut tightened up, it holds it very firm. It will need case hardening, which can be done with prussiate of potash, or wet some finely-powdered charcoal with a solution of the same, and encase it therein in an envelope of old tin, and give it an hour or two's roasting at a dull red heat. Then slack it in water, when it is fit for use. Serve the nut the same.—JACK OF ALL TRADES.

[10776.]—**Gilding on Glass** (U.Q.).—If "Old Limelight" will use isinglass instead of size he will be able to gild his glass bright. It is what japanners always use. A pinch between the thumb and finger to half a pint of clear soft water, boil for a minute or two, and strain through a piece of muslin.—R. O.

[10816.] — **Scouring Paisley Shawls.**—The following is a most excellent recipe for scouring Tartan shawls, and I should think might with perfect safety be used for Paisley plaids. Scrape 1lb. of soap, and boil it down in sufficient water to make it a thin jelly. When cold, beat it with the hand, and add three tablespoonfuls of spirits of turpentine and one of spirits of hartshorn. Wash the shawl thoroughly in this mixture, then rinse in cold water until all the soap is taken off. Next, rinse it in salt and water, in order to prevent the colours striking. Wring the water out (with a patent wringer, if your correspondent has one), fold between two sheets, taking care not to allow two folds of the article washed to lie together; mangle and iron with a cool iron.—CHAMPAGNE CHARLIE.

[10822.]—**Permanent Polish** (U.Q.)—French polish: Wood naphtha, 4oz.; gum shellac, 1oz.; benzine, ½oz.; dragon's blood, ¼oz. Finish with wood naphtha.—SHAWFORTH.

[10829.]—**Electrical** (U.Q.)—This batch of questions really involves a complete treatise. 1. The copper deposited at the bottom of porous cells is due to local actions set up by particles of zinc and maintained by a process of conduction. 2. They waste the sulphate and break the pots. 3. "Square inches exposed to action" has different meanings in different cases. 4. The resistance of each pot depends on its porosity. 5. Strength of current should mean quantity, and intensity of current is the same. 6. The back of the plate takes part in the action, though much less than the front.—SIGMA.

[10882.]—**Damp Walls.**—Red brick is very porous, and rain comes easily through it, as I know from experience. The only cure is a coating of Portland cement, I have been told. Our village school-rooms were so treated. Waterglass might be first tried, but the best thing is the cement.—M. PARIS.

[10922.]—**Engine Query.**—Your valve has too much lead.—JACK OF ALL TRADES.

[10928.]—**Varnish for Oxford Frames.**—If required dark, use brown hard varnish; if light, use white hard varnish. If the grain is not very porous the varnish will fill it up; but if porous, use plaster of Paris mixed with water before varnishing. Paper down well after each coat; finish off with glaze. Many frames are only polished or rubbed with linseed oil.—SAMUEL SMITHSON.

[10930.]—**Want of Steam Power.**—The only thing I can recommend, if not done, is the following: An ash-pan damper; your boilers should be protected with some non-conducting material, your cylinder and steam-pipe also. Contract your chimney at the base, and exhaust these, if possible, and use your steam more expansively. Last, but not least, drive off a regular strap drum, and not off the driving wheel. If you do not succeed then have more steam space in the shape of a dome; your boiler ought to do it.—JACK OF ALL TRADES.

[10941.]—**Spontaneous Combustion.**—As a supplement to what "our" correspondent "Manus" adduces on p. 16 I could, if necessary, quote similiar cases where combustion, almost immediate, has been produced by rags, containing linseed oil, being carelessly thrown aside. Many years ago Sir W. O'Shaughnessy represented to the authorities at Calcutta, that linseed oil (raw more than boiled) was, more than any other, liable to spontaneous combustion, owing to the quantity of pulp contained in it. I think the subject deserves thorough ventilation in this country.—J. G.

[10950.]—**Madeira.**—The remark that Portuguese is the hardest of the Romanesque dialects was simply copied from the *Athenæum's* leading article of the previous Saturday, on a society lately formed for translating Portuguese and Brazilian literature. I know nothing of the language, but have heard that it contains more grammatical niceties and as many anomalies of pronunciation as the French; which, I suppose, is as far from Latin and anomalous as any of those languages, and would be the hardest to one knowing Latin only, though it is the easiest to us from its poverty, and also its nearness to English in idiom, and in number of identical words.—E. L. G.

[10954.]—**Circulation of the Blood.**—Is not "C. W. H." (p. 18), wrong when he supposes excess of carbonic acid gas in the air to be identical with "oxygen starvation"? Carbonic acid is held by good authorities to be not a diluter like nitrogen, but a sedative poison. I may add that when respiration is affected the circulation of the blood is so also.—M. PARIS.

[10954.] — **Circulation of the Blood.**—If a "Fellow of the Royal College of Surgeons" will reconsider the case, he will, I doubt not, give up the old and still prevalent opinion that the course of the circulation in the veins towards the heart is dependent upon what is often called motion—i.e., greater pressure of the air upon the blood out of the chest than in it. First, because the difference of such pressure is, unless in exceptional cases, very small; secondly, because the veins are not provided with rings as the suction-pipe of a fire-engine, and as the windpipe is, so as to remain open if exposed to excess of external pressure; but like soft hose-pipe would become flat when not distended with blood as they do; while thirdly, it is evident from the fact of the veins becoming more distended if the free passage of blood be impeded, as by a bandage round a limb, that the blood is driven onwards by force from behind, not drawn towards the heart, as is often supposed. It does not necessarily follow that the blood is sent throughout the whole circulation by the force of the heart alone, nor is it.—M. R. C. S.

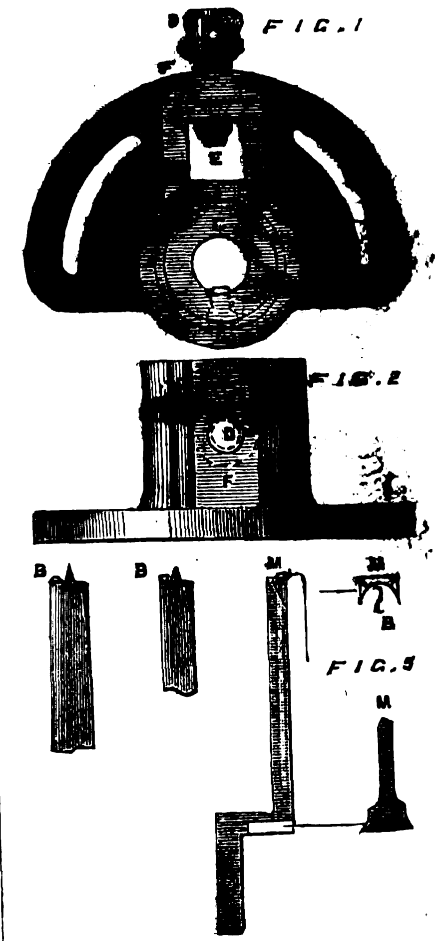
[10966.]—**How to Use a Book Without Hands.**—Let our friend pick up a bit of indiarubber with his teeth, and apply it to the leaf he wishes to turn over. He will find it has sufficient adhesion to the paper to turn it over easily.—ASSOCIATE.

[10974.]—**Polishing Granite.**—"Buz-Fuz" need not be so sceptical. The information supplied by me was quite correct. "Parepa-Rosa" afterwards, in a more detailed manner, accurately described the process. If "Buz-Fuz" will advertise his address I can send him pieces of granite, varying in colour and quality, which were polished in the manner described. If the piece he wishes to polish is of large size he need not attempt the task. It is not to be expected that a person at his first trials can easily accomplish that which is hard work for those in the trade. If the piece is small he may have some hopes of success. "Learn to labour and to wait!"—IRIOBAL.

[10987.]—**The Organ.**—The thicknesses of the bars are the nominal thickness of boards as bought; half-inch boards never measure half an inch. If "J. Butterworth" will lay out his soundboard as described, then lay his bars on, he will soon find the spaces required. The tenor C channel should be ⅝in. wide, and the upper G ⅛in.—J. D.

[10996.]—**How to Use a Book Without Hands.**—My father, who was confined to his bed, and gradually lost the use of all his limbs from rheumatic gout, so that at last he was unable to feed himself, had a very simple way of gratifying his taste for reading without trouble to others. His book was placed on a reading stand made to fit his bed, and he turned over the leaves with comparative ease by a long porcupine quill, which he held in his mouth.—A. J.

[11001.]—**Mortices in Hard Woods.**—The annexed sketch, if carried out, will serve you. It will require some fitting, but I believe it will be found to pay. It consists of a chuck of cast iron, see Fig. 1, that being a front or top view, and Fig. 2 showing the side; F B B are the boring tools, and M M M various views of the mortising tool, which is fixed in the holder or chuck in a mortice E, to any distance from



the boring tool to suit all sizes, by the set screw D, the said tools being packed with packing upon the front side next the bit, so that it will clear, the bit revolves while the chisel remains stationary. This chuck to be bolted upon the face of lathe head or general joiner, and as the mouth of mortising tool forces the chips into the hole the router bit clears it.—JACK OF ALL TRADES.

[11017.]—**Stuffing for Sofa.**—Everything is used for this job—such as cocoanut fibre, hay, straw, rushes or sedge, horsehair, shavings of wood, &c. You can use any of them, or all, as they are more generally mixed. Having a fillet run around the inside for nailing the canvass and webbing to, and outside for the cover, first proceed to nail on the webbing across, then the lengths interlaced; having finished that, strain your canvas and nail it. This should be done with broad-headed clouts, about ⅜in. or ½in., and they should be put into some boiled oil and turned out for a day or two to dry before using, as that prevents them from destroying the material. Now, having made your canvas-bed and your stuffing material, well beat and packed uniformly, spread it evenly over the same, and with a long upholsterer's needle tack it down lightly in its place. For this purpose I make needles out of steel umbrella ribs, which are eyed, tempered, and only need a point. Pass the cover over it and cut to fit, tack down in its place with Flemish tacks, and finish off with brass beading, which can be bought at most ironmongers, or with gimp and gimp pins. After that knot it down, either with leather buttons or tufts of worsted, as the case may be, to match cover, fastening your twine upon the underside.—JACK OF ALL TRADES.

[11052.]—**Rising and Setting of the Moon.**—A friend has pointed out an error I made on p. 673, Vol. XIV.), in subtracting 24·4m. from 19h. 22·6m. which should leave 18h. 58·2m., not 19h. 0·22m. In this case even the large mistake of 2m. is of trivial moment to the amateur observer. The disc of the moon occupies more than 2m. in passing the meridian, and the error of declination thus induced would only change the fifth figure of the logarithm. Strictly, when the semi-diurnal arc has been tentatively found, the declination corresponding to the approximate times of rising and setting should then be employed to give a more correct semi-diurnal arc. But in ordinary cases on shore this refinement is unnecessary, because from intervening hills the moments of rising and setting are not perceivable. In my case the moon is sometimes a quarter of an hour behind the predicted time, her presence, however, throwing a glow over the eastern sky. With a perfectly clear horizon the full orb of the moon would be distinctly seen, when in reality the upper edge was barely becoming visible. This is caused by refraction. Consulting Rios' table, which specifies the ascensional difference for all latitudes from 1° to 64°, and declinations from 1° to 30° inclusive, I find the arc to be added to 6 hours for lat. 37°, dec. 24°, to be 1h. 18m. for lat. 30°, dec. 25°, 1h. 25m. The easiest way of interpolating quantities in tables of double or treble argument is that given by Loomis. Thus the difference for 37° and 38° is 3m., $\frac{5}{6}$ of 3 [because lat. is 37 $\frac{5}{6}$] = $2\frac{1}{2}$m. Again, the difference between 24° and 25° is 4m. $\frac{37 \cdot 8}{60}$ of 4m. = $2\frac{1}{2}$m. As all these quantities are additive, we get

$$\begin{array}{r} \text{1h. 18m.} \\ + \ 2\frac{1}{2}\text{m.} \\ + \ 2\frac{1}{2}\text{m.} \\ \hline \text{1h. 23m.} \end{array}$$

which agrees with the calculated arc within less than half a minute. Rios' table fills two quarto pages, and would occupy a full page of the Mechanic. If desirable I would send a copy. Perhaps such a universal table might be useful to your numerous amateur astronomical subscribers.—Thomas Buchanan.

[11054.]—**Calculating Contents of Cylindrical Vessels.**—Your correspondent "E. L. G." has made a still greater mistake than A. J. Shaw, or there is a misprint. 1ft. 8in. is 1·666ft, not 1·75, nor yet 1·72.—W. H.

[11054.]—**Calculating Contents of Cylindrical Vessels.**—I think if "E. L. G." will kindly refer to qy. 11054 (No. 363, p. 648), he will see that A. J. Shaw's formula is right, and far simpler than that which he gives. There is in that letter, I believe, a typographical error, and, as the human race are all prone to error (typos not excepted), it is there given area of base = $1{\cdot}72^2$, &c., &c.; whereas it should have been $1{\cdot}75^2$, &c., that being the decimal equivalent in feet for 1ft. 9in. Hence, as I take it, not an error on the part of A. J. Shaw. The cubical contents is also correct, as near as it is possible to get it. Now, in "E. L. G.'s" letter (p. 19, No. 365) there is also an error, whether clerical on his part, or misprint by "typo," I don't know. It is 1ft. 8in., instead of 1ft. 9in., although the result coincides with A. J. Shaw) = 10·823 cubic feet. There is no simpler formula, that I am aware of, than $D^2 \times {\cdot}7854 \times H$ = cubic contents, where—

D = diameter in feet or inches, as the case may be.
H = height in feet or inches, as the case may be.

${\cdot}7854 = k$, or the co-efficient ratio $= \frac{\pi}{4}$,

unless you use the slide-rule; then ·7854 on C, put over 1·0 on D, gives the diameters of circles on D, and the corresponding areas on C. In this case it would read 1·75 on D = 2·4 on C. This, multiplied by 4·5, the height, would give 10·8 the cubic contents, and sufficiently near for the majority of purposes.—Tubal Kain.

[11054.]—**Calculating Contents of Cylindrical Vessels.**—Thanks to "A Barrister" for calling attention to my "terrible blunder." I should have said "the solid content of a cylinder is equal to the square of the semi-diameter × the height × 3·14159," or, to put the formula in another way, "the content is equal to one-fourth the square of the diameter × the height × 3·14159." I distinctly remember my attention being several times distracted when writing my replies to queries for that week, which may account for my mistake. I hope this explanation will be accepted: apologising to the querist for having so nearly led him into a fatal error.—Excelsior.

[11061.]—**Polishing Mahogany.**—This is bright, and is composed of equal parts of shellac and pale resin; it is used for carved work in general, as it is not possible to polish such, and is used pretty generally now for cheap goods.—Jack of All Trades.

[11075.]—**French Polishing.**—See reply 11061. You need a soft brush. I find the human hair far better than camel's-hair brushes. It needs no preparation.—Jack of All Trades.

[11075.]—**French Polishing.**—If the article is in the lathe use French polish with a rubber, and finish off with spirit; but, if not so particular, use brown hard varnish, paper down, then use glaze with a brush; this is a so-called trade secret.—Samuel Smither.

[11080.]—**Turkey Stone Cutting.**—Use a piece of zinc or copper, or iron hooping will do, and silver sand.—Jack of All Trades.

[11081.]—**Organ Pallets.**—If "E. F. C." will try the experiment himself and let us know the result, it would be satisfactory to a good many of us. Where would "E. F. C." put his pallets—into the channels, or where? The last sentence in the query is unnecessary.—J. D.

[11089.]—**The Organ.**—The inside line on the scale is three-eighths from the other line, and, therefore, two seven-eighths from the left or straight edge; of course seven pipes are less than the three-inch C. The sizes given are the inside diameters.—J. D.

[11096.]—**Varnishing Wall Paper.**—If your paper has not been sized, and you varnish with turpentine varnish, into which you have put a little linseed oil, it will have the desired effect in places. But as the article has been more or less pasted and saturated in places with boiled paste it will be glazed in patches, which would be difficult to eradicate, but if your paper was put on with raw flour and rosin for paste, it would stand a better chance of success.—Jack of All Trades.

[11109.]—**Soldering Iron.**—If "G. E. E." gets some of the best German silver and melts it down with one-fourth zinc he will have a solder that will suit him.—Jack of All Trades.

[11112.]—**Artificial Leg.**—There is no spring required at the toe joint, as that is only for the convenience of getting on the boot, as the patient can no more bear the thrust upon the flesh than upon the stump; it is made to take its strain equally, the bucket being packed with some coarse worsted material, and the bottom with a horsehair cushion, and sometimes a spring, cork, or indiarubber. It is held up by three straps to a strap that passes around the waist, and a shoulder strap is used. I have used, or rather fitted up, the old timber toes in various ways; the legs of some telescopic with a spiral spring; the shoes for some made of leather, and an indiarubber ball inside; and I have used cork for the same. In all cases the heel should either be of cork or rubber, and the thrust of dead head should be upon the knuckle, and not upon the pin-hole or tenon. Indiarubber is very good when warm, but in cold weather becomes very hard. Where it is in contact with parts having any circulation of the blood it can always be depended upon for its elasticity.—Jack of All Trades.

[11117.] — **Water-Wheels.** — I am obliged to "Tubal-Kain". Being accustomed to 5ft. and 7ft. wheels, but not knowing the rule, I am obliged to copy from others. Finding the fourth bucket to come square with the centre staff, I am now in a fix to know how to find the number of buckets. Should feel obliged to "Tubal-Kain" for an answer.—Youngster.

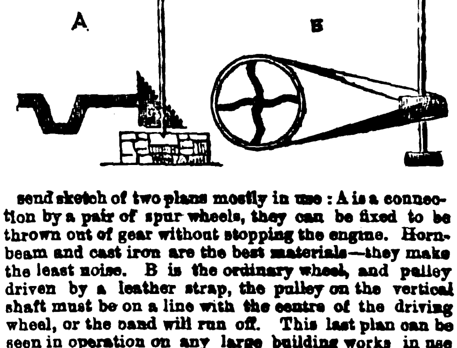
[11119.] — **Heat of Brick Kiln.** — This is a thing that has been wanted some time. Leave two clearances right across from the entrance, about 1ft. apart, and when the entrance is bricked up, make it so that you can take out a brick, and inspect it about half-way down; you will have a better idea from there than the top part.—Jack of All Trades.

[11120.]—**A Question of Sight.** — Something must surely have prevented your acute correspondent, "E. L. G." perceiving the ironical tenor of my remarks at p. 674. My meaning would, however, have been more obvious had the compositor italicised the words underlined in the "copy." "V. B." asks "Why should 'A. J. V. G.' consider the sun as a luminous point?" Why, indeed! The fact is I never had so considered. I distinctly said "*if* the sun be regarded as a luminous point," &c. But who, other than an idiot, *would* so regard the sun? The virtue of the whole question is in the "if;" and so with "Fiddler's" question. If the ether which fills space, not only transmitted light from a luminous source by wave motion, but also scattered light like our dust laden atmosphere; and if at a distance from the earth, of (say) 30 or 40 diameters, a reflecting screen could be placed, so as to represent the walls in "Fiddler's" room, then, and then only, would inhabitants of our earth be in a position in anywise relative to that of the supposed dwellers on "Fiddler's" orange. Because "Fiddler" would not trouble himself to ascertain whether the causes which obtained to produce the effect observed in his experiment also obtain in nature, he rushes his absurdities into print, coolly informing us that probably there is more therein than is apparent at first sight.—A. J. V. G.

[11120.]—**A Question of Sight.**—Steady! J. Barwick, steady! Sound has not a velocity of 11090ft. (!) per second through atmospheric air. You surely made a slip there (p. 20), and meant 1109ft. Yet why say sound has one-eighteenth the velocity of light: the one hundred and eightieth is nearer the mark.—Touchstone.

[11120.]—**A Question of Sight.**—Mr. Barwick darkens this very simple matter as much as the querist and "A. J. V. G." themselves. We know nothing about the comparative nearness of atoms, of ether, or of air, or any other matter. The velocity of sound in air is only a tenth of what he states, and is just the same (at the same temperature) if the atoms be twice as near or twice as distant. "Fiddler" need not cut off "from himself" either direct or reflected candlelight—their reaching him nowise affects the experiment, but their reaching the orange. His own face, even if a negro, will send it more than the moon does the earth. Direct rays from the largest suns do not injure "our sight power" if we are distant enough, as in looking at the Pleiades or the Milky Way; but reflected ones will very speedily, if he puts his eye at the solar focus of, say, a tablespoon. Light cannot be said to be "deemed" vibration: it is as well known to be so as it is known that Ireland is smaller than England. Light does not cease "instantly that combustion stops." If we are as far off as from many stars, we may not begin to see the light till the combustion has already ceased 1,000 years. An earth's shadow "cast by the moon on the sun" is sheer nonsense. The distance of what he calls the "focus of the shadow" of the earth, namely, the extreme extent of her shadow, is readily reckoned, being that at which the earth and sun subtend the same angle; this angle being least when we are farthest from the sun, on July 1, our shadow is then longest, and shortest on January 1, when we are nearest him. It extends but four times the moon's distance, and therefore can approach no other body. If we had a satellite 1,000,000 miles distant, or as far as Jupiter's fourth is from him, it would be too distant ever to be eclipsed.—E. L. G.

[11126.]—**Turning Perpendicular Shaft.**—"One in a Fix" wants to turn a shaft vertically without bands or wheels. It is very unusual to do so; of course it could be driven by a crank and connecting rod, by so doing it would be of no advantage, on the contrary, a vertical shaft is required to revolve to do certain work. The best plan is by a pair of spur wheels, or the next best plan by a strap; by these means the speed can be regulated as required, but if driven by a crank a new crank is required if the speed be altered.



send sketch of two plans mostly in use: A is a connection by a pair of spur wheels, they can be fixed to be thrown out of gear without stopping the engine. Hornbeam and cast iron are the best materials—they make the least noise. B is the ordinary wheel, and pulley driven by a leather strap, the pulley on the vertical shaft must be on a line with the centre of the driving wheel, or the band will run off. This last plan can be seen in operation on any large building works in use for driving the mortar-mills, or for pumps at any pumping-station.—Samuel Smither.

[11129.]—**Greek "Upsilon."**—It ought to have been said that this is a misspelling of the letter's name, tolerable only in French—due, I believe, to French astronomers, and which ours (begging Mr. Proctor's pardon) ought not to copy, knowing as they must that its established rendering in our letters for 2,000 years, and the only one intelligible on any principles of transliteration is *Hypsilon*. As all words beginning with it were aspirated, so the tendency to mix an *h* with the sound when emphatic may be noted now, as in French priests saying mass. The "Harrow Fellow" had better have let this query alone. "The English *u* gives the *only* sound of the Greek upsilon,"—(the *Harrow* upsilon, that is). Now first, what is "the English *u*"? Rule, mule, pull, cull, curl! Here are at least four sounds, if you pass over mere difference of quantity, rule and pull as nothing. Next, how can there be an *only* sound of a letter that is notoriously in ancient Greek always a vowel, and in modern mostly a consonant? But the best of the joke is among all the five or six "English *u*" sounds, it happens to be certain we have neither the ancient vowel Υ nor the modern consonant! (See "Argent Sable's" reply.) Then, our "Harrow Fellow's" way of writing in English the Greek for "I strike," oak, and circle, could not be reconciled with any possible way of distinguishing other words. His "tupto," "drus" and "kuklos" could only represent τουπτω (were there such a word), δρους and κουκλος; the termination os representing none but ως, while us is the sole rendering of ους, and υς of υς.) The historical and sole right way of putting these words in our letters, even at Harrow, is *typto*, *drys*, and *cyclus*; and innovations like "A Harrow Fellow's" can only lead to the most barbarous confusion, and puzzles like the MSS. of the dark ages.—E. L. G.

[11133.]—**Curing Bacon.**—Have a cistern built of bricks and Roman cement, about 2ft. deep, and line with Roman cement. Have a grating made of wood edgeways, and about 6in. deep, put in the bottom for the flitches to rest upon. After they have laid for a day or so, take for every peck or 7lb. of salt ½oz. of saltpetre, a ½lb. brown sugar, and ½lb. basalt; (powder and well mix, and having run a large knife under the blade-bones and knuckles of cushions and gammons, and well crammed with the compost, put about a couple of inches of water in the bottom of tank. Well rub the flitches with this compost, and lay them one upon the top of the other, with a good sprinkle between. After they have been there for four days, turn them about; let them be for four days, turn again, and sprinkle some more; turn over three or four times, then put them into the brine, and in three weeks they will be ready for smoking. For which, take out, drain and dress dry with pollard, and hang up in smoke; left for a week.—Jack of All Trades.

[11141.]—**Phrenology.**—Procure Dr. Gall's works or Fowler and Wells' works. I have read phrenological works for years past. Although I do not indorse all that is written, I have obtained a deal of useful information from such sources.—Samuel Smithers.

[11148.]—**How to Disinfect a House.**—"A Barrister" may think it "absurd" to talk of filling a house (as I have done a small outhouse) with chlorine, and it would be absurd to use the quantities necessary for such filling if any one had ascertained, by "practical knowledge of the subject," what proportion of chlorine and air may be depended on as infallibly disinfecting. I should not myself, however bad the case, employ in a house (as I did in the outhouse) the full quantities I named, or perhaps a quarter; but this would be pure matter of guess and risk. A practical knowledge that some known fraction is as safe as displacing the whole air by chlorine may, and I hope does, exist; but plainly, if "A Barrister" had this knowledge any more than I have, he would have stated that fraction. The question being absolutely "how to disinfect" a place, however bad, I confined myself to saying how this may be done infallibly, leaving to the querist's judgment how far he would go. There is neither difficulty nor danger in arranging to capsize a whole carboy of acid into a pan by pulling a cord outside the house. If the old sulphurous acid plan, used before the discovery of chlorine, be really comparable to it (Davy, and all since him, say not), there must be a minimum proportion of sulphur to air required, for the "pound in each room" (large or small) is, to quote "A Barrister," a "nice joke." I have not the slightest faith in it, and the sulphur dioxide being a vapour, not a gas, and uniting with steam to deposit itself, corrodes paper and vegetable cloth, and hangs about woollen things with its vile odour, as every one knows; whereas chlorine flies off without leaving a trace, and when dry (as I directed) neither bleaches nor corrodes dry things. But beware of thinking you can get it thus good and harmless from muriatic acid instead of salt and sulphuric, and do not confuse it with the vile vapours given off by chloride of lime; they are very different. Mr. Davis's reply (p. 21) is very suggestive, and from what we hear of the virtues of carbolic acid I should certainly try that plan on a house of any size, rather than trust to a very partial filling with chlorine. But as for clothes or bedding, I would simply put them in a closet or case in the open air, with all but its top made airtight, and an arrangement for capsizing sulphuric acid on mixed salt and manganese within it, in the quantities adequate to displace all the air by dry chlorine, as described in my former reply (p. 675). This is both cheaper and more fully verified as effectual, I believe, than any baking or imbuing with vapours; and however offensive the clothes, the chlorine will leave them more scentless than if new from the loom.—E. L. G.

[11148.]—**How to Disinfect a House.**—Chlorine and sulphurous acid are both cheap and effectual disinfectants, and as much as will fill the place with a decided smell of the disinfectant, if continued an hour or so, should be sufficient to destroy all organic impurity; there is no occasion for any such quantity as "E. L. G." speaks of. He proposes for a house enough for a good-sized town. Iodine, though dearer than the others, is one not so dear as to make its cost prohibitory; it is less disagreeable than chlorine, and less injurious to clothes and some furniture than sulphurous acid. It has not been very much used, but some of your readers have no doubt tried it with good effect for preventing annoying smell, and probably for destroying infection—I say probably, for that is often difficult either to prove or disprove, as many exposed to infection are not affected, and many who are affected have been injured otherwise than by the way assumed. —M. R. C. S.

[11149.]—**Examination Question.**—I fail to see why an examiner should not set such a question, as it is only by such physico-chemical questions that he can assure himself that the student has acquired a knowledge of the laws of gaseous combination, and the laws which control the rational formulæ of volatile compounds.

First Experiment.

Original gas	= 100 vol.
After the addition of oxygen	= 400 „
After explosion ($16\frac{1}{4} \times 4 = 65$)	= 465 „
After absorption of CO_2	= 295 „
After absorption of OH_2	= 25 „

This residual gas can consist only of unburnt oxygen. The total amount of oxygen burnt is equal to 305 volumes (found by adding half the aqueous vapour to the carbonic anhydride), which is 5 volumes more than what was added to the original gas. This 5, plus the residual 25, equals 30 volumes, which must have been combined in the original gas. The volume of hydrogen equals the volume of aqueous vapour (270). The volume of carbon vapour equals half the volume of carbonic anhydride (85).

O = 30 vol.
H = 270 „
C = 85 „

385

Percentage composition :—

385 : 100 : : 30 : 7·78
„ : „ : : 270 : 70·02
„ : „ : : 85 : 22·2

100·00

Second Experiment.

Original gas	= 100 vol.
After the addition of oxygen	= 400 „
After explosion ($17{\cdot}5 \times 4 = 70$)	= 470 „
After absorption of CO_2	= 290 „
After absorption of OH_2	= 10 „

This residue consists of oxygen. The total oxygen consumed equals 320 volumes, found according to the above method, being 20 volumes more than what was added to the original gas. This 20 volumes, and the residual 10 volumes, equals 30 volumes, which must have constituted the original gas. Hydrogen equals [illegible] volumes; carbon equals 90 volumes.

O = 30
H = 280
C = 90

400

Percentage composition :—

400 : 100 : : 30 : 7·50
„ : „ : : 280 : 70·0
„ : „ : : 90 : 22·50

100·00

—R. Tervet.

[11166.]—**Area of Segment of Circular Ring.** —"Bernardin," on p. 22, has fallen into a greater mistake than "Thankful" by his rather indefinite data for the question. What meaning can be attached to apothegm, or, accuracy to ·866? He certainly must mean $\frac{1}{2}\sqrt{3}$, ·8660254, the cosine of 30°. As the breadth must undoubtedly be understood as the difference of radii of the two sectors (not the difference of the two cosines) with radii 70 and 50 respectively, as "Bernardin" intimates. The solution must be thus:

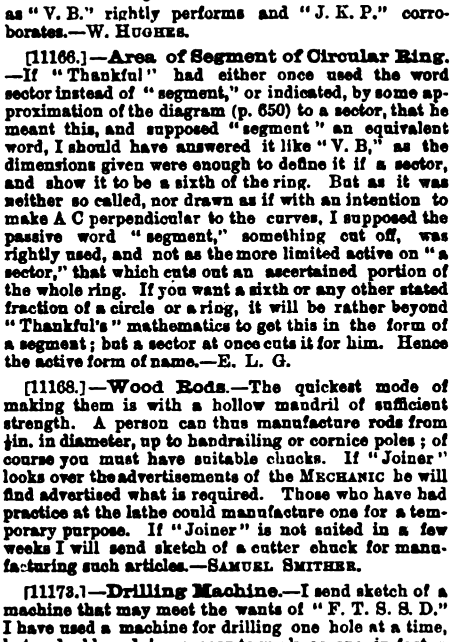
$$\frac{70^2 - 50^2}{6} \times 3{\cdot}1416 = 1256{\cdot}64,$$

as "V. B." rightly performs and "J. K. P." corroborates.—W. Hughes.

[11166.]—**Area of Segment of Circular Ring.** —If "Thankful" had either once used the word sector instead of "segment," or indicated, by some approximation of the diagram (p. 650) to a sector, that he meant this, and supposed "segment" an equivalent word, I should have answered it like "V. B," as the dimensions given were enough to define it if a sector, and show it to be a sixth of the ring. But as it was neither so called, nor drawn as if with an intention to make A C perpendicular to the curves, I supposed the passive word "segment," something cut off, was rightly used, and not as the more limited active on "a sector," that which cuts out an ascertained portion of the whole ring. If you want a sixth or any other stated fraction of a circle or a ring, it will be rather beyond "Thankful's" mathematics to get this in the form of a segment; but a sector at once cuts it for him. Hence the active form of name.—E. L. G.

[11168.]—**Wood Rods.**—The quickest mode of making them is with a hollow mandril of sufficient strength. A person can thus manufacture rods from ½in. in diameter, up to handrailing or cornice poles; of course you must have suitable chucks. If "Joiner" looks over the advertisements of the Mechanic he will find advertised what is required. Those who have had practice at the lathe could manufacture one for a temporary purpose. If "Joiner" is not suited in a few weeks I will send sketch of a cutter chuck for manufacturing such articles.—Samuel Smither.

[11173.]—**Drilling Machine.**—I send sketch of a machine that may meet the wants of "F. T. S. S. D." I have used a machine for drilling one hole at a time, but a double rod is as easy to work as one, in fact, a dozen could be worked at once at the same speed and



bore the same depth. Of course the inquirer understands the ordinary machine for drilling, therefore I need not enter into full details. A is a drilling-machine with two rods driven from the lathe; it can easily be adapted for steam power; one rod drives the other rod by means of a pair of 1in. cog-wheels, same size, and of course the same speed.—Samuel Smither.

[11186.]—**Length of Sidereal Day.**—The apparent discrepancy between my statement of the length of the sidereal and mean solar day, quoted from Herschel, and that quoted by "J. M." from the *Nautical Almanac* is apparent only. As the year contains 366¼ sidereal days, but only 365¼ solar days, one being apparently lost by the earth's revolution round the sun, the mean solar day must be nearly 1·365th longer than the sidereal day, and the hours, minutes, and seconds longer in the same proportion; the sidereal day, which is 3m. 55·91s. shorter, reckoned in solar time is 3m. 56·55s. shorter; reckoned in sidereal time, the real difference being the same—the pendulum of a sidereal clock having a rather shorter pendulum, about a fifth of an inch shorter, if I recollect right, and if wrong, no doubt "Sigma" will set me right in his usual polite manner.—Philo.

[11186.]—**Length of Sidereal Day.**—There must be a difference between the interval of two returns of a star (supposed to have no proper motion) to the meridian, and the return of the equinoctial point; which latter, I believe, is what astronomers always understand by a sidereal day. Moreover, as the precession is not uniform from day to day, the latter cannot be so constant a period as the former.—E. L. G.

[11188.]—**Arithmetic**—Will J. Lewis try and reduce £19 19s. 11¾d. to decimals, and then multiply. First to the decimal of pounds, the results of which will be a little short of £400. Secondly, to shillings and decimals of a shilling, and then multiply; the result will be nearly £8,000. Thirdly, to pence with decimals, the result will be nearly £96,000. And, last of all, reduce the sum to farthings and then multiply; he will find the result to be nearly £384,000. If the above four results do not open his eyes let him try to multiply 19lb. of sugar and 7oz. of pepper by 19lb. of soap and 7oz. of snuff. By means of which operation perhaps the requisite number of grains of common sense will be found. But, joking apart, a little experiment of the above kind is very good for practically showing that concrete numbers cannot be multiplied together.—Moneta.

[11188.]—**Arithmetic.**—Messrs. Harris, Lewis, & Denoarigbe can evidently enjoy a joke, else how is it possible to account for the gross absurdities perpetrated by the trio in their worse than useless replies (?) to the above query? From the several replies to this query the inference is inevitable that pounds multiplied by pounds give a product in square pounds in the same manner that length multiplied by breadth would produce a denomination to be referred to the table of land measure. Perhaps it may be the characteristic of our Transatlantic brethren to answer a question by asking another question. Will Mr. Lewis kindly condescend to define a square pound? When this is done in a satisfactory manner the point will be conceded in his favour. Until then the replies (?) are worse than useless, and are equally unworthy of the nineteenth century and of the English Mechanic.—Jas. Hastie.

[11188.]—**Arithmetic.**—The object of a "Yankee answer" was to induce J. Lewis to consider whether his question had any meaning, and if so, what he meant, and whether he could not say it. Multiplying a concrete quantity by another concrete quantity (or the same) has no meaning. He might as well talk of subtracting 10 yards from 15 pounds—what is the remainder? But £19 19s. 11¾d. is £19 $\frac{959}{960}$, and though you cannot speak of multiplying this sum by itself (which is nonsense), if you take away one of the two £ symbols, then you can multiply that sum by the abstract number 19 $\frac{959}{960}$, or this abstract number by itself, and in two lines, by my method of squaring, lately discussed, and used in reply 11054 (p. 19). It is $20 - \frac{1}{960}$, and therefore its square is $= 400 - 2\left(\frac{1}{960}\right)20 + \left(\frac{1}{960}\right)^2$ If it be the money £19 19s. 11¾d. that is to be multiplied (not, observe, by £19 $\frac{959}{960}$ but by 19 $\frac{959}{960}$, without the £), you have but to subtract from £400 twice $\frac{20}{960}$£, that is 40 farthings (not J. King Harris's 20) and add $\frac{1}{960}$ of a farthing. So that the answer is £399 19s. 2 $\frac{1}{3840}$d. O'Gorman's "rules" are nonsense.—E. L. G.

[11192.]—**Chemical.**—"Oxygen" can try this plan for separating his nitrate and carbonate of potassium, which I think he will find to answer:—Evaporate down cautiously, and allow to crystallise, when crystals of nitrate containing a little carbonate will be obtained. To separate these repeat the above two or three times, when crystals of nitrate practically pure will be obtained. The carbonate can be best purified by evaporating the remaining liquors (from each crystallisation) down to dryness and igniting with charcoal, then redissolve in water, evaporate down, and crystallise, when carbonate of potassium will be obtained.—J. B.

[11193.]—**Pumps of Portable Engine.**—I cannot understand the explanation of "Mendex," p. 23, No. 365, nor can I conceive how the placing of a third valve in a pump would convert it into a self-acting machine, able to empty a pond, although a siphon would do so. The cause of the engine feed pump not drawing is because the water in the barrel of pump gets so hot as to form vapour, which vitiates the vacuum. The remedy may be applied either by placing a valve as close as convenient to the boiler, so that the water in feed pipe may keep cool, or by raising part of the suction pipe higher than the pump, so that, on starting, some of the cold water will flow of its own accord into the barrel of pump, which would cool it.—A., Liverpool.

[11217.]—**Platinic Chloride.**—I think Mr. Somerville will find this plan answer. Add to the solution chloride of ammonia and a little alcohol, let it stand a sufficient length of time for a precipitate to form, then filter, and wash the precipitate—which will, of course, be the ammoniac chloride of platinum—with chloride of ammonium and alcohol; then ignite it, and if the chloride of platinum be desired treat the spongy platinum obtained in the usual way.—J. B.

[11225.]—**Jupiter's Satellites.**—I have to thank "F. R. A. S." for his prompt reply to my query, and at same time to say my lat. is 50° 40′ 38″ and long. W. = 3° 14′ 10″, for which I reckon 12min. 57sec. for the culmination of a star after Greenwich (allowing also for acceleration). Am I correct in supposing that such a small interval would have no effect as to the instant, whether viewed at my station or Greenwich, or at any rate only the fraction of a second?—Vega.

[11229.]—**Ammoniac Chloride.**—Before telling "J. N." how to make the substance mentioned above I may as well tell him that he cannot make it cheaper than he can buy it. He can make it readily in the following manner: Take pure hydrochloric acid, if slightly diluted it will be better, and neutralise with ammonium hydrate (common ammonia); he can tell when it is neutral by its neither turning red litmus paper blue, or blue red. Having neutralised it, evaporate down cautiously, and allow it to crystallise, when crystals of ammonic chloride will be obtained.—J. B.

[11244.]—**Silicate of Soda.**—Silicate of soda, or soluble glass, is usually made on the small scale by fusing together in a crucible 15 parts of sand with 8 parts of carbonate of soda and 1 part of charcoal. The mass thus formed is scarcely soluble at all in cold water, but dissolves when boiled with water, yielding a strongly alkaline liquid. With regard to the manufacture on a large scale, I must refer "S." to some of the back volumes, where several excellent descriptions have been given, with engravings of the furnaces used in the process. I am sorry that I do not know which number it was in, but perhaps some of "our" correspondents may remember.—J. B.

[11265.]—**Drawing a Boundary Line.**—Or rather correcting a boundary line incorrectly laid down. The piece marked I projects beyond A B, the following pieces, viz.:—2·20 × ·20 + 2·48 × ·24 + 1·98 × ·30; or, altogether, 1·6292 chains. The other piece marked G projects beyond A B, the following pieces, viz:—2·40 × ·30 + 2·60 × ·60; or, altogether, 2·28 chains, and the difference between these two is ·6508 chains. Therefore G projects ·6508 chains more than I, and the boundary will have to be drawn towards I to make G project less, and I project more, which it will do both at the same time; or, in other words, half of ·6508 square chain has to be taken off G and added to I. Now, A B is, altogether, 11·66 chains long, and hence $\frac{\cdot 3254 \text{ square chains}}{11\cdot 66 \text{ chains long}}$ will give the distance A B has to be shifted. This, worked out, gives $2\frac{461}{583}$ K. P.

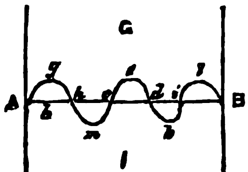
[11265.] —**Drawing a Boundary Line.**— (1) Find the area of the triangles A *g h*, *c e d*, *i l* B, which are cut off from the field I by the trial-line A B.

$$\frac{(220 \times 20) + (248 \times 24) + (198 \times 30)}{2} = 8146 \text{ square links.}$$

(2) Find the area of *h m c*, *d k i*, cut from G.

$$\frac{(240 \times 30) + (260 \times 60)}{2} = 11400 \text{ square links.}$$

(3) Divide the difference of these two results by the



total length of the trial line A B, and the quotient will be the answer required.

$$\frac{11400 - 8146}{220 + 240 + 248 + 260 + 198} = \frac{3254}{1166} = 2\,\frac{922}{1166}.$$

Dividing the fraction by 2, we get $2\frac{461}{583}$ links as the distance which the trial-line A B must be moved towards I, in order that the area of the three triangles cut off from I may equal the area of the two triangles cut off from G. Assuming the surveyor to be in the field I, the "heights" *g e l* are termed "offsets," and *m k* "insets."—EXPERIOR.

[11266.]—**Lifting Water.**—I think if "Ignoramus" were to get a small centrifugal pump it would answer his purpose best, as it discharges a continuous and steady stream, and is little affected by sand, mud, or grit. There was a small centrifugal pump exhibited at the Bath and West of England Show at Southampton, 1869, worked by a one-horse engine, that delivered a stream of water at the rate of 20 gallons a minute.—A COUNTRY TINKER.

[11271.]—**Naval Architecture — Misapplied Wit.**—On p. 47, there is a tissue of rubbish signed, "S. Tremayne, Cantab," which led me to refer to the question on p. 677, which I find is a similar tissue of rubbish, addressed by W. M. Hirpen, to "S. Tremayne" or "Jack of all Trades." Perhaps these people, who have not sense enough to understand the use and purpose of the question department of the ENGLISH MECHANIC (and whose mental calibre is about equal to that of the young ruffians who break windows and wrench off door knockers in search of amusement befitting gentlemen), will have the goodness to address their future witticisms to *Fun*, or, as that periodical might indorse the communication "Declined without thanks," some of the more destitute of the dismal prints which call themselves comic might be induced to welcome Mr. W. M. Hirpen, and gratify his laudable desire to see himself in print.—SIGMA.—[See "Answer" to "A Barrister."—ED.]

[11274.]—**Cement for Stourbridge Clay Fire Backs.**—Fire clay, 42·5; loam sand, 42·5; glass, 10·0; chloride of sodium, 5·0. Another: Fire clay, unburnt, 66·6; burnt, 33·4. Mix well with ammoniacal liquor.—G. D.

[11276.]—**Extracting Glass Stopper.**—Warm the bottle and put a drop or two of turpentine round the stopper, then give it a smart blow on the bottom with the hand, turning the bottle upside down, of course.—EUREKA.

[11276.]—**Extracting Glass Stopper.**—With a feather rub a drop or two of salad oil round the stopper close to the mouth of the bottle, which must then be placed before the fire at a distance of eighteen inches; the heat will cause the oil to insinuate itself between the stopper and the neck. When the bottle has grown warm, gently strike it on one side and then on the other with any light wooden instrument. If it will not yet move, place it again before the fire, adding another drop of oil. After a while, strike again as before, and by persevering in this process, however tightly it may be fastened in, you will at length succeed in getting it out.—F. T. S. S. D.

[11276.]—**Extracting Glass Stopper.**—Put the bottle into boiling water, the expansion of the air will drive out the stopper.—W. L. GILES.

[11276.]—**Extracting Glass Stopper.**—If there is no stump left by which to take hold of with pinchers, a hole must be drilled in the stopper, into which to cement or to screw a strong wire; then warm the bottle gradually in very warm water to expel air; when warm, hold it upright, and keep some water round the stopper until it is cold. Whilst the bottle is cooling, the water is drawn in and loosens the stopper. Twice or three times repeated has always been successful in laboratories.—BARBAROS.

[11277.]—**Soap Boiling.**—The following is a rough outline of the manufacture of soap:—A vat is charged with barilla, kelp, or potash, or a mixture of all three; a small quantity of quick lime is added, and afterwards water sufficient to slack the lime. Near the plughole of the vat some straw is generally placed to prevent any solid particles from passing through when the ley is drawn off. Water is then added to fill up the vat; after standing several hours, the solution is drawn off into a lower reservoir. Water is again added to the material in the vat; the first ley is removed from the reservoir into one nearer the boiler; and then the second ley is drawn off. This is done on purpose to have two leys of different strengths always at hand when boiling. The number of waters added to the materials in the vat depends chiefly upon their quality and the experience of the operator; a good workman can generally tell by the taste whether the water has dissolved the whole of the alkali. The ley being ready to ladle out of the reservoir, which is near the boiler, the tallow or oil, having been weighed, is put in. When it is sufficiently melted, the workman begins adding the ley and stirring the mixture. The alkali and the oil soon begin to unite and form a milky fluid. As more ley is added the mixture thickens. This is continued for thirty hours, and sometimes more, till small portions of the soap, taken out from time to time, assume a proper consistency. The workman then adds a quantity of common salt, which has the effect of separating the watery part from the soap; which contains a proportion of neutral salts, that existed in the crude alkali, especially when more than enough has been added. The fire is now withdrawn, and the mass left to cool. The watery part is found at the bottom, and is removed by means of a pump fixed to the side of the boiler. When this is removed, the fire is rekindled, and if the mass does not melt freely, a little water is added. As soon as the whole becomes liquid, and is made uniform by stirring with wooden poles, the fire is again withdrawn, and the mass allowed to assume a proper consistency for lading. It is laded into square moulds; these are composed of a number of strata lying one upon another, so that when the soap has become solid each layer of framework can be removed, beginning at the top, and the soap is cut into bars or cakes, with a fine brass wire at every interval. Yellow hard soap is formed of soda and tallow, but it also contains resin, and sometimes palm oil. In boiling the yellow soap, the resin and oil, or tallow are put in the boiler first. The ley is prepared in a similar manner to that for the white soap. Soft soap differs in its composition from hard in containing no alkali but potash. Soft soap made with colourless fat is a white unctuous substance, about the consistency of lard. If the fat is coloured the soap partakes of the same colour. On the Continent it is generally coloured with metallic oxides. Those made with yellow oil are sometimes coloured with indigo, which gives them a green colour. The oils generally used are the cheaper oils—such as rape, linseed, hemp, &c. In Holland it is made with whale oil. This oil is forbidden to be used in some parts of the Continent, owing to its offensive smell. In this country all soft soap is made with whale-oil, which gives a transparent mass of a yellow colour. In commerce, it is seldom quite transparent, for the yellow part is generally interspersed with white spots, giving the whole a strong resemblance to the inside of a dried fig.—WILLIAM H. HEY.

[11277.]—**Soap Boiling.**—Soap is composed of fatty substances, soda, and potash. The proportions vary entirely with the kind of soap required, and even for similar kinds of soap the proportions of ingredients are varied by different manufacturers. Ordinary white soap requires 10 to 14 cwt. of tallow or olive oil per ton, and from 10 to 14 parts of soda, and 15 to 20 of potash to every 100 parts of fat. In manipulation, again, different manufacturers vary most considerably, so much so indeed that it would be almost useless to state any particulars. The moulds are of wood or cast-iron, those of the latter material being used for yellow soap.—EXCELSIOR.

[11278.]—**Steam.**—My own formula is $V = 8 \times \sqrt{P - p} \times 2{\cdot}3$. It does not agree with that given by other authorities. It is, however, deduced by experience. Where—

V = the velocity in feet per second.
P = the pressure of supply in pounds per square inch, atmosphere included.
p = the back pressure in pounds per square inch, atmosphere included.

Care being taken to allow for the friction of passage through long pipes, their diameter being increased to maintain the pressure. Arguing from theory, it is impossible to have a steam pipe too large; but with size is also increased the disadvantage of condensation, both by convection and radiation; therefore, there is a practical limit, and a near approximation to a definite size for general use.—TUBAL KAIN.

[11280.]—**Light for the Middle of a Room.**—The treatment must depend on at least three dimensions that the querist has omitted to give. 1. How high are the tops (highest glass) of the side windows above the objects you want to illuminate in the middle of room? 2. How distant, and (3) how high (above the same level) are the nearest buildings outside the windows? State these for both sides if there is any difference between them. Almost the last words of Sir David Brewster were some valuable hints on this subject in the *Builder*; but everything turns on the position and height of neighbouring walls, if any. The treatment of such a room in a street or in open country will have to be totally different.—E. L. G.

[11280.]—**Light for the Middle of a Room.**—I have found a few sheets of tin fastened to a board very effective in throwing light upon dark passages, staircases, cellars, &c., and I should think "One in the Dark" might make an arrangement to effect his purpose. A hint might be taken from the stations (under ground) of the Metropolitan Railway.—F. F. C.

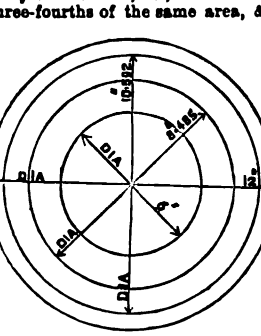
[11281.]—**Value of One Second on the Sun's Disc.**—This question will vary in its result according to the values assigned to sun's parallax and to the earth's semi-diameter. Taking the parallax, as given by the *Nautical Almanac*, 8·5776, which is the value assigned by Encke, and the earth's diameter 7912·5, which is Bessel's determinative, we get $\frac{7912\cdot 5}{2 \times 8\cdot 5776} =$ 462 miles, for the sun's parallax is nothing more than the angle subtended by the earth's semi-diameter at the sun's mean distance.—WILLIAM HUGHES.

[11281.]—**Value of One Second on the Sun's Disc.**—The value of one second on the sun's disc is equal to the sin. one second multiplied by the sun's distance. Taking the mean value of the latter as 91,400,000 miles, we have ·00,0004,848 × 91,400,000 = 443 miles. For the value, when the sun is respectively nearest and farthest from the earth, we have 436 and 450 miles.—G. F. H.

[11285.]—**Chemist's Certificate.** — "Phœnix" should write to the Registrar of the Pharmaceutical Society, Mr. Elias Bremridge, 17, Bloomsbury-square, London, W. C., who will give the required information in full.—PHILADELPHOS.

[11292.]—**Linseed.**—This seed is a nutritious and fattening food, the value of which is well known to farmers. As a remedial agent, the crushed seed, containing all the oil, is much used for poultices, which remain soft and comfortable longer than those made with ordinary linseed meal or bread. Linseed oil, mixed with an equal quantity of lime water, is useful as a first application to burns and scalds. The decoction of linseed (linseed tea) is drunk to allay irritation of the mucous membranes in catarrh, bronchitis, dysentry, gonorrhœa, &c.; and its frequent use is not likely to be injurious, for linseed contains nothing but what the digestive organs may assimilate as food.—PHILADELPHOS.

[11294.] — **Dividing Metal Disc.** — The most simple way that I know of is to find the area of the 12in. disc. Divide the same by four, which will be the area of each of the three rings and disc required. Now find the diameters by dividing quarter the major disc area by ·7854 and extracting the square root of the product for diameter of minor disc. Then take two-fourths of major disc area, &c., for diameter of No. 1 ring, and three-fourths of the same area, &c., for No.



2 ring, and the product will be No. 3 ring as required. As shown in sketch, weights, as a matter of course, are equal.

Areas.

$12^2 \times \cdot 7854 = 113\cdot 0976.$

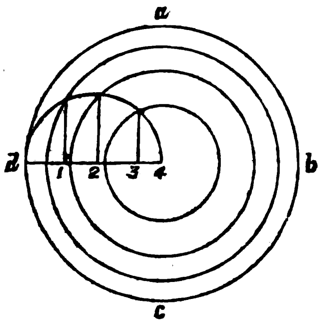
$\frac{113\cdot 0976}{4} = \frac{28\cdot 2744}{\cdot 7854} = \sqrt{36} = 6$ diam. of minor disc.

$28\cdot 2744 \times 2 = \frac{56\cdot 5488}{\cdot 7854} = \sqrt{72} = 8\cdot 485$ „ of No. 1 ring

$28\cdot 2744 \times 3 = \frac{84\cdot 8232}{\cdot 7854} = \sqrt{108} = 10\cdot 392$ „ of No. 2

SEMAJ.

[11294.]—**Dividing Metal Disc.**—Let *a b c d* be the disc; draw any radius, as *d* 4, divide it into the same number of equal parts as it is required to divide the disc into; draw a semicircle on *d* 4, and erect per-



pendiculars from the points of the division to cut the semicircle from the points of intersection of the perpendiculars and the semicircle; describe the circles as per Fig., which will give the required divisions.—G. F. H.

[11294.]—**Dividing Metal Disc.**—First find the centre of the disc. Per question, the radius is 6in. Then, as circles are to each other as the squares of their diameters, the radii taken from the centre of the disc will be—

$$6\sqrt{\tfrac{1}{4}},\ 6\left(\sqrt{\tfrac{2}{4}}-\sqrt{\tfrac{1}{4}}\right),\ 6\left(\sqrt{\tfrac{3}{4}}-\sqrt{\tfrac{2}{4}}\right)\text{ and }6\left(1-\sqrt{\tfrac{3}{4}}\right)$$
$$= 3,\ 1{\cdot}242642,\ {\cdot}953514,\text{ and }{\cdot}803844\text{ inches.}$$

"Disc" has not specified what other divisions he wishes, so it is impossible to comply with his request in that particular; but perhaps the following may be useful, viz.:—Having given the radius (r) to be divided in (n) equal parts, other conditions as per query:—

$$r\sqrt{\frac{1}{n}},\ r\left(\sqrt{\frac{2}{n}}-\sqrt{\frac{1}{n}}\right),\ r\left(\sqrt{\frac{3}{n}}-\sqrt{\frac{2}{n}}\right)\cdots$$
$$r\left(1-\sqrt{\frac{n-1}{n}}\right).$$

—Jas. Hastie.

[11296.]—**Chemical.**—Try black oxide of manganese.—Excelsior.

[11296.]—**Chemical.**—I think "Forked Lightning" will find that a mixture of sulphide of antimony and sulphur will answer his purpose, as it is both cheap and readily explosive.—J. B.

[11297.]—**Spruce Beer.**—Pour eight gallons of cold water into a barrel, and then boiling eight gallons more, put that in also; to this add 12lb. of molasses, with about half a pound of the essence of spruce, and on its getting a little cooler, add half a pint of good ale yeast. The whole being well stirred, or rolled in the barrel, must be left with the bung out for two or three days, after which the liquor may be immediately bottled, well corked up, and packed in sawdust or sand, when it will be ripe and fit to drink in a fortnight. Remember that it should be drawn off into quart stone bottles and wired. If "Constant Reader" wishes, I have a good recipe for white spruce beer, also white spruce wine.—J. H. Gilbert.

[11298.]—**Four-Inch Lathe.**—The hole is intended to carry the end of a boring bar.—Eureka.

[11300.]—**Air-pumps.**—The stuffing boxes of air pump may be packed with cotton that is well greased with tallow, or by a number of leather washers that fit the rod and interior of the stuffing-box tightly; they should be previously dipped in melted tallow that is not hot enough to curl them up. Both these packings are good, and I generally like to pack with leather about half way up, and finish with the cotton afterwards; this method effectually prevents any loose filaments of cotton being drawn through into the barrel. The large piston has no packing at all, it is merely a solid block fitting the bore pretty accurately, and having 10 or 12 fine grooves turned on its surface to baffle the air should it try to get past it. The small piston may either be made in the same way or consist of leather washers bolted tightly together, and turned afterwards to fit the bore. This makes a good piston, which lasts a long time. There is no valve in the pipe that connects the two barrels, and this is the finest feature in the whole arrangement, tending not only to simplification, but materially assisting the attainment of the best result, as there is no impediment to the free passage of the air. Siemen's pump has two barrels of different sizes, but the pistons are both on the same rod, and there are five valves altogether. It has never been popular on account of this complexity, and cannot by any theory be considered equal to the one I have described. I hope "Last" will find these additional particulars of service. Any proportion may be adopted for the barrels, 1½in. for the small one, and 4½in. for the larger being a good construction.—Henry Turton.

[11302.]—**Circular Brass Box Levels.**—Oil is oftentimes used in place of spirit for these.—Excelsior.

[11304.]—**Nessler's Ammonia Test.**—Nessler test for ammonia is prepared thus: Add to a solution of mercuric chloride, a solution of potassic iodide, till the red precipitate first formed is nearly all dissolved. Then add large excess of caustic potash; let the mixture stand in a stoppered bottle for three or for days, decant when clear. It gives a brown precipitate when added to a solution containing a salt of ammonia. This consists of $HgHg_3NI$. (From "Miller's Inorganic Chemistry," page 217.)—G. H. A.

[11304.]—**Nessler's Ammonia Test.**—This reagent is an aqueous solution of potassic iodine saturated with mercuric iodide, and rendered strongly alkaline with soda or potash. Take of iodide of potassium 3·5 grammes, mercuric chloride 1·6 grammes, water 40 c. c. Solution of potash, a sufficiency. Dissolve the iodide of potassium in 10 c. c. of water; the mercuric chloride in 30 c. c. of water. Add the latter to the former gradually till a permanent precipitate is formed. Then add solution of potash till the fluid measures 100 c. c., and filter. As exposure to the air renders this reagent somewhat turbid, therefore keep the stock in large bottle, which only should be opened to supply small bottle, which is kept to hold that which is in immediate use. This reagent added in excess to a liquid containing a trace of ammonia or its salts, assumes a brownish tinge or brown precipitate, according as the proportion of ammoniac compound is less or more, tetramercuric diammoniac diniodine being formed.—Hermes.

[11304.]—**Nessler's Ammonia Test.**—The best way of making the Nessler test is this, which is based upon one of Miller's:—Dissolve fifty grains of iodide of potassium in a small quantity of hot distilled water. Place the vessel containing this solution in a water bath, and add cautiously to it a strong aqueous solution of bichloride of mercury, shaking up as it is added, so that as fast as the precipitate is formed it will be redissolved. After continuing the addition of the bichloride of mercury for some time, a point will ultimately be reached at which the precipitate will cease to dissolve. When this begins, stop the addition of the bichloride of mercury, filter, and add to the solution 150 grammes of solid caustic soda in strong aqueous solution, then dilute the liquid so as to make its volume equal one litre, add to it about 5 c.c of a saturated aqueous solution of bichloride of mercury, allow to subside, and decant the clear liquid, which is the Nessler test. It is advisable to keep a stock of the test in a large bottle, which should only be opened to supply a small bottle kept for immediate use, as exposure to the air renders the Nessler test somewhat turbid.—J. B.

[11309.]—**Breaking Strain of Hollow Iron Columns.**—In long (*i.e.*, in proportion to diameter) hollow cast-iron columns the breaking weight in tons is equal to

$$42\,\frac{D^{3\cdot5}-d^{3\cdot5}}{l^{1\cdot63}}$$

where D = outer diameter in inches, d = inner diameter in inches, and l = length in feet. The formula for the strength "when standing at an angle" would be of no practical use. Who ever heard of an iron column being so disposed with reference to its load?—Excelsior.

[11310.]—**Logarithms.**—These are for facilitating calculations. By the addition or subtraction of logarithms of numbers the same purpose is served, as if the numbers themselves had been respectively multiplied and divided. Use Chambers' "Mathematical Tables."—Excelsior.

[11310.]—**Logarithms.** — Undoubtedly the best hand-book of logarithms for general purposes is that published by W. & R. Chambers, in their educational series. It is a 7-place table, and contains, in addition to the usual logarithmic tables, tables of the trigonometrical functions and their logs., together with a variety of useful matter (price 3s. 6d.). A smaller table, of 5-place logs., containing the logs. of natural numbers, and the trigonometric functions only, is that published by Walton (James). It is very convenient and suited to the pocket, and the logs. are readily turned up in it (price 1s. 6d.). It is said to have been compiled under A. De Morgan's supervision. A larger volume of 7-place logarithms, by Bruhns, has just been published (Williams & Norgate), price about 5s. Schion's tables, edited by De Morgan, are also very generally used, but the work is large and expensive. A full description of the method of using logs., &c., is appended to each of the above, except that of James Walton.—A. B.

[11310.]—**Logarithms.**—I wonder Mr. Proctor has the patience to answer many questions of this class. Remember that he is an advanced mathematician, and that logarithms are understood, at least as far as their application, by any sharp schoolboy of sixteen. The use of the tables is always carefully explained in the preface to each volume, but then the preface to any work is exactly what is not looked into, instead of being made the subject of careful reading. As to hyperbolic logs., I am not ashamed to say that I have not the remotest idea of their practical application, which is in connection with the calculus, but I believe that the hyperbolic log. has to be multiplied by a certain amount —viz., ·43429—to convert it into a Briggs's or common log. It would be a very one-sided arrangement to give the logs. of numbers from 9,999 up to 20,000, and to go no further with numbers of five digits. They have, however, been calculated to 100,000. I think the mathematical tables at 1s., by Law, in Weale's "Rudimentary Series," a very handy book, and it contains full instructions.—J. K. P.

[11314.]—**Polishing Oak Floors.**—The floor is first planed smooth, then smeared with beeswax dissolved in turpentine, and finally polished with short bristle brushes, loaded with lead; sometimes the floors are stained before the wax is put on, to give them a darker appearance. It is considered rather laborious work to get up a good surface.—E. F. Conrath.

[11314.]—**Polishing Oak Floors.**—Use the following:—4oz. beeswax, 1oz. castille soap, 6oz. soft water, 6oz. turpentine, 1 drachm borax; put into a jar and allowed to remain till dissolved.—Excelsior.

[11314.]—**Polishing Oak Floors.**—Polish your oak floor with the edge of a glass bottle and elbow-grease.—W. G. A.

[11317.]—**Sugar Boiling.**—The reason of the sugar crumbling after being boiled is either too little cream of tartar was used, or your cover does not fit your pan. The cover should be without a rim and kept on the sugar for ten minutes after it boils; if you read and practice with care the recipes I have sent I do not think you will have much trouble. The white stripes in mint cushions are a portion of the sugar pulled on a hook until white, then double up until even and regular.—L. W. D.

[11318.]—**Gravitation.**—"C. W. H." is mistaken in supposing that bodies should fall with velocities proportioned to their masses. Their masses have very little to do with it in the case of terrestrial gravitation, the proportion being that of the joint mass of the earth and attracted body. The denser the body the more rapid it will fall, simply because the air resists it only to the same degree that it would a substance of the same volume but less mass, whilst the momentum, but not the velocity, of it is greater than that of a less dense body of equal size. The different velocities being attributable to the resistance of the air, of course when the resistance is removed the velocities are equal.—G. F. H.

[11318.]—**Gravitation.**—1. The mercury in an inverted thermometer would have to alter its form so much, and take so much more lengthy and narrow a figure before it could descend, that, even supposing the vacuum perfect (which it rarely is), its cohesion keeps it in the compacter form, and so suspends its small weight in the bulb. 2. Apart from resistances (as friction and air), because the weights of bodies are proportional to their masses, gravity (at one place) gives them all the same velocity. A pull of a pound can only give to a pound of matter the exact velocity that a pull of a grain gives to a grain of matter. Hence both fall together when they have only themselves to move, as in vacuo. It is very different when the lighter thing has to displace (and raise) perhaps half its weight of air, and the heavier thing not a thousandth of its weight.—E. L. G.

[11318.]—**Gravitation.**—The fact mentioned by "C. W. H.," in the opening sentence of this query, operates in nowise to the prejudice of the theory of gravitation. The phenomena was observed in 1792 by Huygens, and is evidently a result of the adhesion of the mercury to the internal surface of the capillary tube. The "guinea and feather experiment" is certainly capable to demonstrate the "contrary effect" which obtains on removing the resistance offered by the air to the motion of bodies (differing in density) when falling by the attraction of gravity. The resistance of the air is proportional to the surface which the body presents in the direction of its motion. Now the guinea not only may present a smaller surface than the feather, but also the force which it exerts to overcome the resistance is many times greater, because of its greater density, than is exerted by the feather; *ergo*, the guinea will reach the earth's surface before the feather; remove the resistance of the air by allowing the bodies to fall in vacuo, and guinea and feather will fall towards the earth's surface with equal rapidity. Attraction is proportional to the mass of the body which attracts (if the distances of different attracting bodies be the same); *ergo*, the attraction exercised by the earth on a guinea bears to the attraction exercised by the earth on a feather the same proportion as the mass of the guinea bears to that of the feather, and, neglecting the air's resistance, they fall with equal rapidity.—A. J. V. G.

[11321.]—**Galvanometer.**—Although this query is addressed to "Sigma," I have taken the liberty of attempting to reply to it. The examiner doubtless refers to a method, due to 'Melloni,' described in his own work (where the querist will find it at the end of the tenth chapter, I believe) "On Heat," last edition.—A. B.

[11324.]—**Salt Damp in Walls.**—Unless "W.M." has particular reasons to think that there is salt in the sand, he may be sure that it is not salt, but saltpetre; he may convince himself by throwing a little on the fire, when he will see little stars sparkling. The cause of this is dampness from liquid manure, although at some distance, outside or under the wall.—Barbaros.

[11328.]—**Organ Stops.**—To "A Subscriber who appreciates the Mechanic." The scale of the Lieblich Gedact varies in different instances, but the usual dimensions are CC = 3in. × 2 3-19in. Tenor C 1⅞in. × 1⅜in. Middle C 1¼in. × ⅞in. Treble C = ⅞in. × 7-16in. It will have to be set out in the manner described by "J. D." for the stopped diapason, to get the other notes in the octave. The lowest notes should be of ¾ pine, the next 2 or 2½ octaves of ½in., and the remainder of ⅜in. stuff. The heights of mouths vary with the pressure of wind, but for 3in. are generally about one-half the width of the pipes, diminishing to about one-third in the treble. The salicional scale depends upon that of the open diapason, the tenor C 4ft. of the former being of the same diameter as the middle C 2ft. of the latter. The Cremona is a reed stop, having very short cylindrical tubes; in consequence of the small scale the length is little more than half of a full scale trumpet; for it is a noticeable fact that whereas, in flue work, the increase of scale reduces the length of the speaking part of the pipe, and *vice versâ*, in reed pipes it is just the reverse. The Cremona is now frequently placed in a box to subdue the reediness or harshness common to this stop.—E. F. COWRATH.

[11334.]—**Squinting.**—I would advise "G. W. F." to procure a letter and take his little boy to one of the ophthalmic hospitals in London, where by undergoing an operation he would be cured. A friend of mine was quite cured by so doing.—J. CHAMBERLAIN.

[11334.]—**Squinting.**—Spectacles having blackened glasses (perhaps metal discs would answer), with a small perforation in each, are said to be a safe remedy for this defect in vision.—J. G.

[11334.]—**Squinting.**—Squinting frequently arises from the unequal strength of the eyes, the weaker eye being turned away from the object by the fatigue of exertion. Cases of squinting of long standing have often been cured by covering the stronger eye, and thereby compelling the weaker one to exertion. "G. W. F." could try the above with the little boy.—F. T. S. S. D.

[11336.]—**To Mr. Tonkes.**—May I ask what is "S. J.'s" definition or idea of what is expressed by the sign 0 in mathematics? It does not signify what we call "nothing." It is merely an infinitely small number. Since then, 1 is, at any rate, an appreciable number, it must be an infinite number of times greater than 0, or

$$1 = 0 \times \infty$$

$$\therefore \infty = \frac{1}{0}.$$

Or, again, since 0 is an infinitely small quantity, its reciprocal must be an infinitely large quantity—*i.e.*, must be $= \infty$. Again, how can "S. J." make $\infty + \infty = 2\infty$? How can there be a number which is $>$ infinity? "S. J." is justified in writing—

$$1 : 0 :: \infty : 1$$
$$\text{and } 1 : \infty :: 0 : 1$$

But he cannot write—

$$\frac{1}{0} = \frac{\infty}{0}$$

$$\text{deducing it from } \frac{1}{0} = \infty$$

Since, if we allow 0 a value on the left-hand side of the equation, it is only fair to do the same on the right. He cannot, therefore, write—

$$1 : 0 :: \infty : 0$$
$$1 : \infty :: 0 : 0$$
$$1 : 0 :: \infty : \infty$$
$$\text{or } 1 : \infty :: 0 : \infty.$$

Which are, as he says, "most truly absurd."—W. L. GILES.

[11336.]—**To Mr. Tonkes.**—Perhaps by the time "S. J." has mastered the following he may be able to comprehend Mr. Tonkes:—

$$x(x - x) = x^2 - x^2$$
$$(x + x)(x - x) = x^2 - x^2$$
$$\therefore x = x + x,$$
$$\text{or } x = 2x.$$

—EXCELSIOR.

[11337.]—**Equation.**—It is simple enough to those who understand it, but to solve it requires more data than is given on p. 25, No. 365. To render it more simple to an ordinary arithmetician, I supply the missing signs:—

$$= a + (n - 1) \times d \qquad (1)$$
$$S = \frac{(a + l) \times n.}{2} \qquad (2)$$

By formula (1) $l = a$ plus n, minus 1, multiplied by d. By formula (2) $S = a$, plus l, multiplied by n, and divided by 2.—TUBAL KAIN.

[11337.]—**Equation**:—

$$S = \frac{(a + l)n}{2} \therefore \frac{2S}{n} - a = l.$$

$$l = a + (n - 1)d = \frac{2S}{n} - a.$$

$$2l = \frac{2S}{n} + (n - 1)d.$$

$$l = \frac{S}{n} + \frac{(n - 1)d}{2}.\text{—Answer.}$$

—THETAMU, Horsham.

[11338.]—**Marseilles Soap.**—This is an oleo-margarate of soda, produced by boiling an aqueous solution of caustic soda with olive oil. An analysis by Braconnot gave:—

Oily acids	68·40
Soda	10·24
Water	21·36
	100·

—W. W.

[11339.]—**Astronomical.**—It is not true that 365 solar days are 366 sidereal days. It takes 365·254, &c., solar days to equal 366·254, &c. (the same exact fraction) sidereal days.—E. L. G.

[11341.]—**Colouring Photos.**—Lick them. Yes. —EUREKA.

[11348.]—**Meteors, Comets, &c.**—Perhaps I should have said "of the earth," but if Whiston could have shown our globe to have been originally a comet, undoubtedly the other bodies in our system must have been comets also. Whiston's rather absurd theory was, as everybody knows, intended to explain the Noachian deluge.—M. PARIS.

[11353.]—**Distilled Water.**—Distilled water is water which by distillation has been separated from all the impurities which ordinary water contains. It is, therefore, peculiarly adapted to all delicate chemical processes, such as electrotype, photography, analysis, &c., where the introduction of impurity would deteriorate or falsify the results; but it is not adapted for drinking, as it contains little or no air, and hence is vapid and disagreeable to the palate. For some further details, see the article on water in the "Lessons on Chemistry," page 578, Vol. XIV.—S. BOTTONE.

[11357.]—**Berlin Black.**—This is identical with Brunswick black, for which I gave a recipe at p. 442, Vol. XIV. That recipe is excellent. Should "Register" require more information, let him read "Larkin's Iron and Brass Founder," where he will find many thousand useful hints.—S. BOTTONE.

[11358.]—**Pressure of Water.**—"Templeton" says the side of any vessel containing a fluid sustains a pressure equal to the area of the side, multiplied by half the depth. Thus, suppose each side of a vessel to be 12ft. long and 5ft. deep, when filled with water, what pressure is upon each side?

12×5 = 60ft. the area of side
2·5ft. = half the depth, and
62·5lb. = the weight of a cubic foot of water.
Then $60 \times 2·5 \times 62·5 = 9375$lb.

I would suggest to "R. Irons" that if a pipe of any bore, no matter how small, be attached to a tank, the fluid in it will exert the same pressure upon the tank in proportion to its height as if the sides of the tank were carried up to that same height.—A., Liverpool.

[11360.]—**Sun's Declination.**—See "Altair's" letter.

[11361.]—**Preserved Meat.**—The reason why the ends of the tins are concave is because of the vacuum produced during boiling and subsequent cooling. Hence, the atmosphere presses with a force of about 15lb. to the square inch on the surface of the tin, and thus produces the concavity.—S. BOTTONE.

[11367.]—**Magnesium Lights.**—The most effectual and satisfactory mode of producing these lights is by burning the wire or ribbon in a lamp expressly made, in which the wire or ribbon is fed through the nozzle of a small pipe as fast as it is consumed. Nearly all our leading philosophical instrument makers supply these lamps.—S. BOTTONE.

[11370.]—**Electrical.**—In this case the tongue acts the part of the liquid in the cell of a battery, and the copper is the negative plate, as it is in the cell, though the wire from it is the positive pole externally.—SIGMA.

[11378.]—**Killing Beetles.**—1. Place them under a wineglass, in which a few pieces of blotting paper, moistened with a saturated solution of cyanide of potassium are laying. This is a painless mode. 2. Throw them in *boiling* water, and dry on blotting paper. 3. Immerse them in a solution of corrosive sublimate in alcohol. I always use the first method both for *Lepidoptera* and *Coleoptera*.—S. BOTTONE.

[11378.]—**Killing Beetles.**—Pin them by one pin with their backs downwards tightly to a large cork, when in this situation open their mouths with a bent needle, and let a drop of the strongest rectified spirits of wine fall into it from the end of a quill or small feather. For the smaller beetles boil some spirits of wine and dip them in for an instant, and afterwards dry them carefully in an oven.—FANTAIL.

[11381.]—**Rhumkorff's Coil.**—The number of cells depends on the size of the coil, and the insulation of secondary. About two to six Bunsens coupled in series are commonly used.—SIGMA.

[11382.]—**Parrot.**—Let "Cygnus" give "Polly" pills occasionally of bread-paste and cayenne pepper, let her have plenty of fresh air and sunlight; a little fruit now and then will do her no harm; certainly keep all fats and animal food away from her. She should also have plenty of fresh water, not only for drink, but for the bath, of which she will gladly avail herself. I had a fine bird which used to moult all the year round; before she came into my possession she never had any tail to show worth speaking of. She was then fed from the dinner table with any food she would take. When I got her she never had anything but bread and milk, a little fruit, not too much hempseed, and abundance of water. She never moulted again in the eight years I had her, but had always a splendid plumage and tail. Poor "Polly" was shot once in both wings, one of which was broken, she having been out all one night "on the spree" miles away, but she survived this accident by careful nursing for several years, only to be poisoned by burglars.—GEORGE BELL.

[11387.]—**Sundials.**—No sundial could possibly give correct indications for any other hour than noon, either by rotating it on a pivot or adjusting the gnomon vertically, as the fundamental principle of all sundials is that the twelve o'clock line must be truly in the plane of the meridian, and the elevation of the gnomon equal to the latitude of the place. The correction for the equation of time by the tables is far simpler in appliance than any "setting" of the dial could be, were it even possible.—GEORGE BELL.

[11393.]—**Metallic Harmonicon.**—This is only a toy, and is of no service to the musician. An instrument—in which are vibrating metal strips in connection with key and hammer action—has been lately revived by Messrs. Cramer & Co., under the name of the "Bell Pianetto." This is really a useful little instrument for practice, and as its tones resemble strongly those of a harp it is agreeable as well as useful. A patent for this instrument was taken out towards the latter end of last century, so "Valve" need be under no apprehension if he make one for himself. If he can call on Messrs. Cramer he can see the construction; if not, let him write again and I will give details.—S. BOTTONE.

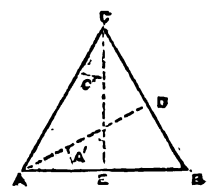
[11398.]—**Stinging of Bees, Hornets, and Wasps.**—Strong brandy or spirits of wine; also vinegar applied with the finger or small sponge.—FANTAIL.

[11400.]—**Pedals for Pianoforte.**—If "J. W. S." will call on Messrs. Broadwood and Sons he will see their "Pedalier," and will immediately understand what he is to do to get the desired result.—S. BOTTONE.

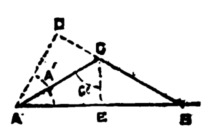
[11403.]—**Gas.**—It is obtained from the company's mains, and is led by a hose into long metal cisterns on the top of the cars, where it accumulates under considerable pressure. From these cisterns it passes into the burners. A gauge, showing whether the cistern is empty or full, is placed on one side of the car.—S. BOTTONE.

[11405.]—**Purifying Zinc Wire.**—Zinc wire should never be used for a battery. Mercury does not purify zinc at all; it amalgamates it. Pure zinc may be obtained by precipitating its sulphate by an alkali, mixing the oxide thus produced with charcoal-powder, and exposing the mixture to a bright red heat in a covered crucible, in which the pure metal will be found as a button at the bottom when cold.—S. BOTTONE.

[11410.]—**Geometrical Question.**—The sides A C and A B being equal, the angles A and B are therefore equal. The angle A C B at the vertex of the isosceles triangle is consequently 180—A—B, or, B being equal to A, 180—2A, the half of which is 90—A. The triangle D A B being right-angled at D, D A B is equal to 180—90—B. But the angle B being common to both triangles is equal to the angle C A B as before, therefore D A B is equal to 180—90—A = 90—A, which is shown above to be the half of angle A C B. If the side B C has to be produced, the same reasoning will apply, substituting D for C.—GEORGE BELL.



[11410.]—**Geometrical Question.**—Let A C B be an isosceles triangle, and let A D be a line drawn perpendicular to B C. As all the angles of a triangle are equal to two right angles, and also that things which are equal to the same thing are equal to one another, therefore the angles A D B, D B A, B A D are together equal to the angles A C E, C E A, C A E. Of these, the angle A D B is (by construction) equal to the angle C E A, and the angle C A E is equal to the angle D B A (angles at the base of isosceles triangle), then the remaining angle D A B is equal to the remaining angle A C E, which latter is half of the angle A C B. Therefore the line A D described at right angles to B D forms with the line A B an angle equal to half the vertical angle of the isosceles triangle. N.B.—The above letters are applicable to both the accompanying illustrations.—C. P. H.



[11410.] — **Geometrical Question.** — "Undergraduate," T. Odger Phelps, "S. M. B.," H. D. Mead, W. Hughes, R. Lupward, Wm. Cook, "V. B.," R. Arrowsmith, "Just Promoted," and "E. L. G." have also answered this query.

[11421.]—**Photography.**—Coat your plate with collodion; let it "set" until the bottom edge takes the impress of the finger pressed against it, without sticking to it. Immerse into the bath, and leave it there (moving it up and down) until all oily streaks have disappeared. Now expose and develope. Does the picture come out well without any fogging? If it does, wash it in a very gentle stream of water. Fix it, by immersion in a saturated solution of hyposulphite, but do not leave it ten minutes. As soon as the creamy iodide is removed, withdraw the plate, and wash again carefully in a gentle stream of water. If your picture still comes away, you may be sure of one of three things. 1. Your chemicals are impure, or your glasses dirty. 2. Your collodion is made with bad gun-cotton, and is what is technically called "rotten." 3. You wash too heavily, so as to carry off the film bodily. I should be inclined to think, from the "mottled" appearance, that dirty glasses lie at the bottom of all the evil.—S. BOTTONE.

[11422.]—**Night and Day Temperature.**—If "A. E. S." will hang out a minimum and maximum registering thermometer, he will soon see how much truth there is in the assertion. With regard to winds, I am not in a position to say anything positive; but from personal observation, I think that winds are rather more prevalent at night than in the day.—S. BOTTONE.

[11427.]—**Degrees in Chemistry.**—Read, mark, learn, and inwardly digest, the contents of Roscoe's and Barff's "Chemistry." In the latter work you will find most of the questions propounded by [illegible] ers from 1865 to 1871 [illegible] —S. Bo[illegible]

[11429.]—**Ferns** [illegible]
give a little air, [illegible]
inserting a wed[illegible]
drainage to th[illegible]

[11434.]—S[illegible]
water, strain [illegible]
This is a ver[illegible]
—PANTILE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "R. O." has answered 10776; "Shawforth," 10832; "Sigma," 10839.

10938 Electric Lamp, p. 597
10942 Plan for Setting Retorts, 597
10944 Portland Stone, 597
10946 Joiners' Tool-chest, 597
10951 Applying Goldleaf to Silk Fabrics, 597
10958 Model Boiler, 597
10960 Straightening Tinned Wire, 597
10963 Brazing Fishing-rod Ferrules, 597
10965 Racks and Pinions for Telescopes, 597
10968 Polishing Watch Steelwork, 597
10970 Corking and Sealing Bottles, 597
10975 Australian Meat in the Royal Navy, p. 598
10976 Tartan of Clan of Sir R. Murchison, 598
10984 Lapidary's Developing Solution, 598
10998 Mildew in Old Engravings, 598
11002 Economy in Steam Power, 598
11007 Roman Sepulchral Inscription, 598
11008 Tilt Hammer, 598

QUERIES.

[11437.]—**Sash Tool Handles.**—By what process are the handles of painters' sash tools made?—Simpleton.

[11438.]—**Lemon Marmalade.**—I should feel very much indebted to any of the readers of the Mechanic, who would tell me how lemon marmalade is made, and also vegetable marrow preserve.—A Young Housekeeper.

[11439.]—**Cost of Chamber Sulphuric Acid.**—Will Mr. G. E. Davis have the goodness to inform me the cost of manufacturing hydrated sulphuric acid at 118° Twaddle?—S. O.

[11440.]—**Double Bass and Violin Stain.**—Would any correspondent be kind enough to give me the sizes and thicknesses of a full-sized double bass, and the kind of wood best suited to make one? Would good selected yellow pine make the breast or does it require the legitimate Swiss pine? Also what would make a good stain for a violin—reddish brown or any other good colour? and oblige—Benson.

[11441.]—**Dyeing Cotton Thread Jet Black for Polishing.**—Can any of our readers inform me the best method of effecting the above?—M. B.

[11442.]—**Old Wives' Science.**—Can any reader of "ours" tell me what is the reason that if the sun shines upon the fire it puts it out?—A., Liverpool.

[11443.]—**Warming Greenhouses.**—Will "E. T. S." please inform me how he uses his petroleum lamp to keep the frost out of his greenhouse? (Reply to query 10083, page 442, Vol. XIV.) Is there any piping to carry off the fumes of the lamp—if not, do they affect the plants at all?—Anxious.

[11444.]—**Bursting of Compressed Air Receivers.**—I beg to solicit the opinions of your numerous correspondents on the following:—What would be the effect of the bursting of an air receiver (say, for example, 30ft. long, 6ft. diameter, and made of ⅜in. boiler plate)? Would the receiver be merely laid open, allowing the compressed air to expend itself, without doing any further damage, or would it be accompanied by the disastrous results usually attending the explosion of steam boilers?—Lyons.

[11445.]—**Electrical.**—Would Mr. Tonkes kindly give me a little information? I wish to make a medical coil, powerful enough to affect three persons when their hands are joined. I propose to make it as follows:—The paper tube to be 1in. diameter, 7in. long, with four layers of No. 16 cotton covered wire for primary; secondary, 6 layers of 32, with a further length of No. 32, soldered on. Will Mr. Tonkes kindly give me his opinion on the above coil, and say how I am to insulate it properly?—J. H.

[11446.]—**Small Coil.**—I wish to construct a shocking coil small enough to carry in the waistcoat pocket, battery included. I have tried hitherto, but without success, as I make it too bulky, owing to bad arrangement of the different parts. Will some of our electrical contributors oblige by giving me full instructions for constructing one? perhaps Mr. Tonkes will oblige.—An Anxious Mechanic.

[11447.]—**Blundered Coin.**—I have a copper halfpenny of Charles II., with a blunder in the title, which, instead of reading "Carolvs a Carolo," is "Craolvs a Carolo." Has any brother collector met with a similar coin?—Moneta.

[11448.]—**Chronometer Balance Spring.**—Would any of your horological correspondents kindly give some information on the steel chronometer balance spring in watches? I have been informed that they are not to be had unless one gives a good price for them. I have a lever watch which I gave £6 5s. for some eight or nine months ago, with a chronometer balance spring (at least I was told so), and it has never yet kept good time. Is there any deception in them? if so, how can it be detected? Also what effect will dampness have upon the balance?—O. M.

[11449.]—**Angelet.**—I have in my possession a gold coin, which seems to be an angelet of James II., but I cannot find any description of it in any work on coins. On the obverse a ship with the title, &c., JACO. II. D. G. M. B. F. . . . ET. HI. REX. On the reverse an angel with a spear standing on a dragon, and the motto, SOLI. DEO. GLORIA. I am sorry to say it is much worn, and pierced in two places, and weighs in its present condition but 30 grains.—Moneta.

[11450.]—**Adjusting Equatorial.**—In adjusting the equatorial "that the polar axis may be placed at the altitude of the pole," according to the rule given by Chambers, p. 640, last edition, it is recommended that the declination of some favourably situate star be obtained, and compared with its declination given in the *Nautical Almanac*. An example is given, a Ursæ Minoris being the star selected. Referring to the *Nautical Almanac* for the present year I find the apparent position of this star (given at p. 371 for the upper transit of Greenwich) for this day is 88° 14' 17·6". My position is some degrees (2° 21' 23") north of Greenwich. Under the circumstances should I not apply a correction to the declination given in the *Almanac* for the difference of latitude? and if so what correction should be applied? I make the inquiry since no mention of any correction is made by Chambers or in Loomis, where the same rule is given.—Lamrock.

[11451.]—**Weight for Safety Valve.**—I have made a safety valve for a boiler, and have tried to work out what weight I shall require for that valve, and the distance to place it on bar, but I cannot get it right. My lever from A to B is 16in.; weight of lever, 12½oz.; weight required to balance ditto at A, 1lb. 14oz.; weight of valve, 7oz.; diameter of valve at E, 1¼in.; distance from A to C, 3in.; required to know what weight I want and what distance I am to place it from the fulcrum A, to blow off at 25lb., 30lb., 35lb. and 40lb.?—E. Nayler.

[11452.]—**Rain-water Tanks.**—I am about to construct a large rain water-tank to avoid wasting the rainfall off the roof of a house, and shall be greatly indebted to any one of experience in such constructions for advice as to the best method of building them, the section of bottom and sides, and as to the cover. My cistern should contain 1,500 cubic feet. I have clay, stone, and gravel for concrete, but no bricks. How is the connection best made between the roof and the tank, and how is it to be cleaned out?—Rosso.

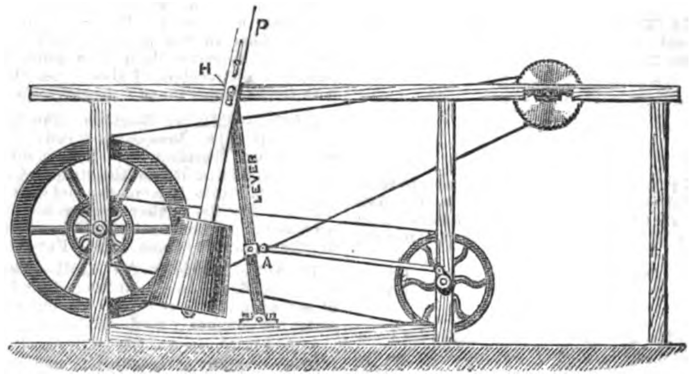
[11453.]—**Saturn.**—In looking through some foreign observations of Saturn, I find it stated that the ball of Saturn has been observed. Would any readers inform me whether the semi-diameter given in the *Nautical Almanac* is for the ball or the ring of Saturn?—William Hutchins.

[11454.]—**Commercial.**—I occasionally find E & OE, written at the foot of a bill or account to the left hand corner; would any one inform me what is the meaning of it?—R.

[11455.]—**Daisy Extractor.**—Can any brother reader of the Mechanic inform me how to make an implement to extract daisies, roots, &c., from lawns, with a drawing?—F. T. S. S. D.

[11456.]—**Saw Sharpening and Gulleting Machine.**—Can any brother reader inform me how to make the above machine, to be driven by steam? I want it to sharpen circular saws and pit saws, with a drawing of same.—F. T. S. S. D.

[11457.]—**Motive Power for Amateurs.**—I send drawing of a saw bench I am fitting up, and which almost explains itself. It will be seen that the long bar, P, which is suspended from the roof, acts as a pendulum, swinging backwards and forwards from the roof, the requisite movement being given with the handle H. This pendulum works a lever hinged at the bottom; on this lever is the sliding part A which can be fixed in any position (on the lever) by the thumb screw. In this manner the swing of the pendulum is regulated. Could any reader tell me if it is possible to arrange a system of weights so as to work a ratchet wheel in connection with the above pendulum (same as in clocks), and if it would swing the pendulum fast enough? If this is possible "there is the motive power for amateurs." I should like to know of any improvement to the above.—Zoo Andra.



[11458.]—**Carmine Staining.**—Should this be done to sections of animal tissue immediately after cutting or after the maceration in glycerine, and when in case of the use of re-agents? Does the same answer apply to sections of vegetable tissue?—Interrogator.

[11459.]—**Printers' Ink.**—Instructions for making the finest dark blue and red inks, for ball programmes and fancy work, would be very acceptable. The common colours run too light.—W. J. H.

[11460.]—**The Bee Hive.**—Mr. Abbott, at p. 19, recommends Mr. Godden to keep his glass hives under cover except when under observation, as they are dangerous things in a house. I wish he would be so kind as to explain the particular danger, and how to avoid it. I have a hive in a conservatory with entrance from the outside, but many of the bees came into the conservatory, apparently trying to enter the hive, and some of them died before I could pick them up and carry them to the hive entrance. Is it probable that the bees were really trying to get into the hive when they saw it? When we covered it over with a cloth fewer bees came into the conservatory, but I am not sure that that was because the hive was hidden. They made very little honey last year, flowers being scarce hereabouts. I live at South Kensington, about half a mile from Kensington Gardens, and a mile from Battersea Park: are such distances too far for bees to fly for food?—Philo.

[11461.]—**Reviving Black Cloth Coats, &c.**—Would some of your correspondents give a recipe for reviving black cloth coats, waistcoats, &c.? I have tried solution of carbonate of ammonia and dilute spirits of hartshorn. These remove grease, &c., but leave the cloth of a whitish hue, and when a trifle threadbare, make it look worse than before.—A. Desroirs, Dublin.

[11462.]—**Steel Hardening Paste.**—At an extensive machine works in Lancashire a few weeks ago, saw the turning tools and drills dipped red hot into a patent red paste. The blacksmith said this cooling or dipping improved all tools before tempering, and that it was a patent. As this was all the information I could get, I shall be pleased to learn more about this red steel paste.—A. B. C.

[11463.]—**Working Engines.**—I have two twelve-horse horizontal non-condensing engines worked by a twenty-four horse double tubed Cornish boiler—one of the engines (only) working three or four days in the week, the other six days. Is there not a great loss in fuel by working with the one boiler? What should I save by getting a separate boiler to each engine? A reply from any of your numerous readers will much oblige.—Dolomite.

[11464.]—**Spring Beds.**—When I lived in Paris I used to sleep on a bed made with metal springs, which required no mattress or feather bed. Is such a bed to be got in London, and where?—Associate.

[11465.]—**Problem.**—Two trains 92ft. and 84ft. long respectively, move with uniform velocities on parallel rails in opposite directions; they pass each other in 1½ seconds; when moving in the same direction, their velocities being the same as before, the faster train passes the other in six seconds; find the rate at which each train moves.—Puzzled.

[11466.]—**Vermin and Pigeons.**—Can "Jack of All Trades" or any other kind reader tell me of a wash to destroy vermin in pigeons and pigeon houses, also, which kind of food is best for them, and what amount ought to be given daily to each bird, and would camphor prevent the nits and fleas breeding in the nests?—Fantail.

[11467.]—**Tests for a Telescope.**—Would our obliging "F.R.A.S." kindly furnish me with a few tests for a 4½in. With-Browning reflector of 5ft. focus, also the theoretical dividing, and light-grasping power of the same. For picking up the tests I have Mr. Proctor's new atlas.—A. L. B.

[11468.]—**Observation Book.**—Will some kind astronomical friend tell me a good plan for an observation book, as to the arrangement of its parts, &c., so that I could refer without trouble to any observation before made.—A. L. B.

[11469.]—**Air and Warmth.**—How many cubic feet of air space should a dormitory contain? And what heat is the most wholesome for an Englishman to keep his room to?—Associate.

[11470.]—**Pocket Barrel Organ.**—What is a pocket barrel organ, and how is it constructed?—E. B. F.

[11471.]—**Bow.**—Would any reader kindly tell me the best kind of wood to make a large bow, about 6ft. long?—Archer.

[11472.]—**Plaster of Paris.**—I read and hear that when plaster of Paris is mixed with water and left to dry, it solidifies and becomes a hard and solid mass; but when I try to use it, it crumbles down almost by a touch. Will some practical correspondent tell me why this is, and how I may correct it? Also, ought it not to allow of being placed in water without softening again? for it is, as I read, used instead of porous earthenware vessels in Daniell's and other batteries.—C. B. B.

[11473.]—**Weak Voice.**—Will some kind reader inform me of the best means of strengthening the lungs, and whether milk is a good thing?—Fond of Singing.

[11474.]—**Botanical Specimens.**—Can any one inform me what is the most convenient and effectual method of preserving botanical specimens?—G. A. D.

[11475.]—**Artificial Butter.**—Can any of your readers inform me how this is made? I believe a patent was taken out for it in France, in 1870, and also that it was made regularly in Paris during the siege.—A Subscriber.

[11476.]—**Pattern Making.**—Will "Jack of All Trades" or any other kind subscriber tell me of some good book or books on pattern making?—Delta.

[11477.]—**Lamplough's Pyretic Saline.**—Will some of our chemical friends kindly give me the result of an analysis of the above? I have analysed it to the best of my ability, but being a beginner, I should like to know how near the truth I am.—H. C. J.

[11478.]—**Silver Bath.**—Will some one please tell me how many plates (carte de visite size) 8oz. of nitrate of silver solution ought to be sufficient for?—F. C. G.

[11479.]—**Tempering Cutting Tools.**—I have a quantity of small cutting tools to harden and temper. I should esteem it a favour if any one could give me some little instruction how to heat them in a lead bath to prevent oxidation of the lead, or how to construct a lead bath on the best principle; also what plan I am to adopt to temper them in an oil bath heated to about 580°, and what oil I had better use.—An Old Subscriber.

[11480.]—**Model Steamboat.**—I have a small double-acting oscillating cylinder. Can any one tell me if it would be able to turn a small pair of paddles, about 3½in. diameter? Could any one also give me instructions how to cut out a model steamboat, as small a size as can be made, with a cabin three inches deep, showing the shape at different parts by diagrams? how much lead should be put on the keel, and about how much would it cost?—DESIROUS.

[11481.]—**Organ Building.**—To "J. D."—I have got all my pipes made, and am now busy with the windchest, but I fancy I have not enough standing room for the pipes. Does it matter if the wood pipes are placed quite close to each other, both sideways and back to back? I am going entirely by your directions, so please continue your valuable papers, otherwise I, with a number more very likely, shall be thrown on my beam-ends. I should like to ask a number of questions concerning my work, but I refrain from troubling you, as I have no doubt you will explain all before long.—ALEPH.

[11482.]—**Algebra.**—I should be glad if any of your readers would work out the following equation, as I cannot arrive at the answers:—

$$x : y = z : t$$
$$x + t = 14$$
$$y + z = 11$$
$$x^4 + y^4 + z^4 + t^4 = 24929$$

—PUZZLED.

[11483.]—**Dyeing Parchment.**—Will any correspondent be kind enough to give me the following information? How can I make some good colours as dyes for white parchment? A permanent red and a permanent blue are what I am n need of most, which must not be affected or changed by coming in contact with water, oil, or grease. Also, give the method of applying the dye.—PARCHMENT.

[11484.]—**Manures and Their Values.**—Can any one inform me if there is any clever little book on agricultural chemistry where all the different kinds of manure are treated of, as well as their relative value and different effects on the soil? Also, will some one say what would be the best way this time of the year to crop a piece of ground of four acres? The whole thing is almost new to me. I have not any manure. I intend to work on the small farm system more than the garden system—that is, I mean to grow potatoes, and either turnips or mangolds, and a small portion of wheat and cabbages. I intended to keep a cow or two for the manure. Perhaps a better plan could be suggested. Are there any manures that would do instead of farmyard manure? The land is only of moderate quality.—WILLIAM RICHARDSON.

[11485.]—**Florentine or Brown Bronze.**—Will "Jack of All Trades" or any other contributor of "ours" kindly tell me if any of the bronzes mentioned on p. 642, Vol. XIV., query 10661, will do for tinwork, or one that will, and how they are applied?—R. O.

[11486.]—**Arithmetical Question.**—A settler in the Far West beginning his building had the misfortune to lose his rule in a rift. Having, however by good chance prepared two rods of 5ft. and 7ft. respectively, with these aids only he measured the length, breadth, and various proportions (in feet) of his log-house. Pray, how did he accomplish this, being unacquainted with geometry? The log-house was 48ft. by 28ft., and 11ft. high.—THETAMU, Horsham.

[11487.]—**Preventing Rust.**—Will any of your readers inform me how to prevent iron from rusting that is exposed to a damp atmosphere? I have tried tallow and oil with no good result. No paint allowed.—COASTGUARD.

[11488.]—**Coating Wooden Concrete Moulds.**—Thanks to "Jack of All Trades" for his recipe for waterproof mastic. I have put up a boiler, and shall try it. I now want a recipe for coating wooden moulds in which I form concrete cornices, &c., so as to enable me to withdraw the moulds sooner than I can when the concrete is in direct contact with the wood. I have tried linseed oil, but it discolours the cement. Will any of the gums, such as shellac, copal, &c., dissolved in spirit, form a coating to which the concrete will not adhere?—KHODA BUX.

[11489.]—**Weight of Cattle.**—Will any correspondent be kind enough to give me a rule by which I can ascertain the approximate weight of cattle by measurement? Problem: A farmer bought a heifer calf, which at three years of age began to breed a heifer calf every year, and the whole issue at three years of age commenced to breed heifer calves in like manner. Required, the number of the farmer's stock at the end of twenty years.—SHEPHERD.

[11490.]—**Dumpy Level.**—Will any brother reader tell me what is wrong with my dumpy level, and how to rectify it? I cannot get the air bubble to remain in the centre of its run during a complete revolution of the level.—SHEPHERD.

[11491.]—**Kid Dressing.**—Will some one be good enough to inform me how I can restore kid skins that have been once dressed, but are now gone rough and brown?—J. R., Leicester.

[11492.]—**Carbonic Ink Paper.**—Can any of your correspondents inform me how carbonic ink paper is made?—TELEGRAPH.

[11493.]—**Indiarubber Overcoat.**—Will any of your subscribers kindly inform me how I can prepare the adhesive solution for repairing the seams in the above? I have had one in wear for some time, and now the seams are giving way, but otherwise the coat is very good.—W. P.

[11494.]—**Utilising Slack.**—Will you oblige by requesting some of your talented correspondents to describe the mode of utilising slack by making it into "patent fuel" (a mixture of slack and fine coal), with a description of the ovens or furnaces in which it is prepared, &c.? Or is there any work published where the information can be obtained?—AN INTENDED UTILISER.

[11495.]—**Double Oscillating Steam Cylinder.**—I have a double oscillating steam cylinder, 1½in. stroke, ¾in. diameter. It is supplied with steam from a strong tin boiler, supplied with heat from three burners burning spirits of wine. I cannot make the steam raise the piston. Is the cause from the steam not being strong enough, or is it from the different parts of the engine not being put together properly? Would two brass tubes put through the boiler increase the power of the steam?—VELOCIDADE.

[11496.]—**Lotion of Hydro-Sulphate of Soda.**—Will any one state how the lotion of hydro-sulphate of soda is prepared? Does it destroy organic tissue?—F. N. B. [A portion of this query being commercial was omitted.]—ED.

[11497.]—**Removing Oil Stains from Billiard Cloth.**—Is there any way of removing colza oil stains from a billiard cloth?—W. BELFIELD.

[11498.]—**Re-'Scaping Old Verge Wheel.**—Will "West Cornwall," "Tometer," or any other practical hand say which is the best way to re-'scape old verge wheel by hand?—B. JAMES.

[11499.]—**Zymotic Diseases.**—We are told that every particle composing our bodies is removed and replaced by a new one within a short period. We are also led to suppose that immunity from a second attack of a disease like small-pox is owing to the first attack having exhausted the soil. Will any reader explain this?—M. PARIS.

[11500.]—**Welding Cast Iron.**—Would any of my fellow subscribers inform me how I may weld two pieces of cast steel together? Should feel obliged for a good recipe or two.—DYRUS.

[11501.]—**Exhalations and Consumption.**—Doubtless, many of your readers have frequently noticed the newspaper extracts from medical reports of the decrease of consumptive cases in localities where the surface moisture is rapidly carried off by good drainage. It would be interesting to me to hear why this is so, and what effect exhaling water has upon the human lungs. It has also occurred to me that it might be found by a parity of reason that the evaporation of water from stoves in close rooms was injurious to persons of delicate chests.—CORNUBIENSIS.

[11502.]—**Stair Noses.**—What is the best protection for the edges of stair canvas where it is much trodden on, and soon gets worn out? I have seen angle pieces of brass, and also slips of lead fastened to the nose of the stair, but probably this would cost as much as a new stair covering.—R. H. P.

[11503.]—**Wollaston's Differential Barometer.**—Would some correspondent describe Wollaston's differential barometer, and how it is applied to determine the draught of chimneys? A sketch of the thing would make it easier understood.—VENTILATION.

[11504.]—**Photographic.**—Can any of your correspondents give the name of a good substitute for canvas or carpet in a large photographic studio? The sitter's part has a square of carpet; it is the rest of the room I don't know very well what to do with. Besides the first cost of canvas it wears off in places, and it has occurred to me that it would be possible to stain the floor in imitation of tiles, and then varnish; the tiles to be the width of the boards.—CORNUBIENSIS.

[11505.]—**A Wooden Pump.**—A friend of mine has a wooden pump on his farm which has become worn by the action of the bucket so that no water can be drawn, and a new bucket cannot be substituted, as it won't go down to the loose place. Is there any alternative but taking up the pump and reboring.—CORNUBIENSIS.

[11506.]—**Refractive Index of Glass.**—How is the refractive index of glass found? Has it anything to do with its specific gravity?—ZETA.

[11507.]—**Mathematical Astronomy.**—Allow me to appeal to "F.R.A.S." or Mr. R. A. Proctor to solve a question for me. It is, of course, possible to find the orbit, mean distance, and other ephemerides of any planet or comet from four or five observations of its R. A. and. dec. What mathematical knowledge is required for this? and would an acquaintance with the elements of spherical trigonometry co-ordinate geometry (algebraical) and conic sections be sufficient, or must I study the differential and integral calculus. Also, would it be possible for "F.R.A.S." to indicate in a letter the outlines of this method?—ARISTARCHUS.

[11508.]—**Star Magnitudes.**—Will "F.R.A.S." or some other of your correspondents kindly give the magnitudes of Argelander, Struve, and Herschel, equal to those of Smyth for stars above the tenth magnitude? I should not ask, if it was not that they are essential to all who wish to use the various star catalogues, and as many of our correspondents, as Mr. Knott, Mr. Burnham, &c., use different scales, without such a table these letters can but be of limited use. If "F.R.A.S." is unable to spare the time, perhaps one of these gentlemen might.—ARISTARCHUS.

[11509.]—**Adapting Barrel to Pianoforte.**—Will any subscriber tell me how to adapt a barrel to a pianoforte (one of Bord's)? How are the barrels made? How are the pins made to act on the hammers? and would it interfere with ordinary playing? with any other information that would be a guide to the same. A drawing would greatly assist me.—G. W. WOOLVEN, Sydney, N. S. W.

[11510.]—**Defective Sewing Machine.**—Will "Jack of All Trades" tell me the reason of the cotton not slipping off the hook freely (one of Wheeler & Wilson's machines) it hangs on the bevelled part after the brush has let go, when the point of the hook has passed the brush, the loop still clings to hook. Any information about machines in general would be acceptable to many readers out here.—G. W. WOOLVEN, Sydney, N. S. W.

[11511.]—**Rubber Tires.**—Could some of our scientific readers tell me if there is not a disadvantage in the rubber tires of bicycle wheels in consequence of the suction which there must be, I think, caused by the flattening of the surface of the rubber on the ground with the weight of the rider upon it. We know that it is much easier for a horse to draw a cart, &c., over a hard smooth road than over a soft one, because it don't draw so heavy, as it is termed. I suppose it is the suction that causes the heavy drawing. Applying the same principles to the rubber and iron tires, which would be the lightest drawing? Rubber tires must make the bicycles go quiet, and give nicely to the unevenness of the roads; but is there not more suction, and therefore do they not draw heavier? Perhaps some one who has had some experience in riding wheels with iron and rubber tires can give an explanation to the above, and oblige—A CONSTANT READER.

[11512.]—**Lathe Chuck.**—I observe in No. 362 a description by "Geist" of a chuck for turning oval handles. I wish him to tell me how he holds the other end of the handle. Perhaps "G at" or "Semper Paratus" will instruct me.—T. LEITH.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, April 2, and unacknowledged elsewhere:—

R. Gay and Co.—John Browning.—J. S. Darton.—H. Dolan.—Wm. Houlker.—Francis Hawkins.—E. T. Sutcliffe.—Geo. Read.—R. G. Moberly.—W. H. Bailey.—Thos. W. Cowan.—R. Nelson.—R. W. Burchard.—J. Clark.—E. H. Greg.—W. L. Pendered.—J. and H. Crace.—H. W. Hollis.—Col. Anderson.—A. Ledger.—H. E. Havergal.—Jas. Johnson.—Wm. Atwood.—J. E. Muspear.—T. C. Mulvany.—W. G. Roberts.—V. B.—E. S. H. Hallett.—Porter and Lane.—Robert Neilson.—Webb and Co.—Charles Baker.—Lieut. Col. Fendall.—E. James.—Q. E. D.—E. J. D.—Billiardist.—B. J.—Agricola.—E. L. G.—Sheet Iron.—Wallace.—Zeta.—Argyrius.—Bachelor Jubilant.—Colombo.—Simple Equations.—Ramsgate.—E. Barber.—R. A. G.—A Constant Reader.—Aspirant.—W.—A Barrister.—Illusionist.—R. M.—Lambrook.—Reed Maker.—W. R. A.—Redivivus.—C. J. R.—Geo. Blackledge.—W. J. Trinder.—Beacon Lough.—J. H. Lancaster.—J. K. P.—Sceptic.—M. A. B.—J. Still.—W. H. Robinson.—Querist.—E. W. J.—A New Subscriber.—Saul Rymea.—R. A. Proctor.—Fidelio.—Chisel.—R. R. Forbes.—Drinkwater.—O. J. L.—Holiday Time.—W. and B.—Old Shoreham.—Organist.—J. G.—W. T. M. D.—H. J. Skelton.—The Harmonious Blacksmith.—Bobo.—Daleth.—C. S. W.—Monte Cristo.—J. M.—Mancuniensis (what a name!)—Ralph Lowdon.—Bernardin.—J. Pemlington.—J. R. D.—J. C.—Excelsior.—Schoolboy.—W. Millard.—A. J. W.—Mercurio.—J. C. P.—Fe Sut.—W. Horrocks.—V.—Zoo Andra.—Un Irlandais.—Peter Wallace.—Thetamu.—C. J.—Gouge.—Jas. S. Cooke.—Cordwainer.—C. W. H.—No. 170.—Rat-Tat.—T. L.—Joiner.—C. E. S.—Yoiza.—J. W. Leamington.—Joe.—West Cornwall.—T. A.—Harry Bailey.—F. T. S. S. D.—Q. E. D.—H. Price.—A. P. S.—J. Asher.—T. H. Sanders.—H. E.—James Ridout.—J. W. Fennell.—G. Lamb.—Domestic.—W. R. Birt.—J. Birmingham.—G. R.—Zulo.—Melodious.—J. O. Phipps.—S. K. S. T.—Wm. Cooke.—R. Lupwards.—Practicus.—J. R. Nichols and Co.—Anglo-American.—A Pattern Maker.—H. C. Symons.—W. E. Cannabe.—Walter Winning.—Robert Walker.—W. Quy.—Tantalus.—F. L.—Novice.—J. C. S. Kenny.—Wm. Oldfield.—William Tonkes.—A Constant Reader.—W. Hughes.—Reader.—S. Bottone.—F. R. A. S.—Capital and Labour.

A VETERINARIAN.—See "Hints to Correspondents," No. 4.

SEMPER VIVO.—Look in future, before you write complaining. Your query was replied to in No. 363, p. 644.

J. FRANKLIN.—We do not remember the query.

R. D. O.—See indices to back vols.

C. MACE (Reading).—Stamps only sufficient for one advertisement.

TUBAL KAIN.—Should be glad of the paper with diagram at your convenience.

COTTON OIL, J. L. S.—Your queries are advertisements.

JAS. HASTIE (Goatfoot Collieries, near Kilmarnock).—The ENGLISH MECHANIC is regularly published on Thursday morning, and if you do not get it till Monday, the fault must be the agents, not ours.

A. KING and E. W. L.—You can't be constant subscribers, or you would not ask to be answered by post.

W. OLDFIELD.—Yes.

E. L. E.—You must try and work out the sums for yourself. The ENGLISH MECHANIC is not a schoolboy's organ.

R. G. B.—See last few numbers for information on incubators.

A CHUMP.—Lay the case before some well-known and trustworthy neighbour, such as mayor, clergyman, or magistrate, or any man of honourable character. From what you say the lawyer is acting dishonestly.

W. C. BUCKNELL.—See "Hints to Correspondents," No. 4.

E. RAE.—Shall have attention.

DOLOMITE.—First query inserted, the second is an advertisement, as it can in no way interest any one but yourself.

A BARRISTER.—Thanks for your letter on query 12271 and answer. "Sigma" has also replied. There are always rascals to be found, and the correspondent who asked and answered this question is one. We sometimes receive hundreds of letters a day, and in the hurry of preparing for the press for this and other publications it is almost impossible to prevent a query like this occasionally slipping into our columns. During the last two years we have received scores of queries and answers, written by men who have more time and money than wit, and who, we suppose, think they are playing practical jokes. But they hardly ever find us napping; we don't even acknowledge their letters, but we keep them as testimonies against them, and it is very likely that one of these days there will be a nice little exposure in our columns or in a law court, as we have no doubt that we shall be able to trace the handwriting to the authors. "A Barrister," or "Sigma," or any other corresp[illegible] may see [illegible] handwriting, and so help us [illegible]

P. N. HASLUCK.—See answer t[illegible] letters are preserved, and [illegible] are the greatest offender[illegible]

J. W.—See pp. 259 and 2[illegible] wire covering machine.

WELSHMAN.—Write to th[illegible]

B.—No room for such profitless communications. You first ask an involved arithmetical question, then solve it in your way, and conclude by asking "E. L. G." his opinion of the solution. Did the thought ever occur to you that the available space of the English Mechanic is in a sense public property, and that it should not be wasted in airing individual idiosyncracies? If not please bear the hint in mind. We esteem those correspondents the most who say the best things in the fewest words, so that the largest possible number may receive the greatest benefit.

H. F.—See indices to back vols.

A New Subscriber.—Ask any maker. You can hardly expect us to engrave representations of ordinary concertinas and accordions, that you may be told "the difference between them."

Communications which can only appear as advertisements to hands from M. A. Adams, Ultima Thule, A Young Student, J. W. Card, Jupiter's Moons, W. J. Porter, Peterborean, A Brewer, J. Gilfillan.

R. S. T.—To destroy moths in furniture, &c., see p. 21, Vol XIII., also recent back numbers.

Ralph Lowdon.—If we understand your query aright its insertion would be irreverent, especially at this season. The event is not one for discussion in these pages.

Subscriber (St. Austell).—We do not know the makers. Address was given, write them.

Pododaktylos For.—For cement for aquariums, see pp. 308 and 582, Vol. XIV.

L. W. D.—A pint contains 34·66 cubic inches.

Q. Yorke.—The society you speak of does not answer the want that "March" wishes to see supplied. We have again and again received complaints of the kid-gloved character of said society, and heard wishes expressed that a more robust one should be instituted, and in more than one instance from members of the said society themselves.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MARCH 26, 1872.

817 G. H. C. Hedley, Wolverhampton, for an improved fire-lighter.

818 R. Gorga, Belfast, Ireland, for a synoptic system and characters employed therein for the more easy learning of the pronunciation of English and foreign languages.

819 G. Pashley, Sheffield, for a new or improved valve for hydraulic and other purposes.

820 E. Feldtmann, Mark-lane, City, for an apparatus for heating and ventilating railway passenger carriages. A communication.

821 M. A. Soul, Southampton-buildings, for a new or improved balloon locomotive or navigable balloon. A communication.

822 C. Dumbleton, Fareham, Hants, for improvements in apparatus for cutting or forming screw threads upon wood, metal, and other material.

823 S. E. Holten, Gracechurch-street, City, for improvements in mechanical writing instruments, applicable for reporting and other purposes. A communication.

824 W. Marshall, Bootle, Lancashire, for improvements in clog bottoms.

825 J. Copeland, Manchester, for an improved valve to be used for regulating and stopping the supply of steam, water, air, gas, or other fluids.

826 W. Garey, Aberdeen, for improvements in preparing paper for photographic purposes.

827 J. H. Johnson, Lincoln's Inn-fields, for improvements in compositions to be used in fireworks and for signalling purposes. A communication.

828 W. R. Lake, Southampton-buildings, for improvements in printing telegraphs. A communication.

829 W. R. Lake, Southampton-buildings, for improvements in printing telegraphs. A communication.

830 W. R. Lake, Southampton-buildings, for improvements in apparatus for raising, retaining, and lowering boats. A communication.

PATENTS SEALED.

2511 J. Verity, for improvements in the construction of chimneys for gas burners and oil and other lamps, and in reflectors and protectors for the same.

2518 T. C. Eastwood, for improved machinery for preparing and combing wool, flax, silk, cotton, and other fibrous substances, and noils and waste from such substances.

2527 C. A. Hardy and A. E. Stayner, for improved method and appliances for shafting picks and other tools, such as are generally formed with an eye.

2528 J. Bailey, for a new or improved joint for screw piles.

2531 E. Baudot and E. Roettger, for improvements in obtaining motive power by the heat diffused in the air or any other fluid or liquid body.

2533 J. Shepherd, for improvements in apparatus for separating water from steam.

2537 A. Wallis and C. J. Steevens, for improvements in apparatus for heating the feed water and partially condensing the exhaust steam in portable engines, locomotive engines, and other engines wherein the cylinders and boiler are fixed together.

2546 A. Pécaud, for a new brake to be adapted to railway carriages.

2568 R. Long, for an improved freezing machine and refrigerator.

2604 T. Jackson, for the improvement of pianoforte actions.

2643 H. Sprengel, for improvements in the preparation of explosive compound.

2665 A. H. Still and D. Lane, for improvements in the manufacture of illuminating gas.

2705 R. P. Williams and J. Price, for improvements in the permanent way of railways.

2778 W. H. Tayler, for improvements in stoves for burning gas or gas and air, for general heating and cooking purposes.

2783 J. H. Johnson, for improvements in disintegrators.

2827 G. Kallmeyer, for improvements in sewing machines.

2840 W. R. Whitelaw, Glasgow, for improvements in furnaces.

2852 A. M. Clark, for improvements in traction engines.

2868 E. de Zuccato, for improvements in apparatus for making and copying drawings and writings.

3225 E. Korting, for improvements in steam engines.

3215 R. B. Evered, for improvements in taps or valves.

3260 J. H. Johnson, for improvements in extinguishing fires, and in apparatus or means to be employed therefor.

117 W. H. Franes, for improvements in machinery for combing wool and other fibres.

131 J. H. Greenhill, for improvements in disintegrating machinery.

149 A. M. Clark, for improvements in applying colours or tints to photographs, albumenised and other surfaces.

199 D. Joy, for improvements in the means and apparatus for the removal of slag from blast furnaces.

329 W. R. Lake, for an improved method of preparing and preserving hops for the manufacture of beer, and for medicinal purposes.

387 W. R. Lake, for improvements in engines to be operated by gunpowder or other explosive material.

2551 S. Schuman, for improvements in fulling or walking and felting wollen and hair fabrics, and in the means and mechanism employed therefor.

2559 H. P. Armstrong, for improved instruments or apparatus to aid in teaching persons to play upon keyed or stringed musical instruments.

2561 N. C. Underwood and W. Adshead, for improvements in the mode of felting hat bodies and other felted fabrics, and in apparatus therefor.

2567 C. de Chastelain, for improvements in the mode of and apparatus for intercepting, collecting, and filtering fæcal and sewage or drainage matters.

2572 H. Turner, for improvements in the formation of plastered ceilings and cornices, being also applicable to wall surfaces generally.

2580 W. E. Gedge, for an improved screening apparatus.

2581 E. T. Hughes, for improvements in reeling machinery used for forming threads or yarns into skeins or hanks.

2587 J. M. Plessner, for improvements in obtaining motive power, and in apparatus to be employed for this purpose.

2589 C. Catlow, for improvements in looms for weaving.

2591 H. Stapfer, for improvements in the filtration or separation of mineral or other oil from oleaginous matter or from matter or compounds containing oil, and in apparatus therefor, applicable also to the filtration of some other matters.

2593 T. Waller, for improved arrangements for the supply of fresh hot or cold air or mixed hot and cold air in infirmaries, hospitals, and other buildings.

2596 T. Varley and F. H. Varley, for improvements in electric telegraphs, part of the invention being applicable to other purposes.

2597 N. D. Spartali, for improvement in apparatus for propelling vessels.

2605 J. H. Kearns, for an improved blotting-pad book diary.

2611 J. E. Liardet, for improved mechanical arrangements for working and protecting ordnance and other fire-arms, and for the defence of the men in charge of the same.

2614 H. Kinsey, for improvements in steam winches, partly applicable to steam engines generally, and to other purposes.

2626 W. I. Ellis, for improvements in machinery for forcing and exhausting air or other gases.

2628 L. Pocock, jun., for improved means or apparatus to be employed in the drying of guano, manure, or other similar substances.

2635 O. Demailly, for improvements in disaggregating textile plants and wood, and in the apparatus in connection therewith.

2640 A. Browne, for an improved revolving pistol toy.

2643 J. Gowans, for a new or improved traction car for drawing or propelling vehicles on tramways.

2644 J. Gowans, for improvements in machinery used in the construction of tramways and railways and applicable to other similar purposes.

2648 H. Walker, for an improved apparatus for making button-holes.

2659 J. Burrow, for improvements in treating sewage and other matters.

2676 T. J. Smith, for an improved process for treating filaments, threads, and fabrics to render them suitable for dyeing.

2678 W. E. A. Hartmann, for an improved mode of and apparatus for burning pulverised fuel.

2703 P. Brannon, for improvements in the construction of fire-proof houses and other buildings.

2717 J. Lodge, for improvements in the manufacture of artificial fuel.

2731 J. Homan, for improvements in rolled iron joists and girders.

2740 C. D. Abel, for improvements in the manufacture of iron and steel, and of alloys of various metals, and in the apparatus employed in connection therewith.

2748 H. S. Dunn, for improvements in boring and winding machinery connected with boring for minerals, wells, blasting and such like purposes.

2756 E. J. Harland, for improvements in apparatus for propelling vessels.

2828 W. R. Lake, for an improved inkstand and appliances to be used in connection therewith.

2963 W. Weldon, for an improved method of drying chlorine gas.

3217 W. R. Lake, for improvements in lamps or lanterns chiefly designed for out-of-door situations.

3241 J. Hodges, for improvements in purifying paraffin.

3284 M. Tildesley, for an improved application of certain known materials to be used in the annealing of cast iron to produce malleable iron.

3342 W. Verity and B. Verity, for an improved perforated fire-clay gas burner adapted for heating or cooking purposes.

4 H. Highton, for improvements in electric telegraphs.

37 W. E. Newton, for improvements in preserving edible animal and vegetable substances.

194 T. K. Scruton, for improvements in the manufacture of neckties or cravats.

202 A. Higginson, for improvements applicable to motive-power engines, engine governors, and pumps.

249 G. Abraham, for improvements in the fittings of window sashes.

261 J. Boyd and W. Henderson, for improvements in machinery for weaving hair cloth.

839 J. H. Johnson, for improvements in nail machines.

840 J. H. Johnson, for improvements in burning hydrocarbons, and in apparatus to be employed therefor.

ADDRESSES.

WATER-WHEELS (Query 11117).—Wheels 5ft. and 7ft. in diameter. Particulars would oblige "Youngster."—CHARLES BREWER, Illogan.

TO BRASS FINISHERS.—WANTED, the Name of a Firm that can supply finished Brass Castings, pattern patented, weight about 10oz.—D. C., Post-office, Stockton-on-Tees.

FOR "ARMLESS ENGINEER," Address, Care of Mr. WALKER, 10, Turncroft, Stockport.

WILL "F. P." (No. 11249) on Concrete Buildings kindly inform W. BUTLER, Witham, Essex, if he may see the building "F. P." is erecting?

"ASSOCIATE" is asked to Advertise his Address in order that some CRYOLITE may be offered him. It is Mr. H. B., Clyde-villa, Surbiton, S.W.

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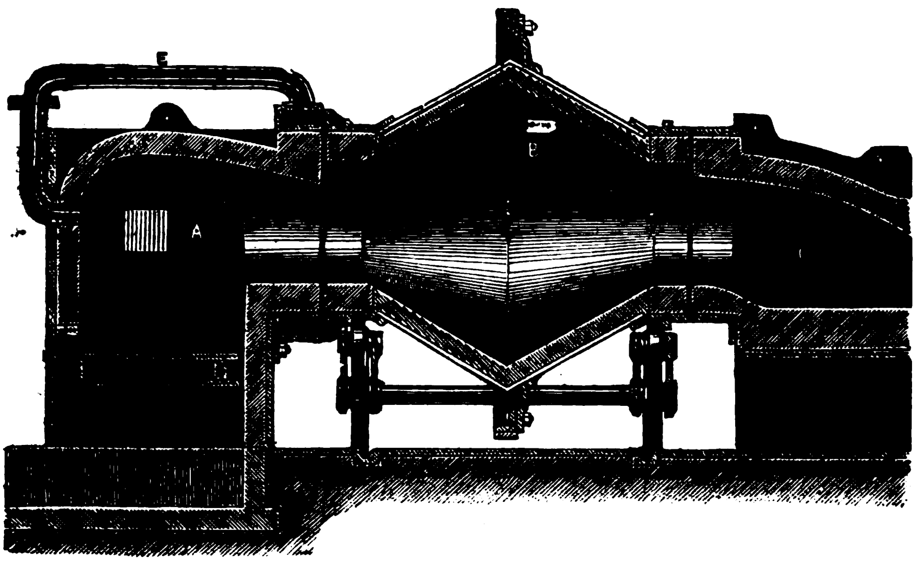
The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 12, 1872.

ARTICLES.

PUDDLING MACHINES.

IN the account of Danks's rotary puddling furnace, which we gave on p. 579 of our last volume, we alluded to the probability of supplementary reports being presented at the meeting of the Iron and Steel Institute, in order that a clearer idea of the whole bearing of the new invention on the iron industry might be rendered more easily obtainable than was possible from the necessarily incomplete description of the process furnished by the Commissioners on their return to this country. Mr. G. J. Snelus, one of the Commissioners, has now presented to the Institute at its recent meeting, as full a report on the scientific, practical, and commercial aspects of the process as the time at his disposal enabled him to accomplish; and from the manner in which the invention was spoken of at the meeting, a great and important change in the manufacture of iron is about to be inaugurated. In fact, it has been stated that Mr. Danks has entered into an agreement with a number of iron-masters, representing various districts, to permit them to put up 200 furnaces on his plan in consideration of a payment of £50,000 in six months. As few of the manufacturers intend to remove their old hand-puddling furnaces, this will represent an enormous increase in the puddling power of the industry, equal to an additional make of 300,000 tons a year.



The theory of the puddling process is described by Mr. Snelus at the opening of his report, and if we give an abstract of this, the advantages obtained by the employment of Danks's furnace will be apparent to our readers. Pig iron is the metal in what may be termed its raw state; it is combined with sufficient carbon to render it fusible at what is comparatively a low temperature, and is possessed of little malleability. A few other elements are generally found in the raw pig, such as sulphur, phosphorus, silicon, and manganese, and the object of the puddling process is to render the iron malleable by removing these "impurities" and the excess of carbon. This is accomplished by submitting the iron to a process of oxidation, the oxygen for which is obtained, in the old process, partly from the "fettling" or lining of the metal bath, and partly from the air which finds its way in through the door at which the puddler introduces his rabble or stirring-rod. By this means the carbon is converted into carbonic oxide or carbonic acid, the silicon into silica, the phosphorus into phosphoric acid, and the manganese into manganous oxide, and these are either carried away or pass into the slag. What becomes of the sulphur is not positively known, but it is believed to unite with the slag as sulphide of iron, or, becoming oxidised, to pass away with the gases from the furnace. In the Danks furnace, however, the whole of the necessary oxygen is obtained from the fettling, and it was the failure to secure this necessary property in the lining of the metal bath that proved so great a stumbling-block to the introduction of a machine for mechanical puddling; for some years ago Mr. Menelaus, who is a most untiring experimenter in this direction, all but succeeded in producing a rotary puddling furnace, being stopped solely by the difficulty of procuring a suitable compound for fettling purposes. It was at this stage of the invention that Mr. Danks, of Cincinnati, took up the subject, and after numerous experiments hit upon a method of fettling with a material which gave the desired results. The revolving chamber or puddling bath of his machine, which we illustrated on p. 579 of the previous volume, is constructed with longitudinal wedge-shaped recesses on its interior face, which assist in firmly holding the mixture forming the first or initial lining of the puddling chamber. This lining consists of an ore free from silica, ground up and mixed with lime cream, so as to form a kind of mortar, which adheres to the plates forming the revolving chamber, and when dried becomes refractory, and sufficiently cohesive to allow of the fettling proper being melted upon it without itself melting, or separating from the plates of the furnace. On this initial lining a quantity of ore, free from silica, is melted and distributed over the whole surface by slowly revolving the chamber, and while this coating is in the molten state large lumps of similar ore are thrown in, and being cold cause the melted metal to set round them and fix them firmly, thus producing a rough lining with a largely increased surface to act upon the charge of pig iron. It is absolutely necessary that these lumps should be of such a texture that they will not crumble with heat, and they must be nearly free from silica. "Tap cinder"—*i.e.*, cinder obtained from a heating furnace where a bath of oxidised iron is used to protect the plates instead of sand—is a suitable material both for the lining and the lumps, but where this cannot be had, and ores free from silica are difficult to obtain and expensive, Mr. Snelus thinks it would pay to oxidise scrap iron for the special purpose. A great advantage of the mechanical puddling process is found in the larger yield of metallic iron, a portion of which is obtained from the lining of the furnace; for it is obvious that if the necessary oxygen for oxidising the carbon in the pig is obtained solely from the oxide of iron forming the lining the latter must be reduced to the metallic state, and so help to swell the yield of puddled iron. It is also worth mention that under these conditions the carbon is oxidised to its highest point, and more pure metal is obtained than when carbonic oxide alone is produced.

The fettling having been successfully accomplished, the pig iron to be puddled is introduced in large lumps, the charge being generally about 600lb. The chamber is then slowly rotated at intervals, so as to expose the charge equally to the action of the flame, and when the whole is in the molten state the chamber is made to revolve about once every half-minute for the first eight minutes or so in order to insure the perfect action of the cinder upon the molten metal. At this stage of the process a jet of water is directed against the lining on the descending side, so as to solidify a portion of the cinder, which is thus carried under the melted iron, and rising up through it combines with and removes the impurities in a more effectual manner than has hitherto been the case, even with hand puddling. Mr. Snelus thinks that the jet of water also has the effect of carrying off sulphur from the cinder. In about ten minutes after the pig iron is all melted the cinder is run off, carrying with it a large portion of the products of the sulphur, phosphorus, and silicon, and the iron begins to boil. The chamber is now made to revolve six or eight times in a minute, and a high temperature being kept up the iron is thrown about violently till the process is complete, and the speed being reduced the ball begins to form. The stopper hole is now opened, and the ball partially solidified by means of a tool, when the head-piece is removed and the ball taken out by means of a lifting-fork, as described in the previous article.

The defect of the process as here described, however, consists in the fact that the time taken to melt the charge is actually longer than that occupied in puddling—viz., from 30 to 50 minutes for a charge of 600lb., and this time consequently represents a large consumption of fuel. It is so far satisfactory to find, nevertheless, that this defect is one the removal of which offers no insuperable difficulty; for finding that while the new puddling furnace is economical in the working of its own peculiar duty, it is a bad melter of the iron, Mr. Snelus points out that the charge must be melted elsewhere and brought to the mechanical puddler in the molten state. By the adoption of this method, he thinks that not only would a moiety of the fuel be saved, but twice the number of heats might be obtained in the same time. The arrangements for firing and regulating the blast of the furnace form an important part of the invention, and contribute largely to the success of the system as a whole. The puddler has, in fact, complete control of his fire; by means of a valve he can so regulate the blast as to urge the furnace to an intense heat or to almost stop combustion altogether. This blast also serves to prevent the entrance of air at the joint between the revolving chamber and the furnace, the full pressure inside stopping its ingress, and thus avoiding all waste of iron which might be caused by the admission of free oxygen.

With regard to the cost of puddled iron by the Danks process, Mr. Jones, the member of the Commission who has drawn up the supplemental report upon this part of the question, estimates a saving of 10s. 8d. a ton, but considers that this is considerably underestimated. Mr. Danks, however, claims a saving of £1 a ton, and it is probable that when the machine is brought into extensive operation, that figure will be reached if it is not exceeded. The effect of so large a reduction in the cost of producing malleable iron, together with the ascertained fact that 12 of Danks's rotary puddlers will turn out as much as 50 of the old hand-worked furnaces, for which of late years it has been difficult to obtain a supply of competent men, owing to the laborious and exhausting nature of the work, will speedily make itself felt in commerce. So that taking into account that this new rotary puddler dispenses with the killing labour of its human namesake, besides doing his work better and cheaper, it is not to be wondered at that the report of the Committee has been received and adopted by the Iron and Steel Institute, and that arrangements are being made for the erection of a large number of Mr. Danks's furnaces. The opinions expressed at the meeting were unanimous in its favour, and, together with the high commendation pronounced by Mr. Menelaus, must be very gratifying to Mr. Danks.

It must not, however, be supposed that while success has thus fallen to the lot of an American, it has not been striven for, and in a measure obtained by, our own inventors. Mr. Spencer has succeeded in constructing a rotary puddling machine, in which the revolving chamber is made up of troughs. The results obtained from this machine are described as being highly successful, but as the iron is divided into comparatively small balls, although this is convenient for after operations, the general opinion was that from the greater expenditure of the fuel and the increased size of the machine itself, it was not so valuable an innovation as the Danks machine. We may, however, give an illustration and description of it in a future number. In the mean time we illustrate what we may term an adaptation of Mr. Danks's principle to the existing furnaces, the joint design of Messrs. Howson and Thomas. The object of these gentlemen is to construct a machine which, while operating on the principle of the rotary puddler, shall utilise as much of the present working plant as possible, so as to avoid the large expenditure of capital rendered necessary by the impending revolution in the iron trade. Experiments have as yet only been made under imperfect arrangements, but the inventors consider that with more complete details their machine will provide a satisfactory makeshift for the Danks's furnace, and thus avoid the total loss of the now "old-fashioned" plant which is still sound and good. The section represents an ordinary puddling furnace, from which the hearth is entirely removed, and the revolving chamber B mounted in its place. A is the ordinary firegrate, which, however, it may be advisable to slightly modify, and C is the flue leading to the uptake, which would remain in much the same state as at present. The revolving chamber, B, is of wrought iron with cast-iron trunnions, and is preferably constructed of two cones, fitted base to base, for convenience in lining. The trunnions are mounted on rollers on a carriage which runs on wheels in a direction across the axis of the furnace. By means of this carriage the chamber is run out between the flue and the firegrate for the purposes of being lined and charged, and for removing the puddled ball. The lining is made of bricks of ground oxide of iron burnt very hard, and the shape of the chamber being favourable a lining thus formed will wear down to ½in. without giving way. The great difficulty to overcome in adapting this chamber to the present furnace consists, of course, in rendering harmless the cold air which finds its way in at the gap between the chamber and the firegrate—a gap which is obliged to be left in consequence of the expansion of the casing by heat. This is accomplished by making the opening against which the trunnion works of two cast-iron rings inclosing an annular space which communicates either with the chimney, by means of a separate flue, or with the fire, as shown in the figure, by means of a pipe, E. A draught is thus formed in the annular space, which draws away the air leaking in at the joint, utilising it at the most serviceable point, and reducing leakage into the working chamber to a minimum. Screens are provided to prevent loss of heat when the chamber is run out, and the puddled ball is readily removed by tipping the chamber when it is drawn beyond the screens, which are perforated with holes for observation and manipulation. The chamber is worked by a steam-engine with 7in. cylinder and 7in. stroke, the gearing giving revolutions of three and six to the minute. It is probable that within the next few months great improvements will be made in the puddling process, now that so many minds will be directed to the subject, and are acquainted with what has been already accomplished; for economy in fuel alone is well worth anxious study and enterprising experiment.

LESSONS ON CHEMISTRY.*

By Selimo R. Bottone.

(*Late of the Istituto Bellino, Novara, Italy.*)

(*Continued from p.* 30.)

119.—OTHER compounds containing chlorine and oxygen exist, but their constitution is doubtful, their composition uncertain, and their very existence as definite compounds is, by many, disallowed. We will notice briefly a few of these bodies, referring the reader who may be desirous of entering into details to the works of Gmelin, Watts, and Millon.

120.—Euchlorine.—If a mixture of a chlorate along with hydrochloric acid be gently heated, a bright yellow explosive gas is evolved, which is the body in question. The composition of this body is constant; but as, by exposure to cold, it resolves itself into chlorine gas and another oxide of chlorine, it is regarded by chemists as a mere mixture. Its composition would appear to be

$$Cl_7', 2Cl_2'O_5'', Cl_2'O_4''; \text{ or } Cl_{11}'O_{13}''.$$

Some chemists look upon this as the missing link in the chain of oxides of chlorine, and represent its formula by a submultiple of the above proportions—viz., $Cl_2'O_2''$. (See Odling, Becquerel, Gmelin, &c.)

121.—Chloro-Chloric Acid.—*Synonym: Chlorate of Chlorine Trioxide.*—When a current of euchlorine is passed through a series of U-shaped tubes, cooled by a freezing mixture, this body condenses as a red fluid, while chlorine gas escapes. It resembles strongly chlorine tetroxide, but differs from it, inasmuch as it does not boil till it reaches 89·6° Fahr.[1], nor explode below 70° Fahr.[2] The composition of this body has been given by Millon as $2Cl_2'O_5''$, $Cl_2'O_3''$, or, what amounts to the same thing, $Cl_6'O_{13}''$. Its formation from euchlorine may be expressed thus:—

$$Cl_{18}'O_{13}'' = 2Cl_2'O_5, Cl_2'O_3'' + 7Cl'.$$

122.—Chloro-Perchloric Acid.—*Synonym: Perchlorate of Chloride Trioxide.*—On exposing chlorine trioxide to the action of light, at a temperature of about 68° Fahr., this compound separates as a reddish brown liquid, smelling somewhat like bromine, and fuming strongly in the air. When acted on by caustic potash, a mixture of two molecules of potassium percholate, $K'Cl'O_4''$, and one molecule of potassium chlorate, $K'Cl'O_3''$ is formed, hence its composition is supposed to be

$$2Cl_2'O_7'', Cl_2'O_3'' = Cl_6'O_{17}''.$$

123.—We have seen that the most stable compound of chlorine with oxygen is chlorine heptoxide; indeed, all the others are resolved into this by heat; hence Millon, who gave the subject much attention, inclined to the belief that the only definite compounds of chlorine with oxygen are chlorine monoxide, chlorine trioxide, and chlorine heptoxide.

Section 6c.—Compounds of Oxygen with Bromine.

124.—Several oxides of bromine corresponding with those of chlorine are known. They present great analogy with the relative chlorine oxides; but as they have been little studied, and are up to the present of no practical use, we shall confine our attention to the three following, which are the most important.

A. Bromine Monoxide.—*Synonym: Hypobromous anhydride*[3]. *Symbol:* $Br_2'O''$ (?) *Molecular weight:* 176 (?).

125.—Up to the present time this body has not been isolated. In union with the elements of water it forms the following compound:—

A (2). Hypobromous Acid.—*Synonym: Hydrogen Hypobromite*[4]. *Symbol:* $H'Br'O''$. *Molecular and combining weight:* 97·0.

126.—Properties.—Almost exactly those of hypochlorous acid; but as bromine holds oxygen with greater tenacity than chlorine does, its bleaching powers are not so active. The hypobromites are almost indistinguishable from the corresponding hypochlorites.

127.—Preparation.—When an aqueous solution of bromine acts on mercury oxide it gives rise to mercury bromide and hypobromous acid. (See 101.)

B. Bromine Pentoxide.—*Synonym: Bromic anhydride.*[5] *Symbol:* $Br_2'O_5''$? *Molecular weight:* 240 (?).

128.—Like the relative chlorine oxide this body is unknown in the separate state.

B (2). Bromic Acid.—*Synonym: Hydrogen bromate.*[6] *Symbol:* $H'Br'O_3''$. *Molecular and combining weight:* 129.

129.—Properties.—A colourless, almost inodorous, oily fluid, strongly acid to the taste. It first reddens and afterwards bleaches vegetable blues. In all its properties it strongly resembles chloric acid, but owing to the greater affinity of bromine for oxygen it does not part with its oxygen so readily.

130.—Preparation.—By acting on potassium hydroxide, $K'H'O''$, with bromine, a mixture of a bromide and a bromate is produced. From this the acid may be prepared in the same manner as recommended for chloric acid, or advantage may be taken of the power which bromine has of abstracting oxygen from the oxides of chloride by the following proceeding:—Chlorine is passed into a warm concentrated solution of potassium carbonate. Potassium chlorate is thereby formed. On adding an equivalent of bromine this latter seizes on the oxygen of the chloric acid, expels the chlorine, and takes its place, thus:—

$$K'Cl'O_3'' + Br' = K'Br'O_3'' + Cl'.$$

From the bromate bromic acid may be prepared as mentioned at paragraph 115, substituting the bromate for the chlorate.

C. Bromine Heptoxide.—*Synonym: Perbromic anhydride.*[7] *Symbol:* $Br_2'O_7''$ (?) *Molecular weight:* 272 (?).

131. Unknown in the free state. Combined with the elements of water, it forms:—

C (2). Perbromic Acid.—*Synonym: Hydrogen Perbromate.*[8] *Symbol:* $H'Br'O_4''$. *Molecular weight:* 145.

132.—Properties.—Very similar to those of perchloric acid; but its oxidising power is not so great, and its affinities are not so powerful.

133.—Preparation.—By adding bromine to perchloric acid as long as chlorine is evolved. The interchange is expressed by the annexed equation:—

$$H'Cl'O_4'' + Br' = H'Br'O_4'' + Cl'.$$

By this we learn, that although the affinity of chlorine for *hydrogen* is greater than that of bromine, yet this latter element has a stronger attraction for *oxygen* than chlorine has, and hence is able to expel chlorine from its oxygen compounds.

Section 6d.—Compounds of Oxygen with Iodine.

Several of these have been described. We shall notice the three most important.

A. Iodine Monoxide.—*Synonym: Hypo-iodous anhydride. Symbol:* $I_2'O''$ (?). *Molecular weight:* 270 (?).

134. This body is unknown in the free state.

A (2).—Hypoiodous Acid.—*Synonym: Hydrogen hypoiodite. Symbol:* $H'I'O''$. *Molecular weight:* 144.

135.—Properties.—A pale, straw-coloured, transparent liquid, smelling somewhat like ozone. It first reddens and then bleaches vegetable blues, but the bleaching action is very tardy and imperfect.

136.—Preparation.—If a few crystals of iodine be placed in a watch-glass, under a glass bell, with a stratum of well-slaked lime surrounding the watch-glass, the iodine gradually volatilises and is absorbed by the lime, which becomes of a more brilliant white, and is found to possess properties similar to those of "chloride of lime," but not nearly so active. Care must be taken that the temperature does not exceed 60° Fahr., as in this case little or no hypoiodite is formed.

When the body thus formed (consisting of calcium iodide and hypoiodite) is distilled along with dilute nitric acid, or, better, with dilute acetic acid (1 part acid to 4 of water), hypoiodous acid passes over. (S. Bottone.) It is worthy of note that the "iodide of lime," prepared as directed above, possesses more active bleaching powers than does the free acid itself. If, in the preparation of the acid (from the hypoiodite), sulphuric acid be used instead of nitric, or if the nitric acid be too strong, iodine, together with hydriodic acid, and not hypoiodous acid, is liberated.

B.—Iodine Pentoxide.—*Synonym: Iodic anhydride.*[9] *Symbol:* $I_2'O_5''$. *Molecular weight:* 334.

137.—A white crystalline solid with a strong acid taste. Prepared by heating iodic acid (see below) to a temperature not exceeding 338° Fahr. It dissolves freely in water, and if the solution be concentrated, crystallises from it, without taking up water.

B (2). Iodic Acid.—*Synonym: Hydrogen iodate.*[10] *Symbol:* $H'I'O_3''$. *Combining weight:* 176.

138.—Properties.—Iodic acid forms colourless, six-sided tables, very sour to the taste, and reddening litmus strongly. It is very similar to chloric and bromic acids. Like them it combines with metals to form a class of bodies called *iodates*, which, like the corresponding chlorates, are decomposed by heat. The iodates differ from the chlorates, inasmuch as the iodates of the heavy metals, instead of yielding oxygen and an iodide, give, on heating, metallic oxides, iodine, and oxygen. The iodates of the light metals, however, behave like the correspon[illegible]

1 Gmelin.
2 Idem.
3 Hypobromous acid.
4 Hydric hypobromite.
5 Bromic acid.
6 Hydric bromate.
7 Perbromic acid.
8 Hydric perbromate.
9 Iodic acid.
10 Hydric iodate.

chlorates, that is to say, they give off oxygen, and are converted into iodides, thus:—

$$M'I'O_3'' = M'I' + 3O''.$$

139.—PREPARATION.—Iodic acid may be prepared by several methods. 1. 1 part of iodine and 40 parts of nitric acid of the specific gravity of 1·5, are to be boiled together in a porcelain capsule, until all the iodine dissolves. The solution is then to be cautiously evaporated to dryness, redissolved in water, filtered through asbestos (while hot), and allowed to crystallise. In this process the nitric acid loses its oxygen, which it gives up to the iodine, thereby converting it into iodic acid. The results of the operation may be seen by the following equation:—

$$I' + H'N'''O_3'' = N'' + H'I'O_3''.$$

In practice, however, pure nitrogen is very seldom evolved, the nitric acid being generally reduced to a lower oxide, and not to nitrogen itself. 2. If a current of chlorine be passed through water containing iodine in suspension, hydrochloric acid and iodic acid are formed. By virtue of its superior affinity for hydrogen, the chlorine combines with this element, while the iodine seizes on the oxygen thus set free.

$$I' + 3H_2'O'' + 5Cl' = 5H'Cl' + H'I'O_3''.$$

The resulting iodic acid may be purified from the hydrochloric acid by boiling, and allowing the liquid to crystallise.

The iodates of the lighter metals may be conveniently prepared by dissolving iodine in a solution of the metallic oxide, and then passing a current of chlorine through the liquid. A chloride, along with an iodate of the metal employed, is the result. The following equation illustrates the interchange:—

$$3M_2'O'' + I' + 5Cl' = 5M'Cl' + M'I'O_3''.$$

From these iodates the acid may be obtained in the mode described for chloric acid.

c. IODINE HEPTOXIDE.—*Synonym: Per-iodic anhydride.*[11] *Symbol:* $I_2'O_7''$. *Combining weight:* 366.

140.—PROPERTIES.—A white spongy mass, freely soluble in water. It is obtained by cautiously heating the next compound to about 320° Fahr. At a higher temperature oxygen and iodine are given off.

c (2). PER-IODIC ACID.—*Synonym: Hydrogen per-iodate.*[12] *Symbol:* $H'I'O_4''$. *Combining weight:* 192.

141.—PROPERTIES.—Per-iodic acid is a white solid, which crystallises in colourless plates, somewhat resembling potassium chlorate. The crystals are permanent in the air. At 266° Fahr. they fuse without undergoing any change. At a higher temperature they lose the elements of water, and are converted into per-iodic anhydride. The acid, as well as its compounds with metals, bears a strong resemblance to per-chloric acid and its compounds; and, although the oxygen is much more tenaciously held, yet the periodates (and iodates) deflagrate when heated with charcoal.

142.—PREPARATION.—By adding iodine to perchloric acid, when the following substitution takes place:—

$$I' + H'Cl'O_4'' = Cl' + H'I'O_4''.$$

143.—Besides the compounds above mentioned, others, supposed to contain oxygen and iodine in different proportions, have been described by several chemists; but their existence is very doubtful. What little is known of them may be found in Gmelin's "Dictionary." The names of these doubtful bodies are:—

Iodic oxide (?)	Hypoiodic acid, I_2O_4 (?)
Iodous acid (?)	Subhypoiodic acid $I_{10}O_{19}$(?)

144. No compounds of oxygen with fluorine have as yet been obtained.

[11] Per-iodic acid. [12] Hydric per-iodate.

METALLURGY OF IRON AND STEEL.

(*Continued from p.* 55.)

A METAL which requires for fusing a very high temperature has the remarkable property of "welding." Iron may be exposed to a considerable range of temperature before melting, and all the time it retains a pasty dough-like state. It is not so with all metals, some pass almost immediately from a solid to a liquid condition. If at that temperature we bring two pieces of iron together, and press them firmly into contact, union takes place, or, in other words, welding occurs. In the Catalan process the iron falls to the bottom of the furnace particle by particle, forming one spongy lump, but the particles brought into contact during the process of hammering become firmly united into a solid compact mass, while any slag which might be diffused through it (and there always is some slag) is expelled by that operation. The lump is familiarly known as "blooms."

As was mentioned before, by varying the proportion of ore and charcoal (or other carbon used as fuel) we get a variety in the quality of the iron produced. The greater the quantity of charcoal used the more steely is the iron obtained, for metallic iron, when exposed to carbonaceous matters at a high temperature, has the property of imbibing or taking up a portion of that carbon, which, although the iron may remain quite solid, becomes diffused through the mass, and it is in this way that steel is produced on a large scale.

Let us endeavour to trace the progress of the growth of the iron manufacture from its rudest stages, as seen in the Hindoo and in the more advanced Catalan process. Man would try to economise fuel and labour, and probably his first idea would be to construct a furnace having a greater altitude. This is done in the "Osmund furnace," so named from the kind of iron produced, used in Sweden. It is a step in advance of the Catalan forge. In the winter time, the Swedes, not being occupied by their agricultural operations, produce very good malleable weldable iron from the ore; but instead of the Catalan forge they employ a much deeper furnace. It is made of material capable of resisting fire, cased outside with wood, and the ore and fuel used is oxide of iron and charcoal. In many cases it is the "lake ore," or brown oxide—*i.e.*, the peroxide combined with water. This ore is formed at the bottom of certain lakes in Sweden, near the places where the rivers supplying these lakes enter, and principally on reedy ground; it is composed of particles of various sizes, some are small—"pearl ore," others larger, "money ore;" sometimes "cake ore," while a kind composed of very small particles is known as "gunpowder ore." In the winter time, when the lakes are frozen over, holes are made in the ice, and the ore dredged up and washed. It is found that in places where the ore has been removed, in the course of about twenty or thirty years a fresh supply has been deposited. The furnace is charged with ore and charcoal, and after some hours (during which the blast is kept up by bellows) a lump of iron is formed at the bottom. This is not extracted from the top as in the Catalan process, owing to the greater height of the furnace, but a contrivance is made for extracting the metal from the bottom. At the bottom of one side a hole is made, or a part of the furnace is made removable, a hole being left for the outflow of the slag. A larger lump of iron can be made in the same time by this method than in a Catalan forge.

Now we come to a furnace 16ft. or 20ft. high, in section quadrangular or circular, with the blast injected at the back by a double-acting bellows worked by men or by water-power. In the front part a space is left which can be closed or unstopped at will. In such a furnace it was found that either malleable or cast iron could be produced. When charged suitably for the production of wrought iron, a lump of metal from six to seven hundredweight might be extracted at the front part of the furnace, with great hooks and chainwork attached to a drum connected with a water-wheel. When extracted the lump is divided and subdivided till the parts are sufficiently small to be forged into bars, heating and hammering during the working as required. There is usually some cast iron accompanying the production of a malleable lump—even in the Hindoo process a small quantity occurs, and therefore the discovery would soon naturally be made that by altering the proportion of the charge malleable or cast iron could be produced at pleasure.

Now we have come from the Hindoo direct process to the modern blast furnace, though at present only on a small scale. And first the furnaces were made higher and more capacious; some years ago a furnace 30ft. or 40ft. high was considered very large, now in Middlesbrough district furnaces have been erected, with the best possible results, not unfrequently 80ft. high: in some cases 100ft. All are not constructed of a similar form, some are everywhere circular in section, others like two truncated cones set base to base. The furnace is constructed of a material which stands a good high temperature, and what better than good honest fire-clay? The interior may be made of good fire-brick, the exterior of some refractory material. By the term refractory applied to clay is meant a substance which has the power of resisting a high temperature without melting or softening. There must be a good solid foundation, where water cannot have access. The part of the bottom immediately underneath the shaft of the furnace may be made of good fire-brick, or of good sandstone, or of some portions of the slag. This latter forms one of the most refractory bodies accessible to us. Next, there must be provided the means of injecting air, through three apertures usually—one at back and one on each side. For that purpose is provided three arched recesses large enough to allow a workman to get easily through. The front part of the furnace is prolonged forwards, because from that part the molten iron is tapped out. In front of this opening, to prevent the iron running away, is placed a strong dam of good thick cast-iron plate, and lined internally with some fire resisting substance. The lower part of the furnace is left open, the top is closed more or less during the working. The furnace shaft is bound firmly by rings of iron round it at intervals from top to bottom, and to prevent accidents from the breaking and falling of the rings chains are hung longitudinally round. A more common method now is to make the rings more expansive, and to encase them in stout boiler plate. Now as to the means of injecting the air: in each of the three openings is placed a large iron twyer. The twyer, if introduced into the furnace would burn away, so precautions are taken to protect it as much as possible by using a water twyer. It is constructed of wrought iron, and consists of two hollow truncated cones, the smaller inside the larger, coinciding at both ends and welded together. There is a clear space left round the inner cone (owing to the inequality of their sizes), and at the thicker end, away from the fire, two wrought-iron pipes communicate with this space, and it is so contrived that when the furnace is in operation a plentiful supply of cold water thus passes around the inner cone. This water twyer does not prevent altogether the burning of the iron, but it keeps it from burning so rapidly away as it would otherwise do. Round the furnace above the twyers is constructed a circular iron pipe suspended above them, and bent or elbow tubes run from this, the nozzle of one being placed in each of the twyers, and the elbow (containing a hole in the joint) serving to allow of inspection, or, in case of hot blast, of ascertaining the temperature. The blast is injected under considerable pressure—not less than three pounds to a square inch—and is produced by double-acting cylinders (about 14in. diameter). In order to support the lower part of the furnace, that part in which the metal accumulates, in some cases water "boshes" are employed, being thick plates of cast iron, through the interior of which water is circulated. The term "bosh" is applied to the lower contracted part of the furnace, and is doubtless a corruption of the German *bosche*, a slope, probably introduced by the German workmen brought over by Elizabeth.

Now let us see what occurs in the blast furnace, and for this purpose we will suppose it is in working order, having had time to dry. To simplify matters we will also assume that the materials employed are quite pure. The fire must be made slowly, and brought up gradually; the material employed may be coal, coke, or charcoal: we will suppose it to be an easily combustible fuel of pure carbon. We must keep adding this from time to time till we have filled the structure with it, all the time injecting air at a pressure of three or four pounds. The bottom aperture is closed so as to make the air find its way upward, and thus we get an upward stream of carbonic oxide and nitrogen. Hitherto we have been considering the fuel only; now we will put into the top of the furnace oxide of iron, no matter which kind. In the first place, the temperature of the furnace will be the highest towards the lower part, and the oxide of iron and fuel being added alternately, as the former descends, it at length reaches a place where the CO streaming upward is sufficiently hot to to act upon and reduce the oxide, and so we get the iron in a metallic state. CO is the grand agent in the reduction of iron ore; almost the whole of the iron produced in the world is produced from the oxide by means of this agent. The CO, by combining with the O in the ore, becomes converted into carbonic acid, and this latter product must not be allowed to remain for one second in contact with the iron, or the reverse action would occur and the iron again be oxidised.

removal is effected by keeping up a good blast. The rapidity of reduction varies with the nature of the ore and with respect to its compactness. The iron after being thus reduced still goes on descending with the glowing carbon to a hotter part of the furnace, and when these two substances are heated very strongly in contact with each other they combine, and we get an easily fusible, comparatively speaking, "pig iron." The term "carburisation" is applied to this part of the action. Descending to still hotter parts the iron becomes perfectly melted, and owing to its high specific gravity falls down on to the hearth.

Practically, we cannot get either pure carbon or pure ore. The ores which we are obliged to use contain certain materials which are very difficult to melt, *e.g.*, silica, which cannot be melted under ordinary conditions. We often have ores with silica or clay, and our fuel employed contains earthy matters. In this case the iron will be reduced as it descends into the furnace, being influenced somewhat by the impurities mixed with the ore; if this stuff associate with the reduced iron, that metallic iron will be intermixed with this infusible stuff, and so contact between the reduced iron and the highly heated charcoal prevented. But in order to get pig iron we must have that contact. The material existing in most of our ores and in fuel is easily converted into a glass-like, easily melted substance—slag—by lime. We, therefore, put in chalk or limestone with the ore, and the same phenomena exactly take place as before. The slag resulting from the addition of lime will contain all the silica and clayey impure matter of the ore, and the ashy matter of the fuel run together. This compound is much lighter than pig iron, and they will not mix with each other; the consequence is the slag swims at the top of the melted iron. Thus from the ore, limestone, and fuel put in alternately at the top of the furnace, we get two things at bottom—slag and pig iron. A hole is made in the side of the furnace for the slag to flow away through, and out of the dam. When the bottom part of the furnace has become nearly full of melted iron it is drawn off. A hole is there, but stopped with clay during the reduction; now with a long bar of iron the clay is broken out, and the metal allowed to run into moulds, sometimes of iron, sometimes of sand, running parallel to the furnace, and thus we get the bars commonly termed pig iron. The limestone is called the "flux."

MICROSCOPICAL NOTES.*

ARTIFICIAL CALCAREOUS FORMATIONS.—Professor Harting has been for some time engaged in researches into the origin and structure of certain organic calcareous structures, and has succeeded in imitating Nature in the manufacture of some of the more interesting forms of these structures. These results may be obtained by placing in the liquid containing the organic matter—albumen, solution of gelatine, a mixture of these, blood, bile, mucus from *Arion rufus*, tissue of the umbrella of *Aurelia aurita*, and the liquor obtained by triturating chopped-up oysters in a mortar; salts which, by their double decomposition, produce insoluble salts of calcium. These salts are, on the one hand, calcium chloride, calcium nitrate, calcium acetate, magnesium chloride, and, magnesium sulphate; and, on the other hand, sodium bicarbonate, potassium carbonate, sodium phosphate, and ammonium phosphate. The experiments occupy many weeks, owing to the extreme slowness of the reactions involved. The most frequently occurring form effected by calcium carbonate in connection with albumen, gelatine, or the other organic substances mentioned, the Professor christens *calcospherites* (Fig. 1, copied from the author's figure in the *Quarterly Journal of Microscopical Science*); when these are formed in the midst of the liquid and it is perfectly tranquil, they are perfectly spherical ("a") and vary from the ·002 of a millimetre to ·2 of a millimetre, and become larger in proportion as their formation takes place with greater tranquillity and slowness. They often contain a nucleus, and all of a certain size are seen to be formed of concentric layers and radiating lines. If the state of equilibrium of the fluid be not perfect the *calcospherites* undergo in the course of their development transformations in consequence of which their form is very much modified, and they become ellipsoidal, oval, or lenticular bodies. One very remarkable form, the *conostat* is shown in Fig. 2, and is characterised by the presence of a cup or goblet-shaped enlargement which becomes filled with air, and by this the conostat remains floating.

When developed in the neighbourhood of one another, the *calcospherites* mutually adhere and form dumb-bells, plates, and polyhedric bodies, recalling the structure of the shells of various *Lamelli branchiata*, &c. (Figs. 3 and 4.)

In certain definite circumstances the calcium carbonate, combined with albumen, forms very thin curved laminæ, precisely resembling the calcareous plates of the "bone" of the Sepia. These concretions consist of a *combination* of calcium carbonate with organic matter, which is the sole residue when the salt is removed with an acid. If the development has taken place in albumen, or a liquid containing it, this fundamental organic substance remains with the form and structure of the calcareous body; but *this fundamental substance is no longer* albumen, but is albumen transformed

FIG. 1

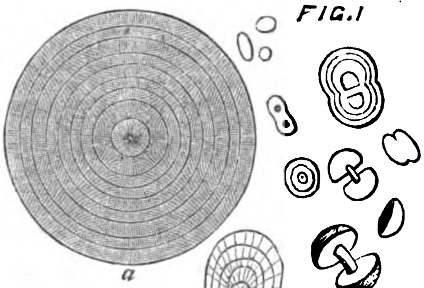


FIG. 2

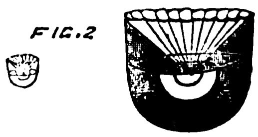


FIG. 3

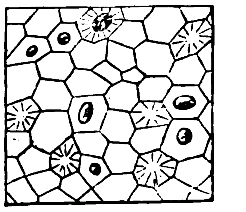


FIG. 4

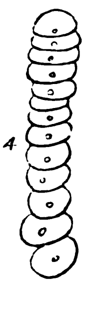
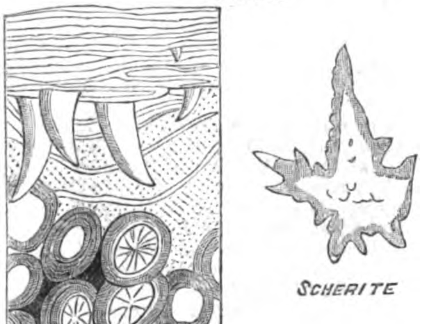


FIG. 5



into a substance, the chemical reactions of which are those of conchyoline, and resemble those of chitine. The author calls it *calcoglobine*. If a fragment of calcic chloride be placed in albumen it is dissolved, and after some days the albumen is transformed in *calcoglobine*, which also presents a fibrillar structure, and after having been washed gives all its chemical reactions.

When calcium phosphate and calcium carbonate are liberated by the double decomposition of calcic chloride and neutral sodium phosphate, or ammonium phosphate, in a solution of albumen or gelatine, the precipitate consists of a combination of the organic material with the two calcareous salts. If the calcareous phosphate constitutes only a small fraction of the constituent, *calcospherites* are formed, but among them are some which form the starting point of various ulterior formations that may be reduced to two fundamental forms, which under certain definite circumstances appear more or less perfectly developed. The first form consists of plates, often of a considerable size, and more or less curved. They are either perfectly homogeneous or show fine fibres, sometimes disposed in a parallel manner, sometimes divergent, and concentric bands, and have precisely the conformation of the calcareous substance which constitutes the internal layer of the shell of the *Lamelli branchiata* and forms almost exclusively the shell of Gasteropoda. On other plates are thickened patches similar to those which exist on the external layer of the scales of osseous fishes. Under the influence of a low and constant temperature there are developed both on the *calcospherites* and on the plates curved spinous projections (Fig. 5). If the liquid contains in addition gelatine, these projections have a warty appearance, and they themselves have either secondary projections or they branch until they come to precisely resemble the *sclerites* of Alcyonaria. Similar *sclerites*, but different in form, are developed in cartilage, which is first impregnated with calcium chloride, and then placed in a solution of potassium carbonate mixed with a little sodium phosphate. All these calcareous formations become charged with any colouring matter contained in the liquid, and thus the coloured calcareous formations of nature may be closely imitated. Biologists will wait with impatience the publication of the author's complete memoir on this most interesting subject.

Structure of Tendon.—Dr. Mitchell Bruce, in an exhaustive but purely technical article on the structure of tendon, gives the following method for preparing cross sections of this tissue, which may be of value to some of our readers. The distal half of the tail is removed from the living animal (rat), the skin stripped off, and the organ placed in a ·5 per cent. solution of chloride of gold for fifteen or twenty minutes, after which time it is removed and exposed to the light in distilled water until coloured. It is then placed in a one-tenth or one-eighth per cent. solution of chromic acid for two or three days until the bones become softened, then transferred to alcohol for a quarter or half an hour and then cut into sections. The sections when cut should be washed in water and mounted in glycerine.

Illumination of Opaque Objects.—The following ingenious plan, which our "binocular" friends may find useful, is taken from the *Lens*, a new American Journal of Microscopy. A beam of light is sent down the oblique body of the binocular microscope, the prism being in position for use binocularly by a plane mirror rectangular prism or ordinary drawing camera, and is directed by the Wenham prism through the objective upon the slide. A small portion of the centre of the field will, if all the adjustments be correct, be brilliantly illuminated. This ought to be of service to diatomists.

New Staining Reagent.—Molybdate of ammonium, a concentrated solution, is diluted with two to three parts of water; to this are added as much iron filings as will lie upon the point of a knife (!) and commercial hydrochloric acid slowly added drop by drop with continual agitation till a deep blue, almost black, colour is produced. When it has acquired the desired colour it is allowed to stand for ten seconds and then filtered. Merkel recommends this for use in staining preparations of the nervous system.

Batceria and Putrefaction.—Professor Cohn has conducted researches into the relation between bacteria and putrefaction, and concludes that all putrefaction is accompanied by the development of bacteria; it is wanting if the access of these be prevented; it commences as soon as they are present even in the smallest number; it proceeds in the same ratio as these multiply, and with its completion ceases also their multiplication. They are then precipitated either as a powder or in gelatinous lumps (zooglea), just as yeast precipitates in completely fermented sugar solution. There can thus be no doubt that there is the same relation between bacteria and putrefaction as between the yeast fungus and fermentation. They are, therefore, exciters of putrefaction (*saprogenous*), whilst the other accompaniments of putrefaction—mould, fungi, and infusoria—are only to be regarded as accompaniments (*saprophilous*). There is no genetic relation between bacteria and mould fungi. Professor Cohn's paper—a print of a lecture delivered before the Silesian Society for Natural Culture, reprinted in abstract in the *Quarterly Journal of Microscopical Science*—is worth careful study by those interested in sanitary science, and especially by our medical friends. We have not space for a further reference to it. H. P. H.

* Extracted and condensed from the *Quarterly Journal of Microscopical Science.*

THE HEATING OF RAILWAY CARRIAGES.

THE means hitherto in use for this purpose have found only a limited application, owing chiefly to the trouble of working them, and the expense they involve. In a pamphlet recently written by Mr. C. Rieches, of Hanover, treating of this subject, he enumerates the following modes:—1. Heating by stoves. 2. Heating by cases or vessels; (a) filled with hot water; (b) filled with sand; (c) filled with glowing charcoal; (d) acted on by a spirit flame. 3. Heating by steam. 4, Heating by heated air.

The first plan, heating by stoves, though it makes the train independent of stoppage at stations for heating purposes, is open to the objection that much space is taken up, and the heat is unequally distributed. For spacious compartments arranged for a comparatively small number of passengers, stoves are suitable, and on some of the East Prussian railways they have been used with success. The fuel is supplied from above, and without incommoding the passengers, and the heating effect is regulated by the admission of air, by an apparatus under control of the officials. The stoves require frequent attention, however, and in a long train this becomes burdensome. In the special kind of stove just referred to it is necessary to use charcoal, as any other fuel would be apt to cause extinction of the fire.

Heating by vessels or cases filled with water or sand is of frequent use. The sand absorbs a much larger quantity of heat than the water, and gives it out more slowly. The cases are sometimes placed under the seats, sometimes between them; in the latter case they are either placed loose under the feet or thrust into hollow spaces made to receive them. Sand is preferable for cases placed under the seat, and water for the others. This method, is, however, also expensive and troublesome. Heating apparatus is required at the stations, and if all the carriages are to be supplied, there must either be long delays in exchanging the cold for hot vessels, or a large staff of men must be employed to do the thing quickly. Where sand is used, it is renewed every four hours; water must be renewed much more frequently.

Another mode is that of filling cases with an artificial fuel, which, in Kienast's method, consists of pulverised charcoal, nitric acid, and starch. At first this was put in iron cases 628mm. long, 105mm. broad, and 65mm. high, which were perforated in the sides. This was found, however, to be productive of headaches, and the fuel was, therefore, put into closed cases, which were pushed from the outside under the seats. The fuel, as used, was made up in half-pound pieces, 105mm. long, 80mm. broad, and 60mm. thick. In an experiment on the line between Aix and Berlin, eight pieces were used, in four cases, for the heating of one compartment. After a 16 hours' journey, the pieces of charcoal were still glowing, and a thorough heating of the compartment had taken place. The cost of a hundredweight of the fuel is 10 thalers (30s.), and the heating now referred to cost 10½sgr., or about 1s.

A further method is that in which the heating is produced by a spirit flame. The apparatus consists of a long flat case, with perforated sides, and a top of wire gauze. A spirit lamp of peculiar shape is suspended in the interior, in such a way that no harm can come of the case being turned on either of its axes. The flame is surrounded with wire gauze, and between the top of it and the cover is a steatite plate. Cross-bars are placed above the case, and there are bags placed over these for receiving the feet. The oil supply lasts 50 hours, and the cost is very small.

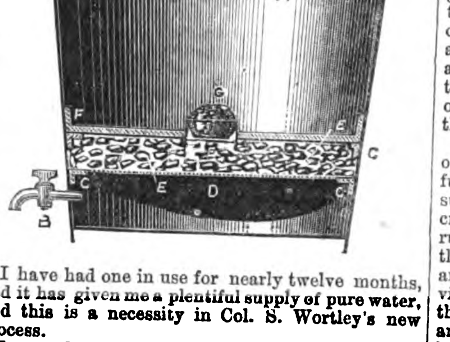
We come next to the heating by steam, a method developed in various forms by Haag, in Augsburg, and which has many advantages. The heating effect can be controlled during the journey from one point in the train; and it can be readily applied to an entire train, while, with suitable arrangement of the pipes, the heat is equably distributed, and no additional apparatus is required at the stations. The pipes may be variously arranged; a main-pipe may be placed along the entire length of the train, with other pipes branching off into the compartments, or the pipe conducting the steam may be used directly for heating the carriages. In the former case, there is the objection of presenting a larger amount of condensation surface, while it has the advantage that it is possible to shut off the supply of steam from single compartments. It is always of importance so to lay the pipes that they may be filled only with steam. It is inconvenient to use steam at a high tension, on account of the necessity in such a case of having strong and accurately fitting joints between the carriages. Two atmospheres may be regarded as the limit. The steam may be brought either from the locomotive boiler or from a boiler specially constructed for the purpose. In the latter case there is the taking up of space to be considered, and the increase of about 20cwt. dead weight. In a long journey a fresh supply of fuel and water must be taken in, and the apparatus requires a special attendant. These objections fall away when the steam is taken from the locomotive boiler, and allowed a certain expansion before admission into the pipes. Where a separate vessel is employed the supply of steam is soon used, and it becomes difficult to preserve the normal tension, and on the other hand steam taken from the locomotive boiler diminishes the working power. In recent experiments made with reference to this on a railway in Lower Schleswig, the steam was taken from the locomotive, and it was found that a very small quantity of additional fuel was adequate to produce the required supply. The question of cost was decided in favour of the plan adopted.

Finally, in the use of heated air, the casing of the stove is formed of some badly conducting material. The cold air enters the stove by openings in the lower part, gets warmed, and rises to the roof of the carriage. By this means a slow circulation is produced, and the temperature is equalised more than in the method first specified. This plan is adopted on many of the Hanover railways. In some cases the heated air is conveyed by pipes from the stove to the ends of the carriage.

A. B. M.

A CHEAP WATER FILTER.*

LAST summer, not believing my drinking water to be pure enough, I had a filter made to order. First, I bought a galvanised iron pail, and then had a tap inserted about an inch from the bottom. Just above that, on the inside, were fixed three or four small zinc ledges, on which was placed (loose) a false bottom of perforated zinc. About 2in. above that were fixed similar ledges, on which was placed a zinc tray, having a lead rim, and in the centre a small circular box with a perforated bottom. This box is let into the tray and soldered; it is filled with fine sponge, which I tie down, and through which passes all the water to filter. The rim (about an inch high) should be wrapped round with cotton wool, so that all the water must go through the sponge. Between the tray and false bottom is filled with charcoal broken to about the size of nuts.



I have had one in use for nearly twelve months, and it has given me a plentiful supply of pure water, and this is a necessity in Col. S. Wortley's new process.

I append a section of the filter:—A, galvanised pail; B, tap for drawing off purified water; C, small zinc ledges; D, removable false bottom of perforated zinc; E, charcoal; F, zinc tray, lead rim; G, sponge box (3in. diameter) and sponge; H, handle.

If any water escape between the rim of the tray and the pail—which you can tell by the bubbles—you must rap the rim until it ceases to do so. The sponge should be kept clean, and the charcoal changed occasionally.

* By ALBERT DUMSDAY, in *Photographic News*.

POLYZOA.

THE following interesting account of these beautiful creatures, and of the method of preparing them for examination, is from the pen of Mr. Lattey, M.R.C.P., and was read before the Quekett Microscopical Society a few months ago:—

Amongst the vast number of animated beings of whose very existence we should have remained in profound ignorance were it not for the invention of the microscope—so justly termed a sixth sense—few afford more beautiful or interesting objects for our contemplation than the group to which the name of Polyzoa has been given; so called from two Greek words—polus (many) and zoon (animal)—being always found aggregated together in masses, and many of them resembling minute plants, so much so as to have been classed, by early observers, amongst the members of the vegetable kingdom. Their complex organisation has obtained for them a high position in the animal kingdom, and the exquisite form which some of them possess cannot fail to excite our admiration. When, for instance, we see the elegant Sertularians, projecting like fairy ferns from the side of a rock-pool, attractive by their graceful forms, even before the microscope has revealed the beautiful little creatures studding their branches like living flowers, or the Polyzoary of the Halodactylus, with its exquisite bell-shaped creatures emerging, one by one, from the jelly-like mass coating the seaweed, like the ribs of a folded umbrella, stripped of its covering, and then gradually expanding into a beautiful bell, the ciliæ fringing its ribs, or tentacles, in perpetual motion, keeping up a constant eddy in the surrounding water so as to bring the floating particles of nutritious matter within the grasp of their open mouths.

Amongst all these creatures, none are more curious than the species of Bugula, called Bugula avicularia, from its possessing those strange appendages called birds' head processes, and most appropriately so, from their very exact resemblance to the head and beak of a bird. They are attached to the margins of the cells by means of a footstalk, and each has two "mandibles;" the upper one fixed and the lower one movable, just as in birds, and they are opened and shut by powerful muscles within the "head." A most singular and curious sight it is to watch the movements of these "objects" when a portion of the Polyzoary is viewed under an inch or two-inch objective, so as to allow a number of these bodies to be in sight at once. It will then be seen that each head keeps up a continual nodding movement, throwing itself slowly back, which its joint-like union to the cell allows, at the same time gradually opening its jaws, or rather depressing the lower jaw until the mouth is open to its full extent, and when the head has gone back as far as it can reach, it suddenly resumes its former position, the mouth closing at the same instant with a sudden snap, and entrapping any luckless animal that may be passing at the time; and then the same proceeding takes place over and over again, without any intermission. It certainly is a most singular—I might almost say ludicrous—sight to see all the avicularia within the field of the microscope practising this perpetual "snapping." The great size and apparent strength of the animals which they are capable of seizing and retaining in their grasp must impress us with a sense of the enormous strength of the muscles which move the jaw, for they seize and retain not only small vermicules, but such large creatures as caprellæ, entomostracæ, &c.; and very curious it is to watch the writhings and struggles of one of these comparatively gigantic victims in its vain efforts to escape from the jaws of its tiny captor. Not unfrequently the captive is seized by another, or even two more avicularia, in other parts of its body, thus making assurance doubly sure, and so deadly is the grip, that I have never seen one of them relax its hold on the application of the medium which is fatal to themselves.

Various have been the conjectures as to the office of these "heads without bodies," and their exact function in the economy of the animal—some supposing that their office is to protect the delicate creatures over whom they mount guard from the rude contact of foreign bodies which might injure their frail structure; but many equally delicate animals, the Halodactylus, for instance, are unprovided with any such protection. Others suppose that they are destined to entrap the passing animals, and hold them in their firm grip until decomposition has diffused them in the surrounding water, thus furnishing the creatures with a supply of nourishment; this, to my mind, appears the most feasible explanation. I have found these animals in great abundance at Ilfracombe, especially upon the rocks near the harbour, mostly depending from the under surface; the Campanularia dichotoma in the same locality on the leaves of brown sea-weeds, and the Sertulariæ growing from the sides of rock-pools at St. Leonards and Exmouth. The Halodactylus may be found in any locality where there are rocks, encrusting the stems and fronds of the common bladder wrack (Fucus vesiculosus) at low water, especially during spring tides. It looks like a firm gelatinous coating of a brown colour, and has a semi-transparent appearance. When put into fresh sea-water, it is seen to become gradually, as the animals emerge from their cells, overspread with what appears, to the naked eye, to be a minute white downy covering.

If it is desired to make preparations of any of these creatures, the following will be found a successful plan. Their extreme sensitiveness, and the rapidity with which they withdraw themselves into their cells upon the slightest touch or jar, makes it necessary to adopt a peculiar plan of proceeding. I would premise that before commencing operations with the Halodactylus it is desirable to cut it into the length required to fit the cell in which it is to be placed whilst the animal is contracted, as it may then be cut in any direction without injury, but when expanded it requires to be very carefully handled, as, if the bells are in any way pressed or put out of shape, they cannot be restored. For this reason it should be so cut as to fit the cell tightly, so as to prevent its being shifted. The object is to coax the animals out of their tiny homes, and to keep them out until you can kill them. To accomplish the first object, it is best to keep them out of the water for several hours, and then to put them into fresh sea-water in any appropriate vessel. I have found a circular glass dish, such as is used for cakes of transparent soap, answer very well, as it can be put upon the stage of the microscope, and the effects of different stages of the operations watched, which is of importance. Some alcoholic spirit must now be added very gradually—spirit of wine, brandy, whiskey, or gin, it matters not which—when they will be observed to come out in greater numbers, evidently attracted by the taste of the spirit, and as it continues to be added they become evidently excited, withdrawing into their cells, and coming out again, bending about, and the ciliæ meanwhile moving in a most rapid manner. This continues for some time, until at length they begin to flag in their movements, which become more and more sluggish, the animals being apparently drunk. This is the moment to pour off the alcoholised sea-water, and pour upon them the preservative fluid, which has the desired effect of bringing out all that are still left in their cells, and gradually killing them, and it has the immense advantage of being at the same time a most excellent fluid for preserving them, so that they can remain in it. I find it of great service to let the Halodactylus lie for a considerable time in this fluid before finally putting them up, as a certain amount of deposit takes place from the sea-weed, which it is better to exclude from the cell. The preserving fluid I use is one recommended by Dr. Beale, as a modification of Thwaites', and is prepared as follows:—

Mix three drachms of creosote with six ounces of wood-naphtha, and add, in a mortar, as much prepared chalk as may be necessary to form a smooth thick paste; water must be gradually added to the extent of 64oz., a few lumps of camphor thrown in, and the mixture allowed to stand for two or three weeks in a lightly covered vessel, with occasional stirring; after which it should be filtered and preserved in well-stopped bottles.

HINTS ON PAINTING.*—IV.

(*Continued from p. 689, Vol. XIV.*)

Varnishing.

THE varnish-room should be well cleaned, walls dusted, floor well wet, and if the weather is cold, a temperature of seventy-five or eighty degrees maintained by a clean tight stove, or what is better, steam pipes. The carriage part and body having now been nicely rubbed down and well cleaned, we begin with the carriage part. Raising all the wheels from the floor by two boxes or barrels placed under the axles, we prepare the varnish and brushes. American finishing varnish is good enough for this part, and with our oval varnish brush and flat "tool" we take our position in front of the wheel with our left hand on the rim to turn it, with the "tool" we spread the varnish heavily between the spokes, and up the front as far as the V shape of spokes extend; then with the large brush we lay on an abundance of varnish on the side of the spoke nearest our left hand, then opposite, and then reach over and cover the back.

Now, wiping out all the varnish in the brush on the edge of the cup, we repeat the operation with the dried brush, laying off the varnish smoothly and removing the bubbles. Next we varnish the hub, and wipe with the "tool" around the "butt" of the spokes; then varnish the inside of the rim between the spokes, finishing the back and front sides last. We keep the wheel turning for a moment or two until the varnish flows evenly, and proceed with the other wheels in the same manner, finishing the springs, axles, &c., lastly.

The body is next looked after. Taking our body finishing brushes (the fitch hair brushes are best for the buggy), we begin with the inside—for which we should have a pair of brushes and a cup expressly. In laying on a heavy coat, we level it off nicely, leaving the brush marks faintly perceptible up and down the panels, always leaving the work before it begins to set.

The outside we next look after, and flow the varnish on very heavily, but as evenly as possible. We lay off from end to end, then across from bottom to top, and repeat; wiping out the brush on the cup, and leave the panel with the last movement up and down. We clean out under the mouldings with a small brush, and bear in mind that a heavy flow must be wiped upward, never down. Having been all over the body with a piece of whalebone—which should be at hand, one end being sharpened to a point—we go over the work, picking out any hairs, dust, &c., and then close up or darken the room and leave the job to dry.

In cleaning a body preparatory to varnishing, I find it an excellent plan to use, after dusting with the dusting brush, a piece of silk dampened with sweet oil. With this I gently wipe the job over, but not enough to grease the surface, and it removes every little particle of dust or lint left by the shammy and duster.

Varnishes.

There is no class of people more pestered with pedlars, if I may so term them, than carriage-makers are with varnish agents. Every few days an agent of this sort makes his appearance, and sometimes proves an intolerable bore. I do not frown upon the enterprise and go-a-head-a-tive-ness of the agent or his employers, for such a spirit is well enough; but I have frequently had occasion to object to the perseverance of such men in seeking the foreman, after a denial from the "boss," and trying, sometimes by bribery, to get him to assist with his influence in introducing the vaunted varnish. Some bosses, to get rid of the agent, order varnish "for trial," and the workman then has to run the risk of spoiling his job; for being unacquainted with the varnish—and all varnishes manufactured by different makers have their respective peculiarities—he goes at the work with more or less nervousness or hesitancy, and is almost certain to turn out a poor job.

Always "let well enough alone," if you have good varnish and know how to use it; let the new man, with his new varnish, negotiate with some new shop, where new work is done, by new hands.

I do not wish to be understood as taking a stand against improvement, but as a general thing, there are too many changes with regard to varnish made in many shops. Neither would I speak disparagingly of varnish manufacturers, but would give all a fair show. Let those, however, who prefer one maker's goods patronize him. "Each one to his taste." I echo the sentiments of a score of painters, and should not be judged harshly therefor.

There are different opinions existing as regards the necessary qualities of varnishes—some preferring a quick-setting varnish, and others, a slow-setting one to enable them to "lay off" well; consequently each must try for himself. In re-varnishing old work it is not well to put English on the old surface, it being apt to "crawl" or "pit." A newly finished job should always be washed with clear cold water, and dried with a clean shammy, before allowing it to leave the paint shop; this hardens the surface and prevents the dust from sticking to it.

If varnish is found to "crawl," wipe the surface with a damp shammy. Never dilute varnish with turpentine, as it kills the gloss. If too thick, warm it by the stove or place the cup on a warm iron.

Polishing.

Polishing on carriages is now among the things of the past; but to describe the method will not be amiss, perhaps.

Finish your job as smoothly and cleanly as possible with American finishing varnish, and let it stand atleast ten days; then rub down with pumice-stone the same as if a rubbing coat; clean off, and rub again with rotten-stone ground fine, until the marks of the pumice-stone are all obliterated; next rub with rotten-stone and oil until a gloss appears. Then substitute Spanish whiting for the rotten-stone; this should be washed, *i.e.*:—Mix the whiting in a pail of water, until like milk: let it settle a moment to get the stones, dirt, or lumps out; pour off the milky liquid into a clean pan, and let it settle thoroughly: pour off the clear water and dry the sediment; it will be an impalpable powder, and mixed with the sweet oil will produce a good polish on the panel. Clean all off with soft silk, and you have a glossy surface, superior to varnish in point of wear—but not in looks.

Fancy boxes may be polished in this way, and are better than varnished surfaces. Furniture, pianos and fancy articles are generally polished, and there are preparations to be had at furniture stores for re-polishing, which answer a very good purpose.

Painting Coaches, &c.

The *modus operandi* of painting heavy jobs differs but little in the foundation coats from light work: therefore I will not enter into details with regard to it. The workman must be more particular with this work, but one who can paint a buggy well should be able to get up a good job on heavy work. Confidence in your abilities is one half the battle.

The panels of such work are generally painted in colours, while the pillars, top stripe, quarters, deck, &c., are always black. Umber colours, lakes, greens, and blues are some of the best colours used on this work. To prepare the body for any of these colours, we should use a ground colour in the place of lampblack on black work

The following are a few of the grounds most approved.

Lake.—Indian red and vermilion mixed to a dark brown, though some prefer a black ground for lake. Lake should never be mixed to dry "dead," but with a subdued appearance, by putting in varnish enough. The best way is to try it on a board before laying on. If "dead," it loses one-half its brilliancy, and will be apt to be cloudy.

Ultramarine.—Mix a medium blue with keg lead and Prussian blue.

Vermilion.—A light pink colour is generally used as a ground for vermilion, but if a pure white ground is gotten up from the beginning, you will find the colour to cover well, and lose none of its pristine beauty. Don't forget to put flowers of sulphur into your vermilion, (as spoken of on page 606, Vol. XIV.) to preserve the colour.

Green.—Green and all heavy bodied colours will cover well on the lead colour without any ground colour.

To Paint Panels Carmine.

To make a good job with carmine, we should get up an English vermilion ground, into colouring varnish, well rubbed down with pumice stone; for we cannot rub a great deal after the job is glazed. Some painters mix their carmine glazing with rubbing varnish and oil, but you will find such jobs frequently "spotted;" the best way is to mix in English varnish, adding a little gold size for a dryer; this flows evenly, and does not cloud or spot if properly put on. When a job is glazed, rub it carefully and apply a coat of American finishing and rubbing, mixed in equal parts. This can be rubbed for finishing coats, whereas if rubbing varnish be put on over the glazing it might crack—but the mixture will stand the wear of years.

Ultramarine blue panels can be made the same way, the ground being gotten up with Prussian blue. A beautiful wine colour or lake may be made by glazing Indian red or brown with carmine. A brilliant green may be produced by a light pea green glazed with verdigris or with Paris green. Striping may be glazed in the same manner, but of course on dead striping colour. Some painters put on glazing the same as, and in the place of, colouring varnish. I think this a very poor plan, as you have no chance to rub the surface until there is so much varnish over it that the colour is injured.

The workman by experiment can discover many splendid variations of shades and tints by the glazing process, and his labours will be better rewarded by knowledge acquired in that manner than if I were to extend this article to greater length with more precepts.

Striping.

When tube colours are used for striping, there will be no trouble experienced in mixing, as they only require thinning with turpentine, and the addition of a little sugar of lead. We must use our own taste in striping; though governed a little by prevailing styles. It would be folly for me to dictate any particular style. The manner in which striping is done can be learned in three minutes by looking at a workman while at work, but long experience is required to perform the operation well: suffice it, then, for me to say, get good tools and colours and practice on a wheel or board painted for the purpose, until you can master the art, for only practice, patience, and perseverance can accomplish it.

When striping on solid colour, the ends of the stripes or any imperfections can be "cut off" or improved with a little of the "dead" colour, but on a glazed or light colour the "cutting off" would show, therefore, when thus employed on these colours we have a little oil ready, and before the stripes are dry, we draw a pencil filled with the oil across the ends. Then the stripes will dry everywhere but in those places where the oil is, and then they can be washed off with soap and water after all the rest is dry, and thus leave the stripes with a square end. Bronze striping is fashionable, while glazed stripes are always considered beautiful. Striping with a mathematical or drawing pen will be found excellent on panels or sleighs. Scotch plaid work is now out of fashion, as well as cane work, or raised cane. The latter "raised Cain" with many who did not know its secret, and although an extended article could be written on that kind of work alone, and would be considered interesting by some, its antiquity will not warrant more than this brief notice.

* From the "Carriage-Painter's Manual." By F. B Gardner. New York: S. R. Wells.

THE INDUSTRIAL CLASSES IN BRAZIL.

THE daily papers lately contained a notice from the Consul-General of the Empire of Brazil, setting forth the facilities which will be afforded on certain conditions to intending European emigrants to that country. How far the prospects of such persons are favourable or otherwise we will endeavour to show. Brazil occupies such a vast territory that great differences are to be found in its various divisions in respect of natural advantages, such as wood, water, climate, and roads, and the reports of the consuls of the seven selected towns contrast accordingly. Para, for instance, in the most northern province, is situated as nearly as possible on the equinoctial line, whereas Rio Grande is about 33 deg. south latitude. But the land is so much elevated above the sea, and is so well watered by magnificent rivers, that though it lies mostly within the tropics, the climate is, on the whole, healthy and delightful. Some of the ports are an exception to this rule. Though splendid to the eye, they lie low, and as the drainage is deficient, epidemic of fever sometimes occur. Brazil is at present in a transition state, as the emancipation of the slaves is being now rapidly carried out. When this measure has been fully accomplished it is reasonable to suppose that it will be followed by a considerable demand for labour. The Government is also constructing railways and new roads in the interior, and the greatly increased steam communication already conveys large importations of ready-made goods of every description. These are chiefly, as far as we are concerned, manufactured cotton goods, wrought and unwrought iron, linens, and woollens, and we receive from Brazil in return, raw cotton, coffee, and unrefined sugar. In fact, our Brazilian trade is nearly three times as large as that of France, and five times as large as that of any other country. The country is peopled by a very mixed race. The original Portuguese settlers intermarried extensively with the Indian women, and there was a further intermixture of race with the African slaves. The Indian element preponderates in the north, while at the seaports the population is chiefly European, the Portuguese predominating. Besides these there are not a few groups of settlers —English, Swiss, and German—who have formed, as it were, separate colonies, having obtained grants of land from the Government. Most of these are in a very flourishing condition, and the men have built for themselves good dwelling-houses. In some cases they have established manufactories, in others they pursue agriculture, but they receive every encouragement from the Brazilian authorities. There are a considerable number of English miners, many of them Cornishmen. In one mine alone there were upwards of 140 European miners and mechanics employed; according to Captain Burton's report, they were well paid and cared for, and as their cottages were built for them by the company, and let to them at a merely nominal rent, they ought to put by money.

European artisans and mechanics are not here, as in most foreign countries, exposed to the disadvantage of having to compete with cheap native labour. The Brazilian is not by nature a handicraftsman. He prefers keeping a shop or breeding and selling cattle; but above all he desires a place under Government. As a workman he is independent, careless, and deficient in steady industry. When he has earned a little money he gives up a job and remains idle until he has spent it. The rate of wages is very high. Tailors, shoemakers, saddlers, ship carpenters, get from 8s. to 10s. per day. Blacksmiths, joiners, carriage builders, bakers, hatters, tinkers, and painters, from 4s. to 6s. 6d.; masons and bricklayers, 4s. to 6s. At Sao Paulo, smiths, turners, and moulders get from 8s. to 10s., railway labourers from 4s. to 6s. There is, according to Consul M. Heinssen, a great demand for female domestic servants. Chambermaids and general servants receive from £2 10s. to £3, and cooks £4 per month. As a rule, all engineering and constructing work, machine making and repairing, saddle and carriage making, brewing, &c., are done by Europeans. The Portuguese are the most numerous, but, though they are hard workers, they are disorderly in their conduct; the Germans are very steady and save much money. A very profitable branch of labour for six months in the year is the extraction of the juice of the rubber-tree. A single man will put up a temporary hut in the forest, and, with a provision of dried fish and mandioca root, in addition to the fruit and game which abound everywhere, can live very comfortably. About 8lb. of rubber is an average day's work, value 13s. 4d.; but some men have been known to earn as much as £2 13s. in one day. The operation is performed in a very primitive manner; but already an American and an Englishman have produced two inventions for performing it more expeditiously and methodically. The Tapuyo, or civilised Indian, is very fond of this kind of work, but it is at present carried on in a most wasteful and short-sighted way, for though the accessible rubber districts are becoming exhausted, no care is taken to plant young trees to re-supply them. It is stated, however, that vast supplies exist in the interior, and when more roads are constructed, it is evident that with care a source of considerable riches might be established by industrious and enterprising colonists. Under the same conditions plantations of cotton, rice, sugar, and cacao would prove a valuable branch of agriculture.

The daily wages to be earned in Brazil by a good workman are, as we have shown, exceptionally high; with regard to the purchase power of money, the statements given by the consuls vary according to the district. In Para it is estimated as about half what it is in England. In Rio de Janeiro an English mechanic would be about as well off with £20 a month as he would at home with £15. In Pernambuco the purchase power is from half to two-thirds, whereas in Rio Grande, Consul Callander, after balancing the high house-rent against the cheapness of food, considers money goes about as far there as here, and Consul Heinssen agrees with him. Consul Dundas thinks that supposing 10s. there is worth only 5s. here in purchase power, still, to a man who chose to save money, the advantage would be considerably in his favour, and explains it thus:—The milreis (coin of the country) may only buy there as much as a shilling would here, but it is valued at 2s. exchange. His savings, therefore, he could convert into sterling at the current rate of exchange; and if he earns 9s. a day, he can live on 5s., or less, very comfortably, and he has the full value of what he is able to lay by. It is affirmed that a steady skilled mechanic, even if married and with a family, ought to save at least one-fourth of his wages, but at the very least he would find himself with about 35s. in hand at the end of each month. From the evidence given we should place this much higher. If emigrant workmen in a distant country insist on having imported luxuries, such as tea, wine, butter, bottled English ale and porter (the only way it can be procured), and wheaten flour, of course they can spend any amount of money; but a reasonable and intelligent emigrant adapts himself to the customs and requirements of the country, and accepts its luxuries in exchange for those he has left in England. For example, in Brazil he would use coffee instead of tea, the small-beer and wine made in the country instead of bottled ale or spirits, and flour made from the mandioca root or maize instead of wheat; while delicious tropical fruits and various kinds of game unknown here, but cheap and abundant there, would very much abate the severity of his self-denial.—*Pall Mall Gazette.*

RESTORING CHARRED MANUSCRIPT.

THE wholesale destruction by the fire in Chicago of the receptacles used for the safe-keeping of valuable written and printed documents has called for some means of restoring burnt manuscript and the like, at least so far as to permit the same to be deciphered. A resident, Mr. J. V. L. Blaney, of the burned city, has attempted to meet the necessity by a patented process, which he describes as follows:—

The charred paper is to be first separated into single leaves, and then immersed in a solution of a soluble compound of silver or copper for such a time as may be required to render the printing or writing sufficiently legible. A solution of the nitrate of silver containing forty grains of that salt to one fluid ounce of distilled water is preferred. If the restoration is only required to be made on one side of the sheet, the solution may be applied with a brush, or by floating the paper upon the surface of the liquid.

The process succeeds best in a dark or a feebly-lighted room. After sufficient legibility has been attained, the paper should be soaked for some time in pure water to remove the excess of the salt used—in the case of silver salts, a dilute solution of hyposulphite of soda or of cyanide of potassium may be used—after which the paper may be exposed to the light, and, when dry, covered with a transparent mucilage or varnish, for preservation.

THE PREVENTION OF PUTREFACTION AND THE DEVELOPMENT OT PROTOPLASMIC AND FUNGUS LIFE.

THE following is an abstract of two papers by Dr. F. Crace-Calvert, F.R.S., read before the Royal Society, on the relative power of various substances to prevent putrefaction and development of protoplasmic and fungus life:—

To carry out this series of experiments, small test-tubes were thoroughly cleansed and heated to dull redness. Into each was placed 26grms. of a solution of albumen containing 1 part of white of egg to 4 parts of pure distilled water, prepared as described in my paper on protoplasmic life. To this was added 1000th, or 0·026grms., of each of the substances the action of which I desired to study.

The reasons why I employed 1 part in 1000 are twofold. First, the employment of larger proportions would, in some instances, have coagulated the albumen; secondly, it would have increased the difficulty of observing the relative powers of the most efficacious antiseptics in preventing the development of the germs of putrefaction or decay.

A drop was taken from each of the tubes, and examined under a microscope having a magnifying power of 800 diameters. This operation was repeated daily with the contents of each tube for thirty-nine days, and from time to time for eighty days. During this time, the tubes were kept in a room the temperature of which did not vary more than 3°—viz., from 12·5° C. to 15·5° C.

In order the better to show the influence of the antiseptics used, I examined two specimens of the same solution at the same time, one of which was kept in the laboratory, the other in the open air.

A marked difference was observed in the result; the one kept outside becoming impregnated with animal life in less than half the time required by the other, while as many vibrios were developed in six days in the tube kept outside as were developed in thirty days in the tube in the laboratory.

A summary of the results of the experiments given in the following table, in which the substances are grouped according to their chemical nature:—

	Days required for Development of	
	Fungi.	Vibrios.
1.—STANDARD SOLUTIONS.		
Albumen kept in laboratory for comparison	18	12
Albumen exposed outside laboratory	None	5
2.—ACIDS.		
Sulphurous acid	21	11
Sulphuric acid	9	9
Nitric acid	10	10
Arsenious acid	18	22
Acetic acid	9	30
Prussic acid	None	9
3.—ALKALIES.		
Caustic soda	18	24
Caustic potash	16	26
Caustic ammonia	20	24
Caustic lime	None	13
4.—CHLORINE COMPOUNDS.		
Solution of chlorine	22	7
Chloride of sodium	19	14
Chloride of calcium	18	7
Chloride of Aluminium	21	10
Chloride of zinc	53	None
Bichloride of mercury	81	None
Chloride of lime	16	9
Chlorate of potash	19	17
5.—SULPHUR COMPOUNDS.		
Sulphate of lime	19	9
Protosulphate of iron	15	7
Bisulphite of lime	18	11
Hyposulphite of soda	18	11
6.—PHOSPHATES.		
Phosphate of soda	17	13
Phosphate of lime	22	7
7.		
Permanganate of potash	22	9
8.—TAR SERIES.		
Carbolic acid	None	None
Cresylic acid	None	None
9.—SULPHOCARBOLATES.		
Sulphocarbolate of potash	17	18
Sulphocarbolate of soda	19	18
Sulphocarbolate of zinc	17	None
10.		
Sulphate of quinine	None	25
Picric acid	19	17
Pepper	None	8
Turpentine	42	14
11.		
Charcoal	21	9

In comparing the results described in the above table, the substances can be classed under four distinct heads—viz., those which prevent the development of protoplasmic and fungus life; those which prevent the production of vibrio life, but do not prevent the appearance of fungus life; those which permit the production of vibrio life, but prevent the appearance of fungus life; and those which do not prevent the appearance of either protaplasmic or fungus life.

The first class contains only two substances, carbolic and cresylic acids. In the second class, also, there are only two compounds, chloride of zinc and bichloride of mercury. In the third class there are five substances, lime, sulphate of quinine, pepper, turpentine, and prussic acid. In the fourth class is included the remaining twenty-five substances. The acids, while not preventing the production of vibrio life, have a marked tendency to promote the growth of fungus life. This is especially noticeable in the case of sulphuric and acetic acids. Alkalies, on the contrary, are not favourable to the production of fungus life, but promote the development of vibrios. The chlorides of zinc and mercury, while completely preventing the development of animalcules, do not entirely prevent fungus life, but I would call special attention to the interesting and unexpected results obtained in the cases of chlorine and bleaching powder. When used in the proportion above stated they do not prevent the production of vibrio life. In order to do so they must be employed in excess; and I have ascertained, by a distinct series of experiments, that large quantities of bleaching-powder are necessary. I found that part of the carbon was converted into carbonic acid, and part of the nitrogen was liberated. If, however, the bleaching-powder be not in excess, the animal matter will still readily enter into putrefaction. The assumption on which its employment as a disinfectant has been based, namely, that the affinity of the chlorine for hydrogen is so great as to destroy the germs, is erroneous.

The next class to which I would call attention is the tar series, where neither the carbolic nor the cresylic acid fluids gave any signs of vibrionic or fungus life during the whole eighty days during which the experiments were conducted. The results obtained with sulphate of quinine, pe[illegible] and turpentine, deserve notice. None of t[illegible] vent the development of vibrio life; bu[illegible] of quinine and pepper entirely prevent [illegible]ance of fungi. This fact, together wit[illegible] able efficacy of sulphate of quinine in cases of intermittent fever, would lead to the supposition that this class of disease is due to the introduction into the system of fungus-germs; and this is rendered the more probable if we bear in mind that these fevers are prevalent only in low marshy situations, where vegetable decay abounds, and never appear to any extent in dry climates, even in the midst of dense populations, where ventilation is bad, and putrefaction is rife. The results obtained in the case of charcoal show that it possesses no antiseptic properties, but that it prevents the emanation of putrid gases, owing to its extraordinary porosity, which condenses the gases, thus bringing them into contact with the oxygen of the atmosphere, which is simultaneously condensed.

The above results have been confirmed by a second series.

A series of experiments was also undertaken, substituting gelatine for albumen, and was continued for forty-seven days. Vibrios appeared in two days in the standard gelatine solution, and bacteria after four or five; and during the whole time of the experiment, life was far more abundant than in the albumen solution. A distinct putrid smell was emitted after twenty-six days. With bleaching-powder it took twenty days for life to appear, instead of seven, as in the case of albumen; while at no time during the twenty-nine days which remained was life abundant. No putrid odour was emitted; but a mouldy one could be detected on the thirtieth day. With chlorine solution vibrio life was only observed after forty days; no putrid nor mouldy smell was given off at any time. The protosulphate of iron gave, with this solution, results quite different from those with albumen, in which, it will be remembered, vibrios appeared in seven days, and fungi after fifteen: whilst, with gelatine, neither protoplasmic nor fungus life appeared during the time the experiments were continued. Another substance, arsenious acid, also presented a marked difference in its action in the two solutions, for although with albumen twenty-two days elapsed before vibrios were present, and eighteen before fungi, with gelatine animal life appeared after two days, and at no time did any fungi exist. The effects of the other substances with gelatine were so similar to those with albumen that it is unnecessary to state them here.

Another series of experiments was undertaken as complementary to those described above, and consisted in adding to a solution of albumen, swarming with microscopic life, one-thousandth part of the substances already enumerated, and examining the results produced immediately after the addition of the substances, and after one, six, and sixteen days; but in this abstract, only the results obtained in the first and last cases will be noticed.

The solutions were placed in test-tubes similar to those described in my last paper. The experiments were begun on September 20th, 1871, the solutions being kept at a temperature of 15° to 18° C. In the standard solution, the amount of life and putrescence increased during the whole of the time. The first class includes those substances which completely destroyed the locomotive power of the vibrios immediately, and completely prevented their regaining it during the time the experiments were conducted:—Cresylic acid.

The second class contains those compounds which nearly destroyed the locomotive power of all the vibrios present when added, and afterwards only one or two could be seen swimming about in each field:—Carbolic acid, sulphate of quinine, chloride of zinc, and sulphuric acid.

The third class are those which acted injuriously on the vibrios on their addition, leaving only a small number retaining the power of swimming, but which allowed the vibrios gradually to increase in number, the fluid, nevertheless, containing less life after sixteen days than the standard putrid albumen solution:—Picric acid and sulpho-carbolate of zinc.

The fourth class includes those substances which acted injuriously at first, but permitted the vibrios to regain their former locomotive power, and which, after sixteen days, contained as much vibrio-life as the standard putrid albumen:—Chloride of aluminium, sulphurous acid, and prussic acid.

The fifth class contains those compounds which acted injuriously at first, destroying the locomotive power of most of the vibrios, but which afterwards permitted the vibrios to increase more rapidly than in the standard albumen solution:—Bleaching-powder, bichloride of mercury, chlorine solution, caustic soda, acetic and nitric acids, sulphate of iron, and the sulpho-carbolates of potash and soda.

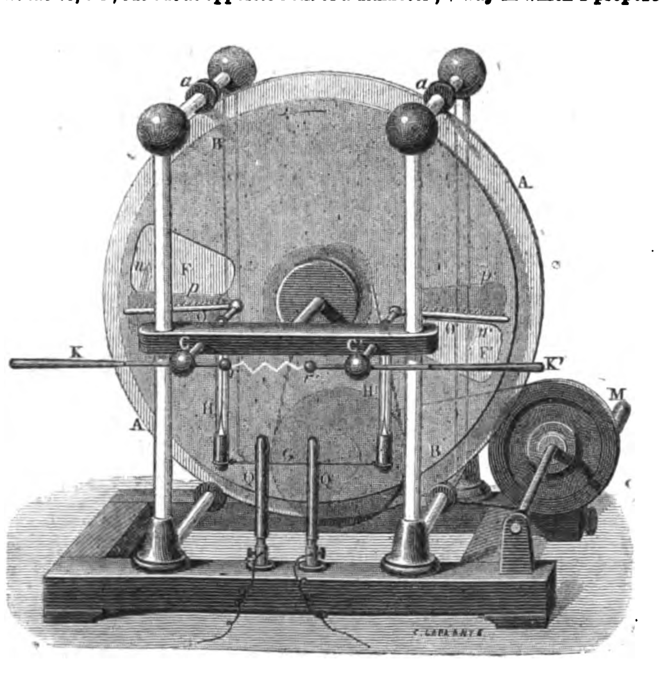
The sixth class contains these compounds which exercised no action on the animalcules either at first or after sixteen days:—Arsenious acid, common salt, chloride of calcium, chlorate of potash, sulphate of lime, bisulphite of lime, hyposulphite of soda, phosphate of lime, turpentine, and pepper.

The seventh class includes those substances which favour the production of animalcules, and promote putrefaction:—Lime, charcoal, permanganate of potash, phosphate of soda, and ammonia.

HOLTZ'S ELECTRICAL MACHINE.

SEVERAL inquiries as to the construction of Holtz's electrical machine having appeared in our columns without eliciting a reply so satisfactory as queries generally obtain, we have thought it advisable to make an abstract of the best description with which we are acquainted, and have accordingly borrowed the illustration and description contained in the supplemental volume of Watts' "Dictionary of Chemistry" just published by Messrs. Longmans.

This is a contrivance by which a very small initial charge is made to give rise to an indefinitely great quantity of electricity of high tension; its action may be described in general terms as equivalent to that of an electrophorus and a condenser combined together in such a way as to act upon each other alternately, the condenser being first charged by the electrophorus, then reacting upon it so as to increase the charge of the cake; next being charged by the electrophorus to a higher degree and reacting upon it more strongly than before; and so on, the charge of each becoming gradually greater and greater until the insulation is overcome. The form usually given to the machine is shown in the figure. Its construction is as follows: A circular plate of thin and very flat glass, B B, is mounted upon an insulating ebonite axle, so that it can rotate in a vertical plane, and a second glass plate, A A, also as thin and flat as possible, is fixed parallel to it, with its centre in the same horizontal line, and at a very short distance (⅛in. to ¼in.) from it. At the middle of the fixed plate there is a round hole, through which the axle of the movable plate can pass without touching, and there are two deep notches or *windows*, F F', cut out at opposite ends of a diameter;



at the back of the glass (that is, on the side turned *away* from the rotating plate) a piece of paper, *p*, about 2in. broad is pasted along the lower edge of one of these openings, and a similar piece, *p*, is pasted along the upper edge of the other opening, each of these pieces of paper having projecting from it a couple of tongues of stiff paper, *n n'*, long enough to project through the opening and just touch the movable plate; both the papers and their projecting tongues are well varnished. On the side of the movable plate which is farthest away from the fixed plate, and opposite to the two pieces of paper just mentioned, are two collectors, O O, each consisting of a row of metal points projecting from an insulated metal arm to within a very small distance of the rotating plate. These collectors are connected with the main conductors of the machine, C C, each of which is provided with a movable discharging rod, K K', by means of which they can at will be placed in electrical connection with each other, or separated by any required interval. In order to put the machine in action, the two conductors are connected together, the movable plate is set rotating at a moderate speed, and while it is moving, an electrified body, such as a piece of ebonite excited by friction, or the cover of an electrophorus, is brought near to, or into contact with, one of the paper armatures. Both the papers then rapidly become strongly charged with opposite kinds of electricity, and if the knobs, *r r'*, of the discharging rods are separated to a short distance, a stream of sparks is seen to pass between them. These sparks become less frequent, but larger and brighter, if each of the conductors is connected with the inside coating of an uninsulated Leyden jar. The sparks also increase in size, but diminish in frequency, when the discharging knobs are moved farther apart, but if the distance between them is made greater than a certain limit, depending chiefly upon the insulation of the different parts of the machine, the sparks cease to pass altogether, and, unless the knobs are quickly brought nearer to each other, the machine soon ceases to act.

For further information as to the action of the machine, and for an explanation of the principles which govern its construction, we must refer our readers to the book itself, which assuredly deserves a place in every public library and chemist's laboratory in the kingdom.

OUR FOOD SUPPLY.

THE Rev. Henry Moule, writing from Fordington Vicarage on the inadequacy of the food supply of this country, comes to the following conclusions:—Let farmers, whatever be the extent of their holdings, make a more provident use of straw, and of stalks of almost every kind, for food for cattle and sheep. Let them make a more provident use of their pastures. Full two-thirds of the pasture of most inclosed fields in the ordinary mode of grazing are wasted. Let far the larger proportion of cattle be fed in stalls, and in that proportion would this waste be prevented, and economy of straw, &c., be promoted. With the abundance of food thus provided there would soon be an end put to the wasteful slaughter of calves and lambs; and by this means alone the stock of a farm would soon be increased. But beyond this, if the manure of the stalls be carefully preserved, and treated in the way in which I propose to treat the refuse of towns, and of which I gave a general idea in the *Times* of December 3, 1871, then the corn produce and the live stock of our 47,000,000 acres might soon be doubled. For, with a due supply of dry earth to the stall and the proper admixture of other substances with this earth, a single cow will produce 12 tons of manure per annum, one, or at the most, two of which shall very largely increase the produce of an acre of pasture. On an ordinary farm two or even three acres are deemed requisite for one cow. If this stall feeding be practised, and the cows be properly tended, and the pasture duly manured, one acre will keep two cows; and, if the land be good, even three cows. The remaining 10 tons of manure from one cow might be applied with great advantage to 10 acres of land, drilled in with corn or the seed of roots. If so, then, together with a saving of nineteen-twentieths on the ordinary carriage of manure (which would of itself admit of a larger amount of human labour throughout the year), 10 cows, besides keeping up their own supply of food from three or four acres, would afford an annual supply of manure for 100 acres of corn or roots, the almost inevitable result of which would soon be the doubling of the live stock and a very large increase of the corn produce of the country. Much more than this, however, might be effected by calling in the aid of the working classes themselves.

PHOTOGRAPHY FOR THE UNINITIATED.*

(*Continued from p. 270, Vol. XIV.*)

A FRIEND said to me a day or two since, that my letters to you were all well enough in their way, but did not enter as fully into detail as the subject required. He stated that they were too general in their character, and had the appearance of passing too hastily over the subject. If such is the fact, then I have succeeded in doing just as I intended, so far as writing in a general rather than in an exhaustive style. To write exhaustingly would be to write a volume. That I never intended, as quantity to the uninitiated is rather more confusing than instructive. For detail and formulæ I refer to the most excellent works of Vogel and Lea. It may be well, however, to look over the letters which I have written, and upon a few points be a little more explicit, and also make some changes and additions.

In letter No. 4 (p. 34, Vol. XIV.) wherein I wrote as to the use of albumen as a substratum upon the plate, and recommended its flowing thereo

* From the *Photographic News*.

while still wet, I have to add as follows:—At a recent meeting of our photographic society, it was stated by Mr. Gardner, as the result of his experience, that if the plate was well rubbed with a piece of canton-flannel or Joseph paper dampened with a solution of alcohol slightly acidulated with acetic acid, that over this dried surface the albumen would flow as freely and as well as collodion. He strongly recommended the use of dilute albumen without the addition of ammonia. This plan presents advantages over the one directed in my letter above referred to, and is fully worth a careful trial. As yet, not having had an opportunity to test it, I cannot speak from personal knowledge as to its merits.

While considering the use of albumen, I may as well state that in my experience it materially "slows" (*i.e.*, lengthens) the time required for the exposure of both wet and dry plates; it decreases intensity in the dry and increases the same in the wet. At the same meeting above referred to, this subject was discussed, and Mr. Newton stated that if a small portion of alcohol was added to the dilute albumen in place of the ammonia the "slowing" effect would be overcome.

The troubles most often met with in out-door photography, in my experience, are those which I shall name in a general way, and suggest the most likely cause of such, so far as my practice and experience go.

Fogging.

This may arise from many causes. 1. From diffused light, either in the operating-room during the sensitising and developing processes, from some defect in the camera or plate-shield. 2. By use of a freshly-made sample of collodion. 3. By the bath lacking in acidity. 4. By the use of too little acid in the developer. These are but a few of the many possible causes, but the most probable.

As to the finish, I need only say, examine the room and articles referred to with great care. To make certain as to the room, go through all the operations of sensitising and developing a plate within the room; if it remains clear, next test your camera and shield, by proceeding the same as you would in full use thereof, except removing the caps from the lenses. If both of these stand the test, you may rest satisfied as to them. As to No. 2, add a trifle of an older and redder collodion to the new lot, until you have it a reddish-yellow tinge, or a drop or two of an alcoholic solution of iodine. If fog still continues, add acid to the bath, as directed to do when making it up, exercising even greater caution. Finally, try more acid in the developer, and be more cautious to wash the plate well before you leave your dark room for the purpose of "fixing." A fog from light is deep-seated and throughout the film; that from the collodion, bath, developer, and insufficient washing, is of a surface character, and can, when dry, be to some extent removed, and leaves below a polished silver surface not easily forgotten when once seen.

Stains and markings result most often in warm weather, from a too great delay in the various operations, especially in keeping a plate too long between the time of its removal from the nitrate bath and development, also from dipping before the film has properly set, from improperly dipping, from improperly draining the plate, from a wet and sloppy plate-shield, from shaking or reversing the plate or shield, scum upon the surface of the bath, &c.

Spots and Pinholes.

Oftener dust than anything else causes them; keep clean. Fixing solution allowed to fall upon the table or floor, becoming dry soon, raises a fine powder or dust, and spoils your work as fast as made; improperly filtered collodion, bath, and developer; sudden shutting of the slide of the plate-shield, dirty camera, and an old bath solution which requires to be overhauled—about which I shall write you some of these days.

Dirty fingers, wet with developing and fixing solutions, used when collodionising or sensitising, do not help matters.

Pressure in Steam Boilers.—The question as to whether the pressure in a steam boiler was equal or different at top and bottom, concerning which there seems to be some difference of opinion amongst engineers—though it is difficult, from the simplicity of the facts involved in considering the question, to see how a difference of opinion should exist—has nevertheless been experimentally determined by the Messrs. Hunter, at their establishment in Philadelphia. An elbow was attached to the end of the blow-off pipe which entered the mud-drum; into this a plug was screwed, and tapped to receive a ½in. pipe; to this a steam gauge was attached and the cock opened. On comparing the indications of the gauges attached at top of boiler and to the top of drum, as above described, it was found that the pressure was greatest at the bottom, by 1½lb., proving, as might readily have been predicted, that the pressure upon the bottom of a boiler is equal to the steam pressure indicated above, plus the weight of a water column equal in height to the difference in level between drum and surface of water in boiler, and in diameter to that acting on the gauge.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

CONTACT OF COMETS WITH THE EARTH.

[3916.]—THE certainty of "astronomical catastrophes" (as the *Spectator* euphemises falls of comets on our earth), both past and future—the former being a fundamental fact necessary to all true geology (as I showed "F. R. A. S." in your columns above three years ago)—depends on a vast mass of evidence of various kinds that may be divided into—1. The proofs of the average rate at which this planet is (so far as accessible statistics can show) encountering comets, *i.e.*, observe their ponderable matter or heads, not merely their showy and mysterious tails, which, being non-ponderant, there is no reason to suppose we should even be aware of passing through; and much evidence that we actually have passed through, as in the last day of June, 1861, without knowing it, and, probably, our ancestors in almost every age as unconsciously. Entering a ball of *ponderant matter* (which every comet's head demonstrably is, however many hundred or thousand times rarer than hydrogen, or than the best "vacuum" of our Geisler tubes) is a very different thing indeed, and yet a thing just as demonstrably happening to our earth from time to time, and therefore one that any *geology* must needs take note of—whatever the deluge of books of the kind "F. R. A. S." commends to my attention on p. 61 (which, with thanks to him, I have seen enough of, and which I cannot call anything but *Lyellology*) may do or leave undone. 2. The past duration of our planet as an *inhabited* one, whether by vegetables, animals, or men, is, of course, a point co-ordinate to this proof; because its age might be found such that there might be a probability of *no* comet having *yet*, since man's existence (or even since far earlier geological periods) met, overtaken, or fallen upon her. A comparison, however, of cometary statistics with the demonstrable past duration of animal life (which though not so great as most Lyellists fancy, is certainly more than a million years) leaves no chance of this time having elapsed without sundry and probably many cometfalls. In fact I shall show that (supposing there were no traces or no geological facts indicating their effects, or no effects but what might be explicable without them) it would not be open to a scientific theorist to assume there have been none. On the contrary, he would have to explain how it happened that such events had left no traces. It would be no more allowable for Scrope or Lyell to say, "perhaps in these 1,000,000 years no comet may have happened to fall," than to account for some peculiarity in the surface of an English building ten years old, by saying "perhaps it has never been wetted; this being a dry locality, there may not have happened any shower here during these ten years." Scrope, in the page to which "F.R.A.S." refers me (letter 3870—he names no page of the other books), harps upon what he thinks an "unlimited" allowance of time might do to certain strata; he insists on "incalculable duration," on "almost unlimited drafts upon antiquity," and a page later, breaks into this beautifully scientific style—

"Time! Time! Time!"

Yes, Mr. Scrope, don't you wish you may get it? Suppose time would give the effects you vainly attempt to explain (which it would not, and has *no tendency* towards), in order to get your "almost unlimited drafts," you have first to get millions of comets out of the skies! For in this actual universe and order of *known* nature, the *average* drafts afforded you between cometfall and cometfall are quite limited and quite calculable. All the Lyellology, to "a score of books", of which "F.R.A.S." would commend my attention, is the *mythical* geology of a *mythical* and unknown universe, one without comets! 3. But a third part of the evidence, that might or might not exist, is the presence of facts on earth not explicable but by cometfalls, or the last cometfall. Were there no such facts at all, this would nowise tend to alter the astronomical necessity that (in the time known to have elapsed) we must have picked up comets, or exonerate a science of geology from taking account of such necessity, and explaining how falls might take place and leave no effect but those seen. In fact, however, the globe is covered with millions of effects utterly inexplicable without a cometfall, and one almost datable to a century, certainly between forty-five and fifty-one centuries ago; and the attempt to geologise without this, and to account for extant phenomena by "causes now in action" alone, has been so resolutely and perseveringly made in this generation—we may say the life of Lyell from early manhood till now mainly given to this one attempt—that all time will really be indebted to him and his compeers for making it impossible to say this trial has not been fully made, fully exhausted, and the result utter and ridiculous failure. (*Vide*, "score of books" in question, and any valley on earth).

The multiplicity of evidence bearing on all these points is so great that in the *embarras de richesse* I should really scarce know where to begin best such information as "J. C." (p. 68) asks for; especially in fragments, the only way the ENGLISH MECHANIC could admit it, as any such fragment seen alone is sure to call up some grandiloquent "venture to hope," like that of "F. R. A. S." (p. 61, par. 3), from Lyellists, who little dream the ridiculous figures they and their "science" are infallibly doomed to cut in a few years more. As "J. C." is chiefly surprised at my looking on a general deluge as "one of the results" most certain to have accompanied each past cometfall, perhaps that is the point I had better first examine; leaving any calculation about the average frequency of falls, as he admits they "might be expected." But I shall have to be guided by the directions that his or other "surprises" and objections may take. Wherever they may lead I promise to follow, and to show that, in short, every kind of evidence that could be fancied on this point exists, and in abundance; and also much, I believe I shall show, that could not be fancied *à priori*. And there is no conflict of evidence. All is harmonious, and tells one tale. "F. R. A. S." is not going to have his wish to hear no more of a "quasi-mythical" deluge, I can assure him. The geologers have had "a chiel amang ye takin' notes," and from him or others, a good deal about the "*quasi-mythical*" they are not going to hear the end of. They are now in a trap much easier to get into than out of, and with some nuts to crack that I have often warned them to beware they did not break their teeth on.

E. L. G.

THE METROPOLITAN CRATER OF THE MOON —LUNAR MAPS—CATALOGUES, &c.

[3917.]—MR. BIRT says (let. 3606) that he failed to find, either in a certain unpublished map that lay before him, or in Schmidt's "Rillen auf dem Monde," any appearance of a cleft figured in M. Gaudibert's sketch of Tycho (let. 3485). Regarding its absence from the Rillen it may be inferred that Schmidt did not look on it as a rill properly so called; and, certainly, it appears to me as no other than one of those clefts that separate the terraces of crater ramparts. In some instances the clefts, after running a certain distance in a more or less rough, and often interrupted, parallelism with the contour of the exterior ridge, are seen to strike across the latter, forming a gap, as M. Gaudibert shows in the wall of Tycho, and as may also be well observed in the not distant crater of Bullialdus. The cleft, or ravine, found by M. Gaudibert outside Tycho, certainly runs from the south-west in the direction of the gap, but I could not say from my own observations that it forms a part of the same formation. I have often noticed a cleft longitudinally splitting the exterior south-western slope of Plato, and reaching with its northern end the summit of the wall. It is very well defined, and is, I should say, quite as striking a feature as the cleft in Tycho, but still I never looked on it as anything more than a chasm between terraces] formed, perhaps, by a landslip.

We must all heartily concur in the tribute paid by Mr. Birt to M. Gaudibert's interesting communications that appear in the ENGLISH MECHANIC, and we must also see the force of Mr. Birt's remarks relative to a catalogue of lunar objects. The chief point now sought to be discovered in lunar science relates to evidences of topographical change which would prove the continued action of the forces from which the aspect of the moon has been derived, and for this purpose catalogues and maps of the most comprehensive possible character are required. All observations up to the present seem to show that no recent indication of those forces operating on a large scale is to be expected, and that there is little use in seeking for new formations except in a locality of which every visible feature, even to the smallest, is correctly mapped and catalogued. Any one who has examined those catalogues and sections of his great map which Mr. Birt has, up to this time, been enabled to publish, must see that it is by such aid as they afford, that we can hope to detect with any certainty a new feature appearing on the moon's surface.

Another great map—the result of thirty-two years' labour—has been completed by Dr. Schmidt, of Athens, but it is, unfortunately, not as yet given to the public. With a diameter of six French feet—double that of Beer and Mädler's—it is executed in a style that makes it what may be called a panoramic view as well as a map, while it exhibits a wealth of detail that looks perfectly astounding in the work of a single observer.

Birt's far larger map, on a scale that will give it a diameter of no less than 16ft. 8in., is constructed on quite a different plan, showing the features only in outline, so that additions can be conveniently drawn on it if necessary. Besides references to previou[s] authorities, and the names and synonyms of [the] principal objects, it gives several measurements [in feet] and metres, with statements and symbols d[...] of character and hypsometrical relations; everything is marked with a number of [...] full description is found in the catalogue.

It cannot be too deeply regretted that of these two great works, one (Birt's) has only a small portion finished, and the other, though complete, is not likely to be published for a considerable period. The difference of design in their construction prevents all rivalry between them, and the time may be expected when both will be considered indispensable to the student of lunar physics. J. Birmingham.

ATMOSPHERIC DUST.

[3918.]—I am glad to find that M. Paris wears his scientific creeds loosely, for there is hope, under these circumstances, that he will recant those most heretical opinions expressed in let. 3887, p. 66. Surely the doctrines that "putrefying bodies are not to be dreaded, but living matter," and that "fresh sewage is far more dangerous than old," were enunciated without receiving much consideration from our friend. The first statement appears to me to be a contradiction in terms, for it is when bodies are putrefying that living matter predominates. Life out of death is true of everything in a state of nature; for though a dead body may not be the cause of the life—may not generate it—it is undoubtedly the source of its development. Kill a bullock and leave its carcase in a field: it will putrefy, and become the habitation of innumerable living things, apparently generated by it, but certainly developed and nourished by it. Some of these living things we see with the naked eye, and it is only reasonable to suppose there may be others we do not see. Whether this life is spontaneously generated by the dead carcase is immaterial to the point; if the dead matter had not been there the life would not have made itself apparent, even if it had existed as a germ, and certainly not if spontaneously generated. So, if the carcase had been utilised before putrefaction set in, no dangerous living matter would have been developed. The same argument applies to fresh sewage. What is there—what can there be—in *fresh* sewage to give rise to the microzymes (?) of contagion? it is only where we allow the sewage to putrefy that it becomes so rich a field for the development (or it may be generation) of living germs. True, we want a disinfectant to kill the living germs, but failing that, it would, I think, be advisable to do what we can to prevent putrefaction, or at all events to remove the putrefying body to a safe distance.

But where does M. Paris imagine that living germs have their origin? If they are originated by the ordinary process of reproduction, the parent germ must have conditions suitable for its multiplication; if it cannot obtain these it will, in the ordinary course of things, die and leave its place unfilled. A thistle seed in a farmer's writing-desk is powerless for good or evil so long as it remains there; but let the farmer drop it in one of his fields and allow it to grow unheeded, and it will remind him in after years of his carelessness. Just so with "living germs": while few in number, and separated from their food-matter, they are harmless or nearly so; but give them the opportunity of multiplying in "putrefying" matter and they then spread contagion all around.

Medical men are divided in opinion on what is known as the germ theory of disease—some agreeing with Professor Tyndall, others considering that disease is produced by the action of dead or dying matter upon living tissue; but I never yet read or heard of any scientific man who could venture to assert that putrefying bodies and festering sewage were not dangerous.

Dr. R. D. Thomson (letter 3887) appears to think that "gases" are the cause of disease; but what gas known to the chemist has ever afforded the slightest suspicion of being the actual "fermenting poison" of zymotic epidemics? Still, M. Paris must acknowledge that the activity of the living germs may be largely increased when surrounded by "putrefaction gases." The lungs, no doubt, are able to throw off a large proportion of the germs and dust which reach them, but that some of the latter is retained we know, and there is every reason to believe that the poison of typhus, variola, and other diseases, whose course the skill of the physician is utterly powerless to stop, is conveyed into the system in this manner, as well as in the food we eat and drink.

Let us, then, prevent putrefaction of dangerous matter, and remove also those conditions which appear congenial to the development of unhealthy fungus life. Decaying matter is doubtless only elements "out of place;" but while they are trying to lift themselves into more respectable positions, they are helping to create fresh supplies of the very matter in which they are so unpleasantly mixed.

It just occurs to me that the blow-fly, with a natural instinct, always deposits its eggs on those parts of a carcase where putrefaction commences earliest; and an accidental cut made in the surgeon's finger while dissecting a "subject" is often attended with fatal results, which never accrue when more extensive wounds are made in operating on the living body.

Saul Rymea.

ALLINGHAM'S PROPELLER.

[3919.]—Unfortunately for Mr. Allingham, his very feasible invention (as shown on p. 39) is, slightly altered, very old. The old form was a framework fixed to each side of the ship, and propulsion was effected by rolling instead of pitching, with similar venetians. It is, perhaps, not necessary to inform the inventor that an unmasted ship rolls (from side to side) more than she pitches in a seaway.

He will find the ship scarcely moves with the most carefully arranged machinery, this being, perhaps, one of the most ineffectual arrangements of utilising the motion of the waves for propulsion.

Cleethorpes. Amos Applevard.

CONCRETE BUILDINGS.

[3920.]—I had intended, with your permission, to have inflicted on your readers, in answer to query 11249, a history of my experiments in concrete during the last two years, but want of time has prevented me. I will, however, when I have finished what I am now doing in concrete—which will involve not less than one hundred thousand cubic feet of work—give you in detail my failures and my successes. The former are numerous. I will back up "F. P." in his advice in telling an intending builder in concrete to visit works that have been executed before he goes to the expense of a single bushel of cement. If your correspondent has the determination to stand over the work, to see all done, and not leave it either to his foreman, carpenter, or labourers, nor yet to a contractor, he will not regret substituting concrete for either brick or stone, either on the score of economy, strength, durability, or freedom from damp. Close attention is required from the beginning to the end. Without close attention your correspondent had better use bricks and mortar. On the score of economy he must not be led away by the flaming accounts of the cement doctors. I have before me an account in which an equal number of yards of cement, sand, gravel, and broken stone are made to produce an equal number of yards in work. My experience has shown me that under no circumstances could I get more than 60ft. to 66ft. in the solid out of the 100ft. of material measured in—even in the case of walls. For roofing, which requires very hard beating, 7·28ft. of cement and gravel produced only 3·34ft. in the solid. A cubic foot of gravel and sand containing stones not larger than would pass through a 1½ inch screen would weigh about 84 or 85lb.; a block of pure flint would weigh about double that per cubic foot; the interstices must be filled partially or entirely with cement and sand, or air, or both. To make the calculation as to the comparative economy of concrete and brickwork—a rod of brickwork will take about 4,500 bricks, 26ft. of stone, or 86ft. of chalk, lime, and 70ft. to 75ft. of sand. Three hundred and six feet of concrete, in proportions of one in ten—*i.e.*, 9 parts gravel 1 part cement,—will require about 410ft. of gravel and sand and 46ft. of cement. As to labour, I believe the usual calculation for ordinary brickwork in walls not less than 9in. thick per rod is 3½ days of a bricklayer and labourer. In cement I have found that it takes six labourers, two stout lads, and a carpenter, to keep frames going to mix and fill about 240 cubic feet per day in walling. The labour bill for concrete is higher than that of brickwork. The economy will depend on cost of cement and aggregates. Mr. Tall puts his labour at 2s. per yard, and 6d. per yard for the carpenter; in other words, $1\frac{3}{27}$d. per foot. From the above your correspondent can make his calculations as to cost.

Quality of Cement.—Your Portland cement should weigh 112lb. per bushel; the heavier the cement—provided it is passed through not less than forty-gauge sieve, or 1600 holes to the inch—the better. The heavier the cement the slower it sets, and the harder it is when set.

Gravel.—The real economy of concrete depends upon the quality and cost at which sand, gravel, and other aggregates can be produced. I have lately taken to washing my gravel—I only regret I did not do it from the first; the slightest quantity of loam destroys the effect of a large quantity of cement. If neither gravel nor sand is procurable in the neighbourhood burnt clay ballast makes excellent concrete—in fact, better than sand and gravel.

Mixing.—The cement, gravel, and sand should be turned over no less than five times—three times dry and twice wet. By turning over I do not mean simply chucking a shovelful from one side of the mixing board to the other, but turning clean over a half shovelful at a time, so that cement, sand, and stones are all intimately mixed.

Water.—The quantity of this depends much on the state of your gravel and sand. In no case should it be more moist than moist brown sugar; on this you will have a battle long and fierce with your workmen. Do not give in. The drier the concrete is put in the firmer it sets.

Filling in Frames.—I again say put in as dry as you can, and ram as hard as you can, and do not fill oftener than twice a week or five times a fortnight. The fever speed of filling upon filling is utterly destructive of good work. One cement doctor recommends his framing as superior to that of a rival by reason of his being able to fill twenty-four inches at a time as against that of his rival, who can only fill eighteen inches. Eschew as you would poison the filling your cement out of buckets. The use of buckets induces the workmen to mix the concrete with far too much water. Fill from the barrow in small shovelfuls, and let the shoveller take his time. This will secure more ramming from the man inside the frame. To the height of twenty feet run your cement on planks and stage; above that height set up a horse run.

As to the frames to be used, you can hire or buy either Tall's or Drake's. If you have any ingenuity you can construct your own. The expense of framing is the great drawback. If you are going to build only one house, *hire*; if you are going to build several, and are not in a hurry, *buy*, or make for yourself. I am afraid I have gone into this at greater length than fair play to other contributors will justify. If your correspondent requires more information, a letter addressed to "P. T. A.," Post-office, Southampton, containing real name and address, will be answered by

Khoda Bux.

SCIENTIFIC NOMENCLATURE.

[3921.]—"L. C. E." (let. 3884, p. 66) must have a marvellous faculty for discovering likenesses, if he discovers so strong a resemblance between the old alchemists jargon of names and those bestowed by modern chemistry. The old names were absolutely arbitrary and meaningless, with the exception of some very few classes, such as the "vitriols," which did recognise a connection between the substances thus named; many of the names were even intended to conceal the substance they indicated from all but advanced adepts. Modern chemistry, on the other hand, gives names intended to exactly describe the constitution of the substance; this certainly results in some considerable confusion at present, but only because the rapid growth of knowledge shows that many names thus given (and given correctly in the then state of knowledge) are not sufficiently correct.

The polysyllabic names of organic compounds are thus attained—for instance, "L. C. E." may consider that such a name as phenyldibenzamide is a grammatical barbarism fit to be compared as mere jargon with the "white blood of the green dragon;" but this latter name has no meaning whatever, it may possibly indicate that in a given experiment a white precipitate forms in a green solution, or some such reaction, but phenyldibenzamide describes the exact substance; it tells us that it is an ammonia, the three hydrogen atoms of which have been substituted by 1 atom of phenyl and 2 of benzoyl:—

$$\left.\begin{matrix} C_6H_5 \\ C_7H_5O \\ C_7H_5O \end{matrix}\right\} N$$

It is true this is "intelligible only to the initiated," but this is so with all knowledge; it is absolutely impossible to make astronomy or chemistry intelligible to an ignorant country bumpkin, and just as those who wish to read the classics must learn their languages, so any one who wishes to comprehend a science must do so by long sustained effort and labour. Science is organised for its students—the initiated—not for mere lookers on. "L. C. E." illustrates this by his examples, he prefers chloride of platinum to platinic chloride, and seems to suppose the latter, which he calls a grammatical barbarism, is adopted only because it is a syllable shorter. Not so: chloride of platinum is incorrect because vague, for there are two chlorides, and the terminals ic and ous distinguish them; better names might be, and, doubtless will be, devised, when chemical theory is better defined, but they serve during the present transition state of the science. Zincic chloride, on the other hand, is erroneous and very few chemists would use it, because there is only one known chloride, and its proper name is, therefore, zinc chloride, $ZnCl_2$.

Electrical terms are very much misunderstood by "L. C. E." It is only since some ten years or so that the idea of exactly measuring electricity and its effects has been thoroughly developed; units for the purpose being devised they required names, and the committee of the British Association adopted Clarke's suggestion, and gave to these units the names of distinguished electricians, and hence we have the Volt, the Ohm, the Veber, the Farad. These names, therefore, are given by the highest possible authority—that, namely, which devised the measures they now indicate, and, so far from being introduced by me in my papers as novelties, as "L. C. E." supposes, they are the established terms used by all electricians. Of course, they are known only to the initiated, because to them only has the idea of definitely measuring electricity become a thing of reality. One name alone have I on my own authority employed, as it was not only my right, but my necessity to do. I used the term equivolt because I for the first time introduced the idea of a definite electric measure, connecting the other measures with what Faraday called the equivalent of electricity, and thus combined the hitherto distinct ideas of "tension" and "quantity" in one unit; this, of course, needed a name, and following scientific precedent, I gave it one which describes its value—viz., a volt of electric tension acting through a chemical equivalent in grains—hence the term equivolt.

The four last paragraphs of "L. C. E.'s" letter must really be read in the light of the preceding one. Many scientific disputes may be valueless, very many may seem so to those who have no comprehension of their meaning. It is easy to sneer at the "hours spent over infinitesimal markings on the Diatomaceæ or the specks in a tadpole's tail." Some day the latter may suddenly throw light upon some obscure problems in the mystery of life; but suppose they never give us one particle of knowledge, are we to count for nothing the training in habits of exact observation, of rigidly minute recording of facts? Is it nothing that for these studies, worthless it may be in themselves, men are earnestly giving themselves to the improvement of instruments of priceless value for other and most momentous purposes?

May not the true lesson be, not that Secchi's observations on the sun flames are worthless, because "no one dreams of classifying the flames that flicker in our grates," but that some one may yet study these latter flames and read therein some of the secrets of the universe?

What use is it? Oh! despicable formula, beloved by the "practical" man. Where would the world be if there was no nobler spirit than this? if men of science were not ever ready to give their time, their lives, for things of—no use? Cancer is not checked, tubercle had not been arrested; therefore, ye delvers in the mines of science, break up your tools—seek no farther. What use is it? Does the tin or coal miner act thus? Is he content to give up his [illegible] after digging for a few feet?

In 1819 Oersted discovered that a magnetic needle moved when an electric current passed in its neighbourhood. Poor fellow, what waste of time. Why did he not dig potatoes? that would have been useful. Ampère, Faraday, and a lot of other foolish people played for years with a lot of wires and steel needles, and philosophical instrument-makers made complicated toys (they, however, were useful, of course, because they were for sale). In 1845 Wheatstone patented his telegraphic instrument—26 years, O "L. C. E."! during which you would have said, "Has any practical result followed?" "Some trifling knowledge may have been gained." But now, ask the shareholders in submarine cable companies. Ah! the most "practical" men now can see what use it is, but between 1819 and 1845 how grand their contempt for the poor triflers of philosophers!

There is no knowledge of which we can say it is of no use: the most insignificant things in appearance may prove to be guides to priceless truths. The man who asks of his studies the question "what use is it?" will never pass beyond mediocrity, will never feel his heart thrill with that glowing energy, that delight in truth for truth's own sake, which is the reward of the true scientific man, who finds in his studies themselves their own exceeding great reward. SIGMA.

LIGHTNING CONDUCTORS, LIMITS OF RESISTANCE IN TELEGRAPH WIRES, &c.

[8922.]—(8846.)—IN reference to the destructive force of a flash of lightning when impeded in its progress by non-conductors, if we may place any reliance upon the researches of competent authorities, we shall not have to fall back upon any recondite hypotheses, such as the instantaneous formation of steam, nor the unknown or at least ill-understood repulsive action, in order to account for any phenomena fairly attributable to this cause. Mr. R. Hunt, in his paper read before the Institute of Civil Engineers so far back as 1857, stated (and I have never seen nor heard of his statement being challenged) that "the mechanical effect of a flash of lightning was analysed, and it was shown that the power developed through 50ft. was = 12,220 horse-power and that the initial explosive force was equal to a pressure of 300,000,000 tons! Surely there is force sufficient here to account for any of the pranks played by intercepted discharges; may I add that the presence of water would be more likely to increase the conductivity of the structure, and hence lessen the danger, than to form steam and thereby increase it?

(11301.)—LIMITS OF RESISTANCE IN TELEGRAPH WIRES.—Our friend "Sigma," in replying to this query (p. 48), has omitted to state that the 7·8 Ohms refer to No. 4 iron wire, and I think it may be taken for granted that Clarke's experiments were confined exclusively to galvanised wire. Wherever Mr. C. W. Henwood got the figures from which he has given in the reply preceding "Sigma's" I cannot conceive, especially as having reference to the question as originally put. Who, in the name of all that is wonderful, ever uses No. 19 much less No. 24 wire gauge copper wire for "ordinary overhead telegraph wire"? But granting that any one should be so insane as to try to use such line wires, where, when, or how did Professor Stokes get the million and a half Ohm resistance per mile from with a copper conductor?

(11359.)—CASTING BRASS SOLID.—The chief fault lies in not giving sufficient ventilation in the top box for the escape of gases and steam generated in the process of solidification, and, above all, the allowance of sufficient git or head of metal to supply the contraction due to the casting, while cooling a good git is little if any loss of metal, and almost invariably insures sound castings. Mr. Allan's mixture for bearings, well tested under severe trials, is—copper 16, tin 3, zinc ½. The temperature must be determined by experience alone. All alloys are difficult to manage in casting in consequence of the difference of affinity between their components and the oxygen of the atmosphere at the high temperature to which they must of necessity be raised in order to run them into moulds; this inevitable evil must be conquered as much as possible by excluding the air during the mixing of the ingredients, and by expertness in pouring, two necessities only to be obtained by constant care and practice.

(11370.)—ELECTRICAL.—I know of no hypothesis by which such a phenomenon can be accounted for, other than that the delicate nerves of the moistened tongue offer less internal resistance in the couple than the cloth, which in the case assumed, forms the remaining part of the internal resistance of the cell. In this case part of the current will flow through the tongue, and give evidence of its existence, and part—but probably (according to circumstances)—will pass through the cloth. In order to test this thoroughly allow me to suggest an exhaustive experiment. Let "H. D. B." drink (say) three glasses of what is sold in London under the name of Scotch whiskey, and while doing so smoke as many "sensation cigars" at one penny each, and having previously arranged the cell he describes, retire to rest (if he can rest at all after such an ordeal); the next morning immediately upon waking apply the terminals to his tongue, and favour us with his experience of the sensation he feels of electricity passing through what a recent writer calls "the rubicund engine of expression." My impression is that would be nil, but the experiment is worth a trial by earnest student. In either case there would, of se, be no poles, as the whole would form a closed it, but the current would flow in the same direction every other dynamic combination.

(11391.)—INSULATING COIL.—It is not absolutely necessary to insulate the secondary from the primary by ebonite, but when setting out to make an expensive machine, it is wise to use every precaution to avoid failure, and this is one of those precautions. I have a bad memory of names, especially of those I do not think it worth while remembering, but I do remember that some short time ago an attempt was made to "haul me over the coals," because I insisted upon this very point. The success of the projected keel-hauling I, sir, must leave in the hands of your "Constant Readers," contenting myself with the expression of opinion I then gave, that any induction coil intended for the exhibition of effects, wherein electricity of high tension was to be obtained between the terminals of the poles of the secondary coil, should be so constructed as to have a full and perfect insulation between the secondary coil and primary coils. The ground assumed by my opponent was that in the three coils forming the primary the tension never rose so high as to require the interposition of special insulation, but he forgot, as I find many of your readers do, the object of the generation of this current of large volume at low tension—viz., the setting up in the secondary of a static charge of extremely high tension, but small quantity (intensity of current), which charge would please itself whether it would overcome the resistance of atmospheric air placed between the terminals of the secondary, and so exhibit the 2in. 3in., &c., arc of flame or, finding a better conductor internally, flash back through the protective insulating medium with a large metallic mass, invitingly opened before it, and restore equilibrium through the shortest and most tempting track, leaving the intervening insulation, and, consequently, the coil itself, a perfect wreck. With such a coil, however, as that indicated by H. Corbett, no such extreme precautions are necessary. A sound coating of sealing wax, varnished, or at most two turns of brown paper saturated with paraffin, would be ample, but as for the length of spark obtainable, that is a matter that, I believe, cannot as yet be predicated, it must be discovered by the stern hand of experience alone. One thing is very certain, if he immerses the terminals of his secondary in the Thames there will be no necessity for calling in the aid of the floating fire-engines.

(11401.)—ELECTRICAL FORMULA.—When I first glanced over this query I gave vent to a mental exclamation "Go to Bath," for "Bladud" was vividly impressed upon my memory, but upon more mature consideration a Pickwickian softness fell upon my spirits, and I resolved to ask the Prince, What are the particular formulæ that give you pain? I have read Culley (1863 edition) earnestly and thoughtfully, and except a few minor trifles (light as air) which have been all or nearly all corrected in a later edition which I have read, but unfortunately do not possess, if ever there was a science reduced to practice in one volume that science is electricity, and Culley is the author. In speaking thus emphatically, sir, let me be thoroughly understood. I know as much personally of Mr. Culley as I do of the individuals whose duty it is to trap bears and utilise their grease for lubricating the northern or southern poles, and I think my name will clear me from any suspicion of trying to thrust a contraband advertisement upon you when I say that the work referred to is the most ample yet succinct, most elaborate yet simple treatise ever yet offered, not merely to the British public, but to the telegraphic world. If, therefore, Prince "Bladud" finds any difficulty in comprehending any of the formulæ it contains, let him at once engage a master to teach him the first four rules of arithmetic, and assist him to a slight knowledge of their application, and all will go well; but if in the mean time he has any particular difficulty to contend against (*bonâ fide*, mind, or I shall bowl him out) I shall most willingly render him all the assistance in my power when he tells us where his ailing lies.

(11405.)—PURIFYING ZINC WIRE.—John S. Darton has surely made a mistake. Zinc wire in any condition is surely not used for the construction of a battery; true, it is made, as Pulvermacher's old form of chains attest, but I have never been able to obtain it in London; but even if procurable for battery purposes, I for one am at a loss to know what "J. S. D." means by purifying. Zinc can easily be amalgamated by combination with mercury, but it is thereby adulterated, not purified. Will "J. S. D." kindly say what he really does mean?

(11406.)—STEAM PUMP.—Try one of Wilson and Co.'s "persuaders"—vulgo, donkey pumps: manufactory, Wandsworth-road, London, S.W. They will fetch "spirits from the vasty deep," and water is sure to follow. WM. TONKES.

LIGHTNING CONDUCTORS.

[8928.]—THERE is considerable interest in the several details given by "J. K. P." (let. 8908, p. 69), of the destruction of the church steeple at King's Norton. The partial conduction by the pendulum of the clock, and the splitting of the stones, evidently in the partial lines of conduction formed by the copper dowels, are good illustration of the law of least resistance, like the fact that the lightning will find its way into a building in order to follow the path provided by gas and water-pipes. All this shows th great importance of connecting by good cond every metallic portion of buildings. In churche large factories perfect safety might be obtai carefully guarding the elevated parts, steeple neys, &c., above the roof level, connecting t gutters, &c., and then leading good conductors the gas-fittings. I do not mean that the reg ductor should not be led to the earth; but that the chief discharge would be quietly led through these very paths which usually constitute a source of danger by inducing the electricity to force through obstacles, such as walls, to reach them.

As to some of "J. K. P.'s" questions, he appears to have overlooked a letter of mine as to surface action. Surface relates only to static electricity: it collects upon them in readiness for discharge; this is the condition of the clouds and the earth in a thunder-storm, these surfaces being in opposite electrical conditions. When the discharge occurs, the electricity (so-called) becomes dynamic, and conduction takes place on the laws of resistance; a wire would be as good (nay better) as the same metal beaten out into foil.

I certainly shall not tell "J. K. P." that "electricity is a fluid, and does the work of a solid," because it is pretty well known by this time that I do not believe in the existence of any such thing as electricity at all, regarding the effects we class under that name as due simply to "a mode of motion," a development of energy among the molecules of matter, which, when the rate of motion exceeds the measure of the cohesive forces of matter, breaks the matter up. It is the enormous tension put upon the lines of conduction which renders lightning so destructive, because it concentrates an enormous amount of energy upon the resistance to be overcome. The conductor, by reducing the resistance, allows the energy to be exerted in developing a rapid but harmless current, and in heat spread through a large mass of earth. SIGMA.

[8924.]—IN answer to "J. G." (p. 39), absolute contact of the metal of lightning conductors, though desirable, is not essential to their success; for electricity of high tension will pass from one conductor to another near it, though not in contact; the only danger is lest it should pass through some part of the building it may damage, but this is unlikely if the break of metallic connection be small, and the contact with the ground good. Nothing can be better than contact with a water or gas main; if that be not within reach, "J. G." should carry his down-pipes so as to reach soil which is always damp.

I think it would be prudent to see that the eave gutters are in contact with the down-pipes, and in connection with the ridges, and it would be well to connect the chimney conductor directly with the down-pipes by copper wire rope (which will not easily rust away), as well as with the roof ridge and gutters.

The more completely all the metal is connected the better. PHILO.

CIRCULAR SAW-SPINDLE.

[8925.]—I DON'T know how many years old the patent of the saw spindle shown on p. 13 may be; but I know I designed years ago—and have made and used—an exactly similar device. And probably, as in other cases, many others have long used it also. HEWETT.

THE SOPER RIFLE.

[8926.]—FOR some time past I have been compelled to forego all writing; however, this morning the restriction was taken away, and I hasten to say a word to two gentlemen who have had the kindness to misread my last letter upon the Soper Rifle. In our experiments in January our sole aim was to find the weakest place in the weapon. The question was, will the breech stand a greater strain than the barrel, or *vice versâ*? The result of our experiments was to blow the breech to pieces, the barrel remaining intact, without the slightest injury. I then stated that I believed no gun had withstood a similar strain, but that in all other cases the breech mechanism had been rendered useless by a slighter strain. I had no idea, and can scarcely conceive of my letter conveying the idea, that my remarks would be taken as referring to the strength of the barrel. The gun depends upon its weakest part —will that part bear all ordinary and a great marginal strain? if so, the gun is strong enough for military purposes.

I would humbly suggest that any gentleman who desires to make remarks upon any subject should at least read the letters treating the subject before taking up your space. C. H. W. B.

WARMING AND VENTILATING.

[8927.]—THE novelty of "Lewis's patent warm air-chamber fireplace" described by "An Architect," at p. 40, is by no means evident to me. I presume it has some peculiarity in its design, for its principle is too old to be a legally protected monopoly. Neither is the advantage evident, of confining air in a chamber, if that to be warmed is taken "from and returned into the hall," as stated. The only apparent advantage of confining air to be warmed being that fresh air warmed, if confined in a channel, is forced into the dwelling, so as to diminish, and if in sufficient quantity prevent, all cold air draught

"An Architec warm-air chamber raised 9 cubic from 85° to 180° or ed 10° in tem- important better if, all en- ately. and pen

INFLUENCE OF COLD ON VEGETABLE GRAINS.

[3928.]—M. Duclaux, who formerly experimented on the effects of the cold on the eggs of the silkworm, and found that the winter cold was a necessary condition of their hatching, has communicated to the Académie des Sciences a note on vegetable grains as influenced by cold. Some grains, falling, when ripe, into the ground, pass the last months of heat in the year without germinating, and it is not till spring that they show signs of life. Such are the grains of Belle-de-Nuit (*Mirabilis jalapa*) and of Volubilis (*Ipomœa purpurea*). M. Duclaux experimented with grains of these plants, on account of the similarity in their evolution to that of the eggs of the silkworm. Having taken them immediately on ripening, and before they were exposed in cold nights, he divided them into three lots. One was kept in a chamber heated constantly to about 15°. The two others were exposed (one for a month, the other for two months) in a glacier, with a surrounding atmosphere of 3°. On the 10th of November he sowed grains from each of these lots in pots, which were then placed side by side in a heated chamber. Germination commenced on the 25th of January, and after the 15th of February it appeared to cease. The following was the result:—

Belle-de-Nuit (6 grains in each pot): Grains exposed to cold 2 months, 5 grains had germinated; grains exposed to cold 1 month, 3 grains had germinated; grains not exposed to cold, 0 grains had germinated.

Volubilis (12 grains in each pot): Grains exposed to cold 2 months, 0 grains had germinated; grains exposed to cold 1 month, 2 grains had germinated; grains not exposed to cold, 0 grains had germinated.

The cold of winter has, therefore, a real influence on the germination of these grains, and this influence is operative in certain cases, just as on the eggs of the silkworm. But, M. Duclaux asks, is it equally necessary? He thinks not: for grains that have been kept all winter in a heated chamber germinate none the less in their season when they have been sown at a proper time, and everything takes place as if what they specially needed was a variation of temperature, which might be either that of zero from the ordinary temperature, or this latter from the usual heat of the days of spring. He proposes to investigate further the fact that in such conditions they germinate with different degrees of activity. If, in fine, there be grains, which, like the silkworm's eggs, need to pass the winter before opening, there are others which germinate immediately after having become ripe, and when placed under favourable conditions. Most grains, indeed, are capable of this; but the discovered influence of the winter's cold on some is a presumption that the others do not entirely escape it. A. B. M.

"PHILO'S" HUNDREDWEIGHT THEORY.

[3929.]—In refutation of this theory of the origin of the 112lb. (p. 663) I gave "Philo" (p. 36) six other numbers each equally the sum of only seven that would make up every multiple of the lowest, not exceeding their total. But he will find this equally possible with any total below 128, the seventh power of 2. And similarly his pedlar could make six weights serve for all the units under 2^6, and n weight for all those under 2^n. If, however, he notes that the seven making the 112 are each an aliquot part thereof, this property, I grant, is less common. Still, it is shared by 96 and 120, the latter a more convenient unit than 112. To have this advantage a number only needs to be the difference of two powers of 2 (say, $2^a - 2^b$) such that b is less than $a-1$, but not less than $\frac{1}{2}(a-1)$. Thus, any of the following series (continually doubled) can be weighed, like the 112, with aliquot parts only:—

6, 12, 24, 48, 96, 192, 384, &c.
28, 56, 112, 224, 448, 896, &c.
120, 240, 480, 960, 1920, &c.
496, 992, 1984, 3968, &c.
2016, 4032, 8064, &c.

Because the $6 = 2^3 - 2$, the $28 = 2^5 - 2^2$, the $120 = 2^7 - 2^3$, the $496 = 2^9 - 2^4$, &c. And their doubles are $2^4 - 2^2$, and $2^6 - 2^3$, &c. E. L. G.

A SUGGESTION FOR THE POSTAL AUTHORITIES.

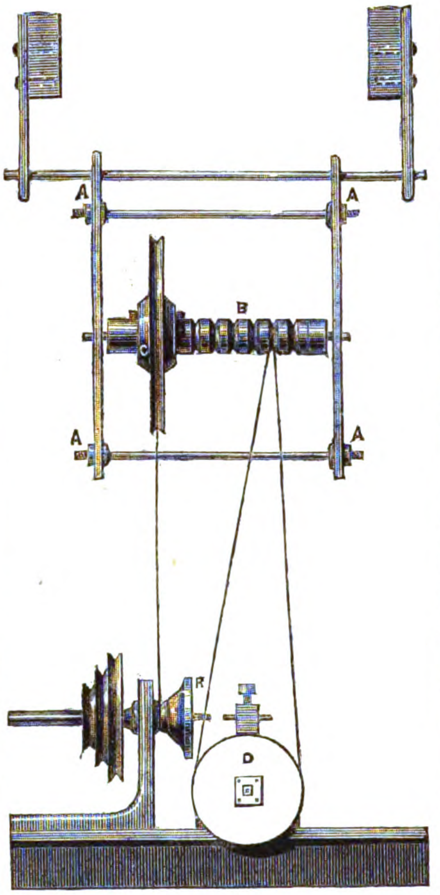
[3930.]—Having frequently observed in the country lines of telegraph poles along roads which, with their tributaries, are quite unprovided with direction posts, it occurs to one that (pending the time when the Post Office or some other government body undertakes the supply in a complete way of these useful guides) Mr. Scudamore might well give a general direction, that in future lines, and in cases of renewal, the poles should always be so arranged as to bring one at each junction and at cross roads. Could there be any objection to such an arrangement, and to allowing the parishes to encircle such posts (to avoid morticing and so weakening the posts) with stout iron bands, or tubes, constructed with three or more sockets to receive the direction boards?

These boards, fastened into the sockets with brass screws, could readily be removed for that re-lettering which Devonshire direction posts, at least, proverbially lack. Jannifred.

[We have had little opportunity of judging the dispositions of those who manage the telegraphic department of the postal service, but if they at all resemble their brethren who control the newspaper post, we fear any *useful* suggestion is likely to meet with but a cold reception.—Ed.]

SPIRAL GRAILING.

[3931.]—I was much interested in the article (p. 34, No. 366) on the subject of "Spiral Grailing." It is now over twenty-five years since I commenced in a small and simple way as an amateur turner, dabbling a little in ornamental work as well, and I very soon found, as "G. C. C." states, how difficult, not to say almost impossible, it was to "grail," or "line"—as I have been accustomed to hear it called—the surface of my work evenly, in concentric circles by hand, and I came to the conclusion that to effect the object satisfactorily, the operation must be self-acting, and if so it must be by making one continuous spiral cut from circumference to centre; and the cut being so very fine and close (almost invisible to the naked eye) I did not see that it could make any difference in the effect, whether it was concentric or spiral. I therefore set to work (more than twenty years ago) to construct a very simple and inexpensive apparatus, which I found to answer the purpose admirably, and, from its working independently of the overhead motion, it obviates some of the difficulty which "G. C. C." describes, as sometimes arising when that motion is made use of for the purpose, from its not having sufficient range backwards or forwards. A A A A is a light frame, the sides of wood about 2in. by ⅞in., connected top and bottom by stretcher rods, of (say) ⅜in. iron (wood would do); the size of frame is about 15in. square. B is a spindle of wood about 2¼in. diameter, working with an iron pin driven in the ends, in the sides of the frame. C is



a wooden wheel or pulley, 11in. in diameter, and ⅞in. or ⅝in. thick, strengthened at the boss by a piece glued on each side to make a broader and firmer bearing on the spindle. A key bed is cut in the spindle, and one to correspond in the boss of the pulley, and a wooden key, slightly taper, fixes it sufficiently firm; the rest of the spindle has a series of V grooves turned on it. This frame is suspended from the ceiling by an iron rod passing through the tops of the two sides, on which it can swing backwards or forwards, in order the better to adapt itself to any altered position of the slide-rest, and is hung in a line with the lathe bed, and as directly over the pulley on the slide-rest as it conveniently can be. It can be worked from the lathe mandril pulley, or, if that gives too quick a speed, it can be worked from the chuck as shown in plan, which is the mode I adopted. As I generally used the screw chuck, I turned a V on the back part where it screws on to the nose of the mandril, and which is 1⅜in. in diameter; from this a ⅛in. or three-sixteenths of an inch gut goes over the 11in. pulley in the frame, another gut from the spindle itself down to a 7in. pulley (of wood) D on the slide-rest screw. This arrangement makes a spiral that it requires good eyesight to see, but if too fine, the speed can be easily modified, as required, by having one or two different-sized pulleys for the slide-rest, and by driving it from lathe mandrils. If the frame is found to be in the way of the working of the overhead motion, by attaching a cord to the bottom rod and passing it over a pulley overhead, it can be pulled up and out of the way when not in use. It would be an improvement if the frame were suspended by indiarubber bands. Many years ago I constructed a very simple effective over-head motion, which I have not seen represented in the various plans of that apparatus which have appeared from time to time in your paper. If you think it worth while, I shall be glad to send you a sketch. N. N.

[Please send.—Ed.]

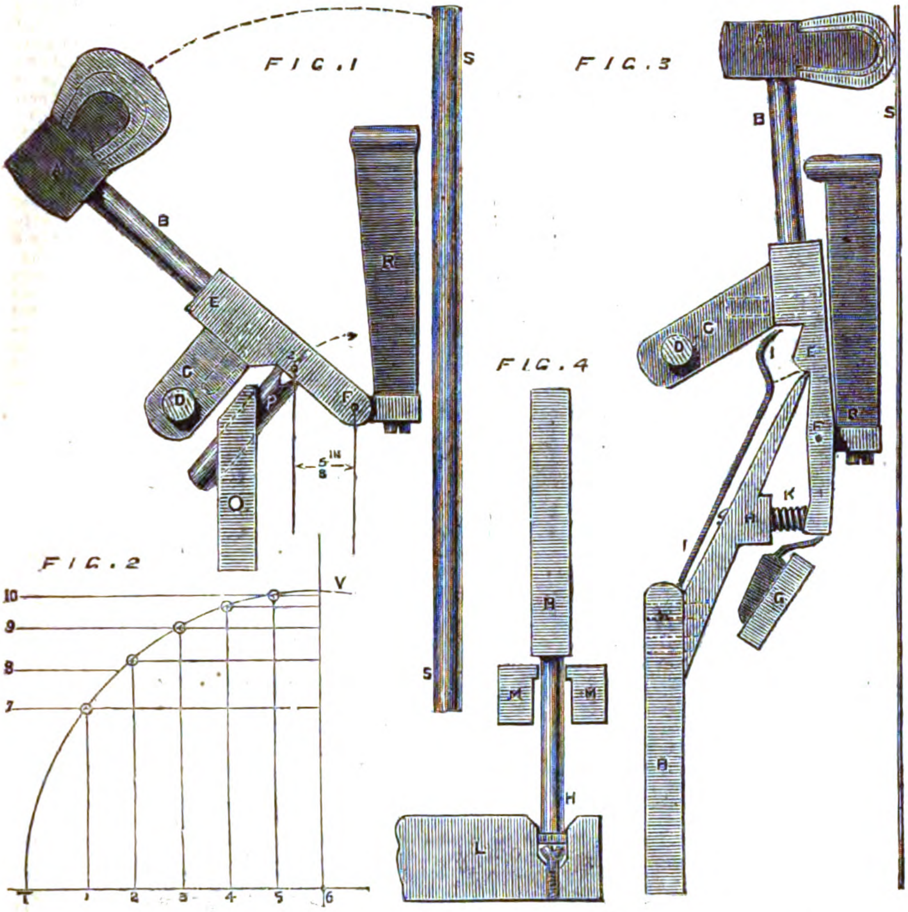
HOW WE SEE A DISTANT OBJECT.

[3932.]—I have paid some attention to the discussion on the above subject, but I am sorry to say I have not been able to understand what the difficulty is or what is its explanation. I think the matter might be simplified if we were to take into consideration that objects are discerned not so much by the presence of reflected light as by its absence. This may seem a somewhat Hibernian way of expressing myself, but I will explain. Objects, then, are discerned by their shadows or shaded parts. If I were to look out upon a landscape and the light were to be reflected to my eyes from every object and from every part of each object with the same degree of brilliancy I should discern nothing but a broad field of uniform light, and if the uniformity of reflection were perfect I should not discern even the faintest outline of any object. In every landscape there is a point of greatest illumination or highest light, be it a white cloud, a chalk cliff, or a shining river. This point the eye unconsciously takes for its standard of illumination and discerns all other objects by their relative dimness. If I wish to make a drawing of this landscape I take a white sheet of paper; this paper reflects the light equally from every part, it therefore represents what the landscape would appear if every object reflected the light in an equal degree, a broad field of uniform reflected light. Having made an outline I proceed to shade—that is, I begin to obscure the light reflected from my paper in different degrees on different parts of my paper according to the objects I wish to represent, so that the objects begin to be discernible on my paper, not so much by the reflected light from my paper—for that was there before I began my drawing—but rather by my obscuring that reflection in certain parts by covering my paper with a less reflecting substance, be it pencil or sepia, so that it appears to me that objects are discerned not so much by the reflected light thence proceeding as by the varying degree of absence of reflected light—in other words, shade. Of course I do not contend that reflected light is not a necessary condition of visibility. Of course we could see nothing in total darkness, neither could we discern any object in uniform light. I merely contend that we discern objects by their comparative darkness—in fact, by their shaded parts. Bobo.

[3933.]—I beg to thank Mr. Proctor for his very kind letter (let. 3829, p. 36) and am very sorry that he should have been kept eight weeks trying to find out the meaning of my letter (3493, p. 510), particularly as he says, "And as I could not explain his difficulty, but greatly wanted to have his query explained, I waited the action of the clever correspondents." He further says, "I am utterly bewildered." Mr. Proctor says, "In this case the answer is undoubtedly, that scattered reflection renders the frame of the mirror descernible. The glass of the mirror is not seen." And he further adds, "but we recognise the shape of the mirror whenever any light at all reaches its whole face, because the frame does not specularly reflect the incident light (or much of it), while the quicksilvered glass does." The ray of sunlight is supposed, in the present case, to strike the centre of the mirror only; where, then, does the incidental light come from, by which Mr. Proctor says the frame is made visible? He says that the frame does not reflect specularly. Well, the frame is moulded in certain curves, and every curve has its proper angle of reflection, and at all events the light is reflected in right lines. The theory of light says "every ray of light carries with it the image of the point from which it was emitted. If, therefore, the pencils of rays from every point of an object are united in the same order in which they proceeded when first emitted, they will form a perfect image or representation of that object, at the place where they are thus united. The rays of light proceeding in straight lines, it is obvious, that to make an object visible at any place to which a straight line can be drawn from it to the eye, they must be detached from every physical point of it in all directions; but only those rays which enter our eyes can render them visible to us." Now, according to this theory if one or more pencils of rays happen to be reflected by any cause from the direct line, the points in any object from which such rays came must be invisible to the observer. Now, the atmosphere is full of organic dust, and as it is sufficiently dense to make the sunbeam luminous; it is evident that this dust opposes the passage of the rays of light which, if the distance be extended, the ray is utterly lost. I did not ask Mr. Proctor what rendered the sunbeam luminous; but I want to know how we see it, when standing some distance off? There is nothing to reflect the light but the organic dust, and the rays, as stated above, cannot penetrate far in a lateral direction. The same observations will apply to distant rocks, &c. We see the entire of the illuminated parts; and less distinctly parts in shadow. But I cannot conceive how rays of light can reach us from every point at the angles of reflection being innumerable. I only use argument to satisfy myself that I comprehend the explanation, and not for the purpose of putting forward a new theory. I have no doubt the necessary explanation will be given me. E. J.

PIANO CONSTRUCTION.—PART II.—To Mr. Schucht and his Fellows.

[3934.]—Several methods naturally suggest themselves to any one familiar with ordinary piano actions by which increased velocity may be imparted to the treble hammers. Perhaps the very simplest and most obvious of all is that used by the old grand makers, who were, in this matter, somewhat in advance of ye modern practical men. They made the butt shoulder or notch considerably higher than the horizontal plane in which the hammer centre was posited. Now, it is obvious the higher the shoulder (against which the hopper acts when lifting the hammer) be made, the farther that shoulder—and the hopper confined to it by the spring and guided by it—must go over towards the perpendicular plane in which the hammer centre is situated; in other words, the nearer a perpendicular drawn from the top of the hopper (when it has lifted the hammer to the string) will approach that in which the hammer centre is fixed. Of course, as it thus approaches the latter the acting length of the leverage, measured horizontally from one perpendicular to the other, becomes diminished; consequently, if the hopper be supposed to be raised by the key with an uniform velocity throughout its path, it will communicate a constantly increasing velocity to the hammer it lifts. The hammer's velocity may be thus accelerated to any extent admissible in practice, indeed, far beyond any such extent.



I may remark this old-fashioned, but most effective, method of communicating accelerated velocity to the hammer may be easily carried out in Carey's or Molyneux actions, which are but modern modifications of the old grand action arranged suitably for upright strings, and in which the escapement takes place at the butt—in my opinion, by far the best place for it. It is hardly applicable to sticker actions, in which the stickers are hung from the butts by leather hinges, because very high quirks would subject the leather hinges to excessive wear. It would also be unsuitable, unless some other means of causing the hammer to fall from the strings than the common loaded sticker were employed, because, as the sticker hinge would be but little in front of the vertical plane of the hammer centre when the hammer touches the strings, its weight would have but little power to pull the hammer back. This plan, however, answered very well in a model I had constructed, in which the sticker—which may then be made as light as is consistent with needful rigidity, a very important consideration when it is hung to a treble hammer—is attached to the hammer by a bushed wire centre; the hammer may be returned either by a spring, which is, perhaps, preferable for strings less than 5in. long, or by a comparatively light counterweight projecting nearly horizontally, which I much prefer for the tenor and bass.

In some actions the hopper is "set off" towards, instead of from, the centre; in all these communicating accelerated velocity to the hammer as it approaches the strings is very easy, all that is required being to make the butt shoulder in the same horizontal plane as the hammer centre, or at least not more than from one-sixth to one-fourth the radius above it. In the latter case, the leverage will become shortened as the hopper rises to some extent, and it will be yet more rapidly shortened by the set-off motion. As in these actions there can be but little objection to the set-off motion commencing with and continuing throughout the motion of the hammer, I think an oblique, double-centred lever, the position of whose fork is capable of adjustment for the purpose of determining the instant the hopper shall escape, would not only be the simplest method of causing the escapement, but also be found to be a very efficient guide for the hopper, which would require no other guidance, if its clothed lower end be made to rest on the head of a screw which forms the bottom of a socket in the key. This is the cheapest effectual method of supporting and guiding the lower end of a hopper I have yet thought of. It has no friction in the hole in the rail, which prevents it from straying about when the action is lifted out (off the keys), because it cannot touch the sides of that hole when in use, and it never becomes noisy, but in common with all actions in which the hoppers are connected directly with the keys, when used for a transposing instrument, it renders necessary the shifting of the keys with the hammers.

In horizontal actions the imparting of increasing velocity to the hammer as it rises soon reaches its practical limit, in consequence of the increase of resistance to the finger which necessarily ensues. When we consider that to double the hammer's velocity the leverage must be diminished one-half, and that doing this must (if the weight of the hammer remains the same) double that resistance to the finger which is caused by the hammer's weight, it is obvious that greatly increasing the hammer's velocity must be limited to the treble (where, fortunately, it is alone desirable), whose hammers are all the better for being what Dr. Ussher would deprecate in febrile patients—viz., "light-headed." Probably, if we can, consistently with their being strong-headed enough—they must not be thick-headed—make them sufficiently light-headed, we may succeed in carrying out this principle, so far as to increase their velocity three or even four-fold at the instant they strike the strings. I need hardly point out to our grand makers, and those who play on their instruments, what influence this would have on the power and quality of their trebles, usually so inferior to that of their bases; it would, as one Will Shakspeare sayeth, "Reform them altogether." Nay, it would convert many a well-made grand with a weak treble into a superior instrument to the very best we now have.

If we may hope, by reducing the weight of the treble hammers of grands to augment their velocity three or four fold, what may we not hope to effect when we come to carry out this principle in upright instruments? In these the hammer's weight resists the finger so greatly when it is on the rest that, in ordinary actions, the weights of the bass hammers are limited thereby, although they might be made at least double the weight they usually are made, to the great improvement of the bass tone. It is obvious that the radius at which the hopper or hammer-lifter acts on its butt being a given quantity, a hammer must resist the finger in proportion to its weight, and that there are only two possible means—so long as the key-balance remains unaltered—by which that resistance can be diminished, one being the reduction of the hammer's weight, and the other the elongation of the radius at which the hopper acts. Now, as the hammer's velocity is not of the slightest practical importance during any other portion of its path, than that at which it strikes the string; it cannot matter how much we increase the radius at which the hopper acts at the commencement of the hammer's motion, so long as that radius becomes short enough to cause the hammer to be impelled with sufficient velocity at the instant it strikes the strings. From this it will be perceived that this principle not only enables us to drive the treble hammers much faster than we now do, but also to employ much heavier hammers for our bass strings, and thereby augment the power.

A moment's reflection will enable the reader to perceive that as the hammer of an upright piano rises towards its strings more and more of that hammer's weight becomes supported on its centre. Consequently, as a mere matter of course, less and less of its weight presses on the hopper, and resists the finger. In a model, constructed for me by my late friend and fellow correspondent "W. T.," in which the escapement occurs from the hammer's centre, which, by the way, is the only one centre in this action, because its damper is attached to the hammer. The latter is provided with an inside check, *à la* Stumpff, which insures good and low repetition. I may remark *en passant* that this action, from its great simplicity and the fewness of its parts, notwithstanding its immense power, costs actually less to make than the common cottage action without a check. The hammer centre is about ⅜in. from the string, and the leverage at which the hopper acts on the butt diminishes while the hammer is rising, until, when it reaches the string, it becomes barely one-fourth what it originally was at the commencement of the key's and hammer's motions. The same weight—2oz.—exactly balances the hammer in every intermediate position between ⅛in. above its rest to within ⅜in. of the strings. I guess, Mr. Schucht, you will allow this is a tolerably equal touch, and that this is a test few upright actions in ordinary use would bear. It is, indeed, more nearly equal than any pianist would require, because an instrument whose touch is 2¼oz. at the commencement of the key's motion, and increases to 3oz. at the instant the hammer strikes, has, by an eminent professor, been deemed very far from unpleasant to play on—much less so than he deemed the common cottage and Zeiter's grand actions, in both of which the resistance to the finger is greatest at the commencement of the key's motion and diminishes as the hammer rises; and it would diminish to a much more sensible extent in the former action were it not for the nearly uniform resistance caused by the loaded striker and the damper, which act throughout the whole of the key's path. When the resistance to the finger—tested by a weight laid on the key—is perfectly equal throughout the whole depth of touch, the mere inertia of the key, &c., will always cause a sensation of slightly greater resistance at first, so that the touch becomes apparently lighter and more pleasant when the resistance is rendered a trifle less at the commencement. Messrs. Broadwood and others effect this in grands by delaying the contact of the key with the damper lever until the former has descended from half to two-thirds its path. Of course, if the damper be attached to the hammer, in which case it causes no additional resistance to the finger, this plan is inapplicable, and it is seldom applied to upright instruments which have Collard dampers, although to them it easily may be by leaving a space of about one-tenth of an inch between the damper lever and the button which lifts it. If the damper lever be properly—*i.e.*, thickly—clothed no noise ensues.

A moderately increasing resistance to the finger being, as I have shown, not only admissible but actually used in modern practice, we may fairly be entitled to employ it for the more important purpose of increasing the power of cottage trebles. When the acting leverage is shortened to one-fifth or sixth the increase of resistance to the finger is in about the proportion 12 to 9 or 3oz. to 2¼oz.; need I tell so practical a pianoforte maker as Mr. Schucht that this will enable him to obtain trebles whose power his customers would be "very much surprised to hear." Probably so great an increase in the force of the blow as this might necessitate some increase of material in the form of strings. Say, instead of those he now uses, three No. 16 or 17 4in. long on his top C.

Besides improvements in scales and actions it seems probable some increase of power may be obtained by improved bellying; many designs for which have been published. In 1860 Mr. Nosworthy designed a method of increasing the power of the trebles (see his patent, May 29, No. 1323, price 10d.), by extending the soundboard in upright pianos (and in down striking horizontal grands) above or beyond the hammer line, the strings being supported on a metal bar, which acted as a bridge, and which was itself supported (on the bracing) by pillars. Others, notably Godwin and Alfred Wornum, have done, or proposed to do, the same thing by other means. That such an extension of the soundboard would almost certainly affect the timbre may be admitted; a great length of soundboard below the bridge is found to do this. That it would increase loudness is non proven. I fear the vibrations of strings from 2in. to 3in. long cannot—unless they be bowed or its equivalent—be made to endure long enough to cause vibrations which produce sounds audible to human ears at those portions of the surface of the soundboard which are more than 3in. or 4in. from the bridge. In No. 208 of English Mech...

Mr. Jenkinson—with whom I much desire to communicate—proposed to apply to pianos Stein's system of constructing clavichords—that is making the unisonous strings continuous end on, instead of side by side, as they usually are. I suggested how this might be carried out in No. 218, but must confess the mechanical difficulties are very great indeed, not to say impossible, which word, of course, English mechanics don't believe in. Probably nothing—excepting improvements in actions—yet suggested for increasing the power of piano trebles is so promising as this. Mr. Jenkinson proposed to place both his belly bridges on the same soundboard, the strings, of course, resting on a metal bridge similar to Mr. Nosworthy's arrangement, but after all the principle of Mr. Jenkinson's design really is making two trebles to one piano. Now, for doing this there can be no necessity that only one soundboard shall be employed. If, from any practical considerations, it be thought desirable to employ two soundboards it may be done—that is to say, a second soundboard might be provided for those strings which are above the intermediate bridge near which the double-headed hammers strike, which bridge might then be made of wood and double pinned, the pins being as close together as they conveniently could be inserted, so that the two hammer heads may not be far apart. The Harmonious Blacksmith.

P.S.—Having in this paper referred to two upright actions which have not yet been published, it has occurred to me that those references would be more intelligible if diagrams of the two actions were printed. It therefore, intend sending those diagrams shortly.

DESCRIPTION OF THE FIGURES.

N.B.—The same parts are lettered alike in all the figs.

Fig. 1.—A, hammer-head; B, hammer-shank; C, arm carrying counterweight D; D, counterweight which returns the hammer; E, hammer-butt; F, hammer-centre; O, sticker; P, arm projecting from sticker which supports the centre wire of the sticker-hinge Q; Q, sticker-hinge; R, hammer-rail; S S, the string for lowest A ¼in. diameter.

Fig. 2.—This is a diagram, double the real size, representing the relative positions of the hammer-centre F and the sticker-hinge Q at the commencement and the termination of its motion, also, at three intermediate places. For the purpose of rendering more easily understood the gradual diminution of the leverage at which the force which moves the sticker acts on the butt, I have drawn five equidistant upright lines parallel to line 6, which represents the vertical plane in which the hammer-centre F is situated. From line 1 to that plane is exactly 1¼in., but from line 5 to it is but ¼in.—viz., only one-fifth the distance of line 1. As the sticker-hinge Q rises from line 1, it successively passes through the points at which lines 2, 3, 4, and 5 intersect the arc T V, which represents its path—each of those points being ¼in. nearer the line 6 than the line immediately to its left. A moment's thought will enable the reader to perceive that as the sticker-hinge Q travels from lines 1 to 2 the leverage at which it acts on the hammer becomes reduced ¼in. When it has arrived at line 3 that leverage is reduced another ¼in., and so on until it becomes diminished to only ¼in. when it arrives at line 5. Consequently it must—assuming the rate of the sticker's ascent to be uniform—then be driving the hammer four times faster than it did when it commenced to move it at line 1. The fact that the hammer is propelled with a constantly-increasing velocity until it is stopped by its striking against the strings is, perhaps, even yet more conclusively demonstrated by the lines 7, 8, 9, and 10. Line 7 intersects the arc T V, which represents the hammer's path when the sticker-hinge Q is in its lowest position, and the spaces between these lines represent three equal divisions of the total rise of the key under the lower end of the sticker by which it is lifted. As the key rises the first third of its path it moves the sticker from where line 7 intersects the arc to where it is intersected by line 8, between which points of intersection there are but few degrees of the circle. The space between the intersection of lines 8 and 9 include about half as many more degrees as the space between 7 and 8 does, but the space between the intersections of lines 9 and 10 actually includes more degrees than both the other two spaces. Consequently, the hammer must be moved through rather less than half its total path by the motion of the key through the first two-thirds of the depth of the touch, and through rather more than half its path by the descent of the key during the last one-third of the total depth of the touch.

Fig. 3.—A, hammer-head; B, hammer-shank; C, arm carrying counterweight; D, counterweight which returns the hammer; E, hammer-butt; F, hammer-centre; G, damper; H, hopper, which carries the check J and the set-off screw K; J J, the flat-headed wire check; K, set-off screw passing through hopper H, and regulated in front.

Fig. 4.—M M represents the section of a rail extending across the action, whose use is to prevent the lower portions of the hoppers H from straying about when the action is lifted out of the instrument. The holes in this rail should be bored about three-sixteenths of an inch larger than the cylindrical portion of the hopper H, excepting for about ⅛in. of its thickness at top, which should be bored about one-fiftieth of an inch larger than the socket which receives the lower end of the hopper and its clothing, so that the latter may be lifted through this hole without injury when a single hopper is taken out of the action. N.B.—The cylindrical portion of the hoppers ... never touch against the inner surfaces of this ... these holes are bored in any of the positions ... be compelled to assume by the back... -d motions communicated during performance to the upper ends of the hoppers in consequence of their being guided by the hammer-butts. L represents the back part of a key, near the end of which a socket, about three-tenths of an inch in diameter, is bored for the reception and confinement of a circular piece of thick box-cloth or felt, which is glued on the bottom end of the hopper H. This piece of cloth or felt should fit in its socket without shaking, but not tightly, so as just to be pushed in easily and confine hopper laterally. This socket is countersunk at top for the more easy introduction of the hoppers when the action, after being lifted out, is replaced in the instrument, and its depth adjusted by a screw in the key, on the head of which the hopper rests. This affords the means of readily and cheaply regulating the height of the top of the hopper to suit the position of the butt-shoulder, against which it acts when lifting the hammer, and enables the regulator to take out any of that abomination yclept "waste touch." The head of this regulating screw ought to be slightly rounded to prevent its edge from cutting into the cloth or felt. I much doubt if many of my practical friends in the pianoforte-making line will readily contrive a much cheaper effectual method of guiding the lower end of the hopper than this, but truth compels me to add it has not much originality. I have been told Messrs. Collard and Mr. Kohlman both inserted strikers into sockets bored in keys, although they did not employ the head of a screw to form the bottom of the socket. I believe the rail M M also to be original in so far that it does not touch or guide the hoppers during performance. The Harmonious Blacksmith.

HERSCHEL NO DECIMALIST.

[3935.]—Mr. Allen well says (letter 3831, p. 86) he will give us Herschel "with certain additions" of his own, but these he should have distinguished. The fact is, we have about ten lines of Herschel at end of first paragraph, and all the rest is Allen. I beg, therefore, you will reproduce the sentences wherein the late philosopher did mark his position toward the question of decimal divisions, because their cautious guarding against the exact ideas it is now sought to father upon him is not a little remarkable. In p. 4 of the essay entitled the "Yard," &c., he insists on the independence of the two questions of standard and division:—"What is intrinsically the best and most available unit of linear measure to adopt as a basis? and secondly, what system of numerical multiplication and aliquot subdivision of such unit for measures of length, and of its derivative units of area, of capacity, and of weight (for these all refer themselves naturally and easily to the unit of linear measure, or at least ought to do so), is most advantageous—either in a great mercantile community like our own, or for the great mass of mankind in the ordinary transactions of life? It cannot be too strongly impressed, and too perseveringly borne in mind, that these two questions stand in no natural and necessary relation to each other, but are perfectly independent. We may resolve, with perfect logical consistency, either to toss aside our present system *in toto*, and adopt the metrical" [French] "one in preference; or to retain our fundamental unit (the Imperial foot or yard) and decimalise our system of denominations. . . . We may, too, retaining all the convenience of our existing denominations (*so far as they are convenient*), superadd to them, by permissive legislation, the additional convenience of a decimal system for facility of calculation, relying on its holding its ground *if really affording* such facility, or working its way into general use, and ultimately driving out the old system, *if found* by the mass of the population to be practically preferable. This last is the course I would myself prefer, and I think it best to say so in the outset, lest those who may take a contrary view should imagine a foregone conclusion to be urged upon them under the semblance of free inquiry." Accordingly, the essay continues purely on the question of standards; that is, according to "Sigma" (p. 69), is exclusively devoted to "only scattering dust about the true object of any importance"—and he does not touch that of decimal or other divisions, save to expressly *disclaim* it (p. 20),—nor allude to it again till the last paragraph, p. 23, where he says:—

"On the subject of decimalisation, it will be gathered from what I have said that I would make any decimalised denominations, which anybody might agree to buy, sell or contract by, *permissive*. There seems a doubt whether such is now the case [1863] and if so, the law should, I think, be altered. But I would leave untouched all our present *denominations* and their relations to the standard, and the only new measure I would legalise would be a "module" (or some other name *at present unoccupied*) of 50 modular inches, being the exact ten millionth of the polar axis, leaving its use quite voluntary."

In p. 20 however, he had well remarked—on the mètre and its decimal subdivisions—that we must "carry out the change in all its train of consequences, to the rejection of our entire system of weights, measures, and coins. If we adopt the mètre, we cannot stop short of this. It would be a standing reproach and anomaly—a change for changing's sake. The change, if we make it, must be complete and thorough. And this in the face of the fact that England is, beyond all question, the nation whose commercial relations, both external and internal, are the greatest in the world, and that the British system of measures is received and used, not only throughout the whole British Empire (for the Indian "Hath" or revenue standard is defined by law to be eighteen British imperial inches) but throughout the whole North American Continent, and (so far as the measure of length is concerned) also throughout the Russian Empire; the standard unit of which, the Sagene, is declared by an imperial ukase to contain *exactly* seven British imperial feet, and the Archine and Verschock precise fractions of the Sagene. Taking commerce, population, and area of soil, then, into account, there would seem to be far better reason for our Continental neighbours to conform to *our* linear unit could it advance the same, or a better *a priori* claim, than for the move to come from our side," [and by parity of reasoning, for *their* return to divisions by 3, 12, and even 7, rather than for our decimalising].

As "Sigma" accuses me (p. 69) of raving against a system "that has gained the approval of the great majority of scientific men," I wish he would name one of this majority. The *only* scientific man, French or not, that is known to me as having *ever* used the decimal angular measures is Laplace; a first-rate one, I grant, but I am not sure that even he rejected hours and minutes, or persevered in the angular decimals; and if he did, "Sigma" has a few more to find to make up a "majority." E. L. G.

THE FAIRLIE LOCOMOTIVE.

[3936.]—For the last few years few things have come before the public so frequently as the merits of the Fairlie arrangement of locomotive, and without desiring to detract from the alleged advantages of this system, I should wish to know the reason this invention is so frequently praised. Trials are frequently made of these machines (and the results always published if favourable), which are really of no practicable value to engineers. Take, for instance, those chronicled just recently, made on a branch of the Manchester, Sheffield, and Lincoln Railway—a steep gradient and curved, and a fair sample of the lines on which most of Mr. Fairlie's experiments have been carried out. It was proved that these enormous engines took an enormous load up bank with a fair expenditure of fuel, but the inventor cannot claim novelty or advantage in this, as the same company, did they require it, could easily build far heavier engines than they at present use, and that without increasing the fixed wheel base. Indeed, of what utility were the trials at all? Surely it was but an easy matter to calculate beforehand the tractive force of the engine as well as an approximation to the total (adhesive) weight. For narrow gauge railways, such as the 3ft. and under, undoubtedly some sort of bogie or "double bogie" is necessary, and it yet remains to be shown by other than newspaper commendation whether Mr. Fairlie's or one of the several other systems devised is best. Until some durable flexible tube is invented, a universal joint—such as is necessary with the engines under discussion—must be a tiresome nuisance when under great pressures and always changing its position. Amos Appleyard.

[3937.]—Although concurring in most of his views, I cannot understand the argument of "Osa" (let. 3864, p. 41), that 100 locomotives of the usual type, with 10 laid up, will be better that 50 Fairlie's, with five under repair, seeing that, as the latter may be made with counterpart boilers and bogies, only one-third of each engine need remain idle—the parts being interchangeable, as in a military rifle. The advantages of the regularity of water level over the fire-box on inclines, and the contingency of one of the motions breaking down, when three cylinders will still remain effective, are also overlooked. G. R.

CO-OPERATIVE SOCIETIES.

[3938.]—Though this is not about co-operative societies, it can only appear under that false title, that it may be known to continue the subject of letters 3655, 3775, 3776, 3847, which "F. C. S." persists in calling by something else's name, until it can be shown that by saying the thing that is, instead of the three that is not, some "benefit will accrue to the shareholders." First, I entirely agree with him that the proposal of "Pro Bono" to "enter the quantity of every article sold" must be preposterously impracticable. It would at least double the storekeeper's work, and, therefore, in any just system, double the entire expense of the "society." For no system is just till it arrive at this: that his remuneration consist wholly and simply of a settled and uniform fee for every parcel sold. The customer A who comes for "2oz. of tea, 1lb. of sugar, 1oz. of tobacco, and 1 pennyworth of biscuits," must pay, besides their marked price, four of these uniform fees—one for the storeman's trouble on each parcel, and must take them away with tin checks recording simply his payment for the goods (not these fees), and giving him claim at the future settling day to proportionate dividend of the surplus (miscalled "profits"). But if B buys and takes away a cwt. of cheese and nothing else (but the checks for its price) he is only to pay one such fee. On these fees the storekeeper is to live, and the whole of the surplus in prices to be returned to customers—that is to say, apportioned among them all (whether shareholders or not) according to their amounts of returned checks; but the dividends so *apportioned* can only be *paid* to those who are full shareholders. The dividend of him who is not yet a full shareholder is not payable, but only to be credited to him in the books, as going towards making up his share. It belongs to him, indeed, so as to be payable to heirs in the event of his death, or to himself after leaving the neighbourhood, and leaving it long enough in the store's use to entitle him to the benefits he has enjoyed, as I explained in the case of "co-operative societies" proper (*i. e.*, factories) in last vol., let. 3044, art. 5, 6; and in fact everything there said, except art. 3, will apply to a joint-store as well as to a factory. Even a mere grocery store (whether in village or city), once adopting the principles of right dealing —but no society without them—will afford a basis for every social reform, the overthrow, at least, of all the enemies there enumerated, the adventure trader, the sickness doctor (*i. e.*, every doctor, whether farming men for health-fees or not, who takes any sickness fee at all, from anybody), the undertaker, the burial club, the assurance company, the baby-farmer, every special benefit-club, every eleemosynary degrader, and, indeed, eventually all these foul cankers that call themselves "society" while they are burning society down; and that poor old England, day by day, has less time left wherein to kill or be killed by.

If "F. C. S." had referred to the pages I mentioned, he would have seen that if I only promised solutions now: I had given or begun discussing them before, and if *bis dat qui cito dat*, I had given them twice already to the best of my power, as long as I am the only correspondent who will touch them at all. It may be that, as "Mr. 1872" complained to the editor (p. 26) I keep "outside the questions in erratic wanderings," and say "but little on the questions themselves." Then whose fault is it that they are left to one so erratic? Why does not "1872" or some one take up "the questions themselves"? Are they too trifling?

Of the store "F. C. S." represents, after what he now tells, I have no hesitation in saying, stick to it as the members may, it will not pay, never pay, until these changes at the least; and how many more, he does not afford me the means of discovering. 1. They must get rid of their unpaid secretary and obtain a paid one, to be paid in the manner I indicated (p. 666). 2. Consequently, they must each be able to state pretty nearly his last year's cost of bread, and also that of groceries. "F. C. S." does not see "how a poor man can be expected to know this." If the converse proposition had been stated, that he did not see how a man incapable of telling this can be other than poor, very and increasingly poor, that would be a remark worthy of a secretary, paid or unpaid; and I should say, keep him. But his actual remark seems to enounce the harsh dogma that a man can only be poor by having been a reckless sluggard, which I take leave to dispute. As a poor man, I maintain that in these days one may be very poor without any such heedlessness and sloth as he says must be expected in "a poor man." 3. They must have a secretary who will use language (whether secret or common) consistently. It is quite open to them, if they think it profitable, to talk by contraries, agree that "hold fast" means "let go," or that a worker shall be called manager, and on the other hand, "manage" be their lingo for "work," or any other secrets of dialect. But they must not have a secretary who will say in one sentence (3847, par. 2), that they have one "manager" to many "co-operators," and in the next that many "manage or mismanage," and only one works; their lingo, however strange, must consist with itself. 4. They must not have a secretary who does "not profess to understand" the methods I have been partially describing (let. 3044, &c.), but on the contrary, he must profess to understand and take interest in even more than those, and to correct me therein, and pursue those questions considerably further. E. L. G.

[3939.]—IT is so very important to avoid the temptation to, or even the suspicion of, fraud, that it is worth while to take much trouble and incur some expense to guard against it. To do so without trouble is impossible, but I think the following plan is the least troublesome one proposed. Let books be prepared of alternate leaves of thick and thin paper, each with corresponding numbers. When a sheet of carbon paper is interposed, whatever is written on the thin paper will be marked also on the thick. It will not require very much trouble or time to write down what every customer buys and what he pays for it, and to tear out of the book the page of thick paper on which it is marked in duplicate corresponding with the leaf of thin paper, with the same number of page. The thick leaf the customer keeps as his voucher to entitle him to his share of so-called profit (really saving of shopkeeper's profit), while the total of the amounts of sums shown on the thin leaves of the books as paid by all the customers is the sum that ought to have been received and be in the till.

This is the plan customary in many drapers' shops, where, as an additional precaution, the customers' accounts are written by one person and checked by another, being initialed by both. After a little practice there is not much loss of time, while mistakes and frauds are scarcely possible, which are very common where no such system is adopted. Mistakes they are always called, but they are generally made in favour of the seller, so far as I have observed. PHILO.

COLOUR.

[3940.]—YOUR correspondent "E. H." (letter 3413, No. 856) is inclined to doubt the sufficiency of the theory of three colour sensations to explain all the phenomena of colour, and thinks that the sensation of white, though produced by a mixture of red, green, and blue lights, may be really a simple indivisible sensation. There seems, however, no need for this more complicated and difficult hypothesis; and there are phenomena which strongly oppose it. The only thing which "E. H." mentions as leading to his view is that "if a red object is placed in juxtaposition with a white object, the tone or strength of the red does not seem at all lowered, as it should be if the red sensation is present in the white sensation, for the red in the white must be very much richer than that of the red object." But let us examine this matter more closely, and there will appear nothing inconsistent with the accepted doctrine.

To do this well, two similar spots of the same red should be placed, one upon a white ground and the other upon black, side by side. In shifting the eye from one to the other we are immediately struck with the comparative darkness of the spot on the white, so that we must shade the spot on the black to make it match the other. Still the white, as "E. H." observes, does not lower the tone of the red, but leaves it as nearly a pure red as before—perhaps it even a little improves it. This is just what we might expect; because no red that we can procure is free from a very considerable mixture of green and blue, which dilutes the red with white, and the brighter white of the ground takes off from this diluting white at least as much proportionately as it takes off from the red, and the result entirely accords with the theory.

The following fact, however, tends still more to establish the doctrine that white is a compound sensation. When the eye has been fixed for a while upon a brilliant red, green, or blue spot, upon a perfectly black background, and is then suddenly directed to a white or gray surface, there appears a sea-green, pink, or yellow spot, slightly darker than the white or gray. This appearance is easily explained as the effect of a diminished sensibility for the red, green, or blue constituent of the white or gray, as the case may be; but if white is a simple colour, what can be the cause of so remarkable a phenomenon?

The great cause of the hesitation which many feel in admitting the compound nature of white is the extraordinary brightness of white objects as compared with those whose colours approach to a pure red, green, or blue, a circumstance that arises mainly from the fact that substances which reflect all kinds of light commonly reflect them all powerfully. If we take a pure gray, more or less approaching to black, we find it by no means so difficult to imagine in it a combination of the different colours. Indeed, when a gradation is carefully made from the colour of scarlet vermilion to that of fresh verdigris, passing through pure gray of medium brightness, the eye is at once satisfied that there is a uniform increase of red from the verdigris end to the vermilion end, and a uniform increase of seagreen from the vermilion end to the verdigris end. The like may be equally well effected with respect to green and blue, and their complimentary secondaries pink and yellow, by making gradations from the colour of emerald green to that of light rose madder, and from the colour of French blue to that of lemon yellow, through the same pure gray. When such gradations are well made, the eye in viewing them seems to see the different complementary colours by turns in the gray, and thus to be able to analyse white by itself. The difficulty of conceiving yellow to be a compound of red and green arises from a similar cause—the intense brilliancy of the yellow, which is produced by a combination of all the brighter rays of the spectrum; and if its brightness is reduced till it becomes an olive green, the middle colour of a gradation between red and green, it is by no means difficult to see both red and green in it. WILLIAM BENSON.

"SCREW'S" ✕ MULTIPLICATION.

[3941.]—I WAS somewhat puzzled by "Screw's" figures in letter 3873, as other readers may probably be, to know how (13 78125 being given) 9·646875 comes to be "given number, but one place out." Of course he means "7 times given number." I only multiply by 2 twice and 3 (the latter a part of the figures only), and he by 7 and 2 twice (and the former the whole of the given figures). To compare the results, it is easiest to operate on 4, so as to get the relative approaches to the well-known 3·1415926536, and the 0's will show the number of figures required if the given number were complex:—

"SCREW'S" METHOD.

	4·00000000
Given number × 7, one place out	2·80000000
Same, another place out	·28000000
Same, × 2, another place out	5600000
Same, another place out	560000
	3·14160000
Deduct given No. × 2, five places out	800
	3·14159200

MY METHOD.

	4·00000000
Add 20th	4·20000000
Deduct quarter	1·05000000
And Do. 2 places out (A)	1050000
And 3 more places out	1050
	3·13948950
Add ·2 of A	210000
And ·3 of same, 3 places out	315
	3·14159265

being a hundred times nearer than 3·141592.

E. L. G.

ERRATUM.—In let. 3873, p. 62, the first line of the sum should be, "Given number × 7, but 1 place out."—SCREW.

CALIPER COMPASSES.

[3942.]—IN reply to "K. T. L." and "J. K. P." (letters 3825 and 3836) the above articles are sold in Manchester under the name of "Roller-coverers' Compasses," and are used for covering with leather small iron rollers used in cotton machinery. G. W.

AMATEUR TURNERS' SOCIETY.

[3943.]—SEEING from time to time the many queries and answers concerning mechanical manipulation in your journal, I am surprised that in this metropolis and its suburbs some central institution has not been established in order to afford means of intercommunication between amateurs who are interested in the mechanical arts. I venture to suggest that it would be quite possible to hire a room in some readily-accessible situation near some station of the Metropolitan Railway or omnibus route (perhaps, as a tentative experiment, in a back street), where lovers of the turning lathe, &c., could meet in order to compare notes and to discuss matters pertaining to their favourite pursuits. Such an institution, if established, ought to be open to all who might be willing to pay a moderate annual subscription—subject, however, to certain rules providing for the exclusion of undesirable persons. No good results can be hoped for if such a society should be started in a narrow spirit, and confined entirely to individuals who may luckily be possessed of expensive apparatus in the way of tools, &c.; but it ought, on the contrary, to be open to all who really love mechanical science for its own sake.

The art of ornamental and plain turning has hitherto been almost entirely a rich man's hobby, by reason of the great expense of the various chucks, slide-rests, and other appendages to the lathe. What is really wanted, in my opinion, is this: a common place of rendezvous where all who are interested in such matters could meet and mutually assist each other.

Nobody can be unaware of the immense advantages to be derived from an interchange of ideas amongst persons of a scientific turn of mind. Many projects of a mechanical nature are allowed to remain undeveloped, owing to the fact that the originators want the stimulus to be derived from mutual emulation. How often does it occur that amateurs who have some favourite scheme to carry out are prevented from bringing their inventions to perfection owing solely to the want of assistance and advice as to certain operations of a practical nature that are only known to a few initiated members of the mechanical profession?

Mr. Editor, I have dropped these few hints in order that, perhaps, some of your readers who, like me, take great delight in mechanical pursuits may be induced to express their views through the medium of your journal in a far abler manner than I have done or can do, and leave these crude suggestions in your and their hands. AN ESSEX AMATEUR.

[3944.]—SOME two or three weeks ago I saw in answer to a correspondent that our obliging editor would forward any such society as above named. I therefore beg to offer a few suggestions as to the formation of such a society. It would be necessary, previous to forming such an association, that a number of those interested should deposit a small sum to be fixed hereafter to cover incidental expenses; next, that a committee of (say) six gentlemen should meet and endeavour to form a foundation to work upon; as in all associations and clubs the qualification for membership would be an annual, quarterly, or monthly premium. I would suggest 5s. as an entrance fee, and £3 per annum subscription. This would enable the society to hire a suitable workshop, fix lathes, benches, &c., to be open to all members at times specified. All members should be taught by competent workmen, at certain stated times; materials, tools, and articles found gratis. A club-room should be attached, with lavatory, &c. I should be happy to assist in forming the society, if any gentlemen will advertise their addresses, with a view to co-operation. SAMUEL SMITHER.

TERRESTRIAL GRAVITATION.

[3945.]—So my method of deciding whether the attractive force at the poles of an oblate spheroid is less or more than at the equator is condemned as inapplicable by Mr. Proctor, who declares that nothing short of the integral calculus can work out this question. I imagined that in spheroids of considerable eccentricity my simple mode of determining the point was admissible, and that the superiority of the attracting force, at the equator of an oblate or the poles of a prolate spheroid was the reason why globules of liquid matter returned to the spherical form when freed from pressure, and why a viscous liquid when dropped from a bottle seemed endued with elasticity.

But Mr. Proctor's letter (3828) has upset all my preconceived notions, so I will close the subject with many thanks for his kind replies, which are doubtless as valuable to others as they are to me. There is one more query I should like to ask for more perfect satisfaction of a lingering doubt. Is it perfectly certain a minus sign is not by some oversight used in place of a plus sign in the formulæ for these calculations? T. A.

DUST IN THE SPECTROSCOPE.

[3946.]—SEEING that our valued friend "F. R. A. S." asks for information about that very annoying phenomenon, "Dust in the Spectroscope," pleading the fact that I have used one of Browning's instruments during much of my leisure time for the last few months, I crave indulgence to send my experience. I see that one correspondent states his belief that this effect arises from imperfect polishing of the prism, from unduly deep cuts in the glass by the polishing powder; the fallacy of this notion will be app[arent] when it is remembered that the prisms are pol[ished with] circular strokes.

I believe that the nuisance occasionally arises from the fact that the jaws of the slit are slightly irregular, although oftener from particles of dust lodged therein (as your obliging correspondent knows well). The most effectual means of removing the latter I have found in an old quill-pen end, having stripped most of the feathers off. S. W.

ORNAMENTAL TURNING.—VIII.

[3947.]—In wood turning the chucks used are various, according to the class of work to be performed, but the principal chucks are three in number—viz., the prong or strut chuck, hollow chuck, and screw chuck. Chucks should be made from wrought iron. Many turners use chucks made of wood—beech or box—but it will be found cheaper by far to have them of iron. Some are made of cast iron or brass, but the extra cost is so little that I advise wrought-iron chucks. I usually pay 4s. to 5s. each for them. I send a drawing of the three chucks. Any article can be made by the use of these that can be turned in a lathe. Should any ornamental chucks be required they should be made to screw upon the screw chuck, and when not wanted hung up in readiness for use. I make it a plan to fix pieces of wood upon my screw chucks, turn them shapeable, bore a hole, and fix any boring bits I may want to use. When required for use I have only to select the one required, and it is fixed on in a moment. Fig. 1, prong chuck for turning wood between centres. Fig. 2, hollow chuck, the wood to be driven in the chuck with a hammer, after paring the ends taper, the most suitable size 1¾in. in the bore. Fig. 3, screw chuck, the screw should be 2in. from socket to end, diameter at the base ⅝in., taper to the point, which should be ¼in. If the point of the screw is made gimlet-pointed it will enter the work without boring (that is to say, in soft woods). I omitted to state at the commencement that the best mandril for the amateur's use is a male screw for iron chucks, but if wood chucks are insisted upon, either on the score of cost or fancy, I certainly advise a female mandril.

I send a list of a few articles that may be easily turned by the amateur; for patterns, &c., he must use his own judgment and skill. Bread platters, size 8in. diameter, 1in. thick—sycamore is the wood most suitable. The platters should be turned with a thumb

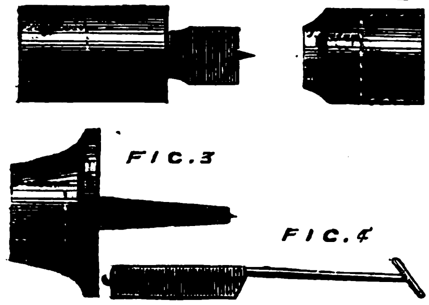


FIG. 1 FIG. 2 FIG. 3 FIG. 4

moulding, with a bead at the edge. Plain ink stands base 6in., top 3in., sunk for ink-pan lid to cover, with penwiper on top; mahogany, box, rosewood, walnut, or maple is suitable. Glass or jug stands 6in. diameter, 1in. thick, hollowed out ⅛in., with a groove at the inner edge, ¼in. deep, to contain any overflow. Walnut or mahogany gas blocks, 2½in. upwards, ⅝in. thick. Mahogany or sycamore shade stands—superior sort, sycamore; common sort, deal and pine; best sort, walnut, ebony, rosewood, or mahogany. Looking-glass or picture frames have a pretty appearance if turned of oak or even mahogany. In concluding my list for the present I may add one more that will amply repay the trouble incurred—viz., a bitter cup. Some few years ago they had quite a run. The cup is turned from a wood called Quassia wood. Very few dealers keep it. I purchased what I required in Long-lane, Smithfield. The last time I inquired for some they were out of it. I had at the time an order for a quantity, but did not trouble to finish them on account of the scarcity of the wood. I usually pay 4d. per lb. for it. To turn them, cut off a piece of wood 5in. or 6in. long, pare the end to fit hollow chuck, drive it in firm, turn the shape required—a goblet looks well—hollow out the inside, do not take out very much wood, as in that case it will not serve so long for private use. I always turned a lid for the purpose of keeping out the dirt and dust. It is a very excellent tonic—quite harmless to a child or adult. Pour in the water, let it stand for two or three minutes, then drink. I used one for ale at dinner. Do not wash them under any circumstances. If dirty rinse them with cold water only. One cup will last months in use. The chips are useful in many cases.

I also send drawing of a cast steel knife (Fig. 4), very useful in a turner's shop. The use of it will soon be found. Samuel Smither.

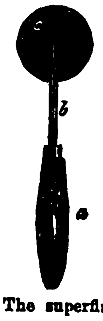
SPONTANEOUS COMBUSTION.

[3948.]—I am led to believe that if Mr. Tonkes had seen as much of the world, and had received the wide experience of it which "Manus" has acquired, and was not so insolently self-sufficient as he has shown himself to be, he would be a better man, and would have secured a larger amount of practical knowledge; and I cannot but express my surprise that he addresses contributors as he does.

I will, however, relate another case of spontaneous combustion. Several truck-cloths were dressed with black paint and boiled linseed oil, folded, and placed one on the other before they were sufficiently dry. The result was that they were seen to smoke, and when removed from their piled up position (in the open air) several were found burnt through, and others charred so badly as to be useless. The discovery of this case was made under my own personal observation. It was only in the heart of the pile of cloths that combustion was generated. And had a spark, or piece of lighted waste or cotton, been placed in the seat of combustion it would have instantly expired. Manus.

A TOOL FOR DESCRIBING PATTERNS.

[3949.]—"One good turn deserves another," and as I have received a good many since I have been a subscriber to the English Mechanic, I now send a description of a little tool which may be useful to "our" bookbinding friends. The manner of using it is thus: On the edges of the covers or round the margin of your book, and also across the back, lay a little resin, in fine powder, and on this gold-leaf. Now for the tool: a is the handle, of wood (see sketch); b, an iron fixed in it, forked at the end. Little wheels, round the edges of which devices are engraved, are fitted to run in this fork. Having fixed the wheel, c, that you want in the tool, heat it and run it along the edge of a ruler; the resin will melt and form a cement, leaving the gold-leaf wherever the tool passed in the devices graven on the edge of the wheel. The superfluous leaf may then be wiped off. V.

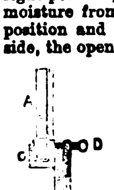


IMPROVED METHOD OF GLAZING.

[3950.]—The method which you have published (p. 88) is a very transparent infringement of that of Pullen, of Bath, who exhibited a house with hollow sash-bars in the garden of the Royal Horticultural Society at South Kensington last year. Grooved bars in both wood and iron are by no means uncommon, as I have known the former in use for more than twenty years, and, therefore, there can be no patent in them. When Messrs. Rendle & Burrows were obtaining their patent, I wonder they did not claim for a refrigerator as well, for it must be clear to every one at all acquainted with hot-house heating, that a more effectual method of absorbing the heat generated could scarcely be devised than that of converting each sash-bar into a refrigerator frequently filled with snow-broth to carry the heat away. Iron sash-bars, when protected by felt, as in Beard's patent, are bad enough, but to convert them into regular coolers for the carriage of water is the height of absurdity.

The great objection to iron for horticultural purposes has been its rapid conducting properties, scorching at one time and freezing at another. The only person who has coped with that difficulty, or who can cope with it during his patent, is Mr. H. P. Ayres, of the Imperishable Hot-house Company who, dispensing altogether with sash-bars, places the glass in one continuous sheet, like slates upon a roof, and thus the glass acts as an insulator by housing nearly the whole of the ironwork, and preventing the radiation of heat. Many thousand feet of this glass may be seen at the nursery of Mr. John Wills, floral decorator to her Majesty the Queen, Sussex-place, Old Brompton, S.W. Peter Wallace.

[3951.]—The plan recommended by my fellow-contributor "Saul Rymea" (let. 3840) is, for its many advantages, well worthy of success. It is both simple and ingenious, and cannot fail to come into general use. By this arrangement mechanics and artisans can glaze their own windows with greater facility and convenience than the professional glazier, while the work done, if properly executed, will excel any done by the old putty system. It has often occurred to many people that panes could be inserted and fastened in the same way as the glass of an ordinary carriage, with a running groove in the sash each side and a recess at the bottom to receive the lower end of the pane let down through an open slit in the top. The glass would thus stand in an inclined position, the ends overlapping each other, something similar to the arrangement of house-slates. The panes might deviate very little from an upright position, and in this way throw off a good deal of moisture from the framework. To keep the glass in position and prevent its removal, except from the inside, the open slit at top could be closed with a binding screw over the centre of each pane, as represented in the figure. A upper pane, B lower pane, C recess in sash (end view) to receive lower end of pane, D screw to prevent its being raised till withdrawn. It also acts as a cramp screw, and presses the edges of sash, if iron, towards each other, closing the interstices and making the joints water-tight. The plan has some advantages over the old system, as a broken pane can be easily repaired or replaced by a new one in a very short time, and one or two can be raised for the purpose of ventilation, or for a breath of fresh air during the summer or autumn months. Rat-Tat.



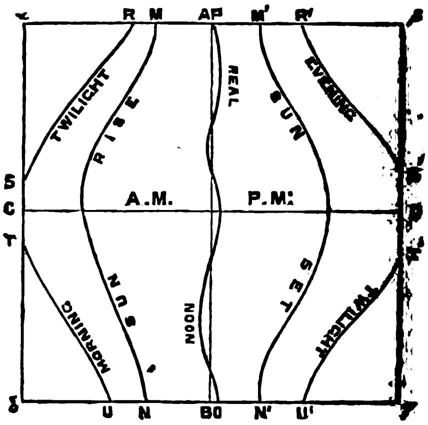
PREPARATION OF PUTTY POWDER OR OXIDE OF TIN FOR OPTICAL PURPOSES.

[3952.]—Having seen from time to time several inquiries as to the preparation of oxide of tin, I send you the following method, which is the result of a great deal of experience. Metallic tin is dissolved in nitro-muriatic acid, and precipitated from the filtered solution by liquid ammonia, both fluids being largely diluted with water. The peroxide of tin is then washed in abundance of water. Collected in a cloth filter and squeezed as dry as possible in a piece of new linen. The mass is now subjected to pressure in a screw press, or between two lever boards, to make it as dry as possible. When the lump thus produced has been broken it is placed in a crucible, and covered up tight to prevent jets from entering, and is then exposed and heated to a white heat, and ground for use in the usual way; this oxide is used specially for cements, polishing of astronomical object-glasses for astro-telescopes. The putty powder of commerce, if good fair quality, is alloyed with about equal parts of tin and lead, which answers for ordinary purposes, but not for polishing lenses, in which good work is wholly dependent on the quality of the powder. Wm. Oldfield.

"SUNRISE CURVE" AND OTHER CURVES.

[3953.]—In so far as the times of sunrise, sunset, real noon, beginning and ending of twilights are, for a given latitude and a given year, functions of the date of the year, they may be represented by curves. Such curves will not be strictly correct for any other year, but they will be sufficiently so for all ordinary purposes of life, since, owing to the nice adjustment of the Gregorian calendar, errors could not amount, for a long time to come, to more than a minute or two of time.

Not having yet seen this very simple idea carried out, I beg leave, Mr. Editor, to send you the following sketch of a drawing which, when fully executed, should be on a much larger scale.



$\alpha \beta \gamma \delta$ is a square, of which A B C D are the middle points of sides. A B may be called the "axis of dates," and C D the "axis of diurnal time." Suppose A B and C D divided into 364 and 360 equal parts respectively, and lines parallel to C D and A B respectively drawn through the points of division. Denote the 365 points from A to B by the 365 successive dates of the year, and the 361 points from C to D by the indications of time for every four minutes from one midnight to the next. By consulting a proper almanac it will now be easy to mark on each horizontal line the corresponding times of sunrise, sunset, &c., and, by joining these points, to obtain such curves as M N or sunrise curve, M' N' or sunset curve, P Q or real noon curve, R S T U or morning twilight curve, R' S' T' U' or evening twilight curve. The drawing is supposed adapted to the latitude of London.

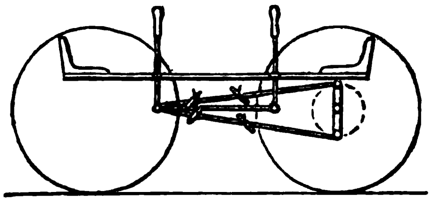
The surface of the whole square representing a year's time, the space between M N and M' N' will represent the proportional amount of daylight during the year, the space between M N and R S T U the proportional amount of morning twilight, the corner spaces the proportional amount of total absence of sunlight (strictly speaking, a 365th horizontal space should be added below γ δ for this purpose). The inclination to the vertical of the tangent to the sunrise or sunset curve at any date will be proportional to the rates of increase or decrease of mornings and evenings at that date. Suitable shading might be introduced, so as to indicate the gradual passing from daylight to darkness.

I need not add that analogous curves might be used for indicating the times of rising, southing, and setting, at a given place and during a given period, of the moon and planets. C. J. Recordon.

VELOCIPEDES.—To Mr. Shearing.

[3954.]—Mr. F. W. Shearing (p. 43, No. 366) asks me if I have ever tried the old-fashioned vertical tread. I am not quite sure whether I understand what he means by the old-fashioned vertical tread. I have used two kinds of these old velocipedes. The first, the usual form, is that in which the seat is placed over the driving-wheels, and to the cranked axles of which long treadles are attached, their forward ends being hung upon light rods; on each treadle is fixed a clog and strap, within which the foot is placed; the two front wheels are to guide, and are controlled merely by a long handle; the force exerted by the legs in these velocipedes consists partly of a forward and partly of a downward pressure, principally of the former. The great objection I always had to this kind was, that at each stroke of the leg the toes were jammed into the end of the boot, the said toes becoming, in about two or three hours' time, terribly sore in consequence. This kind of velocipede is no doubt well known to Mr. Shearing. The second has the driving-wheels in front, and the treadles are of such a shape that the force exerted is nearly all downward; the guiding-wheels are placed behind, and are actuated in front by any suitable contrivance—an upright rod with cross-handle, pulley, and strong gut line answers exceedingly well. In this form of carriage the toe objection is, of course, done away with, but I always found it to induce a painful—and, no doubt, if ridden in for long, injurious—strain upon the abdominal muscles.

But in a velocipede which is propelled by a thoroughly forward thrust, and provided with a properly-hinged clog or receptacle for the foot, both these serious objections are almost entirely, if not quite, removed. I send with this a diagram, which, if you, sir, will kindly find space for, will give Mr. Shearing some notion of a velocipede I am at present making, upon the principle of forward thrust of the legs. The diagram, I think, will explain itself, but I will just say in addition that there are four wheels, each 3ft. 6in. in diameter; cranks are 6½in. throw, giving a reciprocal motion of 13in. for the foot—quite enough. Let me here say that in a stroke of this kind the leg should never be allowed to become *quite* straight.



There are two seats, and two clogs on each treadle, the persons facing one another, as in an ordinary carriage. The machine being light, one person will be able to use it, however, with perfect ease. For ascending inclines, hand-levers, as indicated, will be provided; they can also be used on the level, instead of the feet, when it is desired to rest the latter members. The levers will fold out of the way when not in use; as, like many other persons and things, they are a most intolerable nuisance, and assert themselves very disagreeably when not in actual use. The two steering-wheels will be actuated by a simple arrangement (which is omitted in the sketch). When two persons occupy the carriage, the necessity for turning it round to run in an opposite direction will be obviated, as the steering-gear will be able to be shifted instantaneously from one person to another. It may be an advantage in Mr. Shearing's eyes that in this carriage, by reversing the seat between the steering-wheels, and providing a light footboard, apron, &c., a very comfortable seat can be arranged for a fair companion. This is, however, on the supposition that the muscles of the Christian who has the honour of working the treadmill on the occasion are tolerably developed, and that the said fair companion is at least a little too light to balance in the scale the Tichborne claimant. Mr. Shearing asks if my idea of a forward thrust is the same as that shown in a drawing of Mr. Reveley's some time ago. From my diagram he will see that the principle is very much the same. A. A. M.

ATOMICITIES v. VALENCIES.

[3955.]—Mr. Bottone is taking quite a wrong view of the meaning of the term atomicity in his letter 3862, page 41. This term when applied to atoms means the atom-fixing or atom-replacing power of an element or its chemical value in exchange, the atom of hydrogen being taken as unity. Atomicity when applied to molecules means the number of atoms which a molecule contains, but as we have not been considering the atomicity of molecules he ought not to look at it in that light, as we are only dealing with atoms at the present moment.

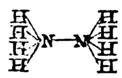
Different elements possess different atomicities: those which have an even atomicity are termed artiads, and those which have an odd atomicity are termed perissads, and furthermore an artiad never becomes a perissad, or a perissad an artiad.

Nitrogen being a pentad is thus equal to five atoms of hydrogen (I don't mean to say that there is such a compound as 1 atom of N, united with 5 of H), and as the atom-fixing powers of an element can only disappear in pairs, nitrogen must always have an atomicity of 1, 3, or 5, and how 1 atom of nitrogen can be made to exist in combination with 4 of hydrogen in ammonium, except as $\begin{cases}NH_4\\NH_4\end{cases}$ I cannot perceive, without our friend Mr. Bottone has been among the atoms of this substance, and cut away all the fifth bonds of all the nitrogen atoms (which I very much doubt). Also for his information I take the density of ammonium to be 9·00. I may also inform him that it is an exception to the general rule of vapour densities, as is also PCl_5 (and Cl_2O_3). See footnote 12, English Mechanic, No. 365, p. 4.

With regard to phosphorus acid, Mr. Bottone must take into consideration that this acid is only dibasic, not tribasic, as his graphic formulæ would lead people to think If he will look at the constitutional formulæ in my letter (3801) which is $POHHo_2$, providing he knows anything about such formulæ, he will see that one of the atoms of the hydrogen is in direct combination with the phosphorus, and consequently not displaceable, the two other atoms of hydrogen in the radical hydroxyl only being displaceable. I cannot thus consider his graphic formulæ as correct in relation to this substance.

In the preparation of chloric acid (p. 30, No. 366) the formulæ for potassic silico fluoride is printed K_2SiF_4, it should be K_2SiF_6, or SiF_4; 2 (KF). I presume this is only a printer's error, and not another error of Mr. Bottone's.

Ammonium in the free state is similar to the monatomic alkali metals; potassium and sodium which exist in the free state as $\begin{cases}K\\K\end{cases}$ or (K)⟶⟵(K) or K_2 and $\begin{cases}Na\\Na\end{cases}$ or (Na)⟶⟵(Na) or Na_2; therefore, ammonium in the free state must exist, as $\begin{cases}NH_4\\NH_4\end{cases}$ or

 or $(NH_4)_2$.

Mercuric.

DISCOVERY OF A MINOR PLANET.

[3956.]—I beg to send for publication in the English Mechanic a copy of a note which I received on the 3rd inst. from one of the Fellows of the Royal Astronomical Society. R. Langdon.

Royal Astronomical Society.

Discovery of a minor planet (118), Peitho, at Bilk, by Dr. R. Luther:

	Mean Time at Bilk	
1872		
March 15	14h. 18m. 59·6s.,	R. A. 12h. 7m. 26·73s. N.P.D. 79° 42′ 33·5″.

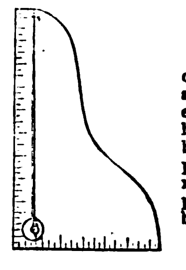
From an observation made by Dr. Tietjen, at Berlin:

	Mean Time at Berlin	
1872		
March 21	9h. 33m. 28s.	R. A. 12h. 1m. 36·36s. N. P. D. 79° 20′ 46·1″.

The daily motion obtained from these observations is in R.A. 60·6s., and in N. P. D. 3′ 45″. The planet is of the 11th magnitude.

March 25, 1872.

ANOTHER COMBINED TOOL.



[3957.]—I inclose a sketch of a tool I have made. It is a combined square, straight edge, plumb-line, serves as a level, rule, and, besides, can be used for obtaining the proportion of pipes, in the same manner as illustrated on p. 35, No. 366, both edges being marked off.

Zoo Andra.

Errata.—In letter 3890, last line of table in col. 1, for "391" read 398. Col. 2, after last table, for "And pounds would be reduced to these mins," read "And these mins would be reduced to pounds." The reduction of pounds into five guinea pieces would be nearly, not quite, as rapid, by adding a third, and then dividing the sum by 7.—E. L. G.

Errata.—In my letter (3879, p. 63), where it reads, "the pumps should be put in motion but sooner," should be read, "but not sooner." The weight of the shore abutments should have been "42,000 tons," instead of "4,200 tons," and their height, "104ft.," instead of "85ft.," which is the average height of the 462 bottom towers. Their weight should have been "1,191,960 tons," not "119,160 tons," as printed in the items of weights, &c. (p. 64).—Sholto Douglas.

The Study of Natural Science.—The examinations for scholarships in natural science, which have recently been held at Clare and at Emmanuel College, Cambridge, have both terminated without an election being made. The reason of this is that at neither of the colleges did candidates present themselves whose attainments, in the opinion of the examiners, entitled them to receive the distinction. The number of competitors was but small in each case—in one three only.

Education in Saxony.—Up to the present time the youth of this little kingdom, when apprenticed to a trade, have been left at liberty to forget what they learnt at school. Attendance at Sunday or evening schools provided by the State and charitable societies was perfectly optional. By a law just passed this liberty is abridged, and compulsory attendance at evening schools exacted for a period of three years. This is said to be the first time in the annals of the world that an attempt has been made by a State to extend the education of the humbler classes beyond the merest rudiments, and after they have entered upon the business of life. Saxony, although the best taught portion of Germany, will, by the new law, be more than ever in advance of her sister States.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10450.]—**Wet and Dry Copper Assay.**—"Experimenter" must excuse my long delay in furnishing him with the promised comparison between the produce of copper ore samples determined by the "dry way" and that found by volumetric analysis, as like, I believe, many more of "our" contributors, it is only in my leisure time that I can attend to queries addressed to me, and of late that has been scant indeed. However, for the future, I hope to be less remiss. The produce of the following samples has been determined most carefully by the dry Cornish assay, and by titrating with standard solution of potassic cyanide in my laboratory, with the following results:—

Nature of Sample.	Dry Assay.	Wet Assay.	Difference.
	per cent.	p. c.	per cent.
American Regulus...	$59\frac{1}{2}$ = 59·50	61·60	2·10 W—D
Carbonate of Copper	$29\frac{5}{8}$ = 29·625	30·70	1·07 W—D
Slime Ore..............	4 = 4·000	4·34	0·34 W—D
Argentiferous Ore....	$\frac{3}{4}$ = 0·750	1·40	0·65 W—D

"Experimenter" will see from the foregoing table the impossibility of fixing any definite ratio of difference between the two systems of assay, as, in fact, they are not comparable. Should "Experimenter" require any further information which it is my power to afford him, it is his with pleasure.—Un Irlandais.

[10501.]—**Water-Power (U.Q.)**—I see your correspondent "K. K." answers query No. 10501, on p. 17, and states that "small turbines are humbugs." As no size is given I cannot say what I should like upon the subject. On former occasions I have ventured to advocate, through your kindness, their more general adoption. There are, I admit, limits to size, as in all classes of machinery, for efficiency. In the absence of any size being given, I venture to say that the far famed turbine at S. Blazien is only 14in. in diameter with certainly a large head, 22 yards; but its calculated power is 40 horse. Those also at Lowell are small, but give every satisfaction; of one in the south of England I know which gives every satisfaction, it being 15in. diameter and gives out 10 horse-power under a head of 45ft., the supply-pipe being 8in. diameter. These are each constructed upon different principles by different makers, and yet are not "humbugs." There are, undoubtedly, many turbines made which, if large or small, are radically wrong in their working, because their construction is faulty. I am sure if a turbine be constructed upon sound principles from, (say) 12in. diameter up to 4ft. diameter, when sufficient water is at command, that their superiority will be found over every other class of motor.—J. G.

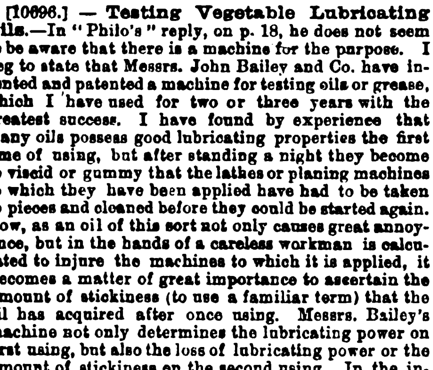
[10556.]—**Jamaica (U.Q.)**—What "No Name" says in his excellent letter on p. 541 of Demerara applies for the most part to Jamaica as well, particularly his remarks on intemperance. I cannot recommend Jamaica to a fortune-seeker of the type of those who go to the "diggings" to make haste to get rich; but to a *bond-fide* settler it offers peculiar advantages, and such a one as "Muscovado," with some capital to start with, would, *cæteris paribus*, in due time rise to affluence, and enjoy an honourable position. I observed that some one else replied to "Muscovado," inviting to a partnership in a turtle-preserving business. I do not know the gentleman, but should think the business profitable. It is a new trade, carried on by only one firm, I believe. There seems to be hardly a limit to the variety of ways of using capital with advantage here. Jamaica is becoming America's tropical garden—a trade in bananas and plantains having just now sprung up, and, considering the enormous demand for these, in a few years, when others besides a few New Yorkers shall have tasted West Indian fruits, there is no fear of the markets being overstocked. Store-keepers, who import, might get good profit, and undersell all others. I fancy that the splendid woods we have are very little known to English mechanics. In pulling down old buildings, I have met with massive timbers as sound as the day they were sawn—perhaps a hundred years ago—and as hard as bone. Many of my fellow-readers, I know, would gladly rescue some of these from the flames or ignominious service. Statistics show that ever since emancipation this colony had been declining until the disturbances of 1866 led to the blessing of Crown government. Now she is rising again, and, in addition to coffee, sugar, and rum, her fertile resources are to be developed with new industries. Some of the planters—good and just men—complain of the precariousness of negro labour ... apply to the Government for coolies. This ... accounted for by the deep-rooted prejudic...

estates' labour amongst many of the people. But I must say that the majority of negroes indulge in the expensive luxury of idleness and rags, and that ministers here, as elsewhere, in proclaiming the Fourth Commandment, do not lay sufficient stress upon "Six days shalt thou labour." Others, again, do not so complain, and prefer the lusty negro to the delicate coolie. It is predicted that this labour difficulty will correct itself in time by the establishment of central factories for the manufacture of sugar and rum, the people growing canes for sale. For other than estates' work there is an abundance of labour at 1s. to 1s. 3d. a day per man. I cannot advise "Muscovado" as to the chance of his finding suitable employment while acquiring experience before embarking capital. This is a delicate matter, and involved with too much responsibility. I see no difficulty if he comes fortified with introductions, nor the least improbability if he come without. He would find us—country people—given to hospitality, and might, with an outlay of £20 for a stout mule and saddle-bags, make a tour of the island at but little expense besides, by being passed from one friend to another, and I should be happy to launch him. I could write much more, but am afraid it would not come within the category of matter of general interest. If I knew "Muscovado's" circumstances—such as age, habits, occupation, whether married or single, &c.—I could, perhaps, serve him further. Will he advertise his address?—Cocoa-Nut.

[10664.]—**Angle of Reflection and Incidence.**—Not having seen any further communication from "A. P. S." I presume he is satisfied with the answers which he has received. I agree with "Lichfield" that the yielding of the cushion is the cause of the deviation. I think "V. B." or myself have mistaken what "A. P. S." means by the angles of reflection and incidence referring to the diagram on page 591. Is not A B E the angle of incidence and E B F the angle of reflection? However, *certum est* that with a gentle blow the ball B striking the cushion in the direction A B is reflected in the direction B F, but with a hard blow will be reflected to the right of the point F. I think your kind correspondent "F. N." is in error when he states that the co-efficient of elasticity is the force of restitution divided by the force of compression, and that the co-efficient of elasticity diminishes with the increase of momentum. This is equivalent to saying that the greater the momentum the greater the difference between the forces of compression and restitution. I think I can prove that when a billiard-ball in motion comes in contact with another at rest the greater the momentum with which the ball in motion strikes the one at rest the lesser the difference between the forces of compression and restitution.—Billiardist.

[10692.]—**Terra Cotta.**—Messrs. Minton, of Stoke-upon-Trent, were the manufacturers of the ornamented columns at South Kensington, not Messrs. Blanchard, as stated in my reply to this query. The designs were furnished by the department.—H. B. E.

[10696.] — **Testing Vegetable Lubricating Oils.**—In "Philo's" reply, on p. 18, he does not seem to be aware that there is a machine for the purpose. I beg to state that Messrs. John Bailey and Co. have invented and patented a machine for testing oils or grease, which I have used for two or three years with the greatest success. I have found by experience that many oils possess good lubricating properties the first time of using, but after standing a night they become so viscid or gummy that the lathes or planing machines to which they have been applied have had to be taken to pieces and cleaned before they could be started again. Now, as an oil of this sort not only causes great annoyance, but in the hands of a careless workman is calculated to injure the machines to which it is applied, it becomes a matter of great importance to ascertain the amount of stickiness (to use a familiar term) that the oil has acquired after once using. Messrs. Bailey's machine not only determines the lubricating power on first using, but also the loss of lubricating power or the amount of stickiness on the second using. In the inclosed sketch, A is a friction drum or pulley of cast-



iron, about 8in. diameter, keyed on a shaft B. C and C' are two clips or saddles of brass, each extending nearly half round the circumference of the drum, and pressed to it with a constant pressure by means of the two weighted levers D D'. E is a thermometer fixed on the top saddle or clip C, and serves to indicate the heat caused by the friction of the drum revolving between the two saddles C C'. The method of using is as follows: The shaft B and pulley A are made to revolve at a speed of 1,800 or 2,000 revolutions per minute, the number of revolutions being shown by a counting machine indicating up to one million, but which is not shown on the sketch to avoid complication. It will be evident that this velocity continued several minutes will generate considerable heat, and that this heat is raised by a less number of revolutions when a bad oil is used than when an oil of superior lubricating power is used. For instance, if it requires 50 revolutions to raise 1 degree of heat in one oil and 100 revolutions in another, it is evident that the quality of the first will only be half as good as the second. Before starting the machine the temperature at which the thermometer stands is noted; this, of course, will be the temperature of the room or workshop. A portion of the oil or grease to be tested is poured or smeared on the friction pulley, and the saddles, with their weighted levers, allowed to press on the drum. The machine is then started and allowed to run till the thermometer indicates a temperature of 200 degrees Fahr. When it is stopped, and the number of revolutions it has made is taken from the "counter," then the number of revolutions divided by the number of degrees of heat that the thermometer has been raised will show its lubricating power. After the first trial the machine is allowed to rest twenty-four hours, and then it is started again without adding any more oil, and without breaking the contact of the saddles with the drum. The number of revolutions of the drum is again taken, and divided by the number of degrees of heat raised in this second trial, and if the result is not more than from 10 to 20 per cent. less than the first trial the oil may be considered good. In very bad oils the saddles are found to be so fast glued to the drum that the machine cannot be started a second time, and in some cases it requires considerable force to break the contact or adhesion between the drum and the brass saddles.—F. R. W.

[10731.]—**Fastening Escape Wheel in Lever Watch.**—I am surprised to see "A Yorkshire Pivot" recommending "S. H. L." to solder his colet on the escape-wheel arbor. This is very wrong, and most unworkmanlike. What necessity is there for soldering it on? Why use soft solder in repairing when not a particle enters into the original composition of the watch? The love of solder among a certain class of watch-jobbers is a little too strong. It forms the great mainstay in all their operations—a sort of universal remedy for almost all the ills a watch is heir to. It is a practice that cannot be too strongly condemned. The proper method of putting on a new escape-wheel is to turn the colet on an arbor and rub on the wheel whilst the colet is still on the arbor, as recommended by "Ex-Watchmaker."—West Cornwall.

[10833.]—**Fork and Wedge Motion (U.Q.).**—The following is the description of a "fork-motion" engine built by Stephenson & Co., about 1844, which I saw about six weeks ago:—In this engine the steam-chests and slide-valves are placed on the tops of the cylinders. There are four eccentrics and eccentric-rods, the same as for the "link-motion," only that the ends of the eccentric-rods are formed into large vertical forks, with a notch at the bottom of each. These notches are to take hold of steel pins fixed into the lower ends of two levers, which are fastened on to the ends of a horizontal shaft or weigh-bar, and hanging down (termed the "lower levers"). On the same weigh-bar two other levers are fastened, of the same size as the lower levers, but standing up (and termed "upper levers"). Two horizontal links are attached to the tops of the "upper levers" by steel pins; the other ends of these links are attached to sockets on the ends of the valve spindles. There is another weigh-bar with lifting arms at right angles to each other, with four suspending links from the ends of the lifting arms to the ends of the eccentric-rods, and an arm and rod from the weigh-bar to the reversing lever on the foot-plate. The effect of putting the reversing lever in "forward gear" is to turn the weigh-bar quarter of a turn round, and, with two of the suspending links, to raise the two forward eccentric-rods, till the forks take hold of the steel pins in the "lower levers," and, at the same time, the other two suspending links lower the backward eccentric rods, so that their forks are clear of the pins. The forks take hold of the pins in the lower levers, and make them move backwards and forwards, and with them the weigh-bar and upper levers, and they communicate the motion to the valve spindles, through the horizontal links. The motion being taken from the forward eccentrics, the engine will run forward the same as in "link motion." The "upper" and "lower" levers, being the same length, the travel of the valve is the same as the throw of the eccentric. The horizontal links are to allow for the oblique motion of the "upper" levers, which move in the arc of a circle, and the valve spindles move in a horizontal position. If the reversing lever be put in "back gear," the weigh-bar with the lifting arms will lower the two forward eccentric-rods, and lift up the two backward eccentric-rods (just the reverse of forward gear). The forks of the backward eccentric-rods now take hold of the steel pins, and only with this difference that as the motion is from the backward eccentrics the engine runs backwards. If the reversing lever be put in the middle, or "out of gear," the weigh-bar will only turn one-eighth round, and the effect is that none of the forks take hold of the steel pins, so that no motion is given to the valve spindles, and of course the engine remains stationary. This motion is going out of date, and soon there will be none to be seen. There is a great fault in it—which is, that if a driver sees danger ahead he dare not reverse the engine, as, if he did, the forks, suddenly taking hold of the pins, will break the pins and forks. It was a good motion, before the "link motion" was invented. Your readers will see the difference between the simplicity of the "link motion" and the complications of the "fork motion."—C. E. S.

[10841.]—**Radius of Surface of Object-Glass.**—In reply to Mr. Cash, p. 43, the radii I gave were for a telescope of 70 inches focal length, as he required. If he grinds his lenses to these curves and has properly determined the refractive indices, the convex lens will have a focal length of 25·48 inches, and the convex of 40·02. I cannot answer for the accuracy of Mr. Cash's own work, but if he finds, upon testing his object-glass, that the colour is not quite corrected, he may, perhaps, mend the matter by slightly altering one of the inner surfaces, providing, of course, that the alteration will not affect the correction for spherical aberration to a noticeable extent. If Mr. Cash can depend on grinding his curves to a great nicety, he had, perhaps, better determine this important quantity with all possible accuracy, and I will find time to go over the figures again for him with the corrected number, so that he may commence his work with a fair start. I do not know where he finds that Herschel recommends that the ratio of the focal lengths in the Huyghenian eyepiece should be as 3 to 2, but this proportion will do as well as that of 3 to 1, which ratio he does say they should have; and, indeed, Mr. Cash need not be very particular in this respect, but to make the eyepiece achromatic it is indispensable, if made of the same material, that they should be placed at a distance from each other of half the sum of their united focal lengths. The lenses are generally plano-convex, with their convex sides towards the object-glass, or crossed lenses of very unequal radii, but Airy says that the field lens should be a meniscus, radii 11 : 4, with convexity towards the object-glass, the eye lens a crossed lens radii 1 : 6, with the most convex side towards the field lens. In some of the eyepieces fitted to my own telescope, the field lens is a meniscus, and the eye lens a plano-convex, and they seem to perform very well, better, certainly, than some which I have with plano-convex lenses. For the purpose of testing his object-glass, however, I should recommend Mr Cash to get an eyepiece which he can entirely depend on; it may, perhaps, save a great deal of trouble.—Henry T. Vivian.

[10853.]—**Textual Revision of New Testament (U.Q.).**—The ancients had no pedantic rules about varying the forms of letters. Each letter had but one form throughout the same manuscript or inscription; the writing-masters' pedantry to make certain letters differently when ending a word began probably among Jews or Arabs of the middle ages; and European scribes, by the time printing arose, had made it a rule for their *s* (whether Greek or Latin) to be thus varied. To understand how such niceties really aided reading, we must remember that till the fifteenth century no one had thought of leaving more space between words than between letters of the same word. This invention supersedes many expedients that were introduced to mark off the length of words. We got rid, about a century ago, of the two *s*'s by making our medial like our final one; and Tischendorf, by a contrary course with the two sigmas, merely follows suit, and relieves his printers of a bit of useless pedantry.—E. L. G.

[10857.]—**Imitation Marbles, &c. (U.Q.).**—"Plaster of Paris, quicklime, salt, ox blood, stones of different colours, also pieces of glass, all beat to powder, and mixed up to the consistence of paste with vinegar, beer, or sour milk, and then lay it into tables, pillars, or what you will; let it stand so long till it is thoroughly dry; then rub it first with pumice stone and polish it with tripoli, giving it the finishing stroke by rubbing it over with leather and oil." The above is a quotation from an old work.—Schoolboy.

[10859.]—**Wheel Cutters.**—The shape of the cutters vary with the shape of the teeth of the wheels to be cut. Pinions, or small wheels, require a cutter for nearly every different number of teeth in the pinion; wheels, or those with large numbers of teeth, one cutter will serve the purpose of cutting many wheels varying from 7 to 20 teeth, although strictly correct only for the one for which it was purposely made. To describe the various forms of teeth used would require a long article, which perhaps "our" Mr. Editor may not care to allow the space for.—Tubal-Kain.

[10883.]—**Rust in Iron Vat.**—The salt crystallised is nitre; there are small traces of muriates and sulphates.—R. J.

[10889.]—**Rose Trees.**—In replying to this query I undertook to affirm something which I beg leave to withdraw from. I find that nurserymen do supply "dwarf" roses which are merely budded on short stocks. Under these circumstances definitions are in a state of fog.—Saul Rymea.

[10889.]—**Rose Trees.**—What is a dwarf and what is a standard rose tree? These names refer entirely to the height of the tree, and have nothing whatever to do with the rose tree being budded or grafted, or on its own roots. A rose tree budded or grafted on a short stock a few inches from the ground is equally a dwarf with one on its own roots the same height. Also a rose tree on its own roots with a single stem 3ft. or more in height, is equally a standard with one of the same height that may be budded or grafted. "Saul Rymea" (p.18) may depend that if an order is sent to a nurseryman for dwarf roses he will be more likely to send budded ones than those on their own roots.—T. M.

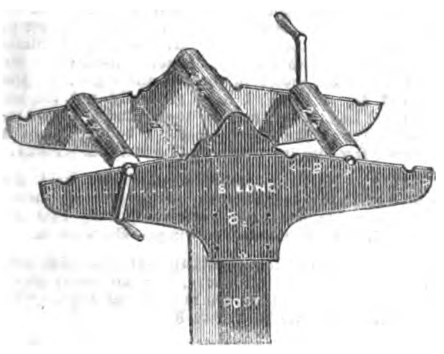
[10913.]—**Screw Cutting (U.Q.).**—Where the screw to be cut has an unequal number of threads it is a difficult matter to stop the lathe and wind back the saddle by hand to meet in the thread partially cut; for short screws time would be saved in having a reverse motion to the lathe. The wear of the lathe would certainly be increased, but that would bear no comparison with the time saved.—Tubal-Kain.

[10917.]—**Power.**—"Undecided's" description of his shafting and gearing seems a roundabout way to apply the power from a steam engine to a single machine. If he can drive direct from the engine shaft to the machine, there would certainly be a great saving of friction, say, (1) horse-power of engine, (2) horse-power required to work the machine, (3) number of revolutions of engine per minute, (4) revolutions of machine per minute, (4) diameter and breadth of pulley on machine, (5) and what is the largest diameter pulley admissible upon his engine shaft.—Tubal-Kain.

[10930.]—**Want of Steam Power.**—I should advise "Agri" to direct exhaust pipe into chimney, and it would cause more draught; if it does not answer after you direct exhaust pipe into chimney, you should make your slide valve longer by putting an eighth of an inch both ends of the slide, or a quarter of an inch. I shall leave the size for you to choose for yourself, it would make the engine run a trifle faster and will not burn so much coal. If you do not like to take the slide out and alter it yourself, let a mechanic do it for you, and you will never regret the outlay. I have altered five or six, and they give the greatest satisfaction, and consume less coal, but if you should feel inclined to do it yourself, I will give any information you should require. A larger fly-wheel on the engine would increase the speed, but it would be expensive; the fly-wheel on your engine is heavier than engine makers use for your power engine; you can work your engine to 80lb. pressure with safety.—F. T. S. S. D.

[10968.] — **Brazing Fishing-rod Ferrules** (U. Q.).—After cutting to size, bring the edges flush, confine with some very fine iron tie wire; rub a piece of borax on a piece of slate, with a little water, until the consistency of cream. Mix it with a small quantity of spelter, lay it down the seam, hold the ferrule over a forge fire; do not let the ferrule touch the cinders or the brass may collapse; as soon as the spelter runs, remove, or your ferrule will run too. You can do them in a kitchen fire if made bright; coke must be used broken small.—Never Rust.

[11009.]—**Bending Tires.**—I once saw a very simple tire bender, of which I send a description; it consists of two iron plates of the shape shown, bolted each side of a post about 7in. thick; and three rollers, the top one fixed, and the others loose to place in the different bearings; for various sized tires, the



end of the tire must be bent with the sledge for the first bite. The two loose rollers must have one of their gudgeons brought out to a square for fitting on a pair of winches. Each journal is ½in. lower than the other, from the middle.—Anglo-American.

[11028.] — **Pocket Aneroid Barometers.**— "Campanile" wants more than the instrument will yield. Mine has accompanied me over many of the Welsh mountains, and I have been able to measure to about 10ft. by it. An ascent or descent almost unappreciable to the eye has been duly marked by the aneroid, but so small a difference as a yard is not to be determined by it. Nevertheless, I find my aneroid a very useful and interesting travelling companion.—J. A.

[11120.]—**A Question of Sight.**—I shall esteem it a favour if I am allowed to refer to the second part of "E. L. G.'s" answer (p. 674), in which he says—"After sunset we continue as before to see the mass of air that the solar rays penetrate above and around us, and call it sky." Does our friend and instructor mean to say that we cannot see light by day beyond the mass of air that surrounds the earth, and that the cause of darkness by night is because there is no matter to reflect the sun's rays? When I look at the blue expanse by day the light seems infinite, through space. What, then, becomes of this illuminated space beyond our atmosphere, and how is it we cannot see it by night illuminated as by day? I dare say the answer is very simple; will some one please inform an ignorant—Fiddler.

[11128.]—**Lantern Pinions.**—I will not be so rude as to flatly contradict "J. K. P.," but I think if he will kindly look into this matter again he will find that I am correct. The word "trundles," in my first reply, was, by mistake, printed "trussells." That is a slight mistake, possibly caused by my writing not being over plain, so that "J. K. P." will kindly overlook that admitted error; I saw it, but did not consider it necessary to send a notice at the time for its correction. "J. K. P." admits that I am right in saying the pitch should be the same. I did not give any diameter for the pitch circle. I will now do so, taking his number and pitch. I make it for 6 teeth × 1in. pitch = 2in. diameter. He will, therefore, please not confound "pitch" with any term I did not mention. To explain the rationale. It is generally expressed by mathematicians that the relative velocities and revolutions of any two wheels (bevil or spur) are to each other in strict proportion to their diameters and circumferences at the pitch circles. So they are, if the teeth were, so to say, innumerable. Take, for example, a pinion of 6 teeth × 1in. pitch, by the circumferential measurement, would be about 1·91in. diameter, and a wheel of 60 teeth × 1in. pitch would be about 19·10in. diameter. To make a wheel and pinion of these diameters and numbers, supposing 1in. pitch, the pinion would be too fine in the pitch for the wheel; or, what is the same, expressed in other words, the wheel would be too coarse in pitch for the pinion. The pitch of pinion would be about ·950in., and the wheel about ·9995in. It will then be proper to assume wheel and pinions to be polygons, and the pitch to be the side of the polygon, with the number of sides corresponding to the number of teeth, and the pitch to be the distance from centre to centre of the teeth in the pitch circle. In this case, the circumscribing, or pitch circle, of a pinion of 6 teeth × 1in. pitch would be 2in. diameter, and that of the wheel 19·108in. diameter. For wheels with comparatively large numbers of teeth, when working into each other, the "diametrical" pitch, as it is termed, will answer all ordinary purposes, and is a much more accurate mode of measurement for very fine pitches, but it will not do for large or heavy gearing, or for wheels usually employed in engineering and mill work, and of unequal numbers. I write from experience and daily practice, and I again repeat that the pitch of the "trundles," or the distance of their centres, or, putting it this way, from centre to centre of the trundles, should equal the pitch of the wheel into which they are to gear. These lantern pinions require a peculiar form of tooth in the wheel, not such as is now generally made, but one of a "bay leaf" form as they were anciently called by the then workmen. It is, however, a kind of gearing so seldom met with in general use that it will be unnecessary for me to prolong this letter. The length of the tooth is the reverse of that where ordinary wheels and pinions are now applied. It is longer from the pitch circle to the point than it is from the pitch circle to the rest, and the curve is formed by rolling a circle of equal diameter to that of the pitch circle of the lantern pinion, upon a circle of the diameter of the pitch circle of the wheel. Allow me to suggest to those who are willing to become acquainted with the theory of the teeth of wheels to consult "Camus on the Teeth of Wheels." What I have termed "trundles" are also, in mill work, known by the names of "rungs" and "rounds."—Tubal-Kain.

[11157.]—**Stearine.**—As neither Richard H. Garth nor "Jack of All Trades" has responded to this query, perhaps it may not be out of place for me, as a person of some experience in this branch of business, to ask "A Puzzled Subscriber" what kind of stearine he has got? also to what use he intends the oil to be put after it is pressed? is it lard stearine or stearine from tallow, olive, or palm oils? or is it stearine from any of the hundred and one greases that are recovered from soapy suds? Reliable information on questions of this kind is not to be got. If "Puzzled Subscriber" is in the trade let him get a man of practical experience, and he will put him all right. As to the other part of the query "the best method of pressing," there is only one method that I know of, and I have been in the business for seventeen years. If a "Puzzled Subscriber will advertise his address in the English Mechanic I will be happy to communicate with him on the subject.—John Murray.

[11168.]—**Wood Rods.**—Many thanks to Samuel Smither for his kind offer of sketch of cutter, and shall be glad to see it. I have an ordinary foot lathe to which I hope to fix it. If it is not asking too much would he give a sketch of a witchet, which was recommended for the job by "J. K. P." in No. 364?—Joiner.

[11188.]—**Arithmetic.**—I remember some volumes back a host of letters were written upon the subject of abstract and concrete multiplication. Would not some correspondents who are now writing upon this subject do well to read those letters? This is only a suggestion, but, if acted upon, would probably save our nerves, for it makes one nervous to read rubbish. Would it not save some words—strong ejaculations—also?—C. H. W. B.

[11192.]—**Chemical.**—If the salt mixed with nitrate of potash be really carbonate of potash it is very easy to separate the greater part of the nitrate, as the latter requires 7 parts of water at 60° Fahr. for its solution, whereas the carbonate of potash is a deliquescent salt dissolving in 1 part of water. In this case the liquid should be concentrated by boiling, and set aside to cool, when the greater part of the nitrate of potash will crystallise out. These crystals may be quickly washed with pure water, redissolved, and recrystallised. If this be done two or three times the crystals may be obtained almost chemically pure. Should the salt be the bi-carbonate of potash the difficulty would be much increased, as it is not a deliquescent salt and requires 4 parts of water at 60° Fahr. to dissolve it. Unless the quantity be very large it is not worth the trouble of trying to separate the salts.—A Barrister.

[11208.]—**Incubator.**—In reply to "M. O." the arrangement was designed for my own use in an experiment requiring a constant heat. As I gather from "M. O.'s" letter that he has but a poor opinion of it I should be much obliged if he would kindly point out the defects. I should be sorry to be the means of misleading other readers.—Shylock.

[11246.]—**Diamond Fields.**—As I have a brother in the neighbourhood of the diamond fields, with whom I am in constant communication, I am enabled to give "Digger" the following information, which may be of some use to him:—The Natal route is undoubtedly the best, as besides being shorter the roads are much better. The winter season commences about April or May; it is by far the pleasantest part of the year, indeed, it is described as surpassing the summer of Baden-Baden. I should certainly take a gun, as in case he wished to dispose of it he would find it readily saleable at a remunerative price. "Digger" could obtain employment at the diamond fields easily, but the wages would be so low as to merely form a subsistence. Kaffir labour being so cheap in South Africa (about 10s. a month, and food, which consists almost entirely of maize, or, as they call it, "meale" porridge). Steamers are run twice a month by the Union Steamship and Cape and Natal Navigation Companies, both advertised in the *Times*; steerage fare is £20, length of passage forty-two days. He would get much information from the *Natal Mercury*, received in England by every mail. If he sends his address and 7d. in stamps to Street's Colonial Newspaper Office, London, they will forward it him.—Zulu.

[11249.]—**Concrete Buildings.**—See letters.—Ed.

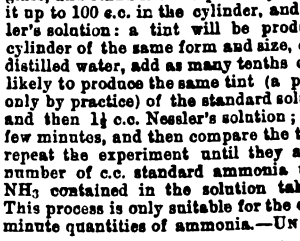
[11265.] — **Drawing a Boundary Line.** — "Thetamu," in his answer to this question (on p. 47) has not stated whether his boundary line is to be shifted from B or A only, or equally from both. In either of the first cases he is right; but in the other it would only require to be shifted half the quantity, as he soon would find out, on adding and subtracting this amount to the different offsets.—W. Hughes.

[11287.]—**Annuals.**—In addition to those named, I would add *Saponaria Calabrica* (red), and *Sap. alba* (white). The former is the most effective, and for growing in a mass, it is inferior to none.—Irish Mechanic.

[11294.]—**Dividing Metal Disc.**—No diagram is needed to show the simplest solution of this and all similar problems; and with a straight edge and square, it need involve no more openings of the compasses than there are circles. Carry the radius of the outermost round it, so as to make six equidistant marks A B C D E F. With the straight edge, join any two, neither adjacent nor opposite, as A C. Then a concentric circle touching the line A C will be half the radius (and a quarter the area) of the outermost. With the straight edge and square make a perpendicular to A C, touching this inner circle, and through the meeting of this perpendicular with A C, draw a second circle, which will contain twice the inner one. Again, make a perpendicular to A C, touching this second circle, and through its meeting with A C draw a third, which will be twice the innermost. Thus your three rings and disc, all of equal weight, are produced. It would not be worth while to print "mathematical proofs," which "Disc" had better discover for himself, from the first book of Euclid, which will enable him to see the four radii thus obtained are necessarily as 1, $\sqrt{2}$, $\sqrt{3}$, 2.—E. L. G.

[11304.]—**Nessler's Ammonia Test** is prepared by taking 8·5 grammes iodide of potassium, and dissolving it in 10 c.c. of water, 1·6 grammes mercuric chloride disolved in 30 c.c., and adding this last solution to the first until a permanent precipitate is produced. Then make up to 100 c.c. with solution of potash, and filter. In order to use it for the estimation of ammonia, a standard ammonia solution will be required, prepared by dissolving ·315 grammes in a litre of distilled water free from NH_3, 1 c.c. of this solution equals one-tenth of a milligramme NH_3. Place the solution to be tested in a cylinder of pure colourless glass, and stand it on a perfectly white surface, make it up to 100 c.c. in the cylinder, and add 1½ c.c. Nessler's solution: a tint will be produced. In another cylinder of the same form and size, containing 100 c.c. distilled water, add as many tenths of a c.c. as will be likely to produce the same tint (a point to be learned only by practice) of the standard solution of ammonia, and then 1½ c.c. Nessler's solution; allow to stand a few minutes, and then compare the tints. If not equal repeat the experiment until they are, and from the number of c.c. standard ammonia used calculate the NH_3 contained in the solution taken for analysis. This process is only suitable for the estimation of very minute quantities of ammonia.—Un Irlandais.

[11308.]—**Geocentric Longitude and Latitude.**—The following is the manner of obtaining the geocentric longitude and latitude from the heliocentric ones. The formulæ given last week by "Chronos" (p. 48) only indicate the connection between the two sets of geocentric co-ordinates. Let E be the earth, S the sun, P a planet, A the first point of Aries, or the vernal equinox, and E p S the plane of the ecliptic. Then A S p will be the heliocentric longitude, A E p the geocentric longitude, P S p the heliocentric latitude, and P E p the geocentric latitude. Call the two latter quantities L and l respectively. Then, from A S p and P S p, supposed to be given, we have to deduce A E p and P E p. Besides the given quantities, we must find the length of ES and p S. We can do this by the help of the *Nautical Almanac*, E S being the radius vector of the earth, and p S that of the planet $\times$ cos. L. We next arrive at the angle ... from the consideration that it is the difference



heliocentric longitudes of the planet and of the earth, the latter quantity being the longitude of the sun (given for every day in the *Nautical Almanac*) added to 180°. Therefore, in the triangle E S p, we now know the two sides E S, p S, and the contained angle E S p, called the angle of commutation. We can thus readily obtain the angle p E S, or angle of elongation; which, added to A E S, the longitude of the sun, gives the geocentric longitude of the planet. To find the geocentric latitude, we have:—

$$P p = E p \times \tan. l = S p \times \tan. L.$$

$$\therefore \frac{\tan. l}{\tan. L} = \frac{S p}{E p} = \frac{\sin. p E S}{\sin. p S E}.$$

$$\text{And } \tan. l = \frac{\sin. p E S}{\sin. p S E} \tan. L.$$

—V. B.

[11309.]—**Breaking-Strain of Hollow Iron Columns.** — The breaking-weight is found thus (Molesworth 1):—

For flat ends, W = 44·34.
For round ends, W = 13.

$$\frac{D^{3 \cdot 55} - d^{3 \cdot 55}}{L^{1 \cdot 7}}$$

D = outside diameter.
d = inside diameter.
L = length.

Or, by Lowndes, thus:—

$$\frac{(\text{Diameter in inches})^{3 \cdot 6}}{(\text{Length in feet})^{1 \cdot 7}} \times 44$$

for flat ends, and 15 for round ends. The strength nearly equals the difference between that of two solid columns, the diameter of which equal the internal and external diameters of the hollow one.—Eureka.

[11334.]—**Squinting.**—As it is probably only one eye that is weak, let "G. W. F." cause his little boy to wear spectacles with the glass next the weak eye covered with paper with a small hole in the centre, so that the eye, in endeavouring to see through the small hole, will pull itself straight. The spectacles should be mere preservatives, or they themselves would affect the sight. Indeed, if it were my own case, I should pull the glasses out altogether, and substitute cardboard with holes pierced exactly in the line of sight. There is a difficulty in making the child wear them, as they restrict the vision; but it is well worth persevering in, the results are so important. The expense is trifling, the trouble a labour of love, whilst a cure would be a joy for life.—J. H., Lancaster.

[11337.]—**Equation.**—The given equations are formulæ of the *arithmetical progressions*, and solution of them can be found in many authors of algebra.—Bernardin.

[11339.]—**Astronomical.**—The reason why the polar star does not change its situation is because the earth's axis in all parts of her orbit is constantly directed towards the same part of the heavens. The greatest difference in the position of the earth is the diameter of her orbit, and of course this is also the width of the parallel lines that may be drawn through the axis of the earth from the opposite parts of her orbit. From this we infer that either the poles have some slight deviation to that point of the heavens, or more probably that the polar star is fixed at such an immense distance that the difference in the earth's position produces no perceptible effect. If the polar star was nearer it would appear to describe a small circle in the heavens with the annual revolution of our earth.—C. W. H.

[11353.]—**Distilled Water.** — Chemically pure distilled water is absolutely pure, and contains nothing but oxygen and hydrogen. Ordinary water has multitudinous impurities, organic and inorganic, and is unfit for chemical manipulation, though more fit in general for drinking than the former, which is insipid and nauseous.—M. A. B.

[11357.]—**Berlin Black.**—Take 1lb. of drop black and ½lb. of Prussian blue; grind well down with turps, mix with turps to the consistency of paint, then add copal varnish to the gloss you require. A little sugar of lead will make it more adhesive.—G. Asher.

[11358.]—**Pressure of Water.**—Multiply the height of the top cistern in feet by ·4335, or divide the height in feet by 2·307, will give the pressure in pounds per square inch. R. Irons must be a dull scholar not to understand this. This is the theory, and for still water. But if the water is flowing due allowance must be made for the friction of the water in the pipe; also, that the pipe, or draw-off cock, from the under cistern is not too large to reduce the pressure therein. —Tubal-Kain.

[11359.]—**Casting Brass Solid.**—Dry your mould well, torch it if you can get at it with resin in a ladle, or dust well with blacking, and blow it well out again. Have two runners to the object, one to let the metal run in, and the other to let the air run out, and do not have your metal too hot. You can have your metal of what composition you like, from 1 of copper to 3 of spelter and upwards.—G. Asher.

[11359.]—**Casting Brass Solid.**—If about 1lb. of lead be added to 16lb. of old brass, when just at the melting point, solid brasses will be the result. In melting old brass, the zinc, or lead contained in it (when fluid) oxidises freely, consequently the proportions of the metal are altered, and require an addition similar to the above. If the brass has not been recast a little less lead will do, but if recast several times it may take the full quantity.—Novice.

[11362.]—**Silver Tubes for Meerschaum Pipes.**—Having made the silver tube to the gauge of pipe-stem and mouth, soften the silver tube by heating it to nearly a red heat (just below fluxing point), and plunge it at once into a silver pickle bath. Then, with a wooden mallet, and piece of bent half round iron or steel bar to size fixed in a vice, hammer to shape required. If it harden before it is properly shaped repeat the softening process and finish. Any shape, curve, or taper may be got by bending and shaping iron or steel rod to form the pattern or stake to hammer upon.—Practical Horologist.

[11362.]—**Silver Tubes for Meerschaum Pipes.** —Silver ferrules may be curved the same as any other metal by filling them with lead; have a pin of stout wire something smaller than the ferrule inside the lead, will serve to hold while bending; make a hole in a piece of wood, take off the sharp edges as if it had been countersunk, and bend to the curve required.—Never Rust.

[11364.]—**Lettering the Backs of Books.**—W. Stead will have to procure the irons necessary for this purpose. Those for lettering are simply punches with letters on the ends; others are made with various devices. These irons must be heated pretty hot, but by no means red hot, and wiped quite clean. A little finely-powdered rosin is then dusted on the leather, on which gold leaf is laid. The hot punch is then applied with firm pressure, by which the rosin is melted, forming a cement which retains the gold in the required form. The superfluous leaf is then wiped off. He had better, also, search old volumes of "our" paper.—V.

[11365.]—**The Wind.**—The south-west wind is the most prevalent; the average number of days the wind blows from this quarter is 114, the next being west, with 52 days. The above values are from Mr. Glaisher's paper on the "Direction of the Wind, 1861 to 1870," in the "Proceedings of the Meteorological Society," Nov. 1871, to which I would refer "Anemometer" for further information on the same subject.—W. N. M.

[11365.]—**The Wind.**—In an old weather book I find the wind blows the following average number of days:—N. wind 42 days, N. W. wind 33 days, W. wind 77 days, S. W. wind 58 days, S. wind 33 days, S. E. wind 26 days, E. wind 58 days, N. E. wind 43 days.—Monte Cristo.

[11369.]—**Etching Steel.**—Nitric acid or nitro-muriatic acid.—Philanthropist.

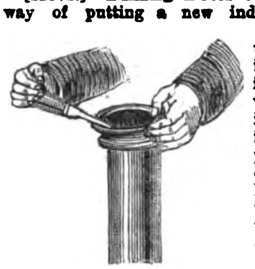
[11369.]—**Etching Steel.**—Dip the end (say one inch) of your spring in melting beeswax. When coated and cold make a hole in the wax with a fine-pointed needle down to the steel the size you require; put a drop of strong nitric acid on it, after an hour rinse off, and apply again; it will gradually eat through.—M. A. B.

[11371.]—**Steel for Lathe Tools.**—"L. S." will find economy in buying the best cast steel of any size. I should think ⅝in. and nine-sixteenths of an inch square would suit him for heavy turning tools for steel or iron, and ⅜in. to ¼in. for brass. The best way for him would be to go to one of the warehouses and look over their stock of odd lengths, and take any that look likely. The standard size—*i.e.*, Holtzapffel's for ornamental slide tools is about $\frac{11}{32}$in. × $\frac{5}{32}$in., or, say, nearly 35 × 15 hundredths. The fly and eccentric cutters are much smaller—viz., 21 × 11 hundredths. Marshall's steel, which comes really from Vickers, Sons, and Co., Sheffield, is good, but I learn that Vickers's XXX is a great deal better if you can get it. Stubs's are first-class, and to my notion Sanderson Brothers are as good as any I ever had. Buck, of Newgate-street, keeps them in all sizes, and Moser, High-street, Borough, all sizes. I used to get Stubs's at Greenfield's, in Broad-street, Soho, and Hedgecock and Cotton and Johnson, in Soho, keep Marshall's, for which now 1s. per lb. is charged for small stuff. Excellent steel is kept also at a shop in the north-west corner of St. John's-square, Clerkenwell, and all sorts of odd sizes at Mrs. Gray's, Clerkenwell-green, close by the Church. It is convenient to have by you a piece of steel that you can cut off in short lengths for making screw-dies. Also some for cutters to fit the different sized boring bars and countersink cutter bars. The better the steel looks outside—*i.e.*, the more carefully rolled round or square, as the case may be, the better chance there is of good inside; don't take any that has any external symptom of a crack, or that is much out of truth in respect to breadth of sides or squareness of edges, and the straight pieces will not require so much "setting" as the crooked ones. You will, of course, take care not to be at a loss for any square size under ⅝in., or any round under 1in. I generally have it cut in lengths of three or four feet. I don't see how you are to mend a broken casting; the only way out of your difficulty seems to be to drill and tap the screw hole a great deal deeper, so as to get down to solid metal, and fit another and a longer screw. I set my face against screws being such tight fits; but I suppose if slack fits were allowed in that nothing else would ever get fitted properly.—J. K. P.

[11371.]—**Steel for Lathe Tools.**—Better order direct from a good maker in Sheffield, and have best quality silver cast steel. State the purpose for which you require it to the maker, and he will fuse the mixture accordingly.—Tubal-Kain.

[11373.]—**History of England.**—"Ince's Outlines of English History" possesses considerable attractions for young pupils.—Excelsior.

[11374.]—**Fixing Belts on Tires.**—The readiest way of putting a new indiarubber tire on the intermediate wheel is to use a small post driven into the ground or fixed in a vice, the top end of which should just fit the inside of wheel, which is thus held in a steady position. Place one edge of the tire on the wheel, holding it firmly with the left hand, insert a turnscrew, as shown in diagram, and pull it round the wheel, which will stretch the tire sufficiently to snap it on. I do not think it worth while for "Blacking" to try and mend old tires.—F. T. S. S. D.



[11376.]—**Marble Busts.**—Warm water, soda and soap, using a brush where necessary; well rinse with clean water, leather off and finish with clean soft rag; if any stains remain make a strong solution of soda or potash, add soft soap, and a little lime or whiting to make a paste; apply to stains, let it be a day or two, then wash as before.—F. H. Saunders.

[11376.]—**Marble Busts.**—Let "M. B." wash the busts with turpentine, applying same with a sponge.—Wee Pet.

[11378.]—**Killing Beetles.**—The best way is to drown them in spirits of turpentine or in spirits of ammonia fortis (amm. spir. fort.)—Wm. Fred. Trinder.

[11378.]—**Killing Beetles.**—Put them floating on beer and sugar mixed in a soup plate, they will die drunk.—M. A. B.

[11378.]—**Killing Beetles.**—For killing beetles, &c., without injury and also without pain, I have always found the following method to be very successful. Get a circular wooden box with a lid that fits moderately tight, such as is usually obtainable at the druggist's, and used for holding violet powder and a puff, then line it throughout with tin foil to prevent evaporation. Then cut a circular piece of cotton wadding to fit the bottom of the inside of the box, then lay on that a disc of perforated zinc or of fine wire gauze to prevent the feet, &c., of the beetles or other insects from getting entangled in the fibres of the cotton. The box is now ready for use. To use it, saturate the cotton wadding with methylated chloroform, cover it with the disc of metal, then place the beetle or other insect in the box and shut it in and leave it for a time. I have generally put the box away for half a day, and on re-opening it I have invariably found the insects dead. I believe there is a perfect freedom from pain by this method.—Yoiza.

[11378.]—**Killing Beetles.**—Carbonic acid gas is used to destroy large moths; perhaps it may answer for beetles. It produces death so quickly that the moths often die with extended wings.—Excelsior.

[11380.]—**Sand for Casting.**—If you reside near a town where there is a foundry, you can easily ascertain where the sand they use is obtained from. "Go thou and do likewise."—Tubal-Kain.

[11380.]—**Sand for Casting.**—"Leonidas" must understand that the same sort of sand used for iron will not do for brass. To make good work, sand for iron should be fine and loamy, but not clayey, such as Mansfield sand. It should be rubbed and well mixed with a little charcoal dust, and used not too wet. When the mould is made, dust over with a slight dust of real yellow loam sand, and then with coal dust or blacking; put your pattern in again, it will make a flux and a print. For brass the sand should be a deal closer and tougher, and should be dried and torched, as it strikes so in damp sand; Moxley is the best sand for brass.—G. Asher.

[11382.]—**Parrot.**—Your bird either has vermin or requires vegetable food, sunshine, and open air; for the former take the head into your hand to protect the eyes, and blow fine snuff through his feathers, and sink the cage for an hour in boiling water. For the latter give a green or dry pepper pod, any kind of nuts, and a bit of apple or softer fruit occasionally, so as to scour gently. A warm bath submerging the body for a minute or two, and the head for a second or two before the application will make the snuff stick better and make the bird healthier; put some bruised aniseed at the bottom of the cage.—M. A. B.

[11382.]—**Parrot.**—"Cygnus" must give his bird a little flowers of sulphur (judge the quantity for himself) with its food, and avoid hemp seed, also sugar; both are very heating to the bird, and will cause it to pick off its feathers. I learnt this recipe from a dealer in birds in the Brazils some years ago, and have never found it to fail in many diseases parrots are subject to. —F. L.

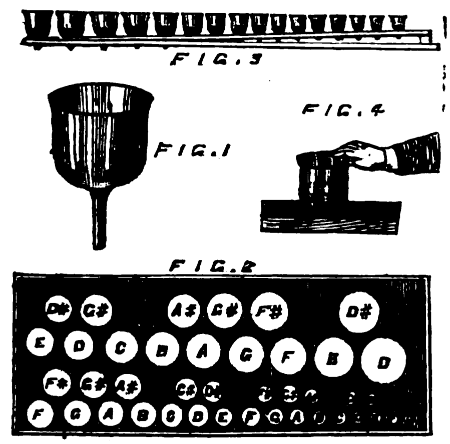
[11384.]—**Small Pox: Its Prevention and Cure.**—Phenic acid is another name for carbolic acid. —A. P. S.

[11384.]—**Small Pox: Its Prevention and Cure.**—In Bloxam's "Laboratory Teaching" phenic acid is described as being the same as carbolic acid. Liquid carbolic acid is usually met with as a brownish or brown liquid, having a powerful smell of tar. When poured into water, it sinks to the bottom. It is also found in moist needle-like crystals, colourless or pale brown. Very easily melted. Water dissolves it sparingly. Easily soluble in potash. Alcohol dissolves it readily.—V.

[11387.]—**Sundials.**—The gnomon has an angle of elevation equal to the complement of the latitude, or what the latitude wants of 90°.—Philanthropist.

[11388.]—**To Mr. Fennell.**—The organ alluded to, formerly contributed by me in the *British and Foreign Mechanic*, March 5, 1870, p. 595, is in no wise connected with the section which appeared in these pages. As the section sent was partly arranged by me from a small organ in the church of S. Bartholomew-the-Less, St. Bartholomew's Hospital. The design alluded to in the *British and Foreign Mechanic*, was not only designed but made by me, and is now in my possession, and as I formerly mentioned, I do not intend to introduce pipes lower than tenor C, as probably I shall descend to C C C C in the lower scale on the harmonium principle. The dimensions I will furnish: height, 8ft. 9in.; frontage, 5ft. 3in.; depth, 2ft. 6in.; height of keyboard, 2ft. 6in.; compass of keys, 3 octaves—viz., C C C up to F, the soundboard is pierced for 362 pipes, the remaining will have pedal arrangements. The dimensions given are not for the section, but my own instrument.—Joseph William Fennell.

[11393.]—**Metallic Harmonicon.**—I suppose "Valve" means an instrument which is played by striking strips of metal or glass with pieces of wood in the same manner as playing a dulcimer. I once bought one, the notes of which looked like gun metal, but after using it awhile I found out that the notes were glass covered over with bronze. Since then I have made one of glass, having five octaves with all the half notes. Each note is got by cutting pieces of glass into strips of different lengths, the notes he tunes by breaking small pieces off the ends with a pair of pinchers. An immense quantity of glass is used, or rather wasted, in obtaining these notes, as the least variation in the thickness of the glass will cause the notes to be wrong, whether it is the right size or not. If "Valve" intends constructing a musical instrument, and is not particular as to expense, let me recommend him to make, or rather put together, the following. Its name I never heard, and this one was constructed by my father many years since, and as far as I know cost a lot of money. It consists of a series of glass globes, similar to an inverted aquarium (Fig. 1), only instead of a knob as on an aquarium glass there is a tang, varying in accordance with the size of the globes. Some of these globes are as small as 1½in.



diameter, and others as large as 8in. diameter. They are arranged in proper order (Fig. 2) in a shallow box about 4ft. by 2ft., which is ornamented to serve as a piece of drawing-room furniture. To bring the tops of all the glasses to a level a piece of wood is fastened to the bottom of the box, seen in Fig. 3. Each globe wants to be fixed firm, and where there are any shakers, from the holes being bored too large, a little worsted is bound round the tang and the globe fitted in its place again. To play the instrument: make a concentrated solution of alum, and partly fill each glass; wash the hands clean, to remove all grease, and dip the middle finger in the alum water, and gently run the finger round the top edge of one of the globes (Fig. 4) and it will emit a clear sweet sound such as will never have been heard before, the nearest resemblance to it is the music produced by an Æolian harp. In playing both hands are used. The alum serves in the same way as rosin does to a violin bow, giving an edge, as it were, to the fingers. Now for the great drawback in the above instrument—expense! It will be seen that the least variation in the size or thickness of the glass will cause the notes to differ; so all depends upon the glass-blower, you might order fifty and still not get the note you wanted, and it is there the expense lies. Would pressed glass globes do instead of blown glass? If so, any quantity of one note could be manufactured, and then the great difficulty would be surmounted. If "Valve" wishes to experiment a bit, let him get two or three wine glasses and play them as stated above, and he will see what can be produced. There is one thing I forgot to say, that is, the edges of the globes are rounded and perfectly smooth. If "Valve" thinks of making one his best plan would be to try pressed glass globes; if he does, I should like to know the result; no doubt some of the readers of the English Mechanic, well up in pneumatics and acoustics, would give some improved shape of glasses to produce the required notes.—Zoo Andra.

[11394.]—**Opera Glass.**—If "Inquirer" will say what power he would like in the opera-glass, and whether he wants to know how to make the framework, or how to make the lenses, or both, I will try to help him, though the query is rather strong in its requirements.—W. Oldfield.

[11398.]—**Stinging of Bees, Hornets, and Wasps.**—If "Apiarian" rubs the part stung with a bruised leaf of common house leek, he will have immediate relief, it is equally useful for blistered hands and feet.—F. L.

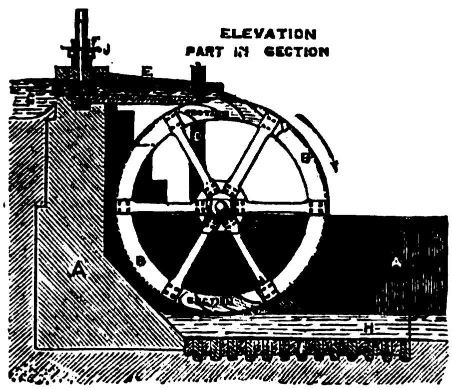
[11398.]—**Stinging of Bees, Hornets, and Wasps.**—In answer to "Apiarian," the first thing he must do is to extract the sting, which can be best effected by pressing the point of a small hollow key on the part, and then removing the sting by a pair of tweezers. Next, a few drops of camphorated spirits should be allowed to run over the stung parts. If this is not available, a little common salt may be rubbed in. (From the "Family Homœopathist," by Dr. Shuldham.)—J. E. A.

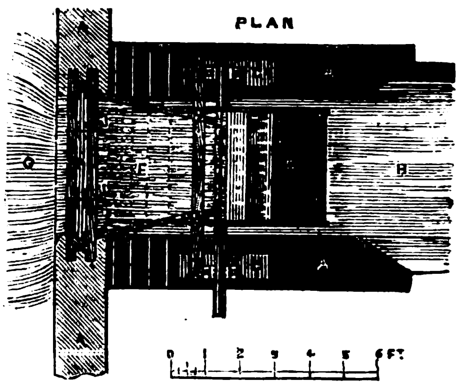
[11398.]—**Stinging of Bees, Hornets, and Wasps.**—Many years ago, in India, I contrived, in the dark, to put my hands on a hornet's nest. I was stung in two places. The pain was fearful. My native servant (a Bengalee) cut a small red onion, or rather several, and kept rubbing the places stung with the cut surface. In about two hours the pain had ceased, and I went to sleep, and (barring a little stiffness in the arm) next morning was not further inconvenienced. Since then I have used the same method for others, with success.—Khoda Bux.

[11398.]—**Stinging of Bees, Hornets, and Wasps.**—If "Apiarian" is going about the bees, let him carry a phial of strong water of ammonia, well corked, and with a camel's-hair brush in it. When stung, put on a drop of ammonia for a second, and wash off. There will be no pain or swelling if immediately applied.—M. A. B.

[11399.]—**Water Power Wanted.**—How many gallons or cubic feet of water per minute can you get, and what fall can you also get, to be applied as a motor? I fear a sketch of a turbine would be of little use to you. Better go to a maker of such if one is applicable.—Tubal-Kain.

[11402.]—**Water Power to Work Saw Bench.**—I inclose you drawing of this water wheel and arrangements. Data: Water wheel 6ft. diameter × 3ft. 2in. broad in clear of shrouds; shrouds, 7in. deep; buckets, 6in. deep; 24 buckets of sheet iron, pitch about 9⅜in.; diameter of shaft at large end for torsion and to carry pit wheel, 3in., of wrought iron; width of delivery end of launder over centre of water wheel, 28in.; width between posts of sluice, 4ft.; inclination or slope of bottom of launder, 1 in 36. A, the masonry of wheel pit and embankment; B, the water wheel; C, the pillow blocks of oak or stone; D, the supports for end of launder; E, the wood to launder; F, the sluice and frame; G, the head water in pond; H, the tail water below the wheel; I, the pitch paving under the wheel; J, two pins inserted in holes to keep the sluice, or gear may be applied. A lengthy description is unnecessary, having a drawing and scale. The lip of the launder should be brought down very thin; the extreme end is advisable to be made of sheet iron, about ⅛in. thick, and just sufficient space to allow the wheel to revolve under it without striking, and should be about 2in. short of reaching as far as a plumb line over the centre of the wheel. The inclination is required to give the water passing through the launder a greater velocity than that of the wheel. "Paddles" is a term applied to the floats of wheels working in an unlimited supply of water, or in flowing stream. In this case buckets is the usual term, from its somewhat similarity to that common utensil, to hold or to carry water.—Tubal-Kain.





[11403.]—**Gas.**—The gas supplied for lighting the underground railway carriages is carried in large tanks on top of some of the carriages, and carried to each carriage by means of indiarubber tubing. The tanks are filled every morning from a gas-works.—F.T.S.S.D.

[11407.]—**Magic and Conjuring.**—Drill a small hole in the bottom of a transparent decanter, partly fill it with a decoction of logwood in imitation of wine, and cork up the decanter's mouth; place the bottom hole in a box or hollow stand in which a basin is concealed; make an ornamental case to cover the decanter entirely; then construct another similar case with a chamber in its upper part having a hole at the top and another at bottom; fill this also with artificial wine, and cork the top hole as before. Exhibit your bottle of wine at one end of the room, pull out the cork, put on the cover, and allow the liquid to run slowly out of sight; meanwhile, place the other cover over an empty tumbler at the opposite end of the room, take out its cork, and the liquid will slowly run down and fill the tumbler; so that when the covers are removed the wine appears to have passed from decanter to glass by magic, though actually done by atmospheric pressure. It helps the delusion to connect them by a long string or chain while the wine is flowing.—Chime.

[11408.]—**Sewing Machine.**—Undoubtedly the rotating hook is the simplest, quietest, and least liable to get out of order, and this I say after six years' use of the same.—J. W., Leamington.

[11408.]—**Sewing Machine.**—Sewing machines I should say, are divided into three classes. (1) The single-thread chain-stitch. This is very simple to work, but the stitch opens out backwards like a stocking. It also uses up a great quantity of thread, fully four times the length of the seam. (2) The double-thread chain-stitch—such as Grover and Baker's. The upper thread is supplied from a spool in the ordinary way; the under thread also from a small spool passes through a snake, which loops it into the upper thread on the under side of the fabric, and presents an appearance very like the chain-stitch, but if anything still more unsightly. This stitch is not so liable to unravel if cut at any part as the single thread-stitch. It can also be taken out backwards; pulling out first the under thread and then the upper. The quantity of thread used is still greater than by the chain-stitch. (3) The lockstitch, formed in two ways, as stated by "E. B. F."—the shuttle as in Singer's, and revolving hook as in Wheeler and Wilson's. In both the under-thread has to be wound on the shuttle; the seam does not rip, and the thread consumed is much less than by the other methods. In the former the needle is straight, and descends perpendicularly, and is, therefore, better suited for leather and heavy cloths. In the latter, the needle has a slight curve answering to the motion of the arm. I should, therefore, recommend Singer's for heavy work, and Wheeler and Wilson's for moderate and light work. The under-thread apparatus of the latter is no more apt to get out of order than the shuttle, while it works more lightly and noiselessly. The seam of the lock-stitch is alike on both sides unless the tension of the under-thread is too great, when it runs right along the under side of the cloth instead of being pulled into it.—Irish Mechanic.

[11409.]—**Canine.**—Probably the distemper is coming on. I cured my dog (a Pomenarian) of this with Dr. Rook's Oriental Pills, giving a couple each day for about eight weeks in pieces of meat, which she readily swallowed with chewing. Giving these on the first signs of the complaint, and always since when the least out of order she had but the slightest touch of the disorder and ever since has had a splendid coat. Long dosing may be required to restore your retriever, but I am certain the pills will eventually do it more effectually than any other medicine.—Amateur.

[11409.]—**Canine.**—I think your dog is too highly fed with animal food. Has he access to grass? which all dogs eat as a purgative. Give only soup (no meat) with plenty of vegetables in it, a good pinch of salt, and occasionally a little sulphur. Does he rub himself against pillars and posts? If so, he has most likely parasites. Sulphur is best administered to a dog by being mixed with lard, and his body smeared all over with it. Chain him then on a bed of clean straw, and he will lick off the sulphur and lard. His smell for some days will be very offensive.—M. A. B.

[11410.]—**Geometrical Question.**—Let "Thetamu" bisect A B in E, and he will see that (having joined C E) the triangles B C E, B A D have one common angle at B, while another angle of each, at E and at D, are right angles and equal. Therefore, their remaining two angles, D A B and E C B are also equal, the latter being half A C B.—Q. E. D.—E. L. G.

[11411.]—**Line Shaft.**—There are two ways of doing it. I should fix my dumpy level as near as possible under the mid-length of shafting, and take sights at the extreme points first, the intermediate points after. Then measure up or down, as the case may be, to horizontal centre of the shafting at the several points. After that drive nails in wall at both ends, and stretch a line from nail to nail for the transverse line of plummer blocks and centre of shaft. An ordinary workman would first fix the two nails as near level as he could, but exactly in the transverse line of the shafting, and set out his plummer blocks by a long "straight edge," upon which he would place a spirit or other level, taking care to prove both the "straight edge and level," by seeing they are true, and will, reversing, show the same result.—Tubal-Kain.

[11410.] — **Geometrical Question.** — Construct figure and draw C E perpendicular on A B, it will easily be seen that C D E and A D B are similar triangles, and that E C B, the half of A C B = D A B.—Bernardin.

[11414.]—**Unripe Seeds.**—M. P. Duchartre in his "Eléments de Botanique," Paris, 1867, gives an extract of a paper on the subject by M. Cohn, of Berlin; the conclusions of that paper are:—1. The germinating power does not coincide with the maturity of the seeds, but precedes it. 2. In many plants belonging to several orders a seed can germinate when its development is not yet very much advanced; it seems, however, necessary that the embryo fills a great part of the cavity of the teguments, and that the albumen has been absorbed or has taken consistence. 3. In general, plants coming from unripe seeds are not weaker than others. 4. The germination seems to take place in the least space of time possible at a mean degree of formation of the seeds; younger or older they germinate slower. (More particulars v. op. cit. p. 688.) —Bernardin.

[11415.]—**Scarlet Runners.**—The red and white (York and Lancaster) are the most ornamental. The white (eclipse or giant white) are the most delicately flavoured, and the beans are much larger and the plant a stronger and taller grower than the other two. All require a soil well manured with rotten dung. The want of water caused the bloom to fall off. This was the case with mine last season, as I wanted all I could spare for marrows. All leguminous vegetables require abundant and constant supplies of water; in fact, in their growing season it is impossible to give them too much. Sow the second week in May, in seed beds, and when the seed leaf is fully developed, transplant where they are to grow, taking especial care to plant them deep enough for the seed leaves to touch the ground. They come into bloom sooner when transplanted.—Amateur.

[11417.]—**White Polish.**—Let "Stilton Cheese" take rectified spirits of wine 2 gallons, gum sandarach 5lb., gum mastic 1lb., gum anime 4oz., put them into a clean can or bottle to dissolve in a warm place. Must frequently shake the vessel and contents. When the gums are dissolved, strain it through a lawn sieve, and it will be fit for use.—Oldham Harry.

[11418.]—**Absorbing Quality of Printing Paper.**—I quote the following from "Notes and Queries":—"Finely powdered *pounce*, rubbed in lightly with the finger and then burnished with an ivory folder, will cure the most absorbent paper. But if, as is generally the case with German manufacture, the paper has a tinge, the burnishing whitens it. For such paper (as for all, except that the resort requires a poultry yard) the white of a fresh egg applied lightly with a flat camel's-hair pencil, produces a sizing like foolscap. It takes but a few minutes to dry and is perfectly transparent.—S. H. A."—Henry W. Henfrey.

[11419.]—**Half-Horse Power Turbine.**—See reply to query 11309.—Tubal-Kain.

[11421.]—**Photography.**—"Camera" should be careful in developing, to see that the developer flows evenly over the whole surface of the plate without being checked until it reaches the opposite extremity, when by gentle oscillation it will flow backwards and forwards until the picture is fully developed, when it should be gently washed, and then placed in the "hypo. bath" and left there for about three minutes, if left longer it may dissolve off a portion of the film, and, of course, carry away part of the picture. The coating, sensitising, developing, and fixing, should all be done in the dark room, and as little artificial light used as possible.—C. S. W.

[11421.]—**Photography.**—"Camera" seems to be wrong considerably. The plates should not be in the bath so long as four or five minutes; I have generally found two minutes quite sufficient. After developing with iron they should be well washed, which is apparently omitted by "Camera." Before fixing they should be intensified or "redeveloped;" an almost endless variety of methods and formulæ for which are given in the works referred to. I have tried a great many, and prefer the pyrogallic and silver. The "fixing" should be a weak solution of cyanide of potassium, washed over the plate until the undecomposed iodide is dissolved. This is much better than plunging into a bath of hypo. It is possible that in addition to the errors in working, a bad collodion is used. Try Mawson's. For "Camera's" comfort I will just observe that the art of photography is by no means easily learned. Difficulties and disappointments crop up constantly, and it is often the case that the very same materials and solutions which produce nothing but "failures" in the hands of a novice, will yield capital pictures when manipulated by a more advanced student. Let your motto be "Nil Desperandum," and push on till you succeed.—J. A.

[11421.]—**Photography.**—"Camera" should not let his plate remain in the hypo. bath so long. As soon as the yellow coating is removed it should be washed thoroughly to free the film from the hypo. He must also wash well after the iron solution, before fixing. Perhaps there is something bad in the washing water which causes the difficulty.—Occasional Photo.

[11421.]—**Photography.**—To "Camera."—One of two things. 1. Your bath is not strong enough; 2. You do not expose long enough, or your pictures want intensifying with pyrogallic acid and silver after the iron develops. Procure a thoroughly good negative on glass, and compare it with yours by transmitted light (by reflected light yours, of course, will have a yellow film of undissolved iodide of silver over it). After the iron development, wash well, and add two drops of your silver-bath to some pyrogallic acid, and swill over plate till by transmitted light it is a shade darker than you require. Fix by swilling plate with solution cyanide potassium, not hypo., and wash well. Wash thoroughly after each different chemical solution.—M. A. B.

[11422.]—**Night and Day Temperature, &c.** —1. The only instance in which the sensible heat is greater by night than by day is, when a bright clear day is succeeded by a very cloudy night. In such a case the heat radiated from the surface of the earth would be reflected back to it by the clouds; the convective currents (which on a fine and starry night rapidly carry off the heat) would be less rapid; and, lastly, in the day, by the conversion of water to vapour, 500° Cent., or 932° Fahr. of heat are rendered latent, and by the liquefaction of ice or snow, 75° Cent., or 167 Fahr., on the setting of the sun a reaction sets in, and a large proportion of this vapour is liquefied, which, with (in winter) the freezing of water greatly increases the temperature of the air by the liberation of the heat rendered latent during the day. But the influence of this latter cause alone would be insufficient to make the temperature of night higher than that of day, were it not for the combined action of the two first mentioned. To sum up all, we may say that the cooling of the earth results from radiation, convection, and free heat becoming latent—hence, when these processes are in any way hindered or reversed, as on a cloudy night, when the clouds act in the same way as the roof of a building, it is plain that the heat by night would often be greater than it would be by day in any place not subject to the direct rays of the sun. 2. Again, with respect to winds, similar causes come under consideration; convection is, perhaps, one of the principal of these; that is, air being incapable of receiving heat directly from the sun, is heated only by contact with the surface, considerably, if the surface be earth, and in a less degree if it be water, which accounts for the fact that the strongest winds flow from the ocean. This rarefied air ascends, giving place to colder, and this process being repeated cause ascending, descending, and horizontal currents, the latter of which we call winds. Now, as this can only effectually be carried on by day in those parts receiving the direct rays of the sun, it is not improbable that the violence of a wind should be decreased by the withdrawal of those rays. But there are evidently exceptions to this rule, for—(1) the sun must be shining somewhere, and consequently the air will flow in a current of varying force towards that part; (2) there are some invariable winds, such as the trade winds, which are caused by the rotation of the earth on its axis, the thin film of air being left behind by the denser matter of our globe. But still there is sufficient ground for the opinion, universal among sailors, respecting the influence of night on the atmospheric currents.—E. James.

[11423.]—**Surgery.** — Do nothing. There is no danger; the piece of needle will work its way out. When the point has protruded sufficiently from the skin for it to be seized by the fingers, lay hold of it and pull it out. It will be rusty and brittle, so no attempt should be made to take hold of it with pliers or any other instrument, as the point might get broken off, and the rest might then remain in the finger for an indefinite period, perhaps for life. Do not let it be cut down upon, for the operation is by no means a simple one, and might not succeed.—F. R. C. S.

[11423.]—**Surgery.**—I speak from the authority of being a F.R.C.S., with fifteen years' constant army and civil practice. No surgeon in his senses would operate. As well look for a needle in a bundle of hay, and the finger might be cut to mincemeat and the needle not found. My advice is, "let it alone," carefully shielding from accidental hurt. The needle in time will work itself out, and if any point should become painful, poultice it continuously with hot poultices. If a small abscess should form, the needle will be discharged through this. Preserve as much motion in the joint as possible without creating pain or inflammation. Pins that foolish girls have swallowed have been extracted after long intervals from the thigh or calf—Heaven knows what road they took. I myself extracted a bullet from the right arm which had entered the left cheek. Above all things, let no one be handling or examining the finger; there is no danger save from meddlesome surgery.—M. A. B.

[11426.]—**Screw Cutting.**—A 4in. centre lathe will require a leading screw of ⅞in. or ⅝in. diameter, and the most convenient pitch would be four threads per inch, with the angle of the thread 22½°. The distance will depend on the design of lathe.—Tubal-Kain.

[11426.]—**Screw Cutting.**—The diameter of your screw depends partly on the length of your bed. I am having one cut now for a 4ft. bed, the largest size that 1¼in. steel will contain, and 8 threads to an inch. A V thread is much better than a square one for convenience in getting the nut to clasp on comfortably. My old lathe with 3ft. 4in. bed has only a ⅞in. screw, but that has a support under the front end of the mandril head, as shown in Fig. 1, No. 187, p. 20, and just omitted immediately over the word lathe in No. 297, Fig. 6, p. 256, of the same volume. I like this way of doing it best, as you can change ends with the screw, both ends being fitted to the socket, and any other arrangement for this purpose seems to me to involve more work, though, to be sure, it is not often done at all. Without this support marked "bearing," the screw would be too weak, as it is only ⅞in. diameter at the bottom of the thread. So I should think Whitworth's standard 1in. in diameter, and 8 to an inch would suit you perfectly and relieve you of all difficulty about making your nut, which should be made in one piece and cut in half after tapping, if of cast iron, or may be in two pieces soldered together if of gun metal. I don't think there is any better plan for the arrangement of the nut than the one I gave in No. 287, p. 20, and that plan seems to have suited the late Mr. Babbage, for I found two new ones ready to be attached to some machine amongst the "useful wrought and cast-iron work" at the sale of his tools on the 1st March last. There is no occasion, however, to make the cam (Fig. 4) with curved slots, which is somewhat difficult, in fact, straight ones properly placed would hold firmer, if that is thought anything of. But it is a mistake to suppose that a V thread has any more tendency than a square one to push the half nuts open, if they each embrace, as they should do, nearly half of the circumference of the screw. If they do not, then, of course, it has such a tendency, and straight slots would cure that as well, or better than curved ones. The screw should be about halfway down the bed if outside in front, which makes 6in. to 6½in. distance of centres for a 4in. lathe. Leading screws have sometimes square threads, and sometimes round tops and bottoms with upright sides. I made a piece of screw about 2in. long as a pattern for Mr. Wilkinson to cut my new one by, flat at the top and bottom, but with sides sloping 10 degrees, and he declared the nut would not open and shut on such a screw, from the sides not sloping sufficiently. I have not tried it, but I can see it would be a near thing whether it would or not, so I have decided on a rounded V thread ⅛ pitch. In the drawing (p. 20) I have put "double thread ⅛ pitch," but that was done for the purpose of obtaining very high pitches which are not commonly wanted, and with my new screw I shall gear from the back spindle where they are, as that travels three times as fast as the mandril. In Whitworth's 5in. lathe the nut embraces about a quarter of the outside circumference on each side, or barely one-half altogether, and much less towards the middle, which accounts for the nut being able to open at all on the rounded thread with upright sides. (See Vol. XIII., No. 314, p. 37, for drawing.)— J. K. P.

[11428.]—**Violin.**—In reply to "W. P. D." in reference to violins made by Thomas Smith, London, I may inform him they are of no famed name or particular value. Smith was a pupil of Wamsley, and wrought until about the year 1800. The violoncellos of this maker were held in the highest estimation, some of them having fetched good prices—viz., £40 and £45, but his violins are rather mediocre in quality.— P. Davidson, Author of "The Violin."

[11429.]—**Ferns.**—If "E. T. S." will try carbolic acid in his fern-case I should think he would get rid of mildew, it being one of the best preventatives of fungus life, as is shown in Dr. Crace-Calvert's last paper read before the Royal Society. Put a few drops of carbolic acid into a small bottle, then cover the acid with water about half an inch deep, to prevent its too rapid volatilisation. Many years ago, before carbolic acid was known commercially, I had to abandon a fern-case, because all the most delicate ferns were killed by mildew; so that if "E. T. S." tries this I shall feel much interested in knowing the result.—B. D. T.

[11431.]—**Tinned Water Bottles.**—"London Rifle" cannot plate them by any means whatever. If he objects to the oxide of iron (it won't hurt him) he had better purchase Britannia Metal or German silver bottles. They are, of course, better if plated.—J. A.

[11431.]—**Tinned Water Bottles** can be plated, but "London Rifle" will find it rather tedious, and most likely to fail. To make a respectable job, unless used to plating, he had better let a practical person do it, but iron rust will do no harm to the liquor. If he has not well washed the bottle with warm water, and allowed it to dry before using it, the tin and salts used in soldering will give the liquor a bad flavour. The bottle should be rinsed, and dried in a warm place, with the mouth open and uppermost, before putting it away after use.—Illusionist.

[11434.]—**Salmon Spawn as Bait.**—"Pantile," in answering this query, should have added that by section 9 of the Salmon Act, 24 and 25 Vic., c. 109, "No person shall use any fish roe for the purpose of fishing," or "buy, sell, or have in his possession, any salmon roe." Penalty 40s. for each offence. The only exception made is possession of salmon roe for artificial propagation or scientific purposes.—Jannifred.

[11434.] — **Salmon Spawn as Bait.** — The querist must be an intended poacher. But, for his consolation, I beg to quote the gist of the Act of Parliament, 25 and 26 Vic., c. 97, s. 11: "To use, or have in possession, salmon roe, incurs £2 penalty, and forfeiture of the roe." I hope no gentleman will answer his inquiry; or you, Mr. Editor, turn your columns into a nursery school for the vilest description of poaching.—Joe.

[11434.]—**Salmon Spawn as Bait.**—That ... (surreptitiously) is the roe, as it is termed, of the fe... fish, small globules about one-sixth of an ... diameter. Perhaps "King-Fisher" is not aware ... its use is prohibited. Some time since, P...

"Advise to young men about to marry" was, "Don't." I would suggest similar advice to "King-Fisher" respecting salmon spawn.—TUBAL-KAIN

[11435.]—**Bootmaking.**—"Crispin" might as well ask a baker to make a loaf with dry flour as ask a bootmaker to work leather without soaking. Sole leather should be well soaked, and when half dry well hammered, it will wear well then. I have been thirty years at the trade but never attempted working dry leather.—CORDWAINER.

[11436.]—**Harmonium.**—"K. T. L." ought to be musician and mechanic enough to know that the channels of an harmonium reservoir (or pan, as he calls it) should be graduated the whole way through the harmonium according to the width and length of the vibrators, leaving plenty of airway and depth for stop slide.—PRACTICAL HOROLOGIST.

[11437.]—**Sash Tool Handles** are, I am inclined to think, made now just as they were forty years ago, i.e., 1st, cut to the required length by a saw; 2nd, dressed by an axe to the nearly required diameter; 3rd, turned in the ordinary way in a common lathe. No improved process has, I fancy, ever been attempted. "Simpleton" may bear in mind (should he be not already enlightened to that extent) that to make a sash-tool handle properly it should be turned down or grooved, as it is technically termed, at the larger end to a depth corresponding with the thickness of the string to prevent the binding from slipping off. Few are made this way; but a painter knows which is best.—J. G.

[11442.]—**Old Wives' Science.**—There is no foundation in the statement that when the sun shines on the fire it puts it out. It is said that if the fire be nearly out, and you put a screen before it, or draw the blinds, or close the shutters, it will immediately begin to revive. But it is forgotten that a fire which, in a well-lighted room, looks dull, or out, will appear to be in tolerable condition when the same room is darkened.* If "A. Liverpool" will refer to *Philosophical Magazine*, September, 1869, he will find an account of a series of experiments undertaken *ad hoc*, by Mr. Tomlinson, which tend to prove that if the sun's rays exert any influence at all it is rather in favour of the fire than against it.—S. BOTTONE.

[* See Rodwell's "Dictionary of Science."]

[11451.]—**Weight for Safety-Valve.**—I send the following for E. Nayler's benefit. Let me first point out the errors which are most commonly made in calculating safety-valves. The first is that of treating the lever as one of the first order instead of the second, and dividing the distance between the centre of the valve and the end of the lever by the distance between fulcrum and valve centre, instead of dividing the full length of the lever by the same. The next is in calculating the weight of the lever. The effective weight of the lever is found by multiplying the weight of the lever by the distance of the centre of gravity of the lever from the fulcrum, and dividing by the distance between centre of valve and fulcrum, which must be divided by the area of the valve in finding the pressure per square inch. Now, the area of the valve in question is 1·767 square inches, and if the lever is parallel, its effective weight will be about $\frac{12·5}{2}$ oz. × 8 = 50oz., which, together with the valve, will equal about 3·5lb.—

$$\frac{1·767 \times 40 - 3·5}{\frac{16}{2}} = 8·397\text{lb.}$$

to be placed at end of lever to blow off at 40lb. Now, we want the position of this weight for 30lb.—

$$\frac{1·767 \times 30 - 3·5}{\frac{8·397}{2}} = 11·8\text{in.}$$

from fulcrum. In the same manner, by substituting 25 and 35 for 30, may be found the positions for blowing off at 25lb. and 35lb.—TANTALUS.

[11454.]—**Commercial.**—E. and O. E. that "R" frequently sees on bills, &c., stand for "Errors and Omissions excepted."—AN OLD CONTRIBUTOR.

[11455.]—**Daisy Extractor.** — Fasten a small block of wood on the back of an ordinary steel pronged dinner fork to act as fulcrum to the lever.—SELWYN.

[11457.]—**Motive Power for Amateurs.**—No combination of weights would give the pendulum power enough to drive the saw. Complication only wastes power by friction, &c., and if a falling weight won't do, nothing added in the way of wheels or mechanism will improve your position. In your sketch the driving band of the saw comes above the saw table. You must avoid this in actual practice unless the table is very wide.—W. J. HOWARD.

[11457.]—**Motive Power for Amateurs.**—As "Zoo Andra" would like to know of any better arrangement than his, he will perhaps forgive me for telling him that he is departing from the first principles of mechanics in using (unless the arrangement is otherwise impossible) any reciprocating motion to produce a rotary one, as the conversion of the one into the other motion implies additional friction. A simple fly-wheel crank handle and strap would be infinitely preferable. If to be driven by hand, and if with a weight, a movement somewhat similar to an eight-day clock, with an adjustable fan to regulate the speed instead of the pendulum, would be far preferable.—A, Liverpool.

[11460.]—**The Beehive.**—To PHILO.—I probably know less about bees than even about electricity, but I can remember being told thirty-two years ago, by a man at Tottenham who kept them, that bees do not go to flowers for honey, but only for the materials for wax, and that his bees, to feed, or at any rate to get honey, went right away across the Lea into Essex to the forest, and that honey is collected from the leaves of the forest trees. He also said that a bee on the wing is one of the fastest flyers in nature; also that he lost many in their attempt, when laden, to cross the Lea when a sudden shower occurred.—J. K. P.

[11464.]—**Spring Beds.**—I would advise "Associate" to have nothing to do with spring beds or mattresses. The weight of the body depresses them most under the region of the heart and lungs, and causes the feet to be unduly elevated, thereby causing stagnation of the blood about the chest, and allowing the feet to become very cold. Though luxurious at first apparently, they are generally enervating after a while.—W. J. HOWARD.

[11466.]—**Vermin and Pigeons.**—Carbolic acid is the best wash for pigeon-houses and for pigeons. One of Dumont's patent puffs (which can be bought at any oil-shop) will destroy any vermin without hurting the birds. Carbolic acid will also prevent mits and fleas breeding.—DYOLL.

[11469.]—**Air and Warmth.**—The amount of air per man in sleeping rooms varies greatly with the season of the year, and the number of persons in the room. One person will do well enough with 300 or 400 cubic feet in all weathers, but the more air the better; but 800 feet would be a poor supply for two persons unless with very good ventilation. My bed-room contains 3,000 feet (20 by 15 by 10) which is a good size for self, wife and baby. The temperature should range from 50° to 60° Fahr., but for young children not below 60°.—W. J. HOWARD.

[11470.]—**Pocket Barrel Organ.**—This is simply a musical-box without a spring, instead of which the barrel is turned round by a handle.—FIDDLER.

[11471.]—**Bow.**—First hickory, second lancewood. —A., Liverpool.

[11472.]—**Plaster of Paris.**—Your plaster of Paris has become valueless by exposure to the atmosphere.—A., Liverpool.

[11473.]—**Weak Voice.**—Milk will certainly do your voice no harm, but raw eggs are said to strengthen the voice. In my opinion the best thing of all is to practice regularly every day the ordinary scales, standing upright, with the head well thrown back, or join a singing-class, and sing as loud as you can.—WHITAKER.

[11473.]—**Weak Voice.**—I am inclined to think that the best remedy is to practice singing with another instrument that has good wind. This will prove the finest medicine if the lungs are not too far gone; for exercise by loud speaking or singing will strengthen the lungs if gradually resorted to. For this reason all young people should sing heartily, and thus banish asthma till they get to a good old age. The best nostrum is a little cold water after your singing.—FIDDLER.

[11478.]—**Silver Bath.**—It will depend on two things. 1. The amount of nitrate of silver in the bath. 2. The amount of iodide in the collodion. A bath which contains much less than 20grs. of silver to the ounce of water will not give satisfactory pictures; hence we may take this as the minimum to which it is desirable to work a bath. Therefore, supposing the collodion not to contain more than 4grs. of iodide to the ounce, the following will be approximations to the amount of collodion which may be sensitised in baths of the two usual strengths:—1. 8oz. bath, containing 86grs. of silver to the ounce; 32oz. of collodion. 2. 8oz. bath, containing 30grs. of silver to the ounce: 20oz. of collodion. It is almost impossible to state the number of plates, as some operators leave so much more collodion on the glass than others.—S. BOTTONE.

[11480.]—**Model Steamboat.**—You do not state the size of your cylinder, but in any case I may tell you that you cannot have a "cabin" 8in. deep in a boat propelled by paddles so small as 3½in. diameter. The machinery of model steamers is always far larger in proportion to their size than in regular ships. But if you determine to try (and after fifteen years' painful experience I would solemnly say "don't") make the boat of tin, it is the lightest material and gives most room inside, and as to shape, copy any row-boat you see.—W. J. HOWARD

[11487.]—**Preventing Rust.**—Give the iron a coating of linseed oil and whiting, mixed together in the form of a paste; it can soon be cleaned off again when you want to use the iron, and will keep the iron from rusting for years.—GIG-LAMPS.

[11489.]—**Weight of Cattle.**—Take the girth of the animal just behind the fore legs in feet and tenths. Take also the length from the top of the shoulder to the tail head in the same way; multiply the square of the girth by the length, and the product by a fraction, which varies according to the sort of animal; for the foreign beasts commonly imported multiply by ·22. For a prime fed North Devon or Scot use ·28. For shorthorns I find ·25 as a multiple very near the mark. The result will be the weight of meat in stones of 14lb. each. For example: a bullock girting 6ft. 6in. and measuring 4ft. 9in., will be 6·5ft. by 6·5ft. by 4·75ft. by ·25 = 50·175 imperial stones. The above was the measurement of an Irish shorthorn heifer which I sold as 35 score, and which realised in the scales 35½ score, or 710lb. = 50 stone 10lb. To measure accurately requires skill, not only in the actual measurement, but also in the making the animal stand fair. I refer your querist to Merton's "Encyclopædia of Agriculture," under the title "Ox." Butchers do not like buying by measurement; in fact, if they know their business they will always buy by hand. If they have not confidence in their own judgment, they prefer buying by weight of dead meat in the scales. I would not recommend the owner of fat cattle to adopt this plan, as the butcher, if so inclined, has the opportunity of diminishing the weight very materially. As I fatten a score or score and a half beasts yearly, I have purchased a weigh bridge and sell by hand, taking care previously to ascertain the live weight, and I then reckon ·60 of the live weight as the quantity to be turned out of the dead meat scales, in case of moderately fat animals. This is within 2 per cent. of the real weight. The old mode of calculating 14 to 8 was too much in favour of the butcher.—KHODA BUX.

[11490.]—**Dumpy Level.**—"Shepherd's" instrument has a very common complaint, which fortunately is practically of small importance. The cause of it is want of truth in the fitting of tube of the rotating plate on the central stalk. Mine was that way for a length of time, and I found on examination that the flat bearing of the end of tube on the plate had a slight inequality. If you find which pair of adjusting screws the tube stands best over, and place that pair of screws so as to be in line with any one of the three legs, and then mark that leg so that you can always know it from the others at the moment you dismount the instrument from your shoulder when going to observe, and take care to let that leg, when on the ground, always point in the direction from which you are travelling, you will always have the telescope in the most favourable position for both back and fore sight, and the marked leg will always be in the best direction for setting the instrument roughly. If you live in or near London, and address me at Pitcairn's Library, King's College-road, N.W., I can arrange to show you how to rectify it, and, perhaps, put you up to a dodge or two in adjusting, and possibly in field-book too.—J. K. P.

[11492.]—**Carbonic Ink Paper.**—Wax, and iron out, between folds of bibulous paper, the desired quantity of any unsized paper. Smoke carefully on both sides, over the smokey flame of an oil lamp or unsnuffed candle. I presume this is to be used for copying.—S. BOTTONE.

[11495.]—**Double Oscillating Steam Cylinder.**—It is evident that your engine is not in working order—something jammed—piston, probably, packed too tight. Very dangerous to use a tin boiler. Look out for your eyes. Will eat into holes quickly—more so, if any other metal, as brass, be introduced. Go to a coppersmith and get a little boiler made with a flue running up the middle for the smoke.—A., Liverpool.

[11505.]—**A Wooden Pump.**—This can easily be done by cutting sufficient off the pump spear, so that the new leather will not reach so far as where it formerly worked, and it will then draw the water as well as before, if the water, from surface of well to lift bucket, does not exceed (say) about 28ft. in height. —A., Liverpool.

[11506.]—**Refractive Index of Glass.**—This can only be obtained by direct experiment. Generally speaking, the higher the specific gravity the greater the refractive index. See "Dictionary of Photography," by Sutton, 1867.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "J. G." has answered 10501; "Cocoa Nut," 10556; "C. E. S," 10833; "E. L. G," 10853; "Schoolboy," 10857; "Tubal Kain," 10918; "Never Rust," 10963.

11012 London Strata, p 622
11014 Green Stain, 622
11020 Strongest Bressummer, p. 623
11022 Steam Engine, 623
11032 Wheel Cutting, 623
11036 Periodical Winds, 623
11039 Polishing Serpentine and Malachite, 623
11043 Carbon Enlarging, 623
11045 The Bug Bible, 623
11047 Engine Surveyors for Board of Trade, 623
11050 Fishing Tackle, 623
11056 Engine Drivers and Stokers, 623
11058 Red Stain and Polish for Kitchen Chairs, 623
11068 Testing Engines, 623
11069 Coach Painter and Labourers' Wages, 623
11078 Aurora Borealis, p. 624
11083 Treacle Beer, 624
11087 Economy in Steam Power, 624
11094 Frosting Electro-Gilt Articles, 624
11095 Microscopic Deposits on Bricks, 624
11097 Hydraulic Punching Machines, 624
11098 Setting Single Flue Cornish Boilers, 624
11102 Hydraulic Lift, 624
11104 Tanning Leather, 624
11105 Cotton Spinning, 624
11110 Incubator, 624

QUERIES.

[11513.] —**Refining Animal Oil for Sewing Machines.** — Could any of your scientific correspondents give the best and simplest way of refining animal oil for sewing machine purposes?—J. W., Leamington.

[11514.]—**Brunswick Black.**—Can "Jack of All Trades," or any other subscriber, tell me how to make the above-named paint—the same is sold in 6d. bottles by all ironmongers, and has a gloss on it when dry—as I want to make it cheaper as I use a great deal of it, and its cost is enormous? Can it be made cheaper?—F. T. S. S. D.

[11515.] — **Wood-Planing Machine.** — Can any brother reader inform me how to make a wood planing machine to be driven by steam?—F. T. S. S. D.

[11516.]—**Veneering.**—Will some reader give me a little information on laying veneering and the process of filling up the grain of the wood, and afterwards the process of French polishing?—Joiner.

[11517.]—**Lathe Queries.**—Dividing (or counting) index for the division plate, pillar fluting chuck, and spherical chuck, with the latest improvements. I would be much obliged if any reader would explain the construction of any of the above, and, if possible, with a sketch of same. Also, the name of the book containing a description of the elliptical cutting frame, as, though an explanation of it has been asked for through the columns of the English Mechanic (on one or two occasions), I have never seen it so described that I could construct one.—H. E.

[11518.]—**Respirator.**—Will any one explain the best plan for making a respirator to wear when gulleting saws with emery wheel?—Jersey Craupaud.

[11519.]—**Horse Power of Compound Marine Steam Engine.**—Would any of your readers kindly inform me the best method or rule of calculating the horse-power of compound marine steam-engine?—G. Lamb.

[11520.]—**Small Photographs.**—Would some of your readers be so kind as to tell me how I can take photographs for the microscope? and how to make a small camera for taking them, if possible, out of spectacle or microscope glasses?—Simple Equations.

[11521.]—**Dirty Flannel.**—Will any fellow reader inform me the best method of washing and whitening small pieces of dirty flannel, and the best washing machine to wash 28lb., 56lb., or 112lb. at once?—R. A. G.

[11522.]—**Gold Fish.**—Can any reader inform me how to judge the healthiness of gold fish when buying them?—S. K. Sc. T.

[11523.] — **Rolla's System of Teaching the Pianoforte.**—What is it? Is it really any good?—S. K. Sc. T.

[11524.]—**Pitch of Roof.**—What is considered as the pitch of a roof, and where measured?—S. K. Sc. T.

[11525.] — **Fresh Water Aquarium.** — What different kinds of fish and plants might be kept in a fresh water aquarium, to agree with each other?—S. K. Sc. T.

[11526.]—**Harmonium Stop.**—Would J. J. Hartley be kind enough to explain the "Cremona Melodie" stop, if it is a 4ft. or 8ft. stop, and tuned in unison with flute or not?—Melodious.

[11527.]—**Barrister.**—Will some of "ours" be kind enough to tell me what are the necessary qualifications for a barrister?—An Aspirant.

[11528.]—**Silicate of Soda.**—I am anxious to know whether any of your readers have tried silicate of soda as a cement for object-glasses, and whether they could state its optical characteristics, its density and dispersive power, &c., as compared with flint and crown glass respectively. I should be glad to learn where I could get it pure, as I understand it is sold in a prepared form as a solid?—J. H., Lancaster.

[11529.] — **Vermestes.** — Could any correspondent of "ours" kindly tell me anything anent a "small ravenous beetle," named Vermestes? It has been used for preparing skeletons of animals, for which purpose I want it. If any friend could describe it he would much oblige—Redivivus.

[11530.]—**Violin Construction.**—Can some one of your correspondents inform me which is the easiest practical method of getting the tones of back and breast of violin in course of construction, as described by Savart? His meaning I don't fully comprehend.—Reed Maker.

[11531.]—**Water Wheel.**—Will any brother reader kindly inform me what horse-power a water-wheel 30ft. in diameter, with a stream of water 2ft. broad and 3in. deep running on to it would be equal to? Also, what would be the cost of a good centrifugal engine, equal to same horse-power? The engine must burn wood fuel.—Colombo.

[11532.]—**Steam Fire Engine.**—I saw some time back an account of a steam fire engine, built for Canada by Shand and Mason, in which it was stated that the weight was 400lb. Is this the fact? as out here they weigh from 1 to 3 tons. Information on this head would be interesting to a great many.—Anglo-American.

[11533.]—**Area of Boat.**—Is there any rule to determine the amount of superficial area of a boat to carry a ton?—Anglo-American.

[11534.]—**Cleaning Metal Buttons, Jackets, &c.**—What are the best means to use to clean both silver and brass buttons on uniform? What is the best mode of whitening the white cloth jackets? and what is best to use to clean German silver keys of flutes?—Fifer.

[11535.] — **Small Wheel-Cutting Machine.** — I, with many others, would feel greatly assisted if some one could furnish practical instruction for making a small wheel-cutting machine, to attach to a lathe, for cutting clock and other small wheels. Simple working drawings or recipe, would answer query 10859, p. 572, and also oblige, with many others—A Horological Mechanic.

[11536.]—**Character of Curve.**—If a circular piece of any elastic material be stretched (as a drumhead and water or other liquid poured upon it, the elastic material will bulge, forming a curve. What is the character of the curve thus formed, or does it vary?—Shylock.

[11537.]—**Scott's Patent Moulding Machine.**—Can any one give any information respecting the principle of working Scott's patent moulding machine, which makes any description or size of teeth wheels?—Anglo-American.

[11538.]—**Dry Solder.**—Would any reader inform me how dry solder is made, and how used?—Young Mechanic.

[11539.]—**Wooden Beehive.**—I am much pleased with the description of wooden beehive by C. N. Abbott, in No. 350, and intend making one and commencing bee-keeping, but as I do not understand the use and construction of the frames or bars for interior of hive, I shall be obliged if C. N. Abbott or some other bee-keeper will explain the matter to me, and, if possible, give sketch and arrangement of frames.—H. A. D.

[11540.]—**Preserving Tub Butter.**—How long will a tub of Irish butter keep good, and what sort of place is best to keep it in during summer and winter? Any information will oblige.—Pattern Maker.

[11541.]—**Dissolving Bones.**—Can any one inform me of the size of ordinary pits for dissolving bones, and average quantities they hold? Also, the usual process followed in the manufacture of dissolved bones?—Pit.

[11542.]—**Small Intensity Coil.**—I have made a small intensity coil about 3½in. long and 3in. diameter. It consists of about 30 or 40 yards of No. 18 cotton covered wire for the primary, and about 6oz. cotton covered wire, No. 30, for secondary. It is thoroughly insulated with shellac varnish, and guttapercha tissue. Now, what I want to know is, is there a limit to the size of condenser? Will 50 pieces of tinfoil, 4in. × 3in. with varnished paper between, do for this coil? Would solid paraffin be as good as, or better than, shellac varnish, for the papers of condenser? I find shellac keeps sticky, as I made a condenser that way, and as it did not act properly, I tried to take it apart, but found that the papers adhered so firmly to the tinfoil that I had to tear it off in pieces, and that with difficulty. The papers had been varnished at least a week previous. What length spark ought this coil to give?—R. W. P., jun.

[11543.]—**Amateur Observations.**— Would Mr. Proctor kindly say what observations may be usefully undertaken by amateurs having telescopes of considerable apertures—say, over six inches? No doubt, many like myself are able and willing to provide themselves with large and good instruments, but are deterred by the idea, that in their hands these instruments would be only toys. The inspection of star after star to try if they can be seen as they are described, and if the object-glass with the particular power used will divide them—or even the employment of a skilled observer uselessly to repeat Greenwich observations would probably soon cease to amuse.—P. S. T.

[11544.]—**Feed Pump.**—Will any reader inform me how I can make a feed pump for steam-engine about half horse-power? The best way of making the valves is what I require.—Roundfoot.

[11545.]—**Sulphur.**—To Jack of All Trades.—In replies to queries, Dec. 22, 1871, No. 10062, you say, "I have never yet found it to separate when I have prepared it." Will you kindly give me your mode of preparing it?—S. C. Salter.

[11546.]—**Electric Signal Bell.**—I have made a bell as described by Mr. Wm. Tonkes, on p. 663, Vol. XIV., but have failed to get it to work. Will any one point out the fault? Battery (one cell) charged thus:—Porous cell, carbon block, 11in. × 1in. square, packed with black oxide manganese and pounded coke (equal quantities), outside cell, chloride of ammonium 2oz., water one quart, magnet coiled with 4 layers of No. 24 cotton-covered copper wire. The magnet fails to attract armature. I believe if I could get the magnet to attract I should succeed, but that's the rub. Height of zinc cylinder, 8in.; length of wire, 12 yards No. 24 copper.—An Electrical Beginner.

[11547.]—**Bass's Beer.**—Will some of your correspondents give me the analysis of the water of which Bass's beer is made at Burton-on-Trent, and also state, if they can, by whom the analysis was made?—R. F. Jenner.

[11548.]—**Bending Amber.**—How is amber bent?—F. H. Lucas.

[11549.]—**Water Floats.**—Will some practical engineer be kind enough to inform me whether water-floats are of any use in a boiler worked at 35lb. pressure per square inch. I find mine to be a fruitful source of trouble, always blowing where the wire enters the boiler, or otherwise so tight that it cannot work.—Young Fireman.

[11550.] — **Preserving Eggs.** — As the season is coming round again, and I am wishful to form a collection, will some one give me some advice about preserving eggs, and the different kinds of varnish for coloured eggs? also, whether it is necessary to destroy the white skin inside the shell, and the best means of doing so?—Young Nest Hunter.

[11551.]—**Cement.**—I should much like to know how to make a cement that would fix meerschaum, having tried all those advertised in newspapers. Meerschaum is composed of silica, magnesia, and water, and when manufactured into pipes cannot be subjected to heat, the cement must, therefore, be liquid.—Zeta, Reading.

[11552.]—**Meerschaum.**—Can any of your scientific readers inform me how to distinguish a meerschaum pipe from the imitation, as her Majesty's Commissioners came to the conclusion that there was no certain test, at the Great Exhibition of 1851? I should also like to know how to analyse this mineral.—Zeta, Reading.

[11553.]—**Agriculture.**—I am very desirous to make myself acquainted with the principles upon which the advanced skilled agriculture of the present day depends. Will any of your numerous readers give the names of the books I should read?—Agricola.

[11554.]—**Pedestrian Tour.**—I shall be glad if some fellow reader will give me a few hints on a tour amongst the lakes of Cumberland, which myself and a friend contemplate making this summer or autumn, starting from Sunderland. (1) What is the most suitable time? (2) The best dress? (3) The smallest amount of luggage necessary? (4) The best inns? And (5) last, but not by any means least, the smallest sum for which we can enjoy ourselves for a fortnight?—Bachelor Jubilant.

[11555.]—**Soap Root.**—What plant of North America is called soap-root? In the *Scientific Press* of San Francisco, of February 24th, it is said that in California there is a manufacture where soap-root is curled as a substitute for horsehair.—Bernardin.

[11556.]—**Po-ca-de Wood.**—What kind of wood is Po-ca-de wood? it comes from British Guiana.—P. C. D.

[11557.]—**Treasury of Botany.**—I wish to know which is the last edition of Lindley and Moore's "Treasury of Botany," and what is the price of that book?—Thankful.

[11558.]—**Refuse Paint.**—Is there any method of working up paint skins, scrapings of kegs, &c.? If so, particulars of the plan would much oblige.—W. T. M. D.

[11559.]—**Jupiter's Satellites.**—I should be glad if some one would explain the diagrams on pp. 480 and 499 of the *Nautical Almanac*, termed "Phases of the Eclipses of Jupiter's Satellites for an Inverting Telescope." I cannot quite understand the explanation given at the end of the book—in fact, I am completely lost.—W. H. Skelton.

[11560.]—**Gold Polishing on Stone, &c.**—Will "Mason," "Jack of All Trades," or some other kind reader inform me through these columns, the best method of polishing gold, after it has been applied to stone, marble, slate, &c.?—T. Pemblington.

[11561.]—**Electric Light.**—There was on view at the Exhibition in London, in 1862, a machine consisting of a number of permanent horseshoe magnets mounted on a periphery or wheel, whereby they were enabled, when connected with a motive power, to revolve with great rapidity in front of their armatures, and through the medium of connecting wires an electric light of considerable intensity was produced. Will some one please inform me how I can make a machine on the same principle, so as to obtain a light equal to 40 cell Grove?—Electric Light.

[11562.]—**The Zither.**—Will any one versed in the intricacies of zither playing say whether it is an advantage to have more than the usual number of melody strings? A new arrangement, having six strings instead of four, has been recently patented, for which the makers claim easier and swifter fingering. Perhaps the encyclopædical "Harmonious Blacksmith" will favour us with his opinion on the matter. I would be glad to know, also, where in the long range of price given in the catalogues—from thirty shillings to nearly as many pounds—usefulness and real value end, and ornament begins; in other words, what a good honest instrument should cost?—W. W.

[11563.]—**Moon.**—Will any correspondent inform me whether the presence of the moon influences the orbit of the earth so as to affect its distance from the sun? If the moon could be annihilated, how would the earth act?—M. Paris.

[11564.]—**Blackberry and Strawberry.**—There is an enormous difference in the flavour of the first fruit, caused by place of growth, also excellent foreign species. Has any attempt been made to cultivate it? I have made a bed of the wild wood strawberry to experiment with, and I have a notion that our now enormous and tender varieties require a little wild blood to bring back the flavour, and to retard ripening. Information on the above thankfully received.—M. Paris.

[11565.]—**Carrot.**—Has anybody observed the "sleep" of the flowers of the carrot just before opening?—M. Paris.

[11566.]—**Equisetum.**—Has the movement of the pollen under the microscope been noted?—M. Paris.

[11567.]—**Rigging Model Yachts.**—Will "W.F.W." kindly inform me how he intends the mainsail and foresail to be fastened to the masts? If he intends brass rings to be used, how many, or how far apart, should they be? I should like, also, to know the neatest way to fasten the shrouds to the sides.—Full Stop.

[11568.]—**Turbine.**—Will any correspondent give me instructions how to construct a turbine of sufficient power to drive a 6in. lathe?—T. Leith.

[11569.]—**Telegraph Posts.**—Will any one tell me why the Post-office posts should have an interval of three feet, just between wind and earth, neither painted nor tarred, as it seems to me that this is precisely the part which is most liable to decay? At least the posts are so economically tarred and painted in my neighbourhood.—M. P.

[11570.]—**Furniture Polish.**—"M. O." (in No. 3[illegible], query 10535) recommends acetic acid, linseed oil, and water as a reviver, but does not tell how to mix the oil and water, and what proportions, or whether the oil is applied to the rubber the same as in polishing. If he will kindly answer these queries he will oblige.—Rigg[illegible].

[11571.]—**Virginia: Its Climate and Soil.**—As "our" Mechanic circulates in the United States, I wish to ask, through its pages, if any of my brother readers there can inform me if Professor Maury's report on the climate and soil of Virginia made to the department at Washington has ever been published, like his physical report of Virginia (which I have read).—E. R. E. A.

[11572.]—**Compressing Water.**—I should feel extremely obliged to any readers for their opinion upon the compression of water. I am of opinion that it is possible to compress it. I have aided in the construction of the largest hydraulic press ever made for the use of the English Government at the Pembroke Dockyard. I will give a rough description of the press to illustrate my reason for thinking as I do. The press is composed of two large blocks of iron, weighing 25 tons each, separated by four massive columns at each corner of the blocks, fitted with nuts of equal strength to resist the pressure of the ram, the ram being forty inches in diameter. The cylinder is composed of seven large steel rings, seven inches square, shrunk on an inner cylinder of steel one inch thick. The press is connected to a massive set of pumps by a copper pipe. Now, when the ram is pumped up and comes in contact with the top block, we shall consider the cylinder full of water. I want to know what becomes of that water that is pumped in after to gain the pressure of four thousand tons. I cannot say how much is pumped in exactly, but it is something over one gallon. It cannot well enter the pores of the steel.—J. Westwood.

[11573.]—**Small Boat.**—Will some reader kindly give me the dimensions for a small flat-bottomed boat to hold one? It must be light, as I wish to carry it to and from the canal, about a quarter of a mile.—J. K. D.

[11574.]—**Gas.**—Will one of your numerous correspondents inform me of the best way of regulating gas? I have tried a mercury regulator, but have not succeeded as my gas bill has increased every corresponding quarter for the last three years, and the consumption is about the same.—H. J. W.

[11575.]—**Well Sinking.**—Can any reader inform me whether a well less than 3ft. 6in. in diameter can be sunk? I am told not, as there would be no room for workmen. I want to sink one 2ft. or so in diameter. Is there any means of boring one or inserting a 2ft. tube?—SCHOOLBOY.

[11576.]—**Water Wheel.**—I have a flow of water on a level of about twenty gallons a minute, and wish to know if I fix a water wheel with a pump attached, will it send a jet of water for a fountain a distance of 300 yards and about 15ft. above the water, and what size of wheel should I require?—J. K. D.

[11577.]—**Hydraulic Lifts.**—What is the nature of the construction of hydraulic lifts such as those at the Royal Albert Hall, the Langham, the Grosvenor, and Charing Cross Hotels? So far as I can see they are lifted by a piston below them, the chain by which they are suspended being only a check against accidents. If so, as they are capable of being raised some 200ft. above the basement, the piston being of course of the same length, it follows that there must be a piston cylinder sunk in a deep well under all. How is the water supplied to the bottom of a cylinder of such great depth? The ascending room can be stopped at any moment by an attendant inside, who, by pulling the proper ropes, causes the machine to be raised, stopped, or lowered, with the greatest facility. Any information on so interesting a matter would oblige.—T. V. B.

[11578.]—**Sun's Declination.**—I return my thanks to your able astronomical correspondents "F.R.A.S." and "Altair" for the lucid manner in which they treated my query (11360, p. 49). I must still reiterate my former statement in saying that the term "diff. for 1 hour" is an incorrect one. However, I see in the later editions of the *Nautical Almanac* the term "var. in 1 hour;" which undoubtedly is the correct one. At the time of the summer solstice (1872, June 21), the sun's declination is greatest, but the question is, does this always occur at noon? If not, how is it possible to get the correct declination for an intermediate time between the noons of June 20, 21, and 22, when the second differences are 1·08", 0·29", and 1·03" respectively? It will no doubt be stated (in reply) that the sign has changed, but what indication have we to that effect? The change in the "equation of time" is marked by a straight line at the head of the column, then why is such a change in the "diff. for 1 hour" not indicated in a similar manner? I am surprised that our valued correspondent "F.R.A.S." should think me unique in my wish to omit the trashy explanation. I must agree with "Altair" in his statement that several things have been added to our *Nautical Almanac* which are improvements; on the contrary there are others which are questionable. Of what use are the 1,000 additional stars inserted in the *Nautical Almanac* when we find that the times of disappearance and reappearance are computed only for one latitude, viz., Greenwich. If the times were given for other latitudes, then the *Nautical Almanac* would be of great service to travellers in far distant countries, who at the present time require further information than that of the limiting parallels. Believing that the various improvements that have been made have conferred a great boon upon those situate in the latitude of Greenwich, still, I should like to be informed why it is that the meridian passage on page 4 is only given for the upper limb of the moon.—HENRY WOODS.

[11579.]—**Blue Billy.**—"Sigma," in reply to a query (in a back volume) regarding "blue billy," stated that he had made an analysis of it, and had predicted that it would make a "hard iron," and that such was the result when tried in the blast furnace. May I ask him what led him to that decision? Was it the presence of copper, or arsenic, or both? If the arsenic is the cause, could it not be volatilised? Is his use of the words "hard iron" synonymous with "forge iron?"—FE. SCOT.

[11580.]—**Soda Ash in Boilers.**—Will "Busy Bee" kindly tell me what quantity of ash to put into an 8-horse boiler, and how often?—WILLIAM.

[11581.]—**Wood Polishing.**—I would be thankful if any subscribers could inform me of a speedy and good plan of polishing light articles in the lathe—such as drawer handles, rings for window poles, &c., and how the last article is gripped when undergoing that process.—CHISEL.

[11582.]—**Spiral Turning.**—I am certain some subscribers could instruct me as to the construction of a spiral lathe. A simple drawing would greatly assist.—GOUGE.

[11583.]—**Vacuum in Barometer Tube.**—Will some one inform me how I can procure a true vacuum in the top of barometer tube (one with weights at the back)? Likewise how to fill a new one; I have boiled the mercury about 6in. or 8in. in top of tube, but still in the lower part of the tube the mercury is divided—air and quicksilver. Any other advice on adjusting tube and weights will oblige.—NEVER RUST.

[11584.]—**Cleaning Cornopean.**—Would some kind reader oblige by informing me how I am to clean the inside parts of the tubing of my cornopean, as it is very dirty?—WEE PET.

[11585.]—**Chemical.**—Would Mr. Bottone kindly inform me of the cheapest and most ready way of resolving chloride of sodium into chlorine gas, and sodium respectively? Would he also tell me what chemicals would be used, and what would be left (after getting the chlorine gas and the sodium separated) in the vessel used to separate them?—VULCANITE.

[11586.]—**Chloride of Nitrogen.**—Would "Explosive" confer another favour on me, by telling me what pressure to the square inch chloride of nitrogen would give? Would he please to put it in figures? Also tell me what proportions the chlorine gas bears to the hydrochlorate or nitrate of ammonia? I do not intend to put any one's life in jeopardy by making any yet for some time, till I can do so with comparative safety, but I wish to know, so as to make some arithmetical calculations.—VULCANITE.

[11587.]—**Cleaning Scarlet Cloth.**—Can any of your correspondents give me a good recipe for reviving scarlet cloth?—W. MILLARD.

[11588.]—**Emery Cloth.**—Will any one practically acquainted with the business be kind enough to say how cloth is prepared for making into emery cloth, so that the cement used may not sink through the cloth? And what is the best cement for fixing the emery to the cloth?—CORUNDUM.

[11589.]—**Dry Steam.**—Can any of "our" chemical correspondents give an analysis of what is termed dry steam? When steam is superheated by passing through a coil of pipes placed over a furnace and allowed to issue into the atmosphere at a temperature sufficient to melt lead or kindle timber, it does not condense into a cloud or mist, and seems to be no longer steam at all. Is this a case of allotropism or what?—CALORIC.

[11590.]—**Carbolic Acid for Cages.**—I want to know if any of your correspondents can tell me if there is any risk of poisoning my birds by using the carbolic acid wash for a large cage, about 5ft. by 2½ft. in which I have 20 canaries, and they are infested with the little red lice every spring. I wash the birds with precipitate powder, but I want some way of cleaning the cage. It is mahogany and ornamental, so that I do not wish to part with it. In what proportions should I use the carbolic acid?—A. WESTLAKE.

[11591.]—**Lighthouses.**—How is a situation obtained in any of the Trinity lighthouses that use the electric light? What are the necessary qualifications, and to whom is application made? Any information respecting foreign lighthouses and situations connected with them will oblige.—W. H. H.

[11592.]—**Medical.**—What salt of iron is most easily absorbed by the system?—WILLIAM H. HEY.

[11593.]—**Lime-juice and Glycerine.**—Will some one tell me how the above-named preparation for the hair is made? I don't think there is any glycerine or lime-juice in it.—DUFFER.

[11594.]—**Foreign Calculation of Engine Power.**—Will some one kindly inform me how the power of steam engines is calculated in the principal foreign countries of Europe and in the United States? What is taken as the unit of work, and what answers to our 33,000 foot pounds, which, when done in a minute, we denominate a horse-power? No doubt one or other of the correspondents who have been recently ventilating their opinions in regard to the metric system will be able to answer my question as regards the countries where that system is in vogue.—V. B.

DOMESTIC RECIPES.

From the *Food Journal.*

To Boil Rice as in India.—Into a saucepan of 2 quarts of water, when boiling, throw a tablespoonful of salt; then throw in 1 pint of rice, after it has been well washed in cold water; let it boil 20 minutes. Throw it out on a cullender, and drain off the water. When this has been done, put the rice back into the can or saucepan, dried by the fire, and let it stand near the fire for some minutes, or until required to be dished up; thus the grains appear separate and not mashed together.

Rizart Haddocks.—A mode of dressing haddocks very common in Scotland is by drying them in the sun. To rizar is explained, in Jamieson's Scottish Dictionary, as signifying to dry in the sun; and its past participle, rizart, as equivalent to the French ressoré, from which the Scottish word is derived (or they have a common root, from which, probably, the word raisin also comes). The haddocks to be prepared for the tabld in this way, must be perfectly fresh, almost newly taken, middle-sized, and are most suitable when they are gutted, thoroughly washed, and allowed to lie in salt for a night. They are then strung on a thick wire passed through their eyes, and hung up for two days in the open air on a wall, but not where they are much exposed to the direct rays of the sun; after which they are skinned, the backbones are taken out, and they are broiled on a gridiron and rubbed with a little butter. Thus prepared, they are extremely palatable, and excellent for breakfast or supper.

Orange Marmalade.—For 7½lb. sugar (lump), 4lb. of oranges (Seville) are required. Boil the oranges until sufficiently tender for a pin's head to go through the skin, having first grated half the number to prevent the marmalade from being too bitter; for if the whole of them are used the jam will be as bitter as the waters of Marah. Cut the oranges in half when you have boiled them sufficiently; remove all the pips; scoop out all the pulp. Cut the skins into thin strips. Put the sugar in your preserving jar, dissolve it in a pint and a half of water, and boil it twenty minutes. Skim it well—whatever you do, skim it well—and on no account add the pulp and peel until the syrup is as clear as "water from the crystal spring." Then put in the pulp and the strips of peel, and boil all together for a quarter of an hour.

Haricots Verts en Salade.—Boil some French beans whole; when cold, dress them with oil, vinegar, pepper and salt, some parsley and capers finely minced, and garnish with hard boiled eggs, anchovies, and beetroot. The dish must be well rubbed with an onion.

Varnish.—To Varnish Beech.—It is a poor-looking wood, with little curl or figure: therefore stain with the following:—Burnt umber and soap lees, and if any knots, give an extra touch or brush; let it stand to dry; the day following size it over twice; and the next day varnish it; use the best varnish.

USEFUL AND SCIENTIFIC NOTES.

Improvement in Telegraphy.—We hear of an ingenious arrangement by which copies of messages sent by telegraph can be left at different stations along the line of transmission. This is the invention of Mr. Little, of New Jersey, United States. By means of a rheostat at each station, the current is divided; one portion passing onward by the wire, the other portion doing its work and passing to the earth. The telegraph employed belongs to the printing variety.

Removal of the Standards.—In consequence of the wall of the Palace at Westminster, in which the imperial standards were immured, having been pulled down in order to form an entrance to the refreshment rooms, the standards have been deposited in the wall on the right-hand side of the second landing of the public staircase, leading from the lower waiting-hall up to the Commons' Committee Room. One alteration has been made. When the standards were originally immured, a brass plate was fixed upon the wall bearing the following inscription in old English letters:—"Within this wall are deposited standards of the British yard and the British pound weight, 1853." The word "measure" has now been inserted after "yard."

Detecting Sulphur in Gas.—Von Wartha describes a neat method of illustrating the presence of sulphur in illuminating gas. He places, on a platinum wire, a bead of carbonate of soda on the edge of the flame of a Bunsen burner for a minute, and obtains then, by partially cutting off the air supply, a small cone of light in the flame. Into this the bead is placed, and the sulphate and sulphite of soda previously formed is brought to the condition of sulphide of sodium by the reducing action of the glowing carbon particles. The bead is then crushed in a porcelain dish, and a solution of the nitro prusside of sodium added, when the characteristic reaction of sulphur is readily obtained. The reaction is said to be more than fifty times as sensitive as that with silver, which is ordinarily used. A minute suffices to obtain it.

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Amount previously acknowledged	£332	13	
S. J. (2nd donation)	0	3	
Cobbler (2nd donation)	0		
W. G., Pulborough	0	0	10
	331	8	4

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, April 9, and unacknowledged elsewhere:—

Jas. R. Gordon.—Jas. Peters.—B. Edwards.—B. C. Brough.—Amicus.—V. M. T.—J. Sargent, jun.—John Watson.—Henry Jackson.—Whitney Partners.—J. S. Cooke.—Mrs. Petrie.—W. A. Gibbons.—W. Simmons.—Rev. Thos. Foster.—Q. E. D.—J. H. D.—Robt. Still.—Geo. R. Hallam.—Anthony Stark.—W. J. Weaver.—Wm. Hughes.—G. M.—Raven.—Bob. J.—O. F. S.—C. Benbow.—G. R. H.—W. C. Manning.—W. R. Hall.—Excelsior.—A Leeds Man.—Thesiger.—George H.—Square.—R. Langdon.—Champagne Charlie.—J. W. Fennell.—Rara Avis.—Numismatist.—Legato.—Dentiste.—J. Newton.—Esmey.—Analyst.—F. Hume.—Moxley.—S. E. Peal.—Monte Cristo.—Electrometer.—Physicus.—H. B. E.—A Shaving Pusher.—W. E. W.—J. O. Y.—M. B.—T. Ritsat.—Fitzbertie.—X.—Anglo-Saxon.—J. B. Yorke.—J. Barwick.—H. E. H.—Valve.—Country Jeweller.—Aden.—Howard.—Photo.—H. H. C.—King Coal.—J. E. H.—Ambition.—Proven.—Zeta.—Opaline.—A. D. W.—Joseph Unwin.—James Weldon.—W. W.—Ioan Goch.—Equilibrium.—J. L. T.—H. H.—Cosmopolitan.—E. L. G.—R. A. Proctor.—A New Subscriber.—E. J. D.—Flactem.—Whitaker.—W. J. Howard.—Sigma.—Khoda Bux.—D. W. Edwards.—F. F. A.—V. B.—Leander.—G. Avery.—A Young Plumber.—Yo. Gaucho.—A Country Plumber.—A Cripple.—Scraper.—A. N. Cooke.—Patman.—Norr.—W. Crisp.—Country Tinker.—Woodstock.—F. W. W.—Z. Y. X.—W. J. H.—J. B. Sharpley.—A. B. M.—Thetamu.—A. J. Adams.—R. Lupwards.—Junius.—Philanthropist.—Leather.—Ralph Lowdon.—A. G. Miller.—W. H. Hey.—Bookworm.—W. D. Mead.—M. Paris.—W. H.—A. W. B.—J. Franklin.—Ampersand.—F. H. Saunders.—Corax.—R. N. Knight.—Veritas.—Transit.—Manchester.—F. R. C. S.—A Beginner.—Samuel Smither.—L. M. F.—J. K. P.—S. Bottone.—A Foreign Subscriber.—A. W. Festing (with copy of work).

VIGILANS.—In speaking damagingly of another correspondent, you might have given your name and address, in the absence of which we think you have acted cowardly, and your letter is gone where it deserves—into the waste-basket.

GEO. P. HILL.—A notice next week.

S. CROZIER.—See answer to S. Bottone.

FOCUS.—The plan you suggest for "baffling pirates" would no doubt insure accuracy, but at the expense, we fear, of inconvenient delay.

NUMISMATIST.—As it is doubtful whether the coin is worth anything, and as the drawing would certainly cost 6s. or 7s. to engrave, and as, after all, it could be of no benefit to any one else, we must decline inserting the query.

S. SMITHER.—Twenty-six shillings.

SCHOOLBOY.—Yes. Lavater's book.

Mac.—We do not receive or forward replies to advertisements. Advertisements must be prepaid.

An Old Contributor.—You had better in such matters speak for yourself, and not for "F.R.A.S." or any one else. The English Mechanic is intended for all classes of inquirers. Its numerous correspondents, who are ever trying to instruct and correct each other, impart to it a peculiar aptitude and power. Like the elephant, it can root up an oak or pick up a pin. That which may appear trifling to you, is valued by others.

Bed of Stone.—Your first query is one for a dog fancier. Your second would take too much space to answer. Consult any good grammar.

C. S. F.—See back vols.

W. R.—We would prefer to wait for your analysis, and as the other has not yet reached us, will at any rate wait till it does. Should you not send yours, "S. S." may infer you are not equal to the task.

A Swimmer.—No; rather beneficial, if you use ordinary care.

A. B. C.—Use Judson's dyes.

Henry White.—Ask an architect.

Dabriada.—Thanks. See our answer to "A Barrister" last week.

J. M.—See advertisement, No. 362, Vol. XIV. March 1.

George Lange.—If, as you say, you have taken in the English Mechanic for five years, you reflect no credit on its brotherhood of readers. During that period we have repeated at least fifty times that we do not answer queries by post.

W. H. Durst (Newark, N.J., U.S.A.)—Last remittance pays up to August 29, 1873, inclusive.

Arthur Orton.—First and third queries can only appear as advertisements. For second query see back vols.

Sceptic.—It would be well for you to be more perfectly acquainted with the principles of the science you attack. Our pages may probably before long give you the opportunity of doing so.

E. Barber.—All requests for private communication must be paid for as advertisements.

Communications which can only appear as advertisements to hand from J. C. P., Subscriber, Argyrius, Novice, Stranger, W. Edwards, Almost Distracted, A 2, X. Y. Z., P. M., Little Bird, Qui Quærit.

W. Millard.—Consult a medical man.

T. Pemblington.—Send.

Daleth.—If you had looked back a few numbers you would not have written so foolishly. See p. 585, Vol. XIV., and previous vols.

H. B. E.—Given long ago.

S. Bottone asks whether something cannot be done to prevent a single line of the English Mechanic being wasted by "cads," like correspondents signing themselves "S. Tremayne, Cantab," and W. M. Hirpen. We fear not, as long as cowards and scoundrels exist; and they do and will exist in spite of police and the contempt of honest men. We occasionally hear, for instance, of some such a person throwing orange peel on the pavement on purpose to throw pedestrians down. Imagine the depravity of a mind that could extract fun from the broken limbs or broken heads of unoffending passers-by! Just of the same quality of heart and mind are those who endeavour to pervert and abuse the educational intentions and efforts of the English Mechanic, which, from multitudinous testimony, is a blessing to thousands. Two or three depraved creatures have recently been sending sometimes indecent, and at other times adroitly worded, but, at the same time, foolish and deceiving communications, to the English Mechanic, for a similar reason, we suppose, to that which induces the rascal to deliberately throw orange peel on the pavement. Happily, a vast majority of such communications have been spotted as soon as read. Though rejected, they have not been consigned to the waste-basket, and may be seen by any respectable correspondent who may feel interested in detecting the offenders. From information already received we are on the track of one, and we believe we have a clue to another—"S. Tremayne, Cantab," who was exposed by "Sigma" last week. Since that exposure and our remarks on it (p. 81), we have received an insulting letter from "S. Tremayne, Cantab," and the same letter contains insulting allusions to "Sigma," and "A Barrister." We need scarcely say that "Sigma," and "A Barrister," are men animated by pure and disinterested motives; they, and particularly "Sigma," gratuitously and ungrudgingly send us information, in the belief that they are benefiting large numbers of persons wherever the English tongue is spoken. On the other hand, we maintain that it is a mean and cowardly thing, to say the least of it, for a correspondent, skulking behind an assumed name, to throw insulting words at such men. But such work is in perfect keeping with the other communications received from "S. Tremayne, Cantab." We hope to have more to say about this gentleman, and one or two who are in league with him, soon.

R.—Our reply was intended to have a *general* application.

W. H. Skelton.—Read query 11465 again. You will see that the trains move in *opposite* directions.

"L. C. E." says:—"I was amused at 'F.R.A.S's' chaffing reply to my query on sundials, but the absurdity arose from the omission of the word 'mean.'"

William Short.—Consult indices of two or three last vols., for information on painting magic lantern slides.

Samuel Smither.—See reply to S. Bottone.

A. Ledger. — For further information concerning Atkins's fire-engine, address the gentleman mentioned at end of article. We do not know the number of the patent.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING APRIL 2, 1872.

831 A. Pye-Smith and C. Ribbans, East Greenwich, for improvements non-conducting compositions for coating steam pipes and boilers, applicable also for preventing the passage of heat or cold to or from pipes, refrigerators, or other vessels.

832 C. A. McEvoy, Bear-lane, Southwark, for improvements in connecting electric cables and conductors.

833 J. Molesworth, Leicester, for improvements in the manufacture of elastic gusset webs.

834 P. J. Ekman, Stockholm, Sweden, for improvements in the construction of window sashes and frames.

835 N. Prada, New Bridge-street, City, for improvements in preserving animal substances and in agents for the purpose. A communication.

836 D. Nicoll, St. Paul's Churchyard, for improvements in compounds for and in the treatment of fabrics to render the same waterproof and uninflammable.

837 R. Monteith, Carstairs, Lanark, for an improved process for preserving animal and vegetable substances. A communication.

838 A. M. Clark, Chancery-lane, for an improved compound for cleaning, restoring, and preserving carpets, rugs, and similar. A communication.

839 R. Howson and J. J. Thomas, Middlesborough-on-Tees, for improvements in revolving puddling furnaces.

840 F. R. Window, Baker-street, Portman-square, for an improved method of taking silhouette or outline pictures.

841 J. Rawcliffe, jun., W. Bibby, and A. Fleming, Preston, for improvements in spinning mules.

842 R. Smith, Plymouth, for improvements in sounding boards for pianofortes and other stringed musical instruments.

843 H. G. Slevier, Aldersgate-street, for improvements in the manufacture of umbrellas and parasols and in the machinery to be employed therein.

844 J. D. H. T. Decamps, Brest, Paris, for an improved suspensory apparatus for raising and supporting the sick or wounded, and others.

845 W. Whyte, jun., Glasgow, for improvements in boilers to be used in treating or bleaching paper-making materials and textile materials and fabrics.

846 F. Lebacq, Laurie-terrace, Southwark, for shoeing horses by a system of fluted iron to prevent the contraction of the foot.

847 J. J. Bleckly, Warrington, for improvements in machinery or apparatus for rolling iron, steel, or other metal bars into wire rods, hoops, or small sections.

848 U. A. Lenteigne, Paris, for improved machinery for ornamenting, engraving, embossing, or sculpturing wood or other material.

849 H. Y. D. Scott, Ealing, for improvements in the treatment of sewage water.

850 G. Little, Oldham, for improvements in machines for combing cotton and other fibrous materials.

851 J. A. Jaques, Tottenham, and J. T. Oakley, Grange-road, Bermondsey, for improvements applicable to machinery for grinding, surfacing, drilling, or otherwise working articles made of iron or steel.

852 E. Malhere, Paris, for improved machinery for the manufacture of lace.

853 R. Spence and E. J. Spence, Bridgwater, for improvements in machinery for the manufacture of bricks from plastic clay.

854 W. E. Newton, Chancery-lane, for improvements in breech-loading ordnance. A communication.

855 W. R. Lake, Southampton-buildings, for improvements in machines for attaching covers to pamphlets. A communication.

856 W. R. Lake, Southampton-buildings, for improvements in machines for setting and securing lacing hooks in leather, cloth, or other materials. A communication.

857 W. R. Lake, Southampton-buildings, for improvements in ovens, chiefly designed for baking bread, biscuits, and other like articles. A communication.

858 W. Carr, Bury, Lancashire, for improvements in spindles and shuttles.

859 J. Hopkinson, sen., and J. Hopkinson, jun., Manchester, for improvements in the construction of street lamps.

860 A. Budenberg, Manchester, for improvements in pulley blocks. A communication.

861 J. Rice, Oxford-street, for improvements in apparatus for propelling vessels.

862 J. Jefferson, C. Jefferson, L. Jefferson, and M. Jefferson, Bradford, for improvements in machinery for combing wool and other fibres.

863 W. Benson, Allerwash, Northumberland, for improvements in machinery or apparatus for cutting coal.

864 W. R. Lake, Southampton-buildings, for improvements in button-hole sewing machines. A communication.

865 J. Werner, Mannheim, Germany, for an improved composition to be used as a substitute for "brewers' pitch" for lining vats, casks, and tubs, and for other like purposes.

866 H. G. Cardozo, Bath-place, Upper Holloway, and A. W. Taylor, Seven Sisters' Lodge, Holloway, for an improved method of and apparatus for facilitating the payment and preventing the fraudulent appropriation of the fares of passengers travelling in tramway cars, omnibuses, public vehicles, or other conveyances, also applicable to public bars, restaurants, or other places where a check on payments is desirable.

867 W. A. Lyttle, The Grove, Hammersmith, for improvements in poles for telegraphic and other purposes.

868 J. Young, Kelly, Renfrewshire, for improvements in apparatus employed in the manufacture of the carbonates of soda and potash.

869 E. T. Hughes, Chancery-lane, for improvements in mechanical movements for converting motion. A communication.

870 A. C. Stevenson, Glasgow, for improvements in glass and other reverberatory furnaces.

871 H. B. Barlow, Manchester, for improvements in looms for weaving. A communication.

872 H. Adlam, Battersea-park, for an improvement in stays.

873 J. Gillies, Glasgow, for improvements in machinery and apparatus for making moulds for casting certain articles in metal.

874 J. S. Brown, Bridgwater, Somersetshire, for improvements in raising or lifting liquids and apparatus therefor.

875 A. V. Newton, Chancery-lane, for improved means for converting a reciprocating into a rotary motion. A communication.

876 J. Lewis, Birmingham, for improvements in joining or connecting the parts of the head, foot, and side rails of metallic bedsteads and cots, and metallic railing for various purposes, which improvements are also applicable to the connecting of metallic ornaments to articles of metallic furniture.

877 F. Ransome, Queen's-street-place, City, for improvements in the manufacture of artificial stone. A communication.

878 P. M. Parsons, Blackheath, for improvements in ordnance and carriages, and projectiles for the same.

879 J. Milroy, Edinburgh, and J. W. Butler, Willesden, Middlesex, for improvements in the construction of coffee-dams.

880 H. Hollefreund, Havelberg, Prussia, for improvements in the treatment of potatoes, maize, corn, millet, and other starch-containing vegetable matters to obtain saccharine and other products therefrom, and in the apparatus employed therein.

881 W. S. Brolly, Southampton-buildings, for improvements in combination locks and in mechanism connected therewith. A communication.

882 L. A. M. Helle, Paris, for an improvement in holding or bottling and drawing off cider. A communication.

883 J. B. Muschamp, Kensington, for a new or improved liquid meter.

884 I. Pickard, Leeds, for an improved arrangement of machinery or apparatus for transmitting motion to sewing machines.

885 C. W. King, Bedford Leigh, Manchester, for an improved method of regulating the speed of marine engines and apparatus therefor.

886 C. Owen, City-road, for the better protection of accidents in railway tunnels.

887 E. A. Cowper, Great George-street, Westminster, for improvements in regenerative hot-blast stoves for heating air, steam, and other gases.

888 W. Darlow, North Woolwich, for improvements in portable magnets for curative and other purposes.

889 J. Howard and E. T. Bousfield, Bedford, for improvements in the construction of ploughs and other tilling implements.

890 R. M. Letchford and W. B. Nation, Three Colts-lane, Bethnal-green, for improvements in the treatment of paraffin.

891 T. Giles, Manchester, for improvement in safety valves.

892 W. Walton, Worcester-street, Pimlico, for a new or improved lever spring lock sash fastener.

893 W. H. Baxter, Brixton-hill, for improvements in machinery or apparatus for weighing or measuring corn and other substances.

894 J. F. Allen, Mott-Haven, New York, for improvements in steam generators.

895 W. R. Lake, Southampton-buildings, for an improved cartridge for fire arms. A communication.

896 W. R. Lake, Southampton-buildings, for improvements in apparatus for mounting and working ordnance. A communication.

897 W. R. Lake, Southampton-buildings, for improvements in apparatus for mounting and working ordnance. A communication.

898 E. G. Brewer, Chancery-lane, for improvements in the construction of studs or buttons. A communication.

899 W. Garton, Southampton, for improvements in brewing.

900 W. R. Lake, Southampton-buildings, for improvements in fire extinguishing apparatus. A communication.

901 A. M. Clark, Chancery-lane, for an improved joist for the lids or covers of gas retorts. A communication.

902 A. M. Clark, Chancery-lane, for improved elevating apparatus for firemen's, builders', and other purposes. A communication.

903 W. R. Lake, Southampton-buildings, for an improved mode of and apparatus for supplying and using steam for driving street-railway carriages and other vehicles. A communication.

904 G. Little, Oldham, Lancashire, and T. C. Eastwood, Bradford, for improvements in machinery for preparing and combing wool, cotton, and other fibrous materials.

905 J. Howard and E. T. Bousfield, Bedford, for improvements in steam boilers.

906 W. Neill, Bold, Lancashire, for improvements in the valves of cylinders used in forcing air.

907 Z. Shrimpton, Redditch, Worcestershire, for improvements in the manufacture of crochet and netting needles, penholders, hair pins, and other similar articles.

908 G. J. Snelus, Dowlais, Glamorganshire, for an improved lining for cupola furnaces, also applicable to the formation of the beds of reverbratory furnaces.

909 W. R. Lake, Southampton-buildings, for improvements in composition bearings for the journals of axles, shafts, or spindles. A communication.

910 S. Moorhouse, Cheadle Bulkeley, Chester, and W. J. Kendall, Heaton Norris, Lancashire, for improvements in the construction of umbrellas and parasols, and for other purposes.

911 T. Smith, Leeds, for an improved fire escape.

912 W. Trimmer, Hornsey Rise, for improvements in casks.

913 J. C. Mewburn, Fleet-street, for an improved mode of and apparatus for making cigarettes. A communication.

914 J. H. Johnson, Lincoln's Inn-fields, for improvements in ice-cream freezers. A communication.

915 H. B. Fox, Oxton, Cheshire, and J. Wilde, Liverpool, for an improved implement for extracting plantain and other noxious weeds and roots from lawns.

916 G. Allix, Church-terrace, Isle of Dogs, and H. Gardner, Clifton-road, Middlesex, for improvements in stoppers, valves, or apparatus for closing the necks, mouths, or openings of bottles and other vessels, and in appliances connected therewith.

917 W. E. Newton, Chancery-lane, for improvements in telegraphic apparatus. A communication.

918 J. Reilly, Barrack-street, Manchester, for improved arrangements of apparatus for the prevention of accidents on railways.

919 J. Lawson and B. Hainsworth, Halifax, for improvements in siphon ventilators.

920 C. R. Mathews, High-street, Bloomsbury, for improvements in apparatus for safe, speedy, and easy mode in fixing, connecting, and disconnecting gas pendant, bracket, pillar, or ground connections, especially adapted for outside reflecting lamps.

921 G. H. Smith, Southampton-buildings, for an improved mode of and appliances for preventing the corrosion of iron pipes or tubes, and keeping them free from incrustation.

922 B. Richards, Penzance, for improvements in walking-sticks.

923 J. E. Holmes, Buckingham-street, Strand, for improvements in apparatus for utilizing atmospheric pressure as a motive-power, part of which improvements relate to pistons for the same and for other purposes.

924 J. Wolstenholme, Radcliffe-bridge, Lancashire, for improvements in steam pumping engines.

925 G. D. Morisseau, Paris, for improvements in buttons for gloves.

926 A. C. Henderson, Charing-cross, for improvements in the distillation and filtration of fecal solid and liquid matters direct from privies for the manufacture of sulphate of ammonia, together with the apparatus therefor; the said process being equally applicable to the distillation and filtration of liquids of all kinds. A communication.

927 J. S. Joseph, Rhosllanerchrugog, Denbighshire, for improvements in the preparation and treatment of oxides of iron for the manufacture of paint and other useful purposes.

928 T. T. Prince, Kensington, and R. Blakemore, Leadenhall-street, City, for improvements in horse-shoes and in nails for the same.

929 C. G. Johnson, Middlesbrough, for improvements in the manufacture of iron and steel and in the apparatus connected therewith.

930 J. B. V. E. Dupont, Manchester, for improvements in musical wind instruments and in the music-holders attached thereto.

931 T. R. Crampton, Great George-street, Westminster, for improvements in furnaces.

932 W. H. Dilnutt, Mawbey-road, Old Kent-road, for improvements in furnace fire bars.

933 G. Westinghouse, jun., Southampton-buildings, for improvements in pneumatic apparatus for working brakes and communicating signals in railway trains.

934 W. P. Butchart, Dundee, for improvements in softening, combing, and beating jute, flax, and other fibrous substances, and in the machinery or apparatus employed therefor.

935 E. Meldrum, Dechmont, N.B., for improvements in the purification of paraffin oils and paraffin.

936 N. H. Hughes, Ayrshire, for improvements in cultivating land and in the machinery or apparatus employed therefor.

937 P. C. Evans, Brimscombe, Gloucester, for improvements in apparatus for feeding scribblers, carding engines, willies, and other opening machines employed in the treatment of fibrous materials.

938 A. Munro, Russell-road, Kensington, for improvements in the extraction of oil and other hydrocarbons from bituminous substances, and for the production of coke and charcoal, and for the means and apparatus employed therefor.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 19, 1872.

ARTICLES.

THE ALCOHOL QUESTION.

THE Manifesto of the doctors issued a few months ago, together with the efforts of the teetotallers and the Permissive Bill men, to limit or stop the use of alcohol, will probably produce a whole volume-full of opinions on the old vexed questions whether or no alcohol is food, whether its use is attended with good or evil results, as well as on the pressing question as to what extent its sale is to be legalised and permitted. With what may be termed the sentimental aspect of the subject we have but little concern in this article, our purpose being merely to lay before our readers what is known by scientific men of the physiological action of alcohol, and to point out to what extent its use may be beneficial or useful to mankind. Students of chemistry will not require to be told that there are many kinds of alcohol, or that the one to which we have applied the name is really ethyl alcohol, which forms the "spirit" principle of the various decoctions, extracts, and mysterious compounds of the wine-shop and the public-house. Absolute alcohol, when perfectly pure, consists of carbon, hydrogen, and oxygen combined in the proportions which the chemist represents by C_2H_6O, and when absorbed into the human economy by any of the ordinary methods—viz., inhalation of its vapour, injection into the tissues immediately under the skin, or by means of that long-suffering organ the stomach, produces those effects with which dwellers in our cities and towns are only too familiar. Dr. Pereira divided these effects into three well-marked stages—excitement, intoxication, and coma or true apoplexy, and we know that the changes produced are invariably uniform, by whatever channel the alcohol is administered. According to Dr. Richardson, who has written an able article on this subject in the *Popular Science Review*, his researches have shown that the maximum effect is produced when the quantity of spirit is in the proportion of sixty grains to the pound weight of the animal's body.

Is alcohol food, however; and, if so, is it wholesome food, fit for man and beast? A first glance at the chemical formula which is employed to denote this combination of certain elements would induce a reply in the affirmative; for alcohol contains carbon, and that, we know, is heat-giving, and in one or other of its forms is an article of diet at nearly every meal. But there is another point to be considered, by far the most important of the two, and that is can the human stomach split up the alcohol, separate it into its constituent elements, and while sending those which are useless to the various eliminatory channels, can it assimilate and utilise what there may be of nutriment in the remainder? Or, on the other hand, is not alcohol eliminated, in some way or the other, as an unchanged chemical compound? The weight of the evidence which we have at present turns the balance in favour of the latter view; but if we regard the question as incapable of settlement with our present knowledge, we can, at any rate, study the effects of alcohol when administered to the human being, or to members of what is called the brute creation. If, then, we apply to alcohol the same rigorous method of investigation which we employ in estimating the force produced by coal in the furnace of a steam-boiler, we shall find that the "energy" stimulated by spirits is delusive; that it is as much wasted force as that thrown away by a careless stoker who, urging his fire beyond what is requisite, causes his valve to open and permit the escape of steam which has not done its quantum of work. If this were the only effect of the administration or drinking of alcohol little harm would be wrought; but here the analogy of the steam-boiler fails us; for while with the latter no damage is done save the possible straining of the boiler-plates, the force exerted by the alcohol is not merely wasted, but is in reality a powerful agent for injury, which cannot be many times applied without making its injurious effects apparent.

When alcohol begins to exercise its powers on the animal body the first symptom which attracts attention is the increased action of the heart and the arteries; the heart beats quicker, the arteries are filled more frequently, and the surface circulation is accelerated, the minute vessels becoming at the same time distended. These effects are made apparent by the heightened colour of the cheeks, and when the use of alcohol is habitual they become permanent and exhibit themselves commonly in the rubicund nose of the confirmed toper. This phase of alcoholisation, which is the stage denominated "excitement," is recognised in the expression "flushed with wine;" but it would be a mistake to suppose, as is commonly done, that this acceleration of blood-flow and distension of the vessels is peculiar to the parts which exhibit these effects to the observer, for if it were possible to see the lungs, the brain and spinal cord, the stomach, the liver, and other organs, the same conditions would be found to prevail. This quickening of the pulse, these extra beats of the heart, are really so much wasted force, the amount of which has been ascertained by the observations of Dr. Parkes and Count Wollowicz. Their experiments were made upon a young and healthy man who for eight days drank nothing but water; during this period the beats of the heart were counted at intervals, and the same course was pursued on six following days when gradually increasing doses of alcohol were administered. During the water period the average number of beats of the heart in twenty-four-hours was 106,000; but when the subject of observation was under the influence of alcohol the beats of the heart increased to 127,000, being 21,000 extra beats in twenty-four hours. On the first day only one fluid ounce of alcohol was taken, causing 430 extra beats; but 4oz. on the third day produced 12,960 extra beats; and 6oz. on the following day caused no fewer than 30,672 extra beats. As there was ephemeral fever on this day a deduction was made to bring its total between that of the previous and the following day, when eight fluid ounces were given and 23,904 beats calculated. The mean daily excess of beats during the alcoholic period, subject to the correction above mentioned, was thus found to be 14,492. Now, taking the daily work of the heart as equal to 122 tons lifted one foot, we find that under the influence of alcohol it was made to do extra work nearly equal to lifting sixteen tons one foot. "Little wonder is it," says Dr. Richardson, "that after the labour imposed upon it by 6oz. of alcohol the heart should flag; still less wonder that the brain and muscles, which depend upon the heart for their blood supply, should be languid for many hours, and should require the rest of long sleep for renovation." How or why the alcohol produces this action of the heart is not clearly established; but, according to Dr. Richardson, recent inquiries have thrown a light upon the subject, and afforded an explanation of the phenomenon which appears to satisfy him of the erroneousness of the idea that alcohol acts directly upon the heart, stimulating it to increased action. On the contrary, it would seem that the acceleration of the heart's action is due to the removal of resistances which in the normal condition are always existing. We have now learned, he says, that there exist many chemical bodies which act directly by producing a paralysis of the organic nervous supply of the vessels forming the minute vascular circuit. These vessels when paralysed offer inefficient resistance to the stroke of the heart, which thus liberated, quickens in action, dilating the minute and feebly-acting vessels, and giving evidence really not of increased but of wasted power.

When the amount of alcohol imbibed is sufficient to produce the phenomena of the second stage, the well-known state of intoxication is observed. The nervous control of some of the muscles is lost, and they begin to lose their contractile power. The seats of thought and volition in the larger brain are upset; the intellectual part of the man is shunted, and the animal nature has full play, till nervous power is utterly exhausted, the muscles refuse to act, and the whole system becomes insensible in a deep sleep. During the progress to this stage there is a gradual but steady decline of the bodily temperature, which, slightly raised in the first stage by the increased circulation on the surface, declines, for the simple reason that no heat has been really added to the body. It is this well marked and invariable fall in the temperature that helps to prove that alcohol cannot act as food; and that "drops" of spirits taken "to keep out the cold" neither supply vital heat nor assist in preventing its loss. But, instead, after the temporary feeling of increased warmth has passed away, there is a steady decline of heat to several degrees below the normal temperature, and but a slow—a very slow—recovery towards the natural state when the alcohol is eliminated.

Dr. Richardson says that alcohol is in reality a narcotic agent, and he compares its effects with those produced by chloroform—the result being that the action of the two is very similar, save that alcohol is less fatal than the well-known anæsthetic. This is possibly attributable to the fact that under alcohol the different systems act evenly though slowly to the last, and that however much the brain may be influenced the nervous centres which govern the respiratory movements and stimulate the action of the heart remain on duty till the end—the latter the longest; for if death occurs during alcoholisation its cause is purely mechanical, from condensation of fluid on the bronchial surfaces and stoppage of respiration. "The animal is literally drowned in his own secretion."

So far we have spoken only of the effects produced by the abuse of alcohol. There are times, however, when the use of alcohol is beneficial to the human economy as we find it among the ordinary surroundings of civilised life. But these times are few and far between. When the action of the heart is oppressed by too great a resistance, when blood flows languidly, and the springs of life are weakend by disease or other causes, then alcohol is of use; but its use is limited by the rigid line we have pointed out. It may and does serve a temporary purpose; beyond this it is waste of force, waste of health, and waste of money. In short, we may say, as Dr. Richardson says, "The evidence is all-perfect that alcohol gives no potential power to brain or muscle." It is like a fire, hot and energetic while it lasts, but leaving desolation behind; it dees nothing at its own cost; it gives nothing for what it destroys; even the effects we see produced are accomplished, so far as we know, without any expenditure on the part of the alcohol itself; it merely accelerates the consumption of useful matter and leaves behind it injuries more or less irremediable. True, the human system is so "wonderfully and fearfully made" that it adapts itself in a measure to the influences of alcohol, and we see its persistent users occasionally living to the allotted span of the human race. But we know that alcohol does its fatal work surely if slowly; the functions of the organs are destroyed and their structure is altered, and if life still continues, it is in spite of its action. Such are some of the scientific aspects of the alcohol question, recorded without bias to one side or the other; alcohol is not food, and it does more harm than good. With regard to the restrictions, if any, to be imposed upon its sale we have nothing to do with them here.

THE STAR DEPTHS.

MR. RICHARD A. PROCTOR, Hon. Sec. R.A.S., delivered last Saturday, at three o'clock, at the Royal Institution, a lecture on the above subject. This lecture, the first of a course of five, was devoted to the consideration of the ancient constellations, and the traces of them now discernible among the star groups, with the object of showing that the figures of the objects associated with certain star groups can really be recognised at the present time if the boundaries of the modern figures be extended, and that, therefore, the stars may be assumed to shine for the most part with a steadfast lustre. Thus our sun, so far as probable inferences from the star depths are concerned, is likely to shine as he now does for thousands of years yet to come. The second division of the lecture was devoted to the consideration of the scale on which the stellar universe is formed.

A series of mishaps with the illuminating apparatus somewhat interfered with the lecturer's efforts. It may be a consolation to amateur manipulators who have come to grief when using the lantern, that in a single lecture at the Royal Institution the oxyhydrogen light was *twice* suffered to go out altogether, and that scarcely one out of some score of illustrations was brought centrally on the screen or properly focussed. Such mishaps suffice to confuse the most practised lecturer, and it seemed to us that during the delays thus occasioned Mr. Proctor continued speaking rather to divert the attention of the audience from the unfortunate lantern than to advance his argument. Logically, a lecturer should remain silent rather than attempt to fill any gap in his discourse with extraneous matter;

but does the lecturer live who would remain absolutely silent for ten minutes before a Royal Institution audience? Truth compels us to notice, moreover, that owing to the delays we have referred to, the second part of the lecture seemed incomplete. The reasoning was satisfactory as far as it went, though delivered with unusual but enforced rapidity of utterance. But the experienced auditor could scarcely fail to notice that a minute or two before four o'clock the subject was broken off in order that the lecture might terminate at the proper hour.

We think that lecturers should be protected from such mischances, which cannot possibly be regarded as unavoidable. The more carefully a lecture has been prepared, and the more thoroughly the arguments have been weighed, the more mischievous is the effect of interruptions involving, as in the present instance, a considerable delay.

DANKS'S PUDDLING MACHINE.

THE validity of the patent obtained in this country by Mr. Danks is contested, and the agreement entered into, but not ratified, between that gentleman and certain ironmasters, under which Mr. Danks was to have received £50,000, is not likely to be carried out as far as one of its provisions is concerned. It appears that in 1858 a Mr. B. P. Walker patented a rotary puddling machine which differed "in no essential particular" from the one claimed as original by Mr. Danks. The failure of Mr. Walker's machine, when tried by the Dowlais Iron Company, is attributed partly to the imperfect method of working it then adopted, but chiefly to an insufficient temperature. In these experiments a fan was used to urge the blast, instead of reliance being placed on the draught produced by the chimney. Mr. Danks, it seems, knew of this machine, as he referred to its failure at the Dowlais Works, when at the meeting of the Iron and Steel Institute. We hope, however, whether the patent is good or not, that Mr. Danks will be able to secure some recompense for his ingenuity.

METALLURGY OF IRON AND STEEL.*

(*Continued from p.* 86.)

THE following tabular statement was given showing the composition of the gases of a furnace at Alfreton, England, as determined by Bunsen and Playfair:—

Component Gases per Cent. by Volume.	Depth in English Feet Below the Mouth. 5	8	11	14	17	20	23	24	34
Nitrogen	55·35	54·77	52·57	50·95	55·49	60·46	58·28	56·75	58·05
Carbonic acid	7·77	9·42	9·41	9·10	12·43	10·83	8·19	10·08	0·00
Carbonic oxide	25·97	20·24	23·16	19·32	18·77	19·48	26·97	25·19	37·43
Marsh gas	3·75	8·23	4·58	6·64	4·31	4·40	1·64	2·33	0·00
Hydrogen	6·73	6·49	9·33	12·42	7·62	4·83	4·92	5·65	3·18
Olefiant gas............	0·43	0·85	0·95	1·57	1·38	0·00	0·00	0·00	0·00
Cyanogen	0·00	0·00	0·00	0·00	0·00	0·00	Trace	Trace	1·34
Proportion of Oxygen above that associated with 100 parts of atmospheric air ...	11·23	9·41	13·67	10·56	13·04	7·76	10·92	13·68	5·97

The old furnaces were very irregular shaped things, the worst possible shape, because affording opportunity for lodgment of the materials in descending. We may consider the matter in the interior of the furnace as consisting of two columns: one of solid materials perpetually going down, being replenished at the top, and going out at the bottom in the form of pig iron or slag; and an upward column of gaseous matter. It is evident that the furnace ought to be constructed to allow the gradual descent of the material, so as to prevent stoppage, and especially lodgment. It was, however, years and years before man learnt the lesson of experience. Not many years ago, Mr. Gibbons examined into the state of furnaces, and he found that a furnace never worked well until a certain period had elapsed, and that during this time the furnace underwent certain changes of form in the interior by the action of the fire and heat, and when that operation was effected the furnace was in good working order. He found that it is necessary that the furnace should have a regular curvature, otherwise a certain time is required to fill up the inequalities. It may be inquired why the lower part of the furnace is constricted. When the air is blown in at the lower part of the furnace vigorous combustion takes place, and that matter is converted rapidly into gas. The temperature here, moreover, is very high—sufficient, and more than sufficient, to fuse pig iron—and therefore a great contraction of volume occurs, because the carbon is continually disappearing, and the materials remaining occupy a much less space. Accordingly, the lower part of the furnace must be constructed proportionally to the relative bulk of the material in its descent. There is another reason why there should be this contraction. We have a great mass of ore, limestone, and fuel in the furnace which will, of course, exert great pressure. If we had the furnace cylindrical down to the bottom, we should get all the pressure of that column of superincumbent material bearing like a dead weight on the fused metal, which would, therefore, be pressed upwards, and there would be no room for the gaseous column, but by means of the contraction, the sides of the furnace take off a great deal of that dead weight, and prevent this contingency. They are usually also contracted at the top, for the convenience of supplying the materials, and in order to prevent too great loss of heat by radiation.

Hot Blast.

This effect was invented by a gas engineer of Glasgow—Mr. Lindsay,—which fact drew forth from the lecturer some remarks about the benefits which had accrued to metallurgy since the manufacturers themselves set to work to become acquainted with the process both in theory and practice. The utility of the hot blast may be seen from the fact that in some furnaces where to obtain a ton of pig iron required 8¼ tons of coal, on the application of a blast heated to a temperature less than that of melted lead, the same amount of iron was obtained with 3 tons of coal. As to the theory of the hot blast, there is at present great uncertainty and little agreement. Some ironmasters are disposed to think that, if the furnace was made high enough, so as to intercept as much of the heat as possible from the gases rising upwards, then you would have as much effect as can be obtained by hot blast. The greater quantity of heat kept in the furnace, the better it should be for the working of it. In the case of a low furnace the gas which has been very highly heated below soon escapes into the air as a waste useless article, carrying off with it an enormous quantity of heat. The first idea, therefore, is to make the furnace higher and higher, and, this being filled with cool solid materials, thus absorbs from that ascending current of gas heat, and becomes warm, and thus is a useful contribution to the economical working of the furnace.

One mode of heating the blast, commonly adopted in South Staffordshire, was then described. The blast is heated by stoves, and may be considered as not fewer than four stoves built together. The heating apparatus consists of two mains of cast iron placed parallel to each other at each side of a fireplace. In these mains are fixed a vertical series of pipes of a siphon form, set by socket or other joints in the main; these pipes are usually oval in section, this form exposing a greater heating surface than circular. The whole of the pipes and apparatus is inclosed in brickwork, a fire is made between the pipes, and air is blown into one of the mains and made to traverse the whole series of pipes by plugs being placed in the mains on each side alternately. The air is thus heated to a temperature usually about equal to that of melted lead.

Slags.

These are more or less earthy, like glass, and often crystalline. The lecturer exhibited one fine piece which he had obtained from South Staffordshire, which in one part showed quite a crystalline structure, while in another it was entirely earthy and stone-like; yet the composition of both was substantially the same. The reason of this was explained to be that the part of the melted mass which is most rapidly cooled retains its glass-like structure; the interior, which is cooled more slowly, becomes highly crystalline, exactly as obtains in glass working. If you take a piece of common green bottle-glass and heat it for a long time at a temperature far below its melting-point, it ceases to be transparent, becomes much harder, opaque, and highly crystalline. The same thing takes place in a piece of barley-sugar; and so also in the slags from a furnace. The more rapidly it is cooled the more certain is the part to be glass-like. It often assumes various colours, black, brown, blue, green, &c. Its constituents are the ash of the fuel, the lime, &c., and on analysis they are found frequently to contain silica, alumina, lime, magnesia, oxide of iron, oxide of manganese, and in some cases potash. One specimen was shown, which the lecturer said contained one per cent. of potash, or one pound's worth in a ton of the slag, but no process had yet been discovered by which to extract the substance economically. Attempts have been made to fashion the slag into various ornamental objects.

Waste Heat.

Formerly a great deal of heat was wasted by the furnaces being left open at the top during their working. Because we have large deposits of coal we ought not to be profligate in the use of that material. Although a delicate subject to touch on, the British fireplace really utilises only about one-eighth of the heat of the coal consumed. The lecturer said he would undertake to warm any house effectually and far more pleasantly with about one-tenth of the coal now consumed. He did not believe there was any foundation for believing that a substitute for coal would be found. It is a question whether we are wise in exporting so much, or any, of this wonderful subterranean treasure we possess.

There are several ways of economising heat in the blast furnace; one means is as follows:—A large quantity of heat is carried up by the ascending column of gas, and if this be allowed to escape at once into the air, the whole of this heat is wastefully dissipated. Now, however, this hot gas is extensively used for heating the blast, for which purpose it is conveyed into the stoves and there burnt with the due admission of atmospheric air. Or it may be mixed with a due proportion of atmospheric air, and conveyed away and burnt under the boilers of engines. Another method is to place in the top of the furnace a cast-iron pan of conical form, with the apex of the cone upwards, suspended by a chain to the end of a lever, so that although, in its usual position, it entirely stops up the orifice at the top of the furnace, it can be let down a short distance to admit of the introduction of materials for the operations. Under this cone a hole is made in the side of the furnace, and a pipe fitted into it to convey away the gases from the furnace to be utilised.

The first time these methods were applied in this country was at Swansea, in 1848, but they had been previously and successfully employed in Germany, and the Germans were thought to be the inventors of the process. But on looking a little farther back I came upon a French article published so long ago as 1814, giving an account of the application of the gases from the top of the blast furnace in 1811. Let me once more remind you that it is not so much (possibly not at all) the sensible heat of the gases which is employed, but the heat evolved during their combustion.

Wrought Iron and Cast Iron.

These terms are commonly used to denote two different kinds of commercial iron. The former is often called "malleable iron," the name implying that it is malleable or hammerable; it is the nearest approach to the pure metal, which is extremely difficult to obtain. It can be rolled out into thin sheets, or drawn out into very fine wire—in other words, it is very ductile. It is forgeable and weldable.

If you try and hammer pig iron it will break directly; it is more or less brittle; it melts easily, wrought iron requiring a very high degree of temperature to melt it. It is not weldable. What

* An abstract report of a course of lectures by Dr Percy at the London Theatre of the Geological Museum.

is the cause of this difference? Malleable iron gives no evidence of the presence of carbon, or only a very small quantity, under one-tenth per cent.; pig iron has three or four per cent. of carbon. In fact, pig iron is iron essentially combined with carbon.

There are two kinds of pig iron, grey and white; both agree in containing carbon. If oxide of iron be heated with charcoal, until you reduce the oxide, and get the metal to take up as much carbon as possible, the result will be grey cast iron. Now, if this be acted on with spirits of salts dissolving all the iron, there remains a black residue of "black lead" or graphite, and this in the grey cast iron is separate, but diffused through the mass in fine scales, so that grey "pig" is nothing more than wrought iron containing black lead diffused through it.

IRON BARGES.

THE question of building iron barges for canal transit is beginning to attract considerable attention at Buffalo and other cities immediately interested in canal business. The experiment of iron boats was tried many years ago, and only failed because of the then greater cost of iron over wood, and the want of facilities which now exist for repairing the iron hulls. These objections no longer exist, and we understand the relative advantages of wood and iron are to be again tested by the construction of iron barges to run in competition with boats already engaged in the canal service. The advantages claimed for iron boats are that they are lighter, and, owing to the thinness of their sides, have a greater stowage capacity for freights than the most capacious wooden boats that can pass the locks. Should these claims be substantiated by actual trial—and we have no doubt, says *Van Nostrand's Magazine*, they will—it is not improbable that iron will supersede wood upon canals, as it is now doing in river, coastwise, and ocean navigation.

SPONTANEOUS COMBUSTION.

IN March last, a well-known Detroit druggist, assisted by two seriously inclined and science-loving gentlemen, resolved to make a number of experiments to test the worth of the talk about spontaneous combustion, and their experiments are well worth the attention of every reader.

They first took a piece of cotton cloth, which had once formed part of a sheet, and which had been used until quite threadbare, and smeared it with boiled linseed oil. An old chest was placed in the loft of a store room back of the drug store, a piece of zinc over it, another piece under it, and then the chest filled with paper and rags, and this particular piece of cloth placed in the centre. Although the room was not a light one, and the weather cold, in eight days there was such a smell of fire about the trunk, and the chances were so good for a conflagration within it, that the contents were emptied.

An examination showed that the fibre of the oil-cloth had untwisted and shrivelled up, and that the rag looked as if it had been held too near a hot blaze. In April, when the rays of the sun were stronger, a pair of painter's overalls, literally covered with paint and oil, were rolled up, a handful of pine shavings placed inside, and these were crowded in next to the roof boards of the loft. The experiment was not a week old when, during one warm afternoon, a smell of smoke alarmed a workman in the next room, and he found the overalls burning, and so tinderlike was the cloth that it had to be crowded into a pail of water to prevent total destruction.

During the hot weather of August, a handful of old cotton rags, in which two matches were placed, but which were not smeared with oil or other matter, were shut up in a tin box, and hung up in the loft, a rear window allowing the afternoon sun to shine directly on the box for several hours. Toward the close of the fourth day the druggist took down the box to see how the experiment was progressing, and found the contents to consist of nothing but a puff of black cinders, which flew all over him as the lid was lifted. Having a vacant corner in his brick wood-house at home, the druggist took the trunk up there, where there was no danger of burning a building. He filled the trunk with the contents of the paper rag-bag, and then smeared one with benzine and threw it in last of all. The trunk was shut tight, everything cleared away from its vicinity, and he commenced watching. One day the family came home to find a few ashes marking the place where the trunk stood, while the bricks above and around were badly stained with smoke.—*Scientific Press.*

Proposed Submarine Tunnel.—It is proposed to tunnel under the Strait of Canseau, between Nova Scotia and Cape Breton, in order to connect the railway at Cape Breton with the mainland. The distance is about 2¼ miles. It is estimated to cost the moderate sum of 2½ millions of dollars.

THE GERMAN NORTH POLE EXPEDITION.

THE *German Correspondent* states that in a sitting of the Geographical and Statistical Society of Frankfort, held on the 27th ult., Lieutenant Weyprecht spoke at some length of his approaching North Pole Expedition. He bases his calculations chiefly on the great Siberian currents, which, on account of their high temperature, greatly contribute to free the northern coasts of Siberia from ice. This effect is most strongly observable in September. The expedition is to sail in its own ship, which will be provisioned for three years. It is to leave Bremerhaven in June, touch at Tromsoe to coal, then leaving Nova Zembla on the south, it will seek its first wintering quarters as far as possible to the east of Tcheljuskin, the most northern cape of Asia. From this point long sledge journeys will be undertaken. New Siberia has been chosen for the second year's wintering place. In the third year the expedition will endeavour to return by way of Behring's Straits. Should this prove impossible, nothing will be left but to abandon the ship, and to endeavour with the boats to make the mouth of some Siberian river, and reach the nearest Cossack posts. One of the weakest points of the expedition is the fact that the store of coal, after calculating what will be required to heat the cabins and for cooking purposes, will only enable the ship to steam at full speed for forty days during the whole period of the expedition. In other respects the vessel is fitted up in a manner admirably adapted to the wants of the expedition, and the provisions have been very carefully selected. In order to avoid scurvy, all salt meat has been excluded, and preserved vegetables have been plentifully provided. Meiding's regulation stoves, which Koldewey's expedition proved to be the most satisfactory, will be employed for heating purposes.

LESSONS ON CHEMISTRY.*

By SELIMO R. BOTTONE.

(*Late of the Istituto Bellino, Novara, Italy.*)

(*Continued from p. 85.*)

(*Continued from p. 85.*)

SECTION 7.—SULPHUR.—*Symbol:* S''.[1] *Atomic weight:* 32. *Molecular weight:* 64.

145.—PROPERTIES.—In its ordinary condition, sulphur (also called *brimstone*) is a pale lemon-yellow coloured solid, possessing little or no taste, tolerably hard, but very brittle. Its specific gravity varies from 2·05 to 2·08. On breaking a rod of sulphur, the fresh surfaces are found to be strongly electrical. If melted sulphur be poured into a wine-glass, and a handle of wood be held in it until the sulphur is solidified, on removing the cone of solid sulphur from the glass it is found to be charged with electricity. By friction also sulphur becomes electrified, as it is a very bad conductor of electricity; during friction a peculiar odour is generated. Sulphur melts at about 232° Fahr., and from that temperature up to 280° appears as a light amber-coloured fluid. On increasing the heat, it darkens in colour, gradually loses fluidity, until on reaching a temperature of 450° Fahr. it becomes so viscid that the containing vessel may be momentarily inverted without spilling the contents. At about 500° it again becomes fluid, and at 824°[2] Fahr. sulphur boils, yielding a red vapour, which condenses on cold surfaces in the form of a fine yellow powder, known in commerce as *flowers of sulphur.* Sulphur is insoluble in water, but is slightly soluble in alcohol and ether, and freely so in oils, hot turpentine (which dissolves about ten per cent.), and in carbon bisulphide. The affinities of sulphur are very powerful, and its vapour supports the combustion of many metals. The compounds formed by the union of sulphur with the other elements are very similar to, and generally isomorphous with, the corresponding oxygen compounds. Like oxygen, it can assume the allotropic state; several well defined forms being known, of which the following are the most important:—

1. Ordinary sulphur, distinguished by crystallising in *octahedra*, and having an average specific gravity of 2·05.—This variety appears to be the normal state of sulphur, as all the others gradually return to this form. It is soluble in oil of turpentine, in sulphur chloride, in carbon bisulphide, and in benzole.

2. Prismatic sulphur.—This variety is obtained by melting ordinary sulphur at 232° Fahr., allowing it to cool until a crust forms on the surface, when, on piercing the crust, and pouring off the fluid sulphur remaining, the inner surfaces are found strewn with transparent prismatic crystals. These, however, soon become opaque, and are then found to consist of an agglomeration of octahedral crystals of ordinary sulphur. The specific gravity of this variety is 1·98. It is also soluble in carbon bisulphide.

3. Amorphous[3] soluble sulphur.—This is a milky white powder, obtained by precipitating sulphur from a sulphide by means of an acid. This variety also is soluble in carbon bisulphide.

4. Amorphous insoluble sulphur.—This is a dirty-looking magma formed by decomposing sulphur chloride by the addition of water. It is insoluble in bisulphide of carbon.

5. Plastic sulphur.—If sulphur be heated to about 500° Fahr., and then be poured into cold water, it assumes the appearance and consistence of softened guttapercha, and retains this state for several hours, or even days. Hence it may be used for taking impressions. In this form the specific gravity of sulphur is 1·96. If plastic sulphur be gradually heated to 212° Fahr., it suddenly becomes fluid, while the temperature simultaneously rises to 232°, owing to the evolution of the latent heat contained in the plastic sulphur; or, in other words, owing to the change in its molecular arrangement. Plastic sulphur is insoluble in carbon bisulphide.

146.—Sulphur is a very important element, both as regards its place in the economy of Nature, and its uses in the arts.

147.—STATE IN NATURE.—Sulphur occurs in the free state in volcanic districts, crystallised in the octahedral form; often incased in pipe-like incrustations of calcareous tufa. (See Fig. 11.) The ores of the commoner metals are mostly compounds of these metals with sulphur (such compounds are called *sulphides*). Sulphur also occurs combined with many metals and oxygen, as sulphate of lime, plaster of Paris or gypsum, heavy spar, &c. It also enters into the composition of many vegetables, as garlic, horse-radish, mustard, onion, leeks, &c., and occurs in the animal kingdom, in albumen, hair, wool, &c.

148.—PREPARATION.—Two processes are followed, one by which the crude sulphur as it occurs in Sicily, &c., is purified from the blue clay, tufa, &c., with which it is mixed, and the other by means of which the sulphur contained in iron pyrites (iron sulphide) is caused to separate from the iron:—

1. Crude sulphur is introduced into the first of a series of large earthenware jars, furnished with spouts at different heights, those of the first jars being nearly at the top, while those of the last are near the bottom. (See Fig. 12.) Heat is then applied, the sulphur in the first jar melts, the earthy impurities sink to bottom of the jar, while the fluid sulphur flows from the spout into the next jar, where a similar deposition of impurity takes place, until, on arriving in the last jar, it is considered sufficiently pure to be run off into wooden tubs containing water, which cools it. Thus prepared, sulphur contains about 15 per cent. of earthy impurities, and is subjected to a second fusion and decantation to obtain it in a purer state.

2. On heating iron pyrites (which is a compound of iron with sulphur) in closed vessels, the sulphur volatilises and may be collected in the ordinary mode. The apparatus required is a large earthenware retort connected with a cool receiver. Sulphur is now manufactured on a large scale by these means. After being prepared by either of the above methods, sulphur is ge[illegible]lted and run into cylindrical moulds, [illegible] as "roll sulphur." Or it is p[illegible] retort connected with a lar[illegible] (Fig. 13.) On the application [illegible] volatilises, passes into the ch[illegible] as a fine powder (flowers of [illegible]

[1] According to several chemists, sulphur is to be considered *hexavalent*, hence Dr. Frankland notes it as Svi. But no compounds with hydrogen with formulæ corresponding to $S^{iv}H_4$, or $S^{vi}H_6$ are known, hence its quadrivalence or hexavalence is based on very dubious grounds. If sulphur be hexavalent, oxygen must be so likewise, for oxygen can be substituted for sulphur in almost every known compound.

[2] Dumas. Some give 559° as the boiling point of sulphur: on what grounds I do not know. I have never known it to boil (under the ordinary pressure) below 800° Fahr.

[3] Amorphous, shapeless—that [illegible] definite form, not crystallisable.

very pure form of sulphur, but it still contains traces of arsenic and other volatile bodies. From these it may be purified by solution in carbon bisulphide and crystallisation.

149.—The uses of sulphur are many and varied. Many important manufactures depend almost entirely upon sulphur; such are the preparation of oil of vitriol, vulcanite, gunpowder, &c. It is also much used in medicine as a mild purgative, and is an excellent application, either alone or in conjunction with iodine for several cutaneous disorders.

Section 7a.—Compounds of Sulphur with Hydrogen.

a. Hydrogen Monosulphide.—*Synonym: Sulphuretted hydrogen; hydrosulphuric acid; hydrogen sulphide.*[4] *Symbol:* $H_2'S''$. *Molecular weight:* 34.

150.—Properties.—At ordinary temperatures this compound is a transparent colourless gas, possessing a most disgusting odour of rotten eggs[5]. Its specific gravity (air = 1·00) is 1·171. It is a potent poison, the presence of $\frac{1}{250}$ by volume in air being sufficient to kill a horse. One volume of water at 32° Fahr. dissolves 4·3706 volumes of this gas, and the resulting solution possesses the characteristic odour and most of the properties of the gas itself. When hydrogen sulphide acts on metallic oxides an interchange of the metal in the oxide for the hydrogen in the sulphide takes place, as illustrated by the following equation:—

$$M_2''O'' + H_2'S'' = M_2'S'' + H_2O.$$

It also reddens vegetable blues; hence it is entitled to be considered as an acid, and is often called hydrosulphuric, or sulphydric acid. The compounds, which result from the action of sulphydric acid on many metallic solutions, are insoluble, and generally endowed with very characteristic colours; hence a solution of sulphydric acid is in daily use by the analytic chemist as a test for the presence of certain metals. Under a pressure of seventeen atmospheres, or when cooled down to 101° Fahr., sulphuretted hydrogen gas becomes liquid. This liquid is transparent and colourless, and has a specific gravity of 0·9. Exposed to a temperature of — 122° Fahr., it solidifies to a white ice-like mass.

151.—In order to reduce gases to the liquid or solid state, three processes are generally followed. The first consists in compressing the gas in a strong cast-iron vessel until liquefaction takes place. The second depends on applying freezing mixtures to the outside of the vessel containing the gas. The third consists in the simultaneous application of cold and pressure. In the first case a strong, egg-shaped, cast-iron vessel, provided with a stop-cock at top and bottom, is provided. Into this the gas to be liquefied is pumped by means of a condenser. When the requisite pressure has been obtained the gas begins to liquefy. The stop-cock which communicates with the condensing-pump is then to be closed, when the liquid may be drawn off for examination from the lower stop-cock. Generally speaking, on allowing the liquefied gas to escape in a fine stream, it returns to its primitive form with such rapidity as to freeze a portion of the liquid to a snow-like mass. This is owing to the fact, that the heat necessary to convert the liquid into gas is abstracted from part of the liquid issuing, which consequently assumes the solid form. Fig. 14 illustrates the apparatus required. In the second process, the gas to be liquefied is passed into a U-shaped tube (see Fig. 9) immersed in a freezing mixture.

We owe the third mode to Professor Faraday. A strong glass tube, bent at right angles and closed at one end, is provided. A substance, capable of evolving the gas to be liquefied on the application of heat, is introduced into the tube, and caused to fall into the closed extremity of the tube. The open end of the tube is now closed by melting the tube over the flame of a lamp, &c. Heat is now applied to the extremity containing the gas generating substance, while the other extremity is immersed into a freezing mixture. Under the combined influence of pressure (from the evolving gas) and cold (from the freezing mixture) the gas liquefies. (See Fig. 15.) The tube may be quickly divided and sealed over a flame, and the resulting liquid preserved.

[4] Hydric sulphide.

[5] Their smell arises from the presence of this gas, derived from the decomposition of the albumen.

FIG. 11

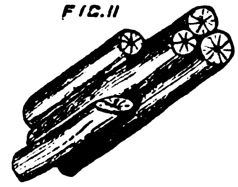


FIG. 12

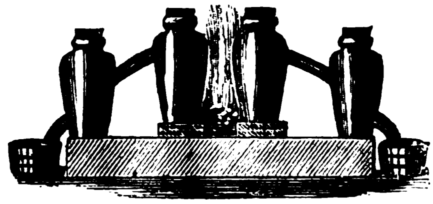


FIG. 13

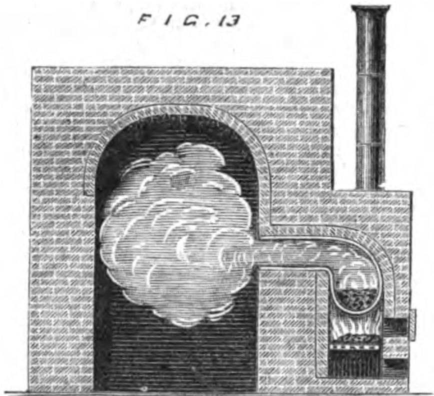


FIG. 14

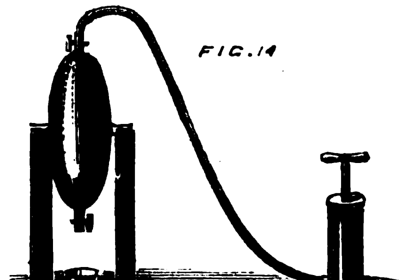


FIG. 15

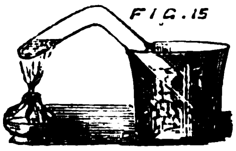


FIG. 16

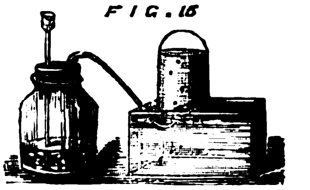
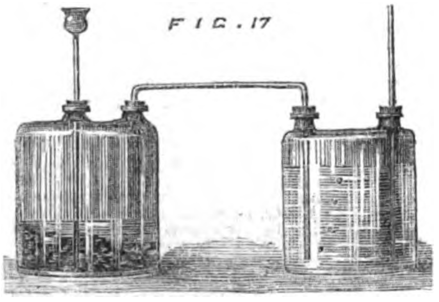


FIG. 17



152.—Hydrogen sulphide burns in air on ignition with a pale bluish white flame. The products of this combustion are water and oxide of sulphur, as the following equation illustrates[6]:—

$$H_2'S'' + 3O'' = H_2'O'' + S''O_2''.$$

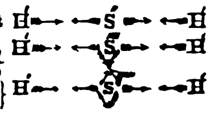
As the elements of the chlorine group possess a much stronger affinity for hydrogen than sulphur is endowed with, they are able to decompose hydrogen sulphide, by precipitating the sulphur and combining with its hydrogen. In the case of iodine, the following equation exemplifies the interchange:—

$$H_2'S'' + 2I' = 2H'I' + S''.$$

Advantage may be taken of this property for the preparation of hydriodic and hydrobromic acids.

Hydrogen monosulphide may be regarded as water, in which the oxygen has been replaced by an equivalent quantity of sulphur. Hydrogen monoxide (water) being $H_2'O''$, hydrogen monosulphide is $H_2'S''$. The molecular constitution of hydrogen sulphide may be represented in several modes, according to our estimation of the valency of sulphur:—

1. Sulphur considered bivalent
2. Sulphur considered quadrivalent
3. Sulphur considered hexavalent



153.—Preparation.—Sulphur can be made to unite directly with hydrogen by the application of heat; hence, if sulphur be sublimed in an atmosphere of hydrogen, or if hydrogen be passed through melted sulphur, sulphuretted hydrogen is the result. For laboratory uses a simple method is adopted, depending on the power which chlorine and several other bodies have of displacing sulphur from its compounds with the metals and substituting it. For this purpose a sulphide (generally iron sulphide) is introduced into a wide-mouthed phial. A cork carrying two tubes, one bent at right angles, and the other terminating in a thistle funnel, is adapted to the phial. Hydrochloric acid is poured in through the funnel, and, coming into contact with the iron sulphide, combines with the iron, liberating the gas, which may be collected from the bent tube in the ordinary mode (over *warm* water). Or it may be collected in recipients half filled with water, which will absorb it, and the resulting solution preserved for use. Figs. 16 and 17 represent these two modes of operating. The following equation illustrates the changes which take place when iron sulphide and hydrochloric acid are used:—

$$Fe''S'' + 2\,H'Cl' = Fe''Cl_2' + H_2'S''.$$[7]

154.—State in Nature.—Sulphuretted hydrogen occurs among the gases evolved from volcanoes, and is found dissolved in several mineral waters, such as those from Harrogate, &c.

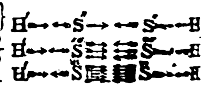
b. Hydrogen Bisulphide.—*Synonym: Hydrogen disulphide.*[8] *Symbol:* $H_2'S_2''$. *Combining weight:* 66.

155.—Properties.—This compound appears as a viscid, yellow, oily-looking body, heavier than water. Its specific gravity is 1·769. Like its relative oxygen compound (hydrogen dioxide) it is very unstable, being easily decomposed by heat into sulphur and hydrogen monosulphide, thus:—

$$H_2'S_2'' = H_2'S'' + S''.$$

It possesses distinct bleaching properties, and whitens the skin. Its odour and taste are similar to those of sulphuretted hydrogen. The constitution of this compound may be expressed graphically as follows:—

Sulphur considered as a bivalent element
Sulphur considered as a quadrivalent element
Sulphur considered as a hexavalent element



156.—Preparation.—We have already seen that when acids act on certain metallic dioxides in the presence of water, hydrogen dioxide is produced. In like manner, when hydrochloric acid acts on calcium disulphide, hydrogen disulphide is found and sinks to the bottom of the containing vessel, while calcium chloride remains in solution, as the following equation illustrates:—

$$Ca''S_2'' + 2H'Cl' = Ca''Cl_2 + H_2'S_2''.$$

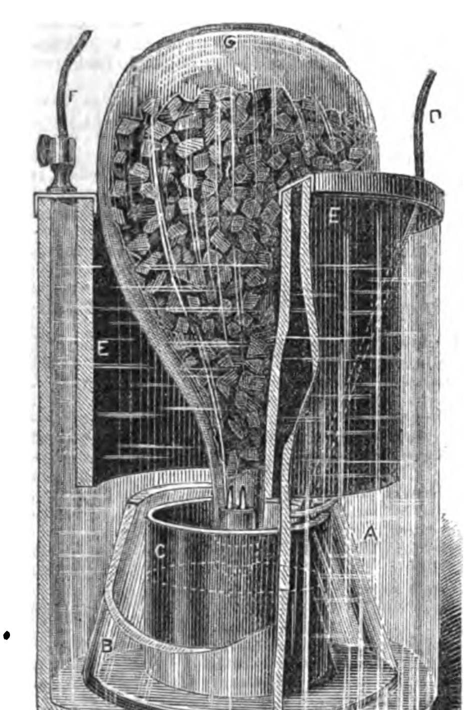
[6] As the nitrogen contained in the air takes no part in the reaction, no notice is taken of it in the above equation.

[7] Iron is by many regarded as quadrivalent; but in order not to confuse the student, we have taken no note of the two reciprocally satisfied valencies.

[8] Bisulphuretted hydrogen. Hydric disulphide.

HIMMER'S GALVANIC BATTERY.

WE gave a brief account on p. 344 of our last volume of a new arrangement of galvanic cell, for which it was claimed that the power could be regulated at will, and the action made continuous so long as the supply of the materials lasted. In order that our readers may be enabled to form a better idea of this cell and to test its advantages, if any, we give an illustration of it as patented in the United States. In the figure, A is a glass jar, resting on the bottom of which is a smaller vessel B in the shape of a truncated cone. In this latter the copper element C is placed, being a thin hollow cylinder to which the wire D is connected. E is the zinc, also a hollow cylinder, supported on the top of the jar A by means of a rim, and attached to which by a screw cap is the wire F. An inverted flask G is so held by the internal edge of the zinc cylinder that its neck just dips into the copper cylinder C contained within the vessel B. The mouth of this flask is stopped by a cork fitted with two tubes, the upper ends of which are drawn out fine to prevent blocking up by the copper salt. The flask is filled with sulphate of copper crystals and water; the jar A being supplied with a solution of magnesium sulphate. The flask is then inverted, and the water dissolving the crystals, the solution gradually flows out into the vessel B, where the pressure being



balanced it rises only up to the tubes in the cork of the flask. The inventor, however, does not state to what height in the jar A the magnesium sulphate solution is allowed to stand. The amount of copper thus brought into contact with the sulphate solution will be active in the cell, and the copper of the solution is deposited by electrolysis on the cylinder C. The sulphate of zinc deposits at the bottom of the jar A, being prevented from dropping into the vessel B by the form of the latter's sides. By this arrangement the inventor claims that the cell will work until the copper salt has been all decomposed or the zinc consumed; but as there is always sufficient copper solution in B to keep the cell in action while the flask is refilled the constancy of the battery is only determined by the duration of the zinc. Now that we have given an illustration of an arrangement which has been thought sufficiently valuable to patent in America, possibly some of our electrical readers may experiment upon it and let us know the result.

Amber.—It is thought that the supply of this substance will soon be considerably augmented. Hitherto amber-gathering has been a very uncertain operation: but it has now been ascertained, by boring, that the blue clay in the neighbourhood of Königsberg, in which amber deposits occur, is of greater extent than was supposed, and arrangements are being made to explore this clay in the usual mining style.

SOME RECENT IMPROVEMENTS IN ENGLISH AND AMERICAN BOILERS.*

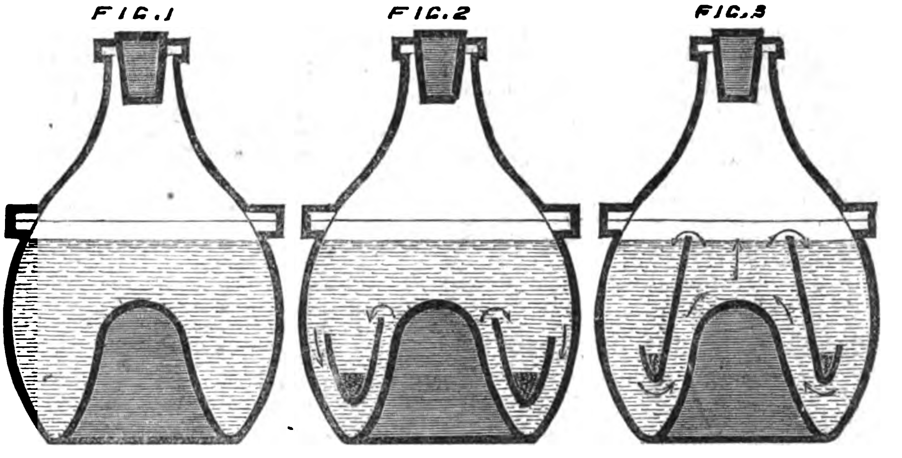
By W. Forsyth Black.

MUCH has been done to perfect the steam-engine, while, as regards the inseparable fundamental source of its power, comparatively little attention has been given to the improvement of the design of the boiler. It has been estimated that from 80 to 86 per cent. of the whole power furnished by the boiler has been employed by the engine in the work it performs, whereas the best boilers commonly in use do not yield over 10 per cent. of the power produced by the combustion of the fuel.

I purpose describing as briefly as I can, and as clearly as the means at my disposal will allow me, a cast-iron boiler which has been for some time in use in this country. Before entering on the arrangement and details of this boiler, let me describe some simple experiments, which give a general idea of the principles the inventor of this class of boilers claims to have carried out in their construction.

The first was originally made by the late Charles Wye Williams, of Liverpool, and is as follows:—A flask like the one represented at Fig. 1, and shown in section, was employed. The upper portion was made of copper, and securely fastened to the lower part of glass. This flask was placed, after having been partly filled with water, over a gas jet, the mouth being closed with a stopper. As soon as the pressure of steam in the interior was sufficient to force out the stopper, the steam not only escaped, but the greatest part of the water was also forced out. Mr. Joseph A. Miller, of New York, made a somewhat similar experiment, but with a flask sufficiently strong to stand a pressure of 50lb. to the square inch, on which he placed a safety-valve so arranged that it would lift suddenly at a pressure of 30lb. After this flask had been placed on a fire, his assistant and himself watched what would result through a small hole bored through a plank which they placed before them for safety.

FIG. 1 FIG. 2 FIG. 3



A few seconds after the flask had been fifteen minutes on the fire, the safety-valve opened entirely, a powerful jet of steam was forced out of the opening, and *instantly after* the flask burst with a loud report, shattered every pane of glass in the window, and damaged the ceiling. The time between the sudden opening of the valve and the explosion was exceedingly short, and seemed just sufficient for the water to be forced against the upper part of the flask when the whole was shattered to pieces.

The second experiment was made with a similar flask, precisely alike in all its arrangements, with the exception of a shield made like a cone-shaped cup, which was suspended within the flask near the bottom, as shown in Fig. 2. This shield divides the water into two parts—one a thin film near the heating surface, and the other, much larger in quantity, not directly exposed to the heat. A little powdered amber was put into the water, that the nature of the currents produced by the application of heat might be observed. When the flask was placed over the gas burner it was found that the heat is first communicated to the cone of the glass, and consequently transmitted to the water in contact with it, as any one would readily suppose. A large portion of the heat, however, is radiated from the inner surface of the flask, and being intercepted by the shield, a thin film of water is, therefore, in contact with two heating surfaces. This water soon becomes warm, and consequently lighter. It was, therefore, forced upwards by the cooler and heavier water in the larger space, and thereby a circulation was produced. This was shown by the motion of the particles of amber to be slow at first, but increased rapidly as the heat took more effect, and in all cases from the bottom, as shown by the arrows in the Fig. Though the motion became rapid in the thin film, it was much slower when it left the heating surface. It was also observed that since this was so, the amber became gradually deposited in the pocket formed by the shield at a distance from the heating surface, and thus no foreign body adds to the thickness of the part through which the heat acts most directly. The pressure soon became sufficient to force out the stopper, and all the water above the top line of the shield was forced out also, but what was below this line remained in flask.

A third experiment was tried with a flask, as before, but in this instance the shield was carried up to the water-level as shown in Fig. 3. When this flask is placed on a gas burner, the whole heat is concentrated on the water between the flask and the shield, instead of part of it being permitted to act on the larger body of water as in Fig. 2. The steam is at once carried into the steam space, not by its own force, but by the superior weight of the cooler water. When the stopper was forced out, not only was no water forced out along with it, but the water level was not in the least altered.

The explanation of the above has been supplied by the hypothesis of Dr. Ure, and others, which is that vapour is formed in the water, and may remain in it, and that unless mechanically assisted, the steam does not leave the water until the water is thoroughly saturated, when the new vapour, which the heat goes on forming, escapes by a series of miniature explosions. For this reason the boiling point differs with the amount of pressure under which evaporation takes place, and this, too, is the reason why the temperature of all liquids suddenly falls when they are stirred. This vapour, mechanically set free, indicates that the presence of the heated vapour in the liquid was the cause of the higher temperature. If apparently boiling liquid in a pot be stirred, the boiling instantly ceases, and the only change is a copious discharge of vapour, and an instantaneous fall of temperature. If the liquid itself had been only raised in temperature to the boiling point, no such effect could have been produced, as nothing had been done by stirring to cool it to any material degree.

Steam is an elastic vapour, and its pressure is proportionate to its bulk, or to the whole space which a given number of atoms (so to speak) occupy at any temperature. When a boiler is working under a pressure of 45lb., the temperature of the steam is 290°, both in the water and steam space. Water cannot, under atmospheric pressure, be raised to a higher temperature than 212°, and water being a medium 813 times denser than steam, it has the capacity of retaining in mechanical mixture with itself steam under at least the same pressure as that in the steam space, and the steam contained in the water cannot be released until the pressure in the steam space is effectually relieved, or sufficient heat or power added to force it from its place in the water. This immense power stored up in the water is the cause, not of the rupture itself, but of the sad and disastrous effects of boiler explosions.

In the first experiment the whole of the water was forced out along with the steam, because the water being itself full of steam, contained the power which expelled it. When the experiment was tried, as I have described, with the addition of a safety-valve, this valve allowed the steam alone to escape, but the space thus vacated by this steam was instantly occupied by what had been previously in mixture with the water. This new and much greater supply then thus set loose, and freed all the more rapidly by the mechanical action exerted by its rush into the space previously occupied by the steam which had escaped by the safety-valve, dashed the water against the sides of the flask, and, as I have stated, destroyed it. In the second experiment the water above the line of the shield only was driven out, simply because the portion below that limit contained no steam, but water alone, which had given up its steam in consequence of the rapid, though partial, circulation induced as explained. Most of the water above the shield, like *all* the water of the flask in the first experiment,

* Read before the Civil and Mechanical Engineers' Society.

contained as much steam, bulk for bulk, as there was in the steam space itself. In the third experiment, the circulation, by raising the shield to the water-level, was extended to the whole mass of water, each part of which gave up its steam as it approached the water-line; and when the steam escaped there was no force remaining behind stored up in the water, either entirely or partially, as in the first and second experiments, to force the water out after the steam. The steam, then, in the third experiment escaped as nearly dry steam by itself, and the water which remained in its entirety in the flask was simply water without admixture of vapour.

If steam be carried mechanically into the steam space and separated from the water, it will rise freely into its own element, no matter what the pressure may be. For instance, if the steam in the steam space be at a pressure (say) of 100lb., and steam be generated of (say) 100lb. pressure and mechanically freed from the water, the latter is simply compressed into smaller bulk by the superior pressure, and being surrounded by this it will remain, and by the very compression it will be raised in temperature. This is evident, from the fact, that pressure and temperature of steam are, one may say, convertible terms.

In a boiler where proper circulation is secured, every particle or atom, so to speak, of steam, as soon as formed, must find its way into the steam space, and that, too, without pushing or forcing its way through superincumbent water. And thus are secured the important results of rapid production of steam—a steady increase of pressure, steam free from water, and water free from steam.

Proper circulation is besides, as we see from the first experiment, a most important requisite to insure safety. For when it is necessary to ease the safety-valve (if such circulation has not been provided for by proper construction) a local relief of pressure only is obtained, the water nearest the valve rises first, and then suddenly falls, and thus produces a mechanical agitation of the whole mass, and the steam held in the water suddenly escapes in large quantities, and exercises such an immense force that must cause rupture, if the boiler is weak in any part, which result would not have ensued on a regular escape of steam. It is true, a judicious regulation of the mode of escape for the steam may be, and often is, provided; but in many cases this is absolutely neglected. What I refer to is, to have in connection with the valve-chest, a long and sufficiently large pipe, which is extensively perforated on the upper surface by a great number of small holes, and this has the effect of distributing the relief given to the boiler; whereas, when no such arrangement is employed, the steam is drawn entirely from the part of the boiler immediately in connection with the valve-chest.

(To be continued.)

THE PRODUCTION OF HONEYDEW.

THE following is an abstract of a paper by M. Boussingault, in the *Comptes Rendus*, on a subject which was discussed some time back in these columns. This translation was read by Prof. Dyer to the Royal Horticultural Society, at their recent meeting. On July 21, 1869, at Liebfrauenberg, the leaves of a lime were coated on their upper surface with an extremely saccharine viscid matter. The tree, in fact, afforded an example of the production of honeydew, a manna-like substance, which is frequently observable upon the lime, the black alder, the maple, and the rose. I have myself noticed it upon a plum-tree and upon a young oak. On the 22nd the honeydew was sufficiently abundant in the morning to fall in large drops upon the ground. It was a shower of manna. At three o'clock the saccharine matter no longer remained fluid upon the leaves which were exposed to the sun. It had sufficient consistency not to adhere to the fingers when touched; it formed, in fact, a sort of transparent and flexible varnish. Out of the sun the honeydew still retained its viscous condition. On the 23rd, at seven in the evening, several leaves at the extremity of a branch were washed and sponged, so as to remove all the saccharine matter. At six o'clock the following morning the leaves which had been washed seemed free from honeydew, but, on examination with a lens, minute glistening dots, due to very small drops, were observable. At seven the same evening the appearance of the leaves remained the same. The day had been warm; the temperature in the shade 84°. On the 25th numerous spots of honeydew were scattered over the leaves, but there was none upon the principal veins; at three o'clock the temperature was 86°.

During the night a violent shower removed a great part of the honeydew formed during the evening. It became, therefore, impossible to follow, as had been proposed, the progress of the secretion upon the leaves washed upon the 22nd. A swarm of bees settled upon the tree. On the 27th, the whole of the honeydew had disappeared, in consequence of the rain which fell during the evening of the 26th. The temperature had stood at between 62° and 75° Fahr. On the morning of the 28th the leaves bore numerous spots of honeydew, which had made their appearance during the night. On the 29th it had increased; on some of the leaves it occupied a third of the surface. At two o'clock the temperature was 84°. On the 30th the honeydew was very abundant. The lime tree remained covered with it till the commencement of persistent rains, which took place at the beginning of September.

On two occasions—namely, July 22 and August 1, honeydew was collected by washing the leaves. The solution, after treatment with lead-subacetate to precipitate albuminous and mucilaginous matters, yielded a syrup in which crystals of sugar formed. On examination it contained a sugar analogous to cane-sugar, and also a reducing sugar. By fermentation with yeast the two sugars disappeared completely. In the fermented liquid, however, a substance remained possessed of very strong powers of right-handed rotation. This proved to be dextrine, already announced by Berthelot as existing in the mannas of Sinai and Kurdistan, and subsequently by Buignet in a manna occurring in "tears" (*manne en larmes*). I have endeavoured to find mannite, and with especial care, because Langlois, an experienced observer, has found it in a saccharine matter collected from the leaves of a lime. Mannite is so easy to detect that I have not the slightest doubt as to its presence in the product studied by Langlois.

Optical observations have shown that the reducing sugar detected in lime-tree manna is not glucose (grape sugar), of which the rotatory power is 56° in the right-handed direction, but levulose (inverted or fruit sugar) which has a left-handed rotatory power of 26°.

Taking into consideration those substances only which rotate the polarised ray, the composition of honeydew will be:—

	July 22.	August 1.
Cane sugar	48·86	55·44
Inverted sugar	28·59	24·75
Dextrine	22·55	19·81
	100·00	100·00

These analyses show that the composition of honeydew collected with several days' interval has not remained the same. No doubt, one has no right to expect that the composition should remain precisely identical; what, however, is remarkable is the analogy which exists in composition between the honeydew of the lime and the manna of Mount Sinai analysed by Berthelot. Its composition is, in fact, identical with that of the honeydew collected on August 1.

Cane sugar	55
Inverted sugar	25
Dextrine	20
	100

It is a discovery not without interest to have found the manna of Mount Sinai in the Vosges.

In attempting to compare by analysis the quantity of honeydew existing upon the leaves of the lime which was affected with the saccharine matter contained in the leaves in their normal state, we arrived at the following result:—

In 1 Square Metre of Healthy Leaves:—

Cane Sugar.	Inverted Sugar.	Dextrine.	Weight in Grammes.
3·57	·86	0·00	4·43
In Honeydew Collected from ditto:—			
13·92	7·23	5·62	26·77
Difference:—			
10·35	6·37	5·62	22·34

The amount of manna, therefore, which exudes from the affected leaves is considerable, especially when one takes into consideration the amount of dextrine, a substance which does not exist in the healthy leaves at all. From calculations made upon a tree of the same age and size, the leaves of the affected lime-tree would have a surface of 240 square metres, or rather of 120 square metres (equal to 145 square yards), since the manna only covers one side of their surface. It would result from this, that on July 22, 1869, the lime bore 2 to 3 kilogrammes (equal to about 4lb. to 7lb.) of honeydew, reckoned in a dry state.

In the normal conditions of vegetation the saccharine matters elaborated by the leaves, under the influence of light and heat, are distributed through the organism of the plant with the descending sap. In the abnormal state, which determines the production of the honeydew, the saccharine matters are accumulated at the upper surface of the leaves, either because the movement of the sap is interrupted, or because it is retarded by the viscosity resulting from the formation of dextrine.

The production of honeydew cannot be due merely to meteorological influences—to the effect of warm and dry summers. No doubt the lime of Liebfrauenberg secreted it during a summer when there were periods of high temperature, accompanied by great dryness; we must not, however, lose sight of the fact that it was a single tree that was attacked by the malady, and that at a little distance there were limes which were perfectly healthy.

It has been supposed that aphides, after having drawn the honeydew from the parenchyma, discharge it again scarcely altered; but it is contrary to the results of analysis to assign it a composition similar to that of leaf sap. It is, however, admitted that certain insects possess the faculty of determining the production of manna. Thus it is to the punctures of a coccus that Ehrenberg and Heimprich attribute the formation of the manna which is still found on the mountains of Sinai.

The manna falls to the ground from the air (that is to say, from the summit of a tree and not from the sky). The Arabs call it man, and they, as well as the Greek monks, collect it to eat upon bread in the same way as honey. I have myself seen it fall, collected it, and brought it to Berlin with the plant and the remains of the insect. This species of manna is produced by Tamarix mannifera, Ehr. As with many other mannas it is the result of the punctures of an insect, which in the present case is Coccus manniparus, H. & Ehr.

The manna, consequently, collected in 1869 at Liebfrauenberg, had not the same origin as the Sinai manna, though it had the same composition. At the time of its appearance upon the lime no insects were observable. It was later that a few aphides were seen glued upon a certain number of the leaves.

I have already stated that after having washed the extremity of a branch, glutinous points were seen gradually to rise; at first scarcely perceptible, they increased each day, so as finally to cover the whole of the upper surface of the leaf. This slow and progressive development of the honeydew was clearly effected without the intervention of aphides, which did not make their appearance till subsequently, like the flies and bees, either to feed upon the secretion or to pilfer it.

In a subsequent number Harting states that honeydew is produced by Aphis tiliæ, which, living on the under surface of the leaves of the lime, drops its excrement on the upper surface of the leaves beneath. Analysed by Gunning at Amsterdam, it proved to consist of cane sugar. Boussingault remarked, in reply, that the manna of Liebfrauenberg, like the Sinaitic manna analysed by Berthelot, contained, in addition to cane sugar, fruit sugar and dextrine. He added, also, that the leaves of the lime contain considerable amounts of cane sugar almost pure, the origin of which could not be attributed to insects.

Professor Dyer then quoted Goethe, as saying, "I have seen limes, of which the leaves seemed varnished, but where not a single insect was visible. The juice is secreted by the plant itself." Mr. Hanbury informed him that he noticed the exudation of a saccharine matter from a canella, and that after repeated cleansings it still made its appearance. He had seen also the occurrence of minute crystals of sugar upon the corolla of the azalea. De Candolle mentions the same thing in Rhododendron ponticum. This is, however, different to the secretion which takes place on leaves, because it is probably merely due to the loss of water from the flower preparatory to fading.

De Candolle remarks that granular secretions are found on the young shoots of the larch, and are collected locally under the name of manna of Briançon; they also occur on Salix alba, and upon some other trees. "We cannot affirm," he says, either that they are a natural excretion, or that they are produced by insects." Dr. Masters states that a manna-like substance is produced from species of Alhagi, and that it is an exudation from the leaves and branches of the plant only appearing in hot weather. Saline secretions from leaves have been more frequently observed. De Saussure states that an accumulation of saline matters at their surface often occurs in garden vegetables, transpiration being impeded, the leaves are ultimately destroyed. De Candolle found a saline secretion from the leaves of a Reaumuria to consist of carbonates of soda and potash.

THE PROGRESS OF GEOLOGY.

THE following abstract of the annual address of the President of the Geological Society (Mr. J. Prestwich, F.R.S.) will be found to contain much interesting information concerning the progress made in the science, together with some valuable and important facts in connection with the geology of the Thames Basin and the water supply of the metropolis. In commencing his address, Mr. Prestwich said: Looking at the labours of the Society during the past year, it is satisfactory to notice the same activity, the same wide range of subjects as ever, and the same independence of research for truth's sake which there ever should be. But though good work has been done in special branches and the technical details of Geology, not so much progress has been made in its higher problems.

The great question of the history of our globe during the Quaternary period seems to be advancing towards more completeness. Many able observers, both in and out of our own society, are engaged upon the subject, and various scientific periodicals and publications of our local societies are rich in contributions bearing upon this interesting subje[illegible]

There is no more wonderful chapter in the earth's history than that which embraces the phenomena connected with the prevalence of great and exceptional cold immediately preceding our time—the first dim appearance of man—his association with a race of great extinct Mammalia belonging to a cold climate—the persistent zoological characters of the one, so far as we have yet gone, in opposition to the variable types presented in geological time by the others—the search for connecting links, and the measure of man's antiquity, all of which constitute theoretical problems of the highest interest, and are now occupying the attention of geologists of all countries. Allied also to this subject are the great questions relating to the form of our present continents—the elevation of the land—the origin of valleys and plains—and of all that which prepared this globe for the advent of man.

But while treating of these abstract and philosophical questions, geology deals also with the requirements of civilised man, showing him the best mode of providing for many of his wants, and guiding him in the search of much that is necessary for his welfare. The questions of water-supply, of building materials, of metalliferous veins, of iron and coal-supply, and of surface soils, all come under this head.

The site of a spring or the presence of a stream determined, probably, the first settlements of savage man: and his civilised descendants have continued, until the last few years, equally dependent upon like conditions—conditions connected first with the rainfall, and, secondly, with the distribution of the permeable and impermeable strata forming the surface of the country. Under ordinary circumstances, few large towns have arisen except where there has been an easily accessible localised water-supply, and where the catchment-basin on which depends the volume of the rivers has been large, and permeable strata prevail. Take, for example, London. Few sites could be more favourable in every respect. Beneath it are strata rich in springs, while at a distance there is that large development of those massive permeable strata so necessary to maintain a sufficient and permanent flow in our rivers.

London north of the Thames stands on a bed of gravel, varying in thickness from 10ft. to 20ft. in round numbers, and overlying strata of tenacious clay from 100ft. to 200ft. The former being easily permeable, the rain falling on its surface filters through it, until stopped by the impermeable London clay, where it accumulates and forms a never-failing source of supply to the innumerable shallow wells that have been sunk all over London from time immemorial, and which for centuries constituted its sole water-supply. Not only does it form an easily accessible underground reservoir, although of limited dimensions; but where the small intersecting valleys cut down through the bed of gravel into the London clay, a portion of the water in this reservoir escapes at the junction of the two strata, and gives rise to several springs formerly in much repute, such as those of Bagnigge Well, Holy-well, Clerken-well, St. Chad's Well, and others.

The early growth of London followed unerringly the direction of this bed of gravel, eastward towards Whitechapel, Bow, and Stepney; north-eastward towards Hackney, Clapton, and Newington; and westward towards Chelsea and Kensington; while northward it came for many years to a sudden termination at Clerkenwell, Bloomsbury, Marylebone, Paddington, and Bayswater. A map of London, so recent as 1817, shows how well-defined was the extension of houses arising from this cause. Here and there only beyond the main body of the gravel there were a few outliers, such as those at Islington and Highbury; and there habitations followed. In the same way, south of the Thames, villages and buildings were gradually extended over the valley-gravels to Peckham, Camberwell, Brixton, and Clapham; while, beyond, houses and villages rose on the gravel-capped hills of Streatham, Denmark Hill, and Norwood. It was not until the facilities were afforded for an independent water-supply by the rapid extension of the works of the great water companies, that it became practicable to establish a town population in the clay districts of Holloway, Camden Town, Regent's Park, St. John's Wood, Westbourne, and Notting Hill.

On the outskirts of London a succession of villages grew up for miles on the great beds of gravel ranging on the east to Barking, Ilford, and Romford—on the north, following the valley of the Lea to Edmonton and Hoddesdon; and on the West, up the Thames-valley to Ealing, Hounslow, Slough, Hammersmith, and beyond; whereas, with the exception of Kilburn, hardly a house was to be met with a few years since between Paddington and Edgware, or between Marylebone and Hendon; and not many even between the New-road and Highgate and Hampstead. As a marked case of the excluding effects of a large tract of impermeable strata close to a great city, I may mention the denuded London-clay district extending from a mile north of Acton, Ealing, and Hanwell, to Stanmore, Pinner, and Ickenham, near Uxbridge. With the exception of Harrow (which stands on an outlier of the Bagshot Sands), and Perivale, and Greenford (on outliers of gravel), there are only the small villages of Northolt and Greenford Green. In the earlier edition of the Ordnance Maps, there was a tract of ten square miles north and westward of Harrow within which there were only four houses. Yet the ground is all cultivated and productive. But immediately eastward of this area, and ranging thence to the valley of the Lea, the ground rises higher, and most of the London-clay hills are capped by gravel of an older age than that of the London valley, and belonging to the boulder-clay series. On these we have the old settlements of Hendon, Stanmore, Finchley, Barnet, Totteridge, Whetstone, Southgate, and others.

There is yet another very common source of well-water supply from beds of gravel directing population to low sites in valleys, which is this. Everywhere on the banks of the Thames and its tributaries there is a lower-lying bed of valley-gravel or of rubble, on, and often passing beneath, the level of the river. This bed is supplied with water both by rain falling on it, by springs thrown out from the adjacent hills, or by the drainage from those hills, and in places by infiltration from the river, when, from any cause, the line of water in the gravel falls below that of the adjacent river; while, on the other hand, the surplus land-supplies find their way direct and unseen from the bed of gravel to the river. It is, however, only in case of exceedingly dry seasons or of excessive pumping, that the supply requires to be supplemented by the river-waters. As in ground of this description, the land-water is generally dammed back by the stream, the level of the water in the wells, which are always shallow, varies with the level of the water in the streams, rising and falling more or less with them.

A few of the higher London-clay hills in the neighbourhood of London are also capped by outliers of the Bagshot Sands, as, for example, Harrow, Hampstead, and Highgate, all of which are sites of old habitations. The sands at these places attain a thickness of from 30ft. to 80ft., are very permeable, and afford a sufficient water supply by means of wells to a limited population. A number of well-known small springs are thrown out at the contact of the sands and the clay on the slopes just below and around the summit both of Highgate and Hampstead Hills. In some instances, owing to the presence of iron in the sands, they are slightly chalybeate. When the Bagshot Sands, further westward of London, attain their fuller development of from 300ft. to 400ft., the depth to the water-level at their base becomes so great that the upper porous beds are left high and dry, and form uncultivated wastes, such as Bagshot Heath, Frimley Heath, and others; but on the outside of this area, where the sands become thinner, and the water-level more within reach, we find a number of villages, such as Englefield Green, Sunningbill, Brackwell, Wokingham, Alderstone, Esher, Weybridge, Woking, &c. There are also some thin subordinate beds of clay in the middle of the series which hold up a sufficient quantity of water for small local supplies, and give rise to small streams in the valleys of the Blackwater and of Chobham. The running nature of portions of these sands, and the presence of beds of ferruginous and green sands, often interfere much with the construction of deep wells, and the quantity of the well-water; and, externally, the mixed clay-and-sand character of the upper beds of the London clay fails to give any good retaining-line for the water, which, therefore, rarely issues as springs, but oozes out from the general surface of the intermediate spongy mass.

The 70ft. to 100ft. of sands and pebble-beds belonging to the Lower Tertiary strata under the London clay, and overlying the chalk, are also very permeable, and being intercolated with some beds of retentive clay, they give rise to one or two levels of water, affording, wherever these strata form the surface—as at Blackheath, Bexley, Chiselhurst, and Bromley—a moderate water-supply to shallow wells. Where these sands dip under the London clay, and only present a narrow belt on the surface, a small valley is commonly formed into which the London-clay hills drain on the one side, and on the other the chalk dammed back by the Tertiary strata throws out its springs, and the sands are thus kept charged with water up to a short depth from the surface.

But besides furnishing a supply by ordinary wells to a number of villages on their line of outcrop, the Lower Tertiary sands have of late years contributed to the metropolitan supply, as well as to the supply of those adjacent districts where the surface is formed of tenacious clay, and water is scarce, by means of artesian wells. For along the line of country just named, and along a more irregular belt on the north of London, these sands pass beneath the London clay, so that the water they receive from rain and springs on the surface passes underground, where it is prevented from rising by the impermeable superincumbent clay; consequently, as there is no outlet for the water below ground, these sand-beds are filled with water along their whole underground range, between their outcrop in Surrey and that in Hertfordshire.

The surface of the ground at the outcrop, just referred to, of the Lower Tertiary sands is about 100ft. above the level of the Thames, whilst under London the sands are at a depth of from 100ft. to 220ft. below that level, thus forming the shell of a basin from 200ft. to 300ft. deep, the centre of which is filled with a depressed mass of impermeable clay. There is, however, a notch in the lip of the basin, where it is traversed by the Thames, at Deptford and Greenwich, which is at a lower level of 100ft. than the rest of the rim. Below this level, as there is no escape for the water, the strata are naturally perpetually water-logged; and if any water is withdrawn from one part, it is, owing to the permeability of the strata, at once replaced from adjacent parts of the same strata. Early in the present century, bore-holes were made through the overlying London clay to the sands at depths of from 80ft. to 140ft., and the water from these deep-seated springs rose at once to a height of several feet above the level of the Thames, where it tended to maintain itself, and thus form, in the lower-lying districts, permanent natural fountains. But the ease and facility with which this abundant supply was obtained, led to the construction of so great a number of such wells that a time soon came when the annual rain outfall no longer sufficed to meet the demand, or, rather, it could not be transmitted fast enough to the central area of abstraction to replace the outdraught. The consequence was that, after some years, the water ceased to overflow, and the line of water-level has gradually sunk at London, until it now stands some 70ft. or 80ft. beneath the surface level.

In order to supply the deficiency thus caused in the Lower Tertiary sand, most of the artesian wells in London have of late years been carried down into the underlying chalk, which also extends beneath London at depths of from 150ft. to 280ft. Both formations are permeable, but in different ways. On both the rainfall is at once absorbed, but the transmission of it is effected in different ways. Through the sands it filters at once; but not so with the chalk. A cubic foot of the latter will hold two gallons of water by mere capillary attraction; but it parts with this with difficulty. Still, in time it finds its way through the body of the chalk, aided by the innumerable joints, fissures, and lines of flints by which this formation is traversed; and, when once under the line of saturation, the water in these fissures circulates freely. This line of saturation is governed in this as well as in all other permeable formations, by the level of the lowest natural point of escape, which is either the coast-line if near, or the nearest river-valley. Below these levels permeable strata are always charged with water; consequently under London the chalk is everywhere water-bearing; but as the Lower Chalk is more compact than the Upper, and is less fissured, especially when covered by other strata, and as the more compact water-logged chalk delivers its charge with extreme slowness, it is not until a fissure is met with that a free supply of water is obtained. Further, as there is no law regulating the position of the fissures, the depth to which the chalk has to be traversed before meeting with a free supply of water is quite uncertain. It is a question of probability depending upon meeting with a fissure sooner or later—10ft. to 15ft. have sufficed in some of the deep London wells, whereas in others it has been necessary to sink to a depth of from 100ft. to 200ft. or more before hitting on the necessary fissures. Large as this supply is, the same causes which have operated in the case of the sands have told also on the chalk supplies (and, no doubt, there is some community between the two), and the great demands on it have occasioned a similar lowering of the water-line.

Numerous and useful as the London artesian wells are, they sink into insignificance when compared with the application of the same system in Paris. Our deepest wells range from about 400ft. to 500ft., and the water comes from the chalk hills at a nearest distance of from 15 to 25 miles from London; whereas in Paris the well of Grenelle is 1,798ft. deep, and derives its supplies from the rain-water falling in the Lower Greensands of Champagne, and travelling above 100 miles underground before reaching Paris. The well of Passy, sunk also through the Chalk into the Lower Greensands at a depth of 1,923ft., derives its supplies from the same source. The water-delivery is large and well maintained. These results were considered so encouraging, that in 1865 the Municipality of Paris decided on sinking two artesian wells of unexampled magnitude.

One of these experimental wells is in the north of Paris, at La Chapelle, St. Denis, 157ft. above the sea-level. A shaft, with a diameter of 6½ft., was first sunk through Tertiary strata to a depth of 113ft. At this point the boring was commenced with a diameter of 5¼ft., and carried through difficult Tertiary strata to a depth of 450ft., when the Chalk was reached. A fresh bore-hole was here commenced which has now reached the great depth of 2,034ft., with a diameter of 4ft. 4½in. It is now in the Grey Chalk, and it is calculated that the Lower Greensands will be reached at a depth of about 2,800ft. The other artesian well is at the Butte-aux-Cailles, on the south-east of Paris, at an elevation of 203ft. above the sea. The Tertiary strata are there only 205ft. thick. This well is not quite on so large a scale as the other, and is still, at the depth of 1,640ft., in the White Chalk. The discharge from these great wells will probably be equal to that of a small river. At Passy, notwithstanding some defective tubage, and the circumstance that the surface of the ground is there 86ft. above the Seine, the discharge at the surface is equal to 3½ millions of gallons daily; and it has been above 5 millions, or enough for the supply of a town of 150,000 inhabitants.

The question may arise, and has arisen, why, with a like geological structure, should not like results be obtained at London as at Paris; and, to a certain extent, it has been answered. At Kentish Town an artesian well was, in 1855, carried through 324ft. of Tertiary strata, 645ft. of Chalk, 11ft. of Upper Greensand, and 130ft. of Gault. Instead of then meeting with the water-bearing Lower Greensands which crop out from beneath the Chalk, both on the north and south of London, unexpected geological conditions were found to prevail, and not only were these Greensands found to be absent, but likewise all the Oolitic and Liassic series. The bore-hole passed at once from the Gault into a series of red and grey sandstones, probably of Palæozoic age, and not water-bearing. The Chalk has more recently been traversed at Crossness, near Plumstead, where its base was reached at a depth of 785ft., and the bore-hole carried 159ft. deeper into, but not through, the Gault, when, owing to difficulties caused by the small size of the bore-hole, the work had to be abandoned.

Such is the geological structure of the ground on which London is dependent for its first and immediate water-supply by means of wells. The highest seam of water, that in the drift-gravel, extends almost everywhere under the streets and houses, at depths of from 12ft. to 25ft., forming what is called ground-springs. The Lower Tertiary sands, with their greater thickness, and their larger and distant area of outcrop, contain the second and larger underground body of water beneath London. The third underground reservoir is the Chalk, which, from its large dimensions—500ft. to 1,000ft. thick—and extensive superficial area, forms a still larger reservoir, and source of water supply.

With the increase of population, however, the need for larger quantities necessitated the recourse to river-supply; and this supply, equally with the other, is regulated by geological conditions, only that in this case the question concerns those conditions which affect the strata throughout the catchment-basin of the river itself above the town which needs its supply.

(*To be continued.*)

THE PHOSPHORESCENCE OF THE SEA.

THE phosphorescence of the transparent compound, ascidian-pyrosoma, which occurs floating in occasional shoals both in the Atlantic and Pacific Oceans as well as in the Mediterranean, has long excited the admiration of voyagers. The fishermen of Naples know the pyrosoma by the name of "lanterne." Though its phosphorescence is so intense, yet zoologists have not hitherto rightly ascertained what are the organs which produce the light. Professor Paolo Panceri, of Naples, in the course of his admirable researches on the phosphorescence of marine animals, has, says the *Athenæum*, lately studied that of pyrosoma, and conclusively demonstrated, to the satisfaction of Dr. Krohn and other naturalists now at Naples, that the light-emitting organs are two large granular patches, placed on either side near the mouth of each of the tunicate constituents of the compound mass. By cutting a section of the pyrosoma, placing it in fresh water, and then under the microscope in a darkened room, it is at once seen that the light is produced by these two masses. Professor Panceri has, at the same time, made important observations on the development and anatomy of pyrosoma which were also studied during his voyage in the *Rattlesnake* by Professor Huxley. Professor Panceri has found that from a single egg not only do four embryos develop, but that the "cap" to which they are attached represents a fifth, which attains its development first, has a mouth, nervous system, and a heart, that pumps blood into the chain of four embryos encircling it. It is, in fact, a "nurse." The Italian Professor has also discovered a so-called "colonial" muscular system in pyrosoma, by which it is probable that the excitation causing a wave of phosphorescent light as observed in these animals is transmitted. In his entirely novel and ably worked-out investigations of the phenomenon of phosphorescence (he has already published memoirs on that of Pennatula, Pholas, Beroe, and Chætopterus), Professor Panceri is doing a work worthy to be ranked with the researches of the great Neapolitan naturalists, Cavallini, Poli, and Delle Chiaje.

New Safety-Lamp. — Some experiments of, apparently, a satisfactory character, were made on the 25th of March, at the Coal Exchange, on a new safety-lamp for collieries, invented by Mr. Henry Plimsoll. The principal features in the lamp were, that it was immediately extinguished when in an explosive atmosphere; and that, as the flame was surrounded with a glass cylinder instead of wire gauze, the light was very brilliant. We learn that the lamps are to be tried in some of the fiery collieries of South Yorkshire.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

JUPITER'S SATELLITES—ADJUSTMENT OF AN EQUATORIAL—SATURN'S SEMI-DIAMETER—TESTS FOR A 4¼IN. REFLECTOR—PLANETARY AND COMETARY ORBITS—STAR MAGNITUDES—GRAVITATION—AND THE *NAUTICAL ALMANAC.*

[3958.]—I MUST apologise to "Vega" for having read his original question (11225, p. 676, Vol. XIV.) rather carelessly. Until I referred back to it just now, I really fancied that he had observed the reappearance of Jupiter's first satellite on the night of January 12th, 1871, at 8h. 6m. 57s. *Local* mean time. Now, however, I find that he saw it at (what he imagines to have been) 8h. 6m. 57s. Greenwich mean time, which renders the whole affair inexplicable, even on the assumption that the aperture of his telescope differed to some extent from that of the one employed by Mr. Christie. Of course an eclipse of one of Jupiter's satellites is a phenomenon happening at the same *absolute* instant, at every place whence it is visible. In point of fact, it is as though a bright light were suspended in the air at a sufficient height to be seen over a large area of the earth's surface, and such light were to be extinguished. Reflecting, then, on the fact that a satellite does not plunge into, nor emerge from, Jupiter's shadow *per saltum*, "Vega" will see that the only conceiveable thing which could operate in altering the apparent Greenwich time of the disappearance or reappearance of any given one, as viewed at his station, from that at which the same phenomenon occurred at Greenwich itself, would be difference of telescopic aperture. Obviously, the bigger the object-glass or mirror, the later the satellite could seem to disappear, and the sooner to reappear; but if he and Mr. Christie had been observing with the same sized instruments, then, as Mr. Christie saw the reappearance at 8h. 8m. 10s., Greenwich mean time, "Vega" ought to have caught it at 7h. 55m. 18·3s. of his Local mean time—*i.e.*, at the identical instant of its Greenwich observation; inasmuch as 3° 14′·10 = 12m. 56·667s. I do not know quite what your correspondent means about "allowing also for acceleration."

If "Lamroch" (qy. 11450, p. 80) will consider for an instant, he will see that the polar distance (or declination) of a star must be the same, whether his place of observation be at Manchester or Marseilles. The altitude of the pole varies, *but not the distance of individual stars from it*; so that the only correction required is one for refraction, for which he will find ample directions in "Loomis." I wrote on this same subject some time ago in these columns, and illustrated the effect of refraction on the identical star mentioned by your correspondent, by the aid of a diagram. "Lamroch" will find this letter and illustration on p. 417 of your twelfth volume.

In answer to Mr. Hutchins (query 11453, p. 80) it is the semidiameter of the Ball of Saturn that is given on pp. 301 and 303 of this year's *Nautical Almanac.* The elements for the determination of the dimensions and appearance of his rings are given on p. 513.

I may reply to the first query (11467, p. 80) of "A. L. B." by saying that the theoretical light grasping power of his 4¼in. Browning-With reflector, would render a 12·1 magnitude star of Argelander's Scale his minimum visibile; and that its separating power would be about 0·96″, or, say, 1″. For tests he might try σ^2 Cancri, ζ Cancri (I doubt if he will do much with this), 84 Virginis, 126 P XI. Virginis, ζ Boötis, μ^2 Boötis (very difficult), Struve 1884 Boötis, 35 Comæ Berenicis, η Coronæ Borealis, Struve 1932 Coronæ, and ξ Ursæ Majoris.

"A. L. B." will find his second question (11468) answered on p. 273 of your last volume. He surely can devise an index for himself.

All I can possibly hope to do for "Aristarchus" (query 11507, p. 81) is to give him some kind of idea of the principles on which the orbits of planets and comets are computed. To go into anything like numerical detail would be wholly impossible within the limits of a letter, inasmuch as many pages are devoted to the methods of calculation of the orbits of these bodies in works on spherical astronomy. Firstly then, with reference to the elements of the orbit of a planet. They are seven. 1. The periodic time. This is obtained directly by observing its right ascension and declination for several days when it is in or near one of its nodes. These we must turn into longitudes and latitudes, in the manner exemplified a week or two ago. Then by a simple proportion we find out when the latitude of the planet was nothing; and it is, of course, at that instant in its node. We have only to make similar observations when the planet comes round to the same node again, and this will give us the time of one revolution. 2. The mean distance from the sun, or semi-axis-major of its orbit. This is most easily got by Kepler's law, when we know the periodic time. Otherwise by observation which I cannot ask for space to explain. 3. The longitude of the ascending node. This is calculated from the observed longitude of the planet in one of its nodes; and the longitude of the sun and the radius vector of the earth at the same instant. These data are again obtained when the planet returns to the same node, and hence the direction of the line of nodes calculated. 4. The inclination of the plane of the planet's orbit to that of the ecliptic. This is found by the longitude and latitude of the planet being determined at the instant when the sun's longitude is the same as the heliocentric longitude of the node; then a very simple formula in spherical trigonometry gives us the required quantity. The heliocentric longitude and latitude of a planet is also trigonometrically derived from its geocentric longitude and latitude. 5. The eccentricity of the orbit; and (6) the longitude of the perihelion are found by ascertaining the length and position of three radii vectores (assuming the orbit to be an ellipse). 7. The place of the planet at a particular epoch is the subject of direct observation. There is nothing in all this beyond the mathematical capacity of "Aristarchus." In order to determine the orbit of a comet we, in the first place, require its position in the heavens at three different times; and the longer the interval which separates these times, the more trustworthy will be the ultimate results. It simplifies calculation if the intervals are equal. Well, then, as a preliminary step the observed right ascensions and declinations are turned into longitudes and latitudes. Next, the longitudes of the sun, at the three instants of observation, are taken from the *Nautical Almanac*, and from these data a diagram is constructed which I cannot here reproduce. The first calculations of a cometary orbit are made on the supposition that it is parabolic, and it is assumed, as a matter of course, that the plane of the orbit passes through the sun, is a conic section, that the quotient of the area described by the radius vector, divided by the time, is a constant quantity; and that for different bodies revolving round the sun these quotients are proportional to the parameters of their orbits. Then a plane is hypothetically assigned to the comet's orbit, and it is seen whether any of the canons just enunciated are violated. If they are not, we have hit upon the right plane; if they are, we must try again. So then at last by a system of trial and error, the true plane is found; and then places of the comet are calculated for some time in advance on the supposition that the orbit is parabolic and described in that plane. By the comparison of its observed places with the predicted ones, we soon find out whether the comet is really describing a parabola, or whether its orbit is a hyperbola or an ellipse. Such is the very barest outline of the method adopted to arrive at the figure and dimensions of a cometary orbit. In practice, as I told a "Young Astronomer," the geometrical relations involved are represented by equations, and then are solved by successive approximations. My querist should get Chauvenet's, Norton's, Main's, or some other work on spherical astronomy, as I must repeat that it is hopelessly impossible to enter into any detail in such a letter as this.

In reference to query 11508 (same page), I must express my exceeding surprise that "Aristarchus," as an amateur astronomer, does not possess a copy of Webb's "Celestial Objects for Common Telescopes," inasmuch as I fancied that it was (as it ought to be) in every observatory in England. From it I have copied the little table which follows:—

Smyth's Mag.	Struve.	Herschel.	Argelander.
10	9·3	10·4	9·4
11	10	11·8	10
12	10·4	11·7	10·6
13	10·7	12·5	11·2
14	10·9	13·3	11·8
15	10·9	14·5	12·4
16	10·9	15·9	13·0

I do not quite see the nature of Mr. Skelton's difficulty (query 11559, p. 106) with regard to the diagrams of the eclipses of Jupiter's satellites in the *Nautical Almanac.* Let us take that for the present month (p. 457) as an example. On the night of the 25th satellite 1 will reappear from eclipse at 8h. 39m. 30s., Greenwich mean time. Well, in order to observe this phenomenon Mr. Skelton must direct his telescope (presumably furnished with a Huyghenian or inverting eyepiece) to the little spot marked *r* in figure 1. Or if he should be on the look out for the reappearance of satellite 2 from eclipse during the early morning of the 23rd, he must watch the spot marked *r* in Fig. 2. Again, the disappearance of satellite 3 in eclipse, 38 minutes and 11 seconds after midnight on the 18th will take place at *d* in Fig. 3, and its reappearance next morning (after Jupiter has set) at *r* in the same figure, and so on. The only thing which strikes me as possibly being a little unintelligible to your correspondent is the reference in the explanation on p. 563 to Jupiter's opposition [illegible] this will disappear when Mr. Skelton reflects that [illegible] that time Jupiter's shadow—as viewed from the earth—*shifts from one side of him to the other*: so that [illegible] diagram can possibly be true for the whole month [illegible] which this phenomenon occurs.

Speaking theoretically, the moon in one part of her orbit pulls the earth in the same direction as the sun does; and in another tends to separate them. As it is, it is the centre of gravity of the system of the earth and moon, which describes an orbit about the sun: were the moon to be annihilated, as imagined by M. Paris (query 11563, p. 106) the only difference would be that the centre of gravity of the earth itself would continue to describe that orbit.

With reference to what Mr. Woods reiterates (in qy. 11578, p. 107), as to the defects of the *Nautical Almanac*, I must say that I demur altogether to his designation of the explanation given on p. 539 as "trashy," inasmuch as, as far as it goes, it is perfectly sound and good. The *Nautical Almanac* has enough to answer for in the shape of its defective tables of the phenomena of Jupiter's satellites, and absolutely scandalous ephemeris of Uranus, without being made responsible for faults from which it is free. Mr. Woods must really forgive me for saying that he can have but little practical acquaintance with occultation work, or he would never make such an astounding demand as that the times of occultations should be given for other latitudes than that of Greenwich! Why, does he know that the time of an occultation differs even as seen from Greenwich and from Highgate? and that, in fact, it is conceivable that a star may be occulted at one of these places, and not at the other at all? The *Nautical Almanac* contains all the data needful for making the calculations for any given locality: to make and tabulate the computations of the times of all visible lunar occultations for every inhabited place on the globe would be to produce a book to which the "Encyclopædia Britannica," would stand in the relation of a thin pamphlet. I must further crave my querist's pardon if I point out that it is *not* the time of meridian passage of the "upper *limb*" of the moon (however, such a phenomenon may be imagined to occur) which is given on p. iv., of each month; but the instant at which the moon's centre is on the upper *meridian* at Greenwich—*i.e.*, due south. When she is on the lower meridian, she is, of course, due north, and below the horizon—which, on the whole, satisfactorily accounts for the latter phenomenon being left unnoticed in the *Nautical Almanac*.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

DUST IN THE SPECTROSCOPE.

[3959.]—MR. BROWNING (let. 3886, p. 66) is altogether right in his surmise that I did not put the question to which he has so kindly and satisfactorily replied solely in my own interest; and therefore, in thanking him, I think that I may, at the same time, legitimately congratulate not only myself but a goodly number of my brother readers on having elicited so very useful and practical an answer from the Dollond of the spectroscope. I say useful and practical an answer; because, following his directions implicitly, I succeeded perfectly in freeing the slit of my own instrument from dust on the first trial.

Whether it be the fact or not, that striation of the prisms does produce longitudinal lines in the spectrum, "when the slit is nearly closed," as stated by Mr. F. Bird (let. 3899, p. 69), I can answer for it, that, in my own case, the striping proceeded from minute particles of dust; inasmuch as I always examined the jaws of the slit with a powerful magnifier, after my attempts to clean them.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

P.S.—I must not forget to thank "S. W." also for his letter (3946, p. 97).

CONTACT OF COMETS WITH THE EARTH.

[3960.]—THE most charitable conclusion that I can come to with reference to letter 3916, p. 91, is that "E. L. G." must be labouring under some hallucination when he says that he "showed" me certain things "in your columns," &c. He, *more suo*, made some dogmatic *assertions*; but, until I (and others) can rise to his sublime height of belief in his own omniscience and infallibility, I must be forgiven for doubting that he has *shown* anything.

As far as his sneers at Mr. Poulett-Scrope are concerned the whole matter lies in a nutshell. Mr. Scrope, and every one else who has examined the extinct volcanoes of Auvergne *in situ*, are agreed in referring them to a period extending from the Upper Eocene, through the Miocene and Pliocene. The minimum antiquity of the last named epoch is perfectly familiar to every geologist who reads these lines. But, upon the steep sides of these cones lie, absolutely undisturbed, scoriæ, lapillæ, and pumice-stone, which anything is the nature of a flood, sixty thousand—to say nothing of *six* thousand—years ago, must inevitably have swept away, and redeposited in a chaotic mass elsewhere. Hence, wherever the Noachian deluge went it did *not* penetrate to the Valley of the Auvergne.

With regard to "Lyellology," that can take care of itsel

As for the "grandiloquent" brag about what "*I* shall show," and the warning that *I* have given, &c., I can only say that I seem to have an idea that men have arisen before who were going to set all the world to rights; and that just as "E. L. G." is about to frustrate and confound all the "geologers," so did a certain man called Hampden essay but the other day to *show* that astronomers were idiots, and that the world was even as a pancake. If my memory serves me, *though*, it was Hampden himself—and not the earth —who was proved to be a "flat."

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

NOMENCLATURE, &c.

[3961.]—I RATHER fail to see, exactly, what "L. C. E." (letter 3884, p. 66) is driving at; inasmuch as his aim would appear, on the surface, to be to convert himself into a kind of literary Malay, and "run a-muk and tilt at all he meets."

In limine, he surely does not mean seriously to deny the inestimable advantage of technical terms in Science; nor imagine the English language to be so rich in words as neither to require, nor admit of, any additions! Had he read the most valuable and popular series of papers on Electricity, by "Sigma," running through your recent volumes, and notably had he consulted Vol. XII., p. 290, he need have been under no difficulty as to the exact meaning of the "quite new" words to which he takes exception; but which even he, I think, cannot deny are short, easily remembered, and convenient. Besides, I assume that a period must have existed when *every* word was "quite new." Almost certainly, in our fathers' time, "Lucifer," as a name for matches igniting by friction, must have had its origin: while, in our own, "florin" and "telegram" are two out of several which strike me as having arisen in, or been adopted into, the English tongue.

It seems almost idle to point out how circumlocution and periphrasis are avoided by the use of a single technical word; and it would be hard to find fault with those used by "Sigma" on any other ground than that of their novelty (to "L. C. E.").

Into the terminology of chemistry I must decline to enter. "*Ne sutor*," &c., and we have plenty of excellent chemists both able and willing to take their own parts.

With regard to "L. C. E.'s" strictures, on the mode in which selenography appears to be pursued, I would just observe that if ever we are to know anything of the causes which have operated in the production of the moon's existing physical condition at all, it must be by the patient and almost *niggling* collection of such details as those to which he takes exception. I fancy that we have "broad facts" enough—and to spare—as to the general state of our satellite as it is.

And again, with regard to Secchi's researches on the solar flames, we *know* that these consist of stupendous uprushes of incandescent hydrogen gas: obviously through a resisting medium—and that is very nearly all. To observe, then, how high they extend above the sun's surface, before they are deflected, or become spread out—to note carefully any peculiar spiral conformation or the like—is to add to a mass of facts whence, some day, the most important possible deductions will probably be derived.

I am not concerned to defend my brother microscopists, who have, I fear, wasted a great deal of time over Diatomaceæ; and made species and invented synonyms, *usque ad nauseam*. I have known a man spend as much as would keep a labourer, his wife, and family, for three months, on a single object-glass, merely in order to resolve the "acus"—and fail, dismally, to do it, after all.

As for microscopic anatomy, though, it is in its infancy; and no man may say whereto it will grow. "What," said Franklin, "is the use of a new-born baby?" Oersted's famous discovery was only made in 1820; and already the electric telegraph girdles the earth!

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

[3962.]—"TAKE astronomy as exemplified in 'our' pages; look at those straggling sketches intended to represent some mountain or crater of the moon, and then read the long discussion as to whether a little crooked mark is a cleft or a rill. What on earth does it matter which it is?"

This passage (which occurs in let. 3884, No. 367, p. 66) having arrested my attention, a few remarks on it, I apprehend, may not be out of place. "L. C. E." is certainly not "a master in understanding" things regarding the moon. It is well for him to *fear* when such is the case, as he may then be excused for putting the question, "What on earth," &c.? To those who are content with *earthly things* it may well be a matter of indifference whether a "straggling sketch" represents one thing or another, and the signification of "a little crooked mark" is a matter of very little moment. If we were looking on the motley group pacing to and fro in St. Paul's Churchyard from the gallery surmounting the dome we might be inclined to think that the creatures thus engaged were of Liliputian stature; but we take a higher standpoint, and from the car of a balloon we gaze upon the "map" spread out below us, in which the very dome on which we lately stood has diminished to a mere point. Stretching out in every direction from the vast masses of building, themselves fringed with buildings, are narrow lines, some straight and others crooked, quite distinguishable at a certain elevation, but growing narrower as greater altitudes are attained. At length night comes on. By some remarkable agency our aërial travellers have lost—not consciousness, but—discernment, forgetful of what they saw on *terra firma*. A number of twinkling points of light engage their attention, and they begin to speculate as to what they can be. They are the *minutiæ* of the scene; and while the aëronauts remain in the mental state in which we suppose them to be, it is only by a process of observation and reasoning that they might be able to arrive at the conclusion that these twinkling points were lamps to enlighten the darkness of the Liliputian inhabitants, themselves *minutiæ* amongst the larger features seen by daylight. We readily grant that such a process as we have supposed is *apparently* unaccompanied by any tangible *benefit*; but personal benefit, apart from the discipline of the mind, is one thing, and the discipline of the mind is another. The straggling lunar sketch, the little crooked mark, are letters in Nature's alphabet. The great A's and crooked S's first attract the attention of intellectual children, and they learn to regard them as exponents of mountains and valleys, elevations and depressions of the moon's surface. By-and-by they find that the minutiæ of the language must be studied, the B's and E's and M's must be combined to form words, and when sentences are introduced they would be in a measure unintelligible without the minutiæ of points—the commas, semicolons, and periods. Selenographers have made out many of the broad facts of their science, and they are proceeding slowly to combine with them such *minutiæ* as will enable them to take a further step in interpreting the phenomena presented to their notice. To form a *correct* judgment of anything seen at a distance no little mental discipline is necessary, but rather well-trained habits of observation, accompanied by a facility of grouping and examining facts, not neglecting such as are seemingly unimportant—"a single grain will turn the scale."

W. R. BIRT.

P.S.—"Sigma's" letter (3921, No. 368, p. 92) is much to the point, and may be read with great advantage.

THE METRIC SYSTEM.

[3963.]—"E. L. G." (let. 3935, p. 96) asks me for evidence that the metric system has "gained the approval of the vast majority of scientific men." That statement of mine referred to the ordinary French decimal metric system of weights and measures, and also to the general principle of decimalising measures; it is, therefore, more ingenious than ingenuous of "E. L. G." to set forth Laplace as the only one who ever used decimal *angular* measures, about which I was not speaking, and which, however useful they may or may not be in themselves, do not necessarily belong to the system.

It is quite needless to seek for names; we need only open any scientific book, and we shall find that decimal measures are always employed. If any one wishes to express the mechanical equivalent of any agency, we find foot-pounds run out to millions, or else foot-tons taken for a larger unit. I do not believe that a single instance can be found of any one reducing those decimal figures to tons, hundredweights, quarters, and pounds. Why? Because the decimal figures are all comparable among themselves with the smallest mental effort, while the others are not so, but require considerable effort to understand; but this is exactly the reason why the decimal system is advocated for general use.

The same illustration will give us further evidence of the adoption of the French system by most scientific men, for we have only to glance over the best chemical manuals to find that they use that system almost exclusively. Again, why? Simply because to scientific men the advantage of that system is so self-evident that they will no longer burden their pupils with the useless complications of the English weights, &c.

It is really of very small consequence whether Herschel was a decimalist or no, because every man has a right to his own opinion; but the quotations given us by "E. L. G.," so far from proving him an anti-decimalist, are almost identical with my own arguments on the subject. He distinguishes clearly the two parts of the question, the unit and the divisions. As to the first, the unit and its standard, there may be plenty to be said, and the arguments as to the superiority of the English unit over the metre would be perfectly sound if all the world were afflicted with a confusing system like ours, and anxious to unite with us in remedying the evil; but this is not the case —those who have the metre have none of our confusion, and to ask them to adopt our foot, even if it had any great inherent advantage over the metre, would be to invite them to make a change for change sake, to give them a perfectly needless trouble without in the least diminishing our own share of trouble; for it is self-evident that if we change our whole system of measures, our retaining the foot for the unit would not be one fraction less confusing than the adoption of the metre.

It is for this reason that I said that discussion about the merits of units and standards was "scattering dust about the true object of any importance." The question of importance is this: Are the troubles attendant on our present weights and measures great enough to warrant our enduring the great temporary trouble of *any* change? If any change is to be made, the question becomes a practical one, simply that of least trouble united to greatest advantage, and is resolved by the fact of half the world (civilised) having already adopted a satisfactory decimal system; practical considerations put out of question all debate about any abstract philosophical quidities as to units and standards: we are left to decide simply whether we will adopt the same system as others, who clearly will not change their system to please us; or whether for the sake of preserving some fragments of our own old system, we will deprive ourselves of the great advantage of partaking of a universal system.

Herschel, in his quoted remarks, simply points out the various courses at our option, but instead of being "no decimalist," actually suggests that if we do still cling to our present system, it would be desirable to superadd to them "the additional convenience of a decimal system for facility of calculation," leaving the result to the process of natural selection. And natural selection we can easily foresee will ultimately bring us the metric system, because one nation after another is already adopting it, and each one puts increasing strain upon others to follow the example.

SIGMA.

DECIMALS AND THE DECIMAL SYSTEM.

[3964.]—The praises of a decimal system of coinage, weights, and measures cannot, I believe, be too often sung; and it is a pleasure to find that the matter is receiving such attention in "ours." In these days of improvement in every branch of manufacture, of advancement in education, in arts and science, it seems marvellous that we, as a nation who have hitherto done so much, should in some respects be content to adhere to old and effete ideas rather than follow in the wake of those who have so wisely led.

If we, labouring under the influence of our insular pride and prejudice, are determined to cling tenaciously to systems as intricate as Chinese puzzles, we must not be surprised if at some future time we feel their pernicious effect in the decline of our commercial intercourse with foreign nations; for what country is there which will care to traffic much with one whose currency, &c., are so difficult of comprehension, when it can obtain full value for its money in other ports where no similar obstacles exist?

From time immemorial nearly every nation on the globe made use of a series of numerals, of which 10 was the limit, all above that number being in "progression of tenfold proportions;" in other words, a decimal notation, which commenced with the use of the fingers as counting instruments, hence the word "digit," as applied to the cardinal numbers—from "digitus," a finger.

Now, it seems reasonable to suppose that if, by the repetition of those numbers, we are able to *increase* them to any extent in a decimal proportion, we ought to be able to *decrease* them in a similar ratio. With this idea before us, it is not difficult to conceive the manner in which decimals were originated. As already stated, we had a notation with 10 for its limit, and expanding in decimal proportions, yet when fractions were to be considered, we found ourselves in unutterable confusion.

In their case no ready means of comparison was at hand, and in order to effect it, it became necessary to create a new notation, less than unity, yet possessing all the advantages of the other—*ergo*, "the art of tenths, or decimal arithmetic," invented by Stevinus, a Flemish mathematician, which was improved upon by Oughtrede, in the year 1631, from which date the said system may be considered as fully established. Thus we became possessed of a simple form of notation capable of either expansion or diminution, according to the same law, and to any extent, commencing from unity as a fixed number. In order, therefore, to distinguish between the *integral* and *fractional* notation, a sign became necessary. Various kinds were used, but not one met with so much favour as the "dot," or decimal point, now finally adopted. What greater proof have we of the advantages of the said system when we find it invariably used by scientific men of tried ability and of careful research, who, from the very nature of their pursuits, are loth to undertake any reform that affects them without very mature deliberation? Yet when we step outside the pale of scientific research, and come into the precincts of commercial life, we find a system unique in its eccentricities, and totally at variance with all uniformity and order. If, as the old "wise saw" hath it, "order is of universal importance," and if science has found a decimal system to be of such use, surely commerce, so intimately connected as it is with science, should profit thereby. It is peculiar that we who are so precise and methodical in other matters, should thus far so signally fail to support the character in this particular, and, I imagine, it can only be put down to sheer obstinacy or short-sightedness on our part. Comparatively few there are at the present day who do not coincide in the views herein set forth, and taking it for granted that the majority carry the day, it behoves us to undertake the reform with as little inconvenience to the public mind as possible. This can be done by the introduction of the metric system, which, as I have above shown, already exists as far as our integral notation is concerned. Whatever advantages a duodecimal or other scale may possess, would at once be obliterated by the difficulty and magnitude of the change necessitated by the introduction of either, and cannot be brought forward as a reform for the better. It has been urged by some short-sighted persons that a universal currency would be of immense advantage; simply, I presume, because they possess a peculiar inability to comprehend a foreign coinage. Even were such to be started, exchange transactions would exist so long as commercial intercourse took place between countries, thus rendering the various coinages as widely different as before. So long as it becomes necessary to remit money from one country to another, exchange—which is nothing more than the combination of freight, insurance, and commission—must obtain.

In 1858, now nineteen years ago, the select committee appointed by Parliament to inquire into and report upon the advisability and means of introducing a decimal system, forwarded its report. It recommended the metric system of weights and measures as adopted by France, and with respect to the coins stated that it would be desirable to withdraw certain of them from circulation, and to substitute certain others having reference to a decimal scale. It contemplated "the retention under any circumstances of the present sovereign (1,000 mils), half-sovereign (500 mils, or 50 cents), florin (100 mils, or 10 cents), and shilling (50 mils, or 5 cents)," and considered "that the present sixpence under the denomination of 25 mils might be retained, and the crown or piece of 250 mils (25 cents), of which few were in circulation, need not be withdrawn." It urged the desirability of dispensing with the half-crown, the threepenny and fourpenny pieces as inconsistent with a decimal scale," and contemplated the introduction "of copper coins of 1, 2, and 5 mils, and silver coins of 10 and 20 mils (1 and 2 cents), to which should be added such others as experience might show to be requisite."

There are but few, I should think, who can raise any objection to the plan suggested by the said committee. During a period of eighteen years, spent in various parts of the world, I have had much to do with very varied currencies, and have been fortunate enough to contribute a little towards commercial literature (Tables of Exchange for Gibraltar, 1855; and Tables of Exchange for North America. Canada, G. E. Desbarats; New York, Appleton & Co.; and Halifax, R. T. Muir), and in my opinion words are too feeble to extol the praises of a decimal system.

The late Professor De Morgan, whose talent and ability will ever be fresh in the memories of those who are acquainted with his works, thus sums up the advantages of a change to a decimal coinage:—

1. All computations would be performed by the same rules as in the arithmetic of whole numbers.
2. An extended multiplication table would be a better interest table than any which has yet been constructed.
3. The application of logarithms would be materially facilitated, and would become universal, as also that of the sliding rule.
4. The number of good commercial computers would soon be many times greater than at present.
5. All decimal tables, as those of compound interest, &c., would be popular tables, instead of being mathematical mysteries.
6. The old coinage would be reduced to the new by the simple rule. (*Vide* his contributions in the "Companion to the Almanac," 1853).
7. When the decimal coinage came to be completely established, the introduction of a decimal system of weights and measures would be very much facilitated, and its advantages would be *seen*.

The opinions of numerous other men remarkable for their erudition and research could be cited in support of this change, all of which agree with the above.

It is necessary to call especial attention to paragraph 7 here, as it is somewhat opposed to the views which have been advanced by some writers as well as to the proceedings of the meeting held at the Mansion House some time ago. The said paragraph conceives the introduction of a decimal coinage as the *first* measure, and I entirely concur in the opinion so ably set forth, because the present coinage being universal throughout the kingdom, the change would be more easily effected than in the case of the weights and measures which, as every one knows, vary considerably with almost every county. The introduction of a decimal coinage would be the insertion of the "small end of the wedge," and the other change would follow so soon as it became generally understood. All who have written on this subject agree to the advisability of retaining the present sovereign, and of dividing it, as herein referred to, into 1000 mils.

The following simple rule, which I have constructed, will be found very useful in converting the old coinage into the new, and it can be mastered with a very little practice:—

(1) Old coinage into the new.—Shillings: Place a cipher to the right and divide by 2; the result will be cents. Pence: Multiply by 4, and if the product exceed 10 or 35, add 1 or 2, respectively, thereto; the result will be mils.

Example.—Reduce 15s. 10d. to new coinage:—

$$\left.\begin{array}{r} \dfrac{150}{2} = \cdot 75 \\ 10 \times 4 + 2 = \cdot 042 \end{array}\right\} = \cdot 792.$$

(2) As it may be useful to possess a simple rule for reducing decimals of a pound to shillings and pence, the reverse of the above will suffice, viz:—If there be less than 3 decimal figures, append as many ciphers to the right as are required to make up the number; then divide the first two taken together, or the cents by 5 for shillings. If there be no remainder, divide the third figure or mils by 4, for pence. If there be a remainder, prefix it to the mils and divide. If, after dividing, there be more than 2 remaining, add a halfpenny.

Example.—Reduce £0·792 to shillings and pence:—

$$\left.\begin{array}{l} \dfrac{79}{5} = \text{15s., and 4 over} \\ \dfrac{42}{4} = \text{10d.} \end{array}\right\} \text{15s. 10d.}$$

Whilst on the subject of decimals, I think it desirable to add one or two more simple rules, which I trust will be acceptable. They are as follows:—

(3) Inches into decimals of a foot, or months into decimals of a year.—For the first two places of decimals: Multiply the inches or months by 8, and if the product exceed 24, 48, or 72, add 1, 2, or 3 respectively; in the case of one inch only, prefix a cipher thereto. For the third place: If the number of inches or months be even, add 5 to the second decimal, and adopt the right figure of their sum for the third place; if the number of inches or months be odd, repeat the second decimal. In either case the third figure is a recurring decimal.

Decimals of a foot into inches.—When great accuracy is not required, and if the first two places exceed 24, 48, or 72, deduct 1, 2, or 3 respectively therefrom, and divide by 8; if the remainder be either 2, 4, or 6, add ¼, ½, or ¾.

Examples.—Reduce 4in. and 7in. to decimals of a foot: 4 × 8 = 32 (which exceeds 24, ∴ add 1) = 33 (and 4 being even, repeat 3) = ·333; 7 × 8 = 56 (which exceeds 48, ∴ add 2) = 58 (7 being odd, 8 + 5 = 13, ∴ 3 is the third place) = ·583. Reduce 0·083 and 0·125 of a foot to inches. 8 ÷ 8 = 1 and no remainder = 1 inch. 12 ÷ 8 = 1 and 4 over, or ½, = 1½in.

(4) Ounces into decimals of a pound, or drachms into decimals of an ounce (avoirdupois weight).—For the first two places of decimals: Multiply the ounces or drachms by 6, and if the product exceed 24, 48, or 72, add 1, 2, or 3 respectively; in the case of one ounce or drachm, prefix a cipher to the product. For the second two places of decimals: Multiply the first two places by 4, and strike the hundreds out of the product; if the remaining figures equal 24, 48, or 72 in value, add 1, 2, or 3 respectively thereto.

Examples.—Reduce 1 and 11 ounces to decimals of a pound (avoirdupois): 1 × 6 = 6 (prefixing 0) = ·06; 6 × 4 = 24 (add 1), ∴ 1 oz. = ·0625 of a pound.

$$\left.\begin{array}{ll} 11 \times 6 = 66 \text{ (exceeding 48, ∴ add 2)} & = 68 \\ 68 \times 4 = 2/72 \text{ (adding 3 for 72)} & = 75 \end{array}\right\} = \cdot 6875.$$

In the reverse of the above, when great accuracy is not required, if the first two places exceed 24, 48, or 72, deduct 1, 2, or 3 respectively therefrom, and divide by 6 for ounces or drachms, and if the remainder be either 1, 3, or 5, add ¼, ½, or ¾.

(5) The following diagram of days in decimals of a week will, I trust, be found useful:—

Days...............	1	3	2	6	4	5
Decimals.........	$\dot{1}$	4	2	8	5	$\dot{7}$

Here the whole of the decimals are recurring, and to find the equivalent to any particular day commence with the figure thereunder, and read on, repeating in the proper order as required—for example, 6 days = ·857142 of a week.

We cannot, I think, urge too strongly the adoption of a complete system of decimal coinage, weights, and measures, and when we think of the small majority that sufficed to "throw out" the last bill on the subject, we may yet hope to find it pass into law ere long. Perchance a petition signed by as many as can be found to support the measure would go some way towards effecting the desired reform.

A. M. Festing, F.M.S.

METRIC AND OTHER DECIMAL SYSTEMS—DUODECIMAL ARITHMETIC.

[3965.]—It is curious to see how a man of scientific acquirements, like "E. L. G." (letter 3890), can fall foul of the decimal system in the way he does, and I think that he can have had very little practical acquaintance with matters of account, or he would have hesitated before passing such a wholesale and sweeping condemnation on the system.

Allow me, Mr. Editor, to recommend "E. L. G.," by way of experiment, to add up (say) 40 columns of 50 or 60 lines each of moneys, and 40 more of avoirdupois weight, tons to pounds, and make the totals of the columns agree with those of the lines. By the time he has done with this I think he will agree with us poor accountants that the use of the decimal system, and consequent abolition of the compound rules, would materially facilitate such operations, and would, therefore, be a great boon.

While on this subject, allow me to make a few remarks on a decimal money system. I submit that there are grave objections to the proposed use of the pound sterling as the unit of value, inasmuch as all the smaller of our present coins except the florin would be useless, and the mass of the people (the chief users of the small coins) would be great losers before they could become used to the new ones. To remedy this, I would suggest that the new coinage should be in dollars and cents, the cent being exactly equivalent to our halfpenny. Then all our present coins would be available, and the trouble of learning the new system would be reduced to a minimum, which to most people, especially the poor and uneducated, would be a great boon.

What, in the name of wonder, can be the meaning of the fuss made about the multiplication of concrete quantities (query 11188)? Verily, the doctors disagree on this point as on others. Here we have "F. R. A. S.," "E. L. G.," "Moneta," and others, proclaiming the impossibility of the thing, while in most authorities on arithmetic a rule is given for doing it. Passing over "Walkinghame" as antiquated, take, for example, "The Principles and Practice of Arithmetic," by no less a person than John Hind, M.A., F.C.P.S., F.R.A.S., &c., hailing from the classic (or mathematic) shades of Cambridge.

His first example is as follows:—Find the area of a rectangular parallelogram whose adjacent sides are 5ft. 8in. and 4ft. 9in. He proceeds to do this in this wise:—

ft.	in.	
5	8	= length.
4	9	= breadth.
21	0	= product by 4ft.
3	11·3	= product by 9in.
24	11·3	= area.

Now, if feet can be multiplied by feet, and inches by inches, why not pounds by pounds, or shillings by shillings?

I may add that most computations of timber measure are performed in this way.

No. 170.

MODE OF DISCOVERING THE LONGITUDE AT SEA BY THE MOON AND FIXED STARS.

[3966.]—SUPPOSE, when the moon comes to the meridian of Greenwich, that any one of the fixed stars is then two degrees to the west of the moon, if an observer at sea finds on that day that fixed star one degree less to the west when that planet (moon) comes to the meridian he is in, and that as to its velocity it precedes in a mean progression, the observer is then 27 deg. 19min. 17sec. to the east of the Greenwich meridian. If the fixed star be found at sea one degree more to the west, the ship is 27deg. 19min. 17sec. to the west of the meridian of Greenwich. Consequently, if the fixed star is 27min. to the east of the meridian of Greenwich, or if 1min. more to the west, the ship is 27min. to the west of the meridian of Greenwich, and so on in proportion. But as the moon's velocity varies, allowances must be made for these variations, and equation tables made accordingly. These tables can be made to as great exactness as is requisite by making observations with the telescope and micrometer, wherewith the distances to some of the fixed stars is to be measured, not precisely from the moon, but from the meridian when the moon comes to it. The meridian must be distinguished by lines in the telescope from the higher to the lower part thereof, one end of which line in the observation must seem to touch some remarkable spot or mountain of the lunar orb when it is at its meridian altitude: then the said line exactly shows the meridian.

The distance of any of the fixed stars in the neighbourhood of the moon from the meridian ought to be measured by the screw of the micrometer, or by lines divided into digits, and sub-divided into lesser denominations, which lines must cut the meridian line of the telescope in right angles.

In making observations at sea the telescope ought to be fixed on a pedestal (being a pole or rule of a proper height), furnished with plummets depending on wires or plateens, and traversing to contrary points of the compass and of the ship.

Example: If one plummet traverses north or south, or from starboard to larboard, or larboard to starboard, another must be so placed as that it may traverse east or west, or from stern to stem, *vice versâ*. The pedestal must be kept exactly even with these plummets, and thereby upright or perpendicular, by an assistant who has an even hand, and by a machinery resembling that of a mariner's compass, in which, by means of proportionate weights, the pedestal must traverse on pivots n contrary ways. A microscope must be made use of n viewing the plummets, and a screen may be requisite to keep off the wind, thereby the telescope or any other mathematical instrument will always be, notwithstanding the motion of the ship, in the same position with regard to the zenith, especially in moderate weather. Pedestals may be made in which one plummet only would show the various declinations of the ship with regard to the zenith. The telescope is to be so placed on the pedestal as that it may be easily moved from one point of the compass to another without moving the pedestal.

In this method it is not requisite to know the place of the moon as to its declination, either at sea, or at the meridian of Greenwich, or any other. It will be requisite only to find the moon's right ascension, of which tables may be made according to the general opinions of astronomers by the observations already made, within one or two minutes of a degree; but by observation with the new micrometer, which measures the distance of the fixed stars' directly from the meridian, it may be pre-calculated within a few seconds of a degree, on which the more exact discovery of the longitude depends.

It is next to an impossibility to find the moon's exact place as to its declination, because the moon has always some parallax and refraction of declination, except within the tropics, when it is directly east or west, or just in the zenith. But the moon's right ascension can be exactly observed with the meridional micrometer every time it appears at its meridian altitude near any of the fixed stars, because, when it is at its meridian altitude it has no parallax or refraction of right ascension. It is requisite to take notice of the declination of a fixed star, because the greater its declination the less space will make a degree, minute, or second distance from the meridian. The meridian altitude of some remarkable spot or mountain of the moon may be taken by another observer with any of the quadrants that are commonly made use of at sea. He must give notice thereof to the observer who observes with the telescope and micrometer, who must then observe the distance of one of the fixed stars from the meridian. Or the moon's meridian altitude can be exactly taken by the same observer with the same telescope and micrometer disposed in an astronomical quadrant, kept by the same machinery as the telescope, in such a position with regard to the zenith, as that of an altitude at sea without a horizon. The plummets of the marine pedestal which I have described will inevitably direct the hand and eye to keep the instrument in such a proper position at sea for making the necessary observations. Although the motion of a ship or any other cause would occasion an error of a few minutes of a degree in observing the meridian altitude of the lunar orb, it would cause an error only of a few minutes of a degree in the longitude, because there would be about a difference of a few seconds of a degree as to the distance of a fixed star from the meridian line of the telescope. But in case of such an error, and that the observation may be the more exact and sufficient, the fixed star must by all means be in the vicinity of the moon, and at a proper distance from the zenith.

If it be on the same side as the observer of the moon's parallel of declination, the more remote it is from the zenith, and the more exact the observation, as is demonstrated by a triangle, one side of which will be a segment of a line passing from any certain point of the moon (when it is a few minutes of its meridian altitude or a few minutes below), another side of the said triangle a line from the said point of the moon to the star of observation, and the other side a line from the star to the zenith line, so as to join the zenith line at right angles. But if the star be on the other side of the moon's parallel of declination, the nearer it is to the zenith the more exact still the observation, as is proved by a similar triangle on the other side of the moon's parallel of declination. In either case, the more the place of observation is north or south of the moon's parallel of declination the more exact the observation. As it requires extraordinary accuracy and expertness, and cannot be learnt but by diligence and practice, it would be commendable that particular astronomical schools were more established for this branch of experimental astronomy. I apprehend the longitude can be easily and certainly discovered at sea by this method within half a degree of a circle, and frequently nearer.

It will be an advantage in navigation, although the other methods—viz., by observing Jupiter's satellites (I need not say much regarding these minute bodies) with which, by measuring time with a watch, should likewise prove true, as it is to be hoped they will, because observation of the longitude can be more frequently and exactly made by the moon and star than by the eclipses of Jupiter's satellites, as a watch must be sometimes corrected. By this method it can be corrected at sea, and therefore can be useful for discovering the longitude when the moon is invisible at the time it comes to the meridian, or the star imperceptible by the interposition of clouds, or from the light of the sun. This method can be rendered immediately practicable if the tables that are made of the moon's right ascension are pre-calculated to sufficient exactness, which can be soon known by experiments; probably they are. By future observation the said pre-calculation may be improved and brought to as great perfection as can be expected—that is, within a second or two of a degree. The other great difficulties proceeding from parallaxes and refractions are in this method completely obviated. This method of discovering the longitude at sea depends on the experimental astronomers and mathematical instrument-makers to reduce it to practice.

High Heworth, Gateshead. RALPH LOWDON.

"SCREW'S" MULTIPLICATION.

[3967.]—I DON'T see the good of "Screw's" mode (let. 3941). But it reminds me of one published in "The Short Calculator" (Longman, Lancaster), which shortens process for heavy numbers—*e.g.*, to multiply by 999, add 3 ciphers, and deduct the multiplicand. Thus, multiply 476521 by 999999 : add 6 ciphers, &c.—

$$\begin{array}{rr} & 476521000000 \\ - & 476521 \\ \hline \end{array}$$
$$= 476,520,523,479 \text{ the product.}$$

Multiplying thus by 1 additional (which is simply adding ciphers), and subtracting the multiplicand to compensate for it, completes the whole process. To multiply by 998, add 3 ciphers, thus—

$$\begin{array}{rl} & 476521000, \text{ and deduct } 2 \times \text{ multiplicand} \\ - & 953042 \\ \hline \end{array}$$
$$= 475,567,958 \text{ the product.}$$

To multiply by 7999, add 4 ciphers; and, as it requires 2001 to complete the multiplier to the number 10,000, deduct multiplicand × 2001—

$$\begin{array}{rrl} & 4765210000 & \times\ 7999 \\ - & 953042000 & = \times\ 2000 \\ \hline & 3812068000 & \\ - & 476521 & = \times\ 1 \\ \hline \end{array}$$
$$= 3,811,591,479 \text{ the product.}$$

In the same way, to multiply £9 19s. 11d. by itself, multiply £10 by itself = £100, and deduct 1s. 8d. for added 1d. to each side involved, multiplier and multiplicand. Thus—

$$\begin{array}{rrrr} & £100 & 0 & 0 \\ - & & 1 & 8 \\ \hline = & 99 & 18 & 4 \text{ the product.} \end{array}$$

This is right, I believe, within the 5760th of a penny.

J. BARWICK.

"E. L. G." AND GEOLOGY.

[3968.]—SOME weeks ago I endeavoured to extract from "E. L. G." some facts in support of his theory of comet-falls, but without success. I was much disappointed at the tone in which he carried on the discussion, for the question was a *bonâ-fide* attempt to correct possibly erroneous opinions, and, as the event proves, the question was not without interest to other readers; as the theme has again been opened, perhaps I may be allowed to make a few remarks. "E. L. G." envelopes his argument in such a cloud of words that he puts me in mind of the cuttle-fish, which retreats from his enemies under cover of a discharge of ink. The name of Lyell acts upon him like a red rag on a bull. In all the letters he has written on "Geology," he has never given one fact in support of his theory; it has been all assertion, something or other is always demonstrable, then why on earth does he not demonstrate it? Let us have no more palaver about Lyell; what does it matter whether this or that man advocates the doctrine of continuity? What we wish to know is whether that doctrine be true or false. Let "E. L. G." give us but one fact (we do not want millions), which is inexplicable on the supposition that cataclysms have never occurred, and he will gain at least one follower, and although I am now of opinion that the present and past distribution of life on the earth is incompatible with the occurrence of any universal catastrophe, I will proclaim myself a convert. For instance, let him show that the ordinary forces of nature are incapable of forming turret-shaped hills, and that they must have been fashioned in a few days, or let him show that his floods of water could have had no effect in interrupting the growth of the coral reefs of Florida, and he will go far to upset the doctrine which so raises his choler.

P. SANTALINUS.

TERRESTRIAL GRAVITATION AND MERCURIAL VAPOUR.

[3969.]—APPRECIATING as I do Mr. Proctor's mathematical knowledge, and being rather diffident of my own, I would hesitate before questioning any statement of his on a mathematical subject, but if I understand him in letter 3828, p. 86, *ante*, I am under the impression that he must be wrong. He there distinctly states that without the use of the integral calculus it is impossible to determine the attraction of a sphere on a particle outside, or on its surface. Now, if I am not very much mistaken, this is done without the integral calculus in Thomson and Tait's "Natural Philosophy," articles 471 and *seq.* If I am wrong will Mr. Proctor be good enough to set me right?

In reply to W. R. Birt's question about mercurial vapour (letters 3858 and 3674, Vol. XIV., p. 611) the only experiments that I am aware of to measure the actual elastic force of mercurial vapour at different temperatures are those of Avogrado in 1832, and Regnault in 1844—the former at various temperatures from 230° to 290° C., being 58mm. at the former and 253mm. at the latter, from which he deduced a formula, giving 0·03mm. at 100° C., 19·30 at 200°, 302·00mm. at 300°, and 760·00mm. at 360°, or boiling point of mercury. Regnault could discover no measurable force at 0° C., at 25·4° = 0·034mm., at 49·15° = 0·087mm., at 72·74° = 0·183mm., at 100° = ·407mm., at 146·3° = 3·46mm., at 178° = 10·72mm., at 200·5° = 22·01mm. As density of mercury vapour, according to Bineau, is 6·7, it is easy calculating the weight of mercury vapour in a cubic foot by following formula $\frac{x}{760}$ 7·6 (weight of cubic foot of air at atmospheric pressure), x being elastic force in millimetres.

F. N.

AMERICAN AND SCOTCH INVENTIONS.

[3970.]—IN No. 368 I observe an illustration of a universal angular drilling machine. The selfsame kind of tool was in use here, in Dundee, eighteen years ago, and it is twelve years since I first used it in different workshops here. The inventor was well known here at that time—a poor working fitter, who never saw America, who was advised to patent it, but had not the means. The machine is and was chiefly used for small holes, such as boring steady-pin holes in machine framing. The only apparent difference is that instead of the crank handle a fly-wheel was and is used with a handle fastened in the rim.

FITZBERTIE.

DR. CARPENTER AND PERSPECTIVE.

[3971.]—I BEG to quote the following from a paper by Sir David Brewster, as it appears to relate to the statement made by Dr. Carpenter: "This tendency of the eye to invert the perspective of rectangle prevents or diminishes that appearance of convergency on the plane face of a lofty square tower when we are standing not very far from the base. A photograph of the tower taken from the same spot would exhibit a painful convergency upwards which is not seen by the eye." Being accustomed to sketch, I may add my opinion, perhaps, which is that in practice the convergency is too small to be noticed, as we do not draw high towers near their base.

M. PARIS.

LUNAR OBJECTS FOR OBSERVATION, MAY, 1872.

[3972.]—MAY 9, Mare Crisium, Hansen, Alhazen; May 10, Cleomedes, Burckhardt, Geminus, Messala. May 11, Endymion, *De La Rue* (a fine formation north of Endymion). May 12, Lacus Mortis, Plana, Burg. May 13, Aristoteles, Eudoxus, *Alexander* (a formation south of Eudoxus). May 14, Hipparchus, Triesnecker, Hyginus. May 15, Albategnius, Parrot, Airy. May 16, Clavius, *Terra Photographia* (a region west of Clavius). May 17, Laplace, Maupertius, Condamine. May 18, Mare Humorum, Doppelmayer, Vitello.

W. R. BIRT.

P.S.—The monogram of Hipparchus contains the objects at present known in the interior. For details of the clefts near Triesnecker, consult "Telescopic Work for Moonlight Evenings," ENGLISH MECHANIC, March 10, 1871, No. 311, p. 578; and "Catalogue of Lunar Objects," area 1 A, alpha. This system, with the Hyginus Cleft, is shown in a large drawing by Mädler appended to the new edition of the large map.

ERRATA.—Letter 3856, No. 366, p. 40, April 14, for *Almanore* read *Almanon*; April 18, for *Thebi* read *The*[illegible] April 18, for *Sirius Iridum* read *Sinus Iridum*.—W. BIRT.

HOW WE SEE A DISTANT OBJECT.

[3973.]—"Bobo" is clear and correct; "E. J. D." should study modern optics. We must not forget that light results from ether pulsations on the eye—ether, which itself cannot be seen; that it is only when we see our own eyes in a mirror that we see by rays that rebound or reflect to us without any angle, and when all the rays of light received are returned (as is done by and from a mirror's surface) the surface that reflects is itself unseen and colourless, because it reflects every ray; the rays angularly received on the mirror are reflected at the like angle. A mirror's frame is visible, as "Bobo" shows, by its shading off or not reflecting all the received rays: it reflects but those that denote its colour.

Light is repeatedly reflected, upward, downward, or laterally, distinctness fading with degree of distance, according to the laws of perspective, whether observed in atmospheric dust or in the objects of a landscape. The fading of visibility of distant objects, I take it, is caused by increase of intervening ray-crossings, which obstruct more extensively as distance increases; but also rays diverging, fewer rays reach the eye as distance increases. "E. J. D." may learn something from Sir John F. W. Herschel's "Lecture on Light," the sixth of his "Familiar Lectures," published by Strahan.

J. Barwick.

[3974.]—In reply to the letter of "F. R. A. S." (3870, p. 61) I beg to say that as Mr. Proctor has, to a certain extent, answered my letter (3493, p. 510), the fact of "F. R. A. S." not being able to understand it, is now of no consequence. I beg to assure him, that having often watched with interest the entrance of a sunbeam into a darkened room, and being unable to satisfy myself how small objects illuminated by it became visible to me at some distance, I read the theory of light, and have come to the conclusion that it does not explain in a rational manner how we see distant objects. I, therefore, put forward the problem with a view of ascertaining the opinions of scientific men. I will now propose a question, if he will kindly answer it. Suppose a vast multitude of persons are assembled on a plain, and that in front of them some conspicuous object is elevated, so high that all can see it (say, a large statue of black polished marble); to enable all to see it, the theory of light says:—"The rays of light must be detached from every physical point of it in all directions; but only those rays which enter our eyes can render them visible to us." It is evident from this that two distinct sets of rays must proceed from the object to each of the spectators—that is, one for each eye, and yet the polished surface of the statue ought to reflect the light specularly. Of course I am aware that we cannot make a perfectly polished surface, and yet after making due allowance for the numerous secondary reflections of the atomic prisms (which some suppose all bodies consist of) I cannot conceive how the reflections can be so numerous and so conveniently arranged that they flash in right lines from every physical point of the statue to the eyes of the spectators, and that additional rays must proceed to any distance, or to any point from which the statue can be seen, even to twenty miles, when viewed through a telescope. I shall feel obliged if "F. R. A. S." can remove my doubts respecting this point in the theory of light. I scarcely think he can mistake my meaning, which is to ascertain how, considering the various curves in the statue, it is nevertheless able to send an uncountable number of rays to so conveniently meet the requirements of every spectator, no matter how numerous or where placed, whether far or near, provided the statue is in view.

E. J. D.

LUNAR METEOROLOGY.

[3975.]—Will you allow me to call Mr. Birt's attention to the subject of meteors, in connection with a possible lunar atmosphere? Our satellite must be as liable to be cannonaded by meteors as the earth, and having no appreciable atmosphere, these must impinge upon her surface "as they were," not suffering for the most part dispersion, as is the case with our shooting stars. Now we know that these bolides contain, at all events, occluded hydrogen, and possibly other gases, and as the force of collision must be sufficient, if not to vapourise, at least to pulverise, the bolide, we have here, I think, a source of vapour and gas, of which the otherwise perfect vacuum would prevent the liquefaction or solidification. Again, we know that whatever may be the composition of the moon's rocks, they cannot be pure metal, or the reflection of light from her surface would be different. There must, therefore, be oxidation, and it appears very unlikely for the amount of oxygen to have been only enough to burn up her surface, except upon a supposition I made some time ago—namely, that the moon was herself a bolide, which consisted of pure metal, and had passed through an atmosphere of oxygen in her wanderings. We also know that metals smell, therefore evaporate, as in fact most mineral substances do, and this under a pressure of 15lb. to the square inch. If there be almost a perfect vacuum over the moon's surface, metals, &c., must evaporate much more readily.

Bolides contain substances such as iron, sulphur, &c., which have a powerful odour, and as they must for ages have been showered upon the moon, it seems to me to be certain that our satellite possesses an atmosphere, at all events of vapour, of many of the substances composing them. Whether the light emitted by the collision of an enormous bolide on the dark limb of the moon could be seen by a telescope accidentally turned that way, I think doubtful, yet, if I am not in error, there have been some appearances which render such a supposition just possible.

M. Paris.

BASKET-MAKING.

[3976.]—In back numbers queries asking for information on basket-making have appeared. The following, extracted by the *Journal of Horticulture* from J. C. Loudon's "Suburban Horticulturist" (a work now, I believe, out of print) may be useful.

One year's shoots of the common willow, or of some other species of that family, are most generally used. The shoots are cut the preceding autumn, and tied in bundles, and if they are intended to be peeled, their thick ends are placed in standing water to the depth of 3 or 4in.; and when the shoots begin to sprout in spring they are drawn through a split stick stuck in the ground, or an apparatus consisting of two round rods of iron, nearly half an inch thick, 1ft. 4in. long, and tapering a little upwards, welded together at the one end, which is sharpened so that the instrument may be readily thrust through a hole in the stool or small bench, on which the operator sits. In using it, the

FIG. 1

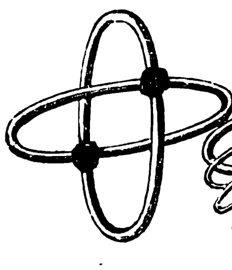


FIG. 2

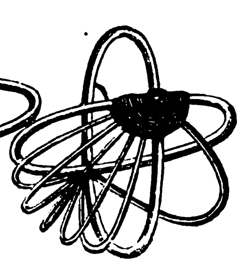


FIG. 3

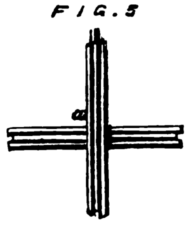


FIG. 4

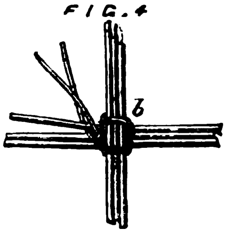


FIG. 5 UPPER SIDE

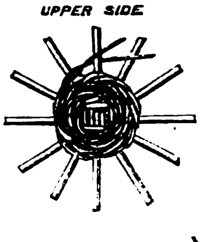
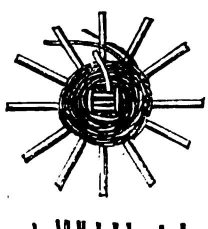


FIG. 6 UNDER SIDE



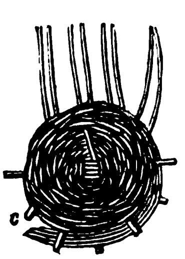


FIG. 8

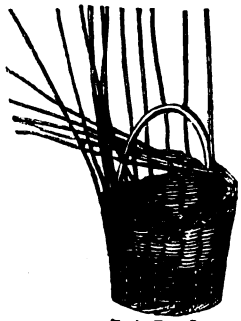


FIG. 9

FIG. 7

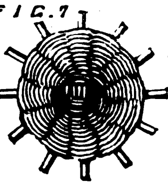
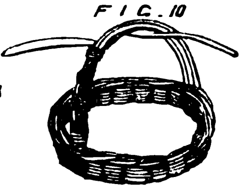


FIG. 10



operator takes the wand in his right hand by the small end, and puts a foot or more of the thick end into the instrument, the prongs of which he presses together with his left hand, while with his right he draws the willow towards him, by which the bark is at once separated from the wood: the small end is then treated in the same manner, and the peeling is completed. Every basket consists of two parts: the framework of the structure, and the filling in or wattled part. The principal ribs in common baskets are two: a vertical rib or hoop, the upper part of which is destined to form the handle; and a horizontal hoop or rim, which is destined to support all the subordinate ribs on which the wands are wattled. The two main ribs are first bent to the required form, and made fast at their extremities by nails or wire. They are then joined together in their proper position, the one intersecting the other; and they are afterwards nailed together, or tied by wire at the points of intersection. The operation of wattling is next commenced, by taking the small end of a wand, and passing it once or twice round the cross formed by the points of intersection; after which one or perhaps two secondary ribs, are introduced on each side of the vertical main rib. The wattling is then proceeded with a little further, when two or more secondary ribs are introduced; and the process is continued till a sufficient number of subordinate ribs are put in to support the wattling of the entire structure. The whole art, as far as concerns the gardener, will be understood from the following figures:—

Fig. 1 shows the handle and rim of what is called the Scotch basket, made fast at the points of intersection.

Fig. 2 shows the same skeleton, with the ribs of one side added, and the wattling or woven work commenced.

Fig. 3 represents the commencement of what is called the English mode of basket-making; in which three parallel rods of 2ft. or 3ft. in length, according to the intended diameter of the bottom of the basket, are laid flat on the ground, and three other rods of the same length laid across them at right angles, as at *a*; and next the weaving process is commenced, as at *b*.

Fig. 5 and Fig. 6 show the progress of weaving the bottom; the latter being what ultimately becomes the under side, and the former the upper side.

Fig. 7 shows the bottom complete, the under side of it being uppermost.

Fig. 8 shows the bottom turned upside down, the points of some of the radiating ribs cut off, some of the rods which are to form the side ribs inserted, and the side weaving commenced.

Fig. 9 shows the basket nearly completed, with part of the rim finished, and the rod on which the handle is to be formed inserted.

Fig. 10 shows the rim completed and part of the handle plaited.

Androcles.

LIGHTNING CONDUCTORS.

[3977.]—I wish to express thanks to "Sigma" for taking any notice of what I wrote on the above subject, as he has been kind enough to do in letter 3923, but at the same time I regret that I should have led him to suppose I ask questions with a view to obtaining knowledge instead of taking the trouble of reading for it.

I put the questions to "Philo" to ascertain whether he had any ground for two statements he made—viz., first, that conducting bodies (see letter 3783) conduct by means of or through their surfaces, as distinct from their interior substance, and, secondly, that a discharge bursts things (see letter 3846) by the expansion of steam produced, "or else" by the repulsion among the particles.

I asked him the second question because he did not notice the first, and because he had taken upon himself to try to set me right (letter 3846), and from the evidence of his letters generally, and 3783 in particular, I did not think he was the right man for the job, otherwise I should have let him slide on.

When I put into "Sigma's" mouth the words "electricity is a fluid," &c., I selected the least likely ones that I could at the moment imagine, and the reply he has actually made is, I am glad to say, just nearly about what I should have anticipated, if I had been on the look out for an answer at all.

J. K. P.

VERDE ANTICO.

[3978.]—Ethel Taylor (p. 560, Vol. XIV.) asks whether the antique green bronze can be perfectly reproduced by chemical means. I guess not; no more than you can reproduce the exact tone of a picture by Raphael, or of an Amati violin. You can imitate them, of course, and so you can the antique green bronze, but only up to a certain point. Moreover, I doubt whether the green now seen on metals at Pompeii had the same tint or tone 2,000 years ago, when first the castings were made, that it has now. This most exquisite tone and tint is probably produced by the oxygen having in twenty centuries worked into the body of the metal, whereas any chemical application is confined to the surface only.

I congratulate Ethel Taylor on the absorbing and interesting pursuit she has taken up. The only objection to it is the way it cuts one's hands to pieces. Mine look very much like those of an inharmonius blacksmith washed clean, for I can't work in gloves as Ethel Taylor does. If she will mention more exactly the way she reproduces the metal objects in Stockholm I may be of use to her, as I am familiar with all the methods of working in wax and metal, and no professional gold, silver, or other metal-worker seems inclined to come to the rescue. "Tubal-Kain" ought, from the name, to be able to help her. It is only a pity that more ladies do not adopt a pursuit so well adapted to them as working in metals is, especially the precious metals, which require a more tasteful and delicate manipulation.

Proven.

LENSES.

[3979.]—If "F.R.A.S." (let. 3710) will examine a gla[ss] which has the deposit he mentions, he will see it to b[e] a fungus mycelium, and will find plenty of spores. [It] is very troublesome, and if it be not removed fr[e]quently it will, after a time, destroy the polish of th[e] glass, and this in a good one is not very p[leasant]. The only prevention, if it be one, is air, and w[iping] the glasses occasionally with dry blotting-paper (m[ade] into a roll, and then the end scraped with a knife) or with very soft velvet. The good of dry blotting-pa[per] is that it effectually removes damp and grease, w[hich] washleather never will do for long, and without a [deal] of trouble.

E. T.

PUTREFACTION AFTER DEATH.

[3980.]—It is admitted, in medico-legal investigations, that the appearances of rigidity and putrefaction in dead bodies may be called in to determine the time of death. Such signs may, however, appear more readily in some circumstances than in others. The causes which favour and hasten decomposition lie both in the surroundings and in the body itself, in the former case depending on heat, humidity, and electricity in the air; in the latter, on the age of the person, his degree of obesity, the more or less humid constitution of his body, and especially the kind of malady that has caused his death. Thus, among general affections, those which alter the humours and solid organisms during life, such as scorbutic disease, variola, dropsy, putrid fevers, &c., hasten putrefaction after death. May the same be said of the effects of alcohol, largely used? M. Champouillon thinks it is so, and he has found proof of it in facts observed during the conflicts in Paris last year.

On the 22nd May, between three and four a.m., fourteen Communists were executed near the Auteuil cemetery. By about midday the bodies had assumed a violet tint, the face was livid and very much swollen, and the wounds gave out the odour characteristic of commencing putrefaction. Phenomena of decomposition, quite as rapid as this, were witnessed at various points in Paris where the insurgents fell in fight. Out of 441 bodies examined it was ascertained that 296 were those of men that had been given to drunken habits. The bodies of 58 soldiers killed in attacking barricades, or other encounters, presented, in the matter of preservation, a striking contrast to those of insurgents that fell at the same place and time. From Monday, the 22nd, to Thursday, 25th May, the weather was warm, but not stormy. On Friday, the 26th, rain fell in abundance, and the temperature of the air fell considerably, a circumstance fitted to retard putrefaction. Nevertheless, M. Champouillon observed that in the Place des Vosges, Place de la Bastille, and neighbouring streets, the bodies of insurgents, lying pell-mell along with those of the military, had preserved a marked advance in the progress of their decomposition. He considers it established, from numerous observations, that drunkenness induces in the bodily organism a state which favours the rapidity of decomposition after death; and that the bodies of drunkards decompose at a more rapid rate than those of sober persons. He hopes to be able to determine, with precision, what are the limits of this advance in decomposition.

A. B. M.

THE FLIGHT OF BIRDS.

[3981.]—There are in Asam ample opportunities of observing the flight of those birds that not only move onwards, but actually rise for considerable heights without vibrating the wings. Being a swampy country waders abound; the larger ones, as the Korson, or Cyrus, the Bor Taellia, Bor Tokolla, and Koonooa, all rise after a few preliminary flaps, and to considerable heights, in this way. I have often speculated on the phenomenon and its cause, and at last find it is a simple affair. If carefully noted, the bird will be seen to travel to leeward in large circles thus: On starting and taking a wide sweep to leeward, it gets up considerable impetus, and on rounding to face the breeze, the wings are more highly inclined, and it rises like a kite, and higher than it was before as the circle is closed. Circle it really is not, nor yet spiral, for the part against the wind has less traverse than the part with it. The latter taking (say) twenty seconds, the former only (say) fifteen seconds, or even ten seconds. Often I have tried to shoot them ere they were too high, and it was by taking aim carefully against a tree stem, that I found each return was both more to leeward and higher, yet the wings never flapped once. There is no possibility of doubting this as a fact. I have never seen them thus rise without a breeze (though I don't say it is impossible). On asking my dusky doorkeeper as I write, he confirms this part, saying, "Bota pallie, pahie na mari" [wind having got, wings (need) not strike].

The Korson is most remarkable of all. Once, at tiffin, soon after I came out, I heard a loud crawk crawk just over the house, and running out to see the Korson fly over was well laughed at; not a feather was visible, though the noise was so loud overhead still. A friend came out, and pointing up told me to look steadily a moment, and sure enough, there, miles up it seemed, were a lot of little black dots seemingly stationary, and they were the Korson, with wings of 9ft. or 10ft. stretch. I afterwards watched them with binoculars, and never saw one of them flap a wing once.

The remarks of your correspondent (let. 3260, p. 382) about noise of wings sounds comical here. My brother and I, both pretty good canoeists, were only yesterday nearly upset by the start we got at five Hooangs or large hornbills suddenly flying off the top of a tree we were paddling past, each flap sounding like tearing sharply a yard of calico. The noise of their wings can be heard at least 240 yards against a breeze: that I have measured.

S. E. Peal.

Sapakattie, Seebsagur, Asam.

COMPETITIVE EXAMINATIONS.

[3982.]—In reference to letter 3918 (page 73) I now understand what Mr. Bottone means; but what does Prof. Barff mean—that it is doubtful that SO_3 is ever produced, or that Prof. Odling and Dr. Debus, the London examiners (the assistant-examiners are Drs. Flight and Mills), doubt it, or have never heard of it? Surely not the latter.

Hedera.

CONSTRUCTION OF TRANSIT LINES.

[3983.]—In the hope that it may be of service to the readers of the English Mechanic, I now describe my plan for the construction of transit lines, which I have for many years employed with success. I can claim no originality in the invention. This is due to Dr. Derham, and will be found described in Lowthorp's abridgement of the "Philosophical Transactions for 1721," Vol. I., chap. 3, p. 227. A bar of iron, A A, Fig. 1, about 5ft. 6in. in length, is fixed to a wall as nearly in the meridian as may be. To this bar are attached by nuts and screws two holdfasts, B B, at about 4ft. distance from each other. These, also, are furnished with nuts at their returned ends. Upon these holdfasts, as centres, turn the iron bars C C, D D. The bars are clamped in any required position by the nuts on B B. At the ends of each bar are sliding-pieces, which have clamping nuts for adjustment, and also slots, in which are the carriers for plumb-lines and the sights for viewing the same. These are secured in their places by thumb-screws. One of these sliding-pieces (carrying a sight) is shown on an enlarged scale at E. The bars are 2ft. in length. The adjustment to the meridian

FIG. 1.

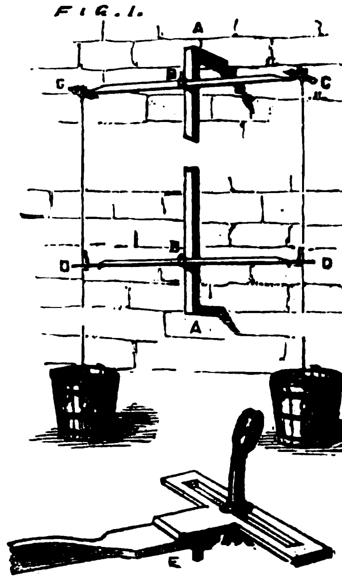
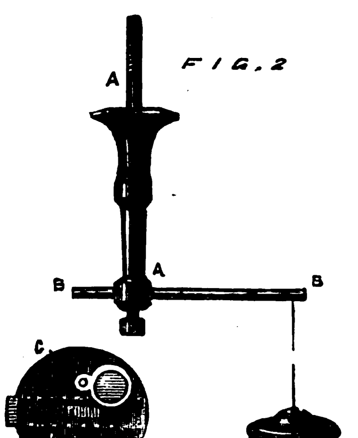


FIG. 2



can be made by any of the usual methods employed for bringing a transit instrument into the meridian; or, supposing the true time of the sun's meridian passage to be given by a chronometer, by simply bisecting the disc at that moment, viewing the southern line through the northern sight. This having been done correctly, the southern sight and the northern line may then be adjusted thus: Bring the northern line over the eye-hole of the northern sight, and bring the eye-hole of the southern sight to agree with the southern line. For greater accuracy, the contact of the two limbs of the sun will, of course, be observed as well as the central passage. The first rough adjustment is made by turning the two bars with their lines and sights on the holdfasts, and then clamping them; the next by the plumb-line in its slot, and the final one by the sight in its slot. By the slide in the direction of the length of the bars the lines and sights can be brought to near or close contact. The weights are suspended in water to check vibration, and pierced with a few holes at right angles to their axes.

If solar observations only are required, then, of course, one line and one sight are sufficient. In this case, the line may be carried in a slot at the end of a support of iron fixed to a wall, and the sight can be adjusted in the slot at the end of another bar or rod of iron attached to the wall at the required height and distance. This is a very simple and very effective kind of transit line, which I have for many years employed. Fig. 2 represents a portable form of transit line for travelling or the pocket. The stem A A is screwed (say) into the upper part of a window-frame, having a southern aspect. A piece of brass wire slides in a hole at the end of this stem, and can be fixed in any position by a clamping-screw. The end of this wire is perforated with a small hole for a plumb-line. C is a sight-vane, having a dark shade for viewing the sun, the sight-hole sliding in a dovetail for adjustment, and furnished, also, with a clamping-screw. This sight-vane is screwed (say) into the cill of the window or other fit place, at the requisite distance from the plumb-line, and as near as may be in the meridian. The rough adjustment is made by sliding the brass wire B B in the hole in the stem A A, and clamping it by the screw; the final adjustment by the slide in the sight-vane, and then fixing by its clamping-screw. All the parts in Fig. 2 are given half size, and I shall be obliged if the same is preserved in the engraving, as well as the position in which they are represented in the sketch. If any reduction is necessary I trust your engraver will state the ratio. Those of your readers who may be interested in the subject of transit lines may be referred to the paper in the "Philosophical Transactions" already quoted; also to Dunn's "Introduction to Astronomy" (1774), p. 28, and Adam's "Geometrical and Graphical Essays," by Jones (1797), p. 427. When once properly adjusted these meridian lines are far superior to any sundial, and give results nearly approaching in accuracy those of the dipleidoscope. With the transit instrument they cannot, of course, be compared. However, the one involves the question of an outlay of many pounds, the other of only a few shillings.

Sidmouth, April 12. N. S. Heineken.

ARE ANTS PIRATES?

[3984.]—Can this possibly mean do ants rob at sea? If so I must answer that I don't know. But I do know from years of experience that they do rob on land, and that most perseveringly and effectually, and to an extent that makes them most formidable and expensive opponents to those living in hot countries. My experience was in Buenos Ayres, where we were kept continually on the alert to circumvent, and, if possible, destroy them, or otherwise they would soon have robbed us of every vegetable that grew in the quinta.

W. Gaucho.

GARDEN STUFF.

[3985.]—(3888).—Potato Culture.—An experienced farmer to whom I related my success last year in raising a large crop without manure, told me that the soil of my garden was so good as to render any sort of manure for potatoes unnecessary. He added that in all soils rank or crude manure was poison to the plant.

(3911).—Are Ants Pirates?—I entirely agree with "J. C." on this subject. How can the ants increase the appetites of the aphides by acting as their scavengers? Earwigs and woodlice I find are terrible bud-eaters. Ladybirds prey upon the aphis, and hop-growers love them. My own observation leads me to think that the ladybird and its larva can effect very little in keeping down the fly.

Weeds.—Always leave a fair proportion of weeds in the garden for the autochthones, slugs, snails, and other varmint, whose ancestors were the lords of the soil ages before man came to usurp it. They, unlike Red Indians, can never be entirely extirpated, and if they do not find their native weeds will devour what we sow. Their numbers can be kept within reasonable limits by traps, such as small heaps here and there of old bricks or vegetable refuse, to be looked over from time to time.

Rockwork.—Ferneries and heaps of tree roots are fertile sources of trouble, as hosts of slugs will breed therein in spite of every care. This should be borne in mind in choosing a situation for such ornaments.

Onions.—An occasional dressing with powdered washing soda is a first rate application.

Strawberries.—You can scarcely tread the ground of your strawberry bed too hard. Cover the blossoms with straw lightly on frosty nights, and look out carefully for woodlice, and a beetle which eats the centre of the flower. This beetle was particularly busy at Wimbledon when I resided there about ten years ago.

Peas.—Soak the seed in strong infusion of tobacco to keep off mice and birds. When coming up sift a little soot over them to disgust the sparrows.

M. Paris.

AN ERRATIC METEOR.

[3986.]—On the 16th of March, I was engaged with a friend in telescopic work, when I just happened to catch sight of a meteor, which, darting down from the head of Taurus, pursued a course over Aries to the horizon; unlike most meteors, instead of pursuing a straight line, it took that of a double curve. It was much swifter in its flight than an ordinary meteor. Are such appearances common, or have they been noted before? I was unwilling to communicate this before, because people are apt to cavil at others observing what they have not done; and at once to declare, that as they had not seen it themselves such things could not be. Witness my observations of the spots on Venus a month or two back.

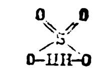
Canis Minor.

EXAMINATIONS, ATOMICITIES, &c.

[8987.]—I am very much surprised that so many of your chemical correspondents should have taken so great a liberty with Dr. Frankland's name in connection with what has been styled "a legal system" of chemical notation. Many of those who have been writing upon the subject of the Government examinations, text-books, &c. (if they will excuse me, and not think me egotistic), know really very little about that upon which they have written. As a science teacher myself, and one who always passed 80 per cent. of those who were examined at these Government examinations, I ought to know something about what is required, and also what Dr. Frankland wishes to be done. In a conversation with the learned doctor he told me "that in the examinations an equal number of marks would be given for a correct answer upon any recognised system;" and in my course of teaching I have never introduced constitutional formulæ, more than that which was required to show the students what it really was. I have dwelt more upon the graphic formulæ, and have illustrated my lectures by the use of Crum Brown's glyptic formulæ, and, in spite of all the objections raised against these systems, I never had one even of my pupils who thought for a moment that the glyptic apparatus represented in reality the actual way in which the atoms were arranged in the molecule, nor had I ever one foolish enough to think that the bonds actually existed, like spikes sticking out of the sides of each atom. The objections to these very useful systems have been broached by men of high standing—those accustomed to teach classical scholars, whose perception is supposed to be much clearer than men of the ordinary stamp. If, then, the difficulties actually existed with them, it does not say much for a classical training, for with my pupils, all of whom save one only received a good commercial education, I venture to say again that not one was ever foolish enough to think that the glyptic molecule actually existed, or that the graphic representation of the radicle or molecule was really the form in which it existed in nature. I argue for these systems because I have found them of great use in teaching organic chemistry; but the system upon which I have always laid the greatest stress is the typical formula of Williamson. This system I have always fully dwelt upon, my pupils have always answered their questions by its use, and that they have been accepted may be seen from the fact that most of the certificates obtained by my pupils have been in the first class. I write this because it seems from the general tone of most of the letters which have been sent you that Dr. Frankland is set down as a harsh and tyrannical examiner, which might probably discourage the tyro if it met his eye. A refutation of this is not needed by any one who is acquainted with the doctor; no one who knew him would have pronounced him as such; and, therefore, any one who did not know him, and the examinations generally, should have waited until they did.

But to return to formulæ. That of H_2SO_4 does not give us any insight into the constitution of the molecule; we do not know whether the hydrogen is possessed of tremendous chemical force, sufficient, in fact, to unite with one sulphur and four oxygen atoms, or whether the sulphur is capable of uniting with four oxygens and two hydrogens. Constitutional, typical, or graphic formulæ will tell us a little more, thus:—

$$SO_2''Ho_2 \qquad \left.\begin{array}{r} H \\ SO_2'' \\ H \end{array}\right\} \begin{array}{l} O \\ O \end{array} \;;$$



Constitutional. Typic. Graphic.

Now, how do these formulæ explain facts? When sulphuric acid is dropped upon red-hot platinum it is split up into SO_2'' and H_2O_2, which latter cannot exist at that temperature, and so forms H_2O and O; it also explains this reaction—$SO_2 + H_2O_2 = SO_2''Ho_2$. This gives us *primâ facie* proof that two atoms of the oxygen are more firmly united to the sulphur than the other two, whilst it in no wise prevents the explanation of its electrolysis. But it is in organic chemistry where constitutional and graphic formulæ are so useful. For instance, if a student was asked by what name the following molecule was called, $C_3H_6O_2$, he might say propionic acid, another might say methyl acetate, and ethyl formiate might be the answer of another. The constitutional formula would admit of a direct answer for those three isomeric bodies, and would be written thus:—

$$\left\{\begin{array}{l} CH_2''CH_3 \\ CO''HO \end{array}\right. ; \quad \left\{\begin{array}{l} CH_3 \\ CO''Meo \end{array}\right. ; \quad \left\{\begin{array}{l} H \\ CO''Eto \end{array}\right.$$

Propionic acid. Methyl acetate. Ethyl formiate.

Where Meo stands for the group $(OCH_3)'$, analogous to $(HO)'$, and Eto for $(OC_2H_5)'$. On Gerhardt's and Williamson's water type they would be:—

$$\left.\begin{array}{r} (C_3H_5O)' \\ H \end{array}\right\} O'' ; \quad \left.\begin{array}{r} (C_2H_3O)' \\ (CH_3)' \end{array}\right\} O'' ; \quad \left.\begin{array}{r} (CHO)' \\ (C_2H_5)' \end{array}\right\} O''$$

Propionic acid. Methyl acetate. Ethyl formiate.

Now, all this is not mere speculation, as some people would have it, but agrees with analysis and synthesis.

Mr. Bottone (letter 8862) says he is beginning to doubt the existence of valency. I can assure him that there are many chemists who have not begun to doubt it, but have for some time denied it *in toto*, and I do not believe in it myself as now put forth; but I am not quite so mad as to stand on the topmost round of a ladder, and knock it away from under me, without building up a support to keep me from falling; still, I make the best of what is, to say the least, an imperfect system, looking anxiously forward for a better before I relinquish hold of that which has been of great use to me in my course of teaching. Mr. Bottone also says, "we can account for the existence of phosphorus acid without losing sight of the trivalence of phosphorus," thus:—

$$\begin{array}{c} H - O'' - P''' - O'' - H \\ | \\ O'' \\ | \\ H \end{array}$$

If the above formula were correct why cannot we form $(PNao_3)$? simply because the graphic formula should be:—

$$\begin{array}{c} O \\ \| \\ H - O - P - O - H \\ | \\ H \end{array}$$

In support of his formula, will Mr. Bottone kindly give me as an illustration any mineral oxyacid which contains the group HO any number of times which is not capable of being replaced by the metallic group Mo, where M signifies one atom of a monad metal? Phosphorus unites with oxygen to form a triad radicle, phosphoryl, and we have the trichloride of this radicle, which, when boiled with water, produces hydrochloric and phosphoric acids; moreover, this phosphoryl trichloride is formed from the pentachloride of phosphorus, two atoms or one molecule of the chlorine being replaced by one atom or half a molecule of oxygen. Now, if we represent phosphorus as only possessing a triadic signification, and that the pentachloride be formed by the combination of the two molecules, PCl_3 and Cl_2 (see "Chemical Philosophy," Wurtz), this harmonious reasoning is destroyed when we unite PCl_3 with one-half molecule of oxygen, or, to speak more correctly, when we replace a molecule of chlorine by an atom or half-molecule of oxygen. Surely no molecular force exists where there exists no molecule, and if we call chlorine a monad element, and phosphorus a triad, where is there any chemical affinity if all is neutralised by combination or mutual saturation—3 to 3? I have not brought this forward because I am specially addicted to this pentad nature of phosphorus and nitrogen, for nearly all the elements alter in their so-called valency, and the valency alters because we have firmly fixed hydrogen as the starting point, never allowing it to appear to become an element of higher equivalency, for the propounders of these so-called atomicity or valency theories have not dared to challenge the hitherto accepted monovalency of hydrogen. For this is their starting point, and the whole theory would then be undermined, and be found to rest upon a very insecure basis.

For my part I do not believe in molecular combination, but rather in the polyvalency of some of those elements which are now called monads. The double chlorides are curious specimens of this, and as chlorine and the halogens generally all form double salts, the light metals with the heavy, some have ventured to assert that chlorine must be a polyad in those molecules; but with some of these double chlorides there is a corresponding sulphate, and as SO_4 is replaced by Cl_2, I am inclined to think that the basyls are the polyad constituents.

Now I am on this subject perhaps it will please the worthy discoverer of the atmonia type, and the predictor of sulphur urea, "Eclecticus," if I give the potassium chloroplatinate formula, which might either be written:—

$$\left\{\begin{array}{l} K = Cl_2 \\ \;| \\ Pt = Cl_2 \\ \;| \\ K = Cl_2 \end{array}\right. \quad \text{or} \quad \left\{\begin{array}{l} K - Cl \\ \;\| \\ Pt = Cl_2 \end{array}\right.$$

The aluminium and potassium chloride, so-called double salt, and its corresponding sulphate, may be written thus:—

$$\left\{\begin{array}{l} K = Cl_2 \\ \;| \\ Al = Cl_2 \\ \;| \\ Al = Cl_2 \\ \;| \\ K = Cl_2 \end{array}\right. ; \quad \left\{\begin{array}{l} K = SO_4 \\ \;| \\ Al = SO_4 \\ \;| \\ Al = SO_4 \\ \;| \\ K = SO_4 \end{array}\right.$$

Chloride. Sulphate.

Both these molecules cannot be halved, if any faith is put in Gerhardt's law of uneven affinities, unless aluminium is made to act as a triad; but then, again, there is a law which states that an artiad is always an artiad, and a perissad always an element of uneven valency or atomicity, and it is in this latter respect that I cannot agree (and not only myself, but many other chemists) with Mr. Bottone, when he tries to make chlorine appear to be first a monad and then a dyad. "Eclecticus" asks whether gold really replaces three atoms of hydrogen? Taking either the old notation or the new, I say, most emphatically, "Yes." Thus:—

$$\left.\begin{array}{r} H_3 \\ H_3 \end{array}\right\} O_3, \quad \left.\begin{array}{r} Au''' \\ Au''' \end{array}\right\} O_3 ; \quad \left.\begin{array}{r} H_2 \\ H_2 \end{array}\right\} O_2, \quad \left.\begin{array}{r} K \\ Au'' \end{array}\right\} O_2$$

Water trebly condensed molecule. Auric oxide. Water doubly condensed molecule. Potassium aurate.

We will now turn to the old notation—

$$\left.\begin{array}{r} H \\ H \\ H \end{array}\right\} O_3, \quad Au''' \} O_3 ; \quad \left.\begin{array}{r} H \\ H \\ H \\ H \end{array}\right\} O_4 \quad \left.\begin{array}{r} K \\ Au''' \end{array}\right\} O_4$$

Water trebly condensed molecule. Auric oxide. Water condensed molecule. Potassium aurate.

and the chloride:—

$$\left.\begin{array}{r} H \\ H \\ H \end{array}\right\} Cl_3 \qquad Au''' \} Cl_3$$

Hydrochloric acid condensed molecule. Auric chloride.

Certainly gold does not directly displace three atoms of hydrogen in hydrochloric acid, for in that menstruum gold is not soluble, but auric oxide easily dissolves thereby, indirectly replacing three atoms of hydrogen for every one of gold fixed, and that this is the normal salt of gold may easily be seen by the ease with which the aurous compounds split up into aurum and the auric salts. This sentence also appears in the letter of "Eclecticus": "Now, the theory is that Pt is diatomic or duad, and that it replaces two atoms of H. Of course it will do so with double the old atomic weight." Now, I beg respectfully to submit to "Eclecticus" that double the old atomic weight is not necessary. On the old notation we had PtCl and $PtCl_2$. Now in this latter salt the Pt (with an atomic or combining weight of 98.5) actually replaces two atoms of hydrogen thus:—

$$\left.\begin{array}{r} H \\ H \end{array}\right\} Cl_2 , \qquad Pt'' \} Cl_2$$

Hydrogen chloride. Platinum bi-chloride.

In answer to his other query, the weight of platinum deposited electrotypically is half the modern theory, if we take an atom of hydrogen; but then theory indicates that the metals (heavy) have an atomic and molecular weight identical, so a molecule is deposited for every molecule of hydrogen—this brings us square again.

I am very glad to welcome such a chemist as "Eclecticus" to "our" columns, for during the past few years I have read his papers with considerable interest, and I feel sure if he continues with us that every one of us will learn something from his communications.

I wish now to have a few words upon the designation atomicities and valencies, as expounded by Mr. Bottone, who positively declares that atomicity is incorrect, and argues that nitrogen cannot be pentatomic, for one atom of nitrogen can only contain one atom. Now, when this name was first introduced into chemical science, did not the promoters of the valency—the then-called atomicity theories—know this? Of course they knew that one atom of a diatomic element did not contain two atoms; and, just the same, they knew that one atom of a pentatomic element did not contain five atoms. What was meant by the term diatomic was that the atom was capable of fixing or neutralising the chemical affinity of two monad atoms, such as hydrogen or chlorine, and a pentatomic element five atoms.

I have often been surprised that the valency theories have been so generally accepted, seeing that we cannot stir out of any one series of salts without meeting with strange inconsistencies, such inconsistencies which have been difficult to overcome, and which have generally resulted in the adoption of a special theory for their elucidation.

Turning again to the standard monad hydrogen, can it be believed that it is a perfect unit of comparison, and the same with chlorine, when we have such compounds as hydrogen chloroplatinate, H_2PtCl_6, which "Eclecticus" would prefer being thus written: $HCl + PtCl_2$, and hydrogen fluosilicate, H_2SiF_6, passing over the vast series of double chlorides, iodides, and the more complicated cyanides and ferrocyanides, of which the hydrogen salt is a type, $H_4FeC_6N_6$.

Mr. Bottone also says that sulphur is only known to combine with two monads. This may be true as regards monad elements, but that sulphur is at least a tetrad may be inferred from the existence of the triethylsulphurous iodide $S(C_2H_5)_3I$. In fact, we have also a tetrachloride of sulphur, SCl_4; but this may be objected to by Mr. Bottone, who considers chlorine a dyad, although its dihydride has not, as far as I am aware, been yet discovered.

Before I close this letter, I should like to put a few queries, and make a few remarks upon N. Du Fai's communication on page 68. I first would ask him, is he sure that ammonium (NH_4 or $(NH_4)_2$) has ever been obtained, or ever will be. If he possesses the secret of its formation, as we would suppose from the authoritative aspect of the query, by all means let us have it. I again repeat what I have said before in these columns, that ammonium is not a metal, but that the ammonium salts are only the first term of a very lengthy series, and that NH_4, or its doubled molecule $(NH_4)_2$, has no separate existence. I know a great many will oppose this; but it is my candid opinion, and both analogy and experiment will bear me out in my statements. In speaking of vapour densities, the densities of the ammonium chloride, sulphide, and cyanide do accord with the theory, for theory states that they dissociate, and at high temperatures are decomposed into ammonia, and the hydrogen salt of the acid radicle; this can be seen to be the case when working with properly-constructed apparatus, dissociation does take place, and the two gases can be separated from each other. I have mentioned the pentavalency of phosphorus and nitrogen in a former portion of this letter, so it is not necessary again to refer to it. I am very glad to see "Sigma's" name among those who stick up for the metric system. I use no other in all my calculations, and in commercial testing I have introduced it among the workmen as far as I have been able, in preference to the old and inconvenient—

20 grains = 1 scruple.
8 scruples = 1 drachm.
8 drachms = 1 ounce.

I am also pleased at the general tone of "Sigma's" letter. If we are to have a change, why not change to a system now so firmly established, and not try to decimalise our pound, so that calculation will have to be made as before, when one country is trading with another; better by half had we adopt the metric system as it now stands, and so in our commercial intercourse use a coin which shall be common to all.

GEORGE E. DAVIS.

ATOMICITIES v. VALENCIES.

[8988.]—I AM delighted to find that "Mercurio" has thought fit to misinterpret my meaning with regard to "atomicity," as it gives me another occasion to point out the necessity of discontinuing the use of this word, when taken in the sense of "valency." So far from my being wrong, or ignorant of the generally received use of the term, I beg to inform him that I was conversant with the term as soon as it was applied by Wurtz, Gerhardt, &c., and I have pointed out its correct application, in the last ten lines, at paragraph 46, of my lessons. But I have also pointed out how conducive to misconception it is, to continue to make use of an expression, which conveys *one* idea, when applied to atoms, and *another totally different*, when it refers to molecules. This would be excusable, had no other better term been proposed; but many years ago Professor Hoffmann coined the very precise word quantivalence (since contracted to "valency") to express the saturating power of any element. Let not the reader for one instant imagine that the objectionable vagueness of the term is a fruit of my imagination; the "monatomic," "diatomic," "triatomic," &c., alcohols (Odling) serve to show that such is not the case; while a cursory glance at any of our standard authors will show that these terms are often used, not only with regard to the number of atoms in the molecule, not only to the valency (or saturating power of the body), but also with reference to a supposed resemblance to the several types:—

(H_2O)	($2H_2O$)	($3H_2O$) &c.
Monatomic.	Diatomic.	Triatomic.

(See Roscoe, Odling, Miller, Wurtz, &c.)

With reference to the "artiad" and "perissad" theory, I have already shown (paragraph 78) that it is inapplicable in several cases, hence unworthy of the confidence of the truly scientific man. Of the ridiculous personality—(possibly meant for wit (?))—respecting my playing with nitrogen bonds, I take no notice beyond calling attention to the fact that a personality is no argument, and only tends to prove the weakness of the premises of the person who descends to use it.

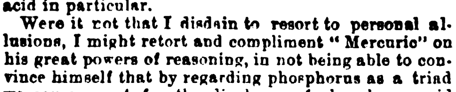
Up to the present time, ammonium has not been obtained in the state of vapour, without dissociation (see Roscoe, page 213, two last lines). Consequently, the statement that its vapour density is 9 00 is, as might have been expected, without any foundation on fact, hence worth just nothing in an argument.

Ammonium, in the free state is *not* "similar to the monatomic alkali metals;" for these latter are *elements*, hence the molecule *must* (according to our present ideas) be composed of two or more atoms, whereas, ammonium being a compound, there is nothing to *prove* that the molecule may not be NH_4.

The idea of "Mercurio" coming forward to "inform" me of something which I have already taught in my lessons, and referring me for information to my own notes, is sufficiently amusing; but it is evidently done to avoid giving an explanation of the abnormal vapour densities of all the ammonium compounds, and most of the phosphorus penta compounds.

Another personality, totally besides the argument and devoid of one redeeming spark of wit, is the one regarding my knowledge of Dr. Frankland's constitutional formulæ in general, and of that of phosphorus acid in particular.

Were it not that I disdain to resort to personal allusions, I might retort and compliment "Mercurio" on his great powers of reasoning, in not being able to convince himself that by regarding phosphorus as a triad we can account for the divalence of phosphorus acid with even greater clearness than we can do when we consider it a pentad. The annexed graphic formula (which, by the bye, I had sent along with my previous letter, but which was not inserted) will elucidate this.



In conclusion, while begging to be excused from continuing the discussion, which is becoming offensively personal; I quote the following Italian proverb, which may induce "Mercurio" to pause ere he repeats questions: "A buon intenditor, poche parole."

S. BOTTONE.

REMOVAL OF THE STANDARDS.

[8989.]—I SEE on p. 107 that the standards of measure and weight have been removed from their old place, and that the word "measure" has been inserted after "yard" on the brass plate. Now, it seems all right that after "pound" the word "weight" should appear, as there is such a thing as a pound "sterling;" but why "measure" after "yard"? A yard "measure" is a piece of wood 36in. long, used by haberdashers, just as a 2ft. "rule" is a 24in. jointed stick used by mechanics, and the standard yard is not a yard measure, but it is a longer piece of metal bearing on it marks to indicate what the length of a yard is. If they had put yard "length" or "lineal," I should not howl.

J. K. P.

KING NUMBERS.

[8990.]—I HAVE not ventured to trouble you with what I promised at p. 607, and of which promise Mr. Box (let. 8881) asks a fulfilment, because he must be reminded that according to "Philo" (let. 8806) I have wasted all the space I took at p. 607, there being nothing there but what "everyone knew before." Everyone, therefore, can continue the series of "noble numbers," and explain to Mr. Box the method of ascertaining each step, and when he once applies this, he will find that (to use another happy expression of "Philo's") it is "easily seen, though tedious (and paper-wasting) to demonstrate" rigorously, that there can be no number above 2,520 which requires so great an increase as doubling to gain more divisors; and, consequently, that 2, 6, 12, 60, 360, and 2,520 are all the "king numbers" possible. Mr. Box points out the obvious error of my remark that 12 was the only one produced by the multiplication of two below it. I saw, before it was in type, but forgot to add a note, that 360 also is, as he says, 6 × 60.

To be as brief, then, as I can, with what "everyone knows," it is shown in Barlow, Legendre, and other works on "Theory of Numbers," that every composite number is the product of two or more primes, each in its simple power, or raised to some higher power; so that if vowels represent prime numbers, and z, y x, &c. (back to any letter), represent all numbers indifferently (prime or composite), every composite number is reducible to the form $a^z \times e^y \times i^x \times o^w$, &c. They then show that, to find the number of divisors any number N possesses, N must be decomposed as above, and then the number of its divisors (which call D, including itself and unity, so that there can never be less than 2) is $D = (z + 1) (y + 1) (x + 1) (w + 1)$ &c.

For N is divisible by a, and by every power of a up a^z; and by e, and every power of e up to e^y; and by i, and every power thereof up to i^x; and, moreover, by every combination of any terms in these several series; that is, of the series—

$$1,\ a,\ a^2,\ a^3,\ \&c.,\ \text{to}\ a^z\ (z + 1\ \text{in number})$$
$$1,\ e,\ e^2,\ e^3,\ \&c.,\ \text{to}\ e^y\ (y + 1\ \text{in number})$$
$$1,\ i,\ i^2,\ i^3,\ \&c.,\ \text{to}\ i^x\ (x + 1\ \text{in number}),$$

and the number of combinations of all these terms is the product of $(z + 1) \times (y + 1) \times (x + 1) \times$ &c., which product, therefore, will = D. Now, as this depends only on the indices z, y, x, &c., and is unaffected by the magnitude of the primes a, e, i, o, &c. (provided they are all different), it is evident that if any prime factor be present without a prime factor that comes below it (if the proposed number N, for instance, be divisible by 7 and not by 5), it is not a noble number, for we may substitute the factor 5 for 7, that is, reduce N in the ratio of 7 : 5, and it will still have D as large as before. The prime factors of every noble number must, whether few or many, consist of the lowest primes, 2, 3, 5, &c., without skipping any. If there are four they must be 2, 3, 5, 7. If five, they must be 2, 3, 5, 7, 11; and so with any number. And further, it is proved in the same way that no factor can be repeated more times in the composition than a lower factor is. Thus, a noble number cannot divide more times by 3 than by 2, or more times by 5 than by 3, &c. It cannot be divisible by 3^2 and not by 2^2, or by a higher power of 5 than it is of 3, &c. In short, when decomposed into this form $2^z . 3^y . 5^x$. not 7^w, &c., the index y cannot exceed z, nor x exceed y or z, nor any index exceed an index that comes before it.

Now, suppose we want to find the lowest noble number above N (a number either noble or not), and let N, to make the method clear, be a very composite number, say the noble one 27720. This must be decomposed into its prime factors, and under them you write their indices each augmented by 1, which are the factors of its D, thus:—

$$\text{Factors of N, } 2^3 . 3^2 . 5 . 7 . 11 = 27720$$
$$\text{Factors of D, } 4 . 3 . 2 . 2 . 2 = 96$$

Now examine the effects on D of the various augmentations, beginning from the smallest, that might be made in N's indices. This will be greatly facilitated by having a table at hand of all the powers and products of the first few prime numbers arranged in order of magnitude, thus:—

3 (prime)	$8 = 2^3$	$14 = 2.7$	$20 = 2^2.5$
$4 = 2^2$	$9 = 3^2$	$15 = 3.5$	$21 = 3.7$
5 (prime)	$10 = 2.5$	$16 = 2^4$	$22 = 2.11$
$6 = 2.3$	$12 = 2^2.3$	$18 = 2.3^2$	$24 = 2^3.3$

and still more if you have all the ratios between such numbers tabulated, so that you may see by their order whether, for instance, the fraction five-sevenths or seven-tenths be the larger, such a comparison being often rather unobvious at mere sight. Now, the smallest increase we could make in the above N would be as 12 : 13, by reducing the indices of 2 and 3, from $2^3\ 3^2$ to $2^2\ 3^1$, and putting the new factor 13. The latter, by adding a 2 to the factors of D, would double it, but the first two of those factors, from 4.3, would become 3.2, which is reducing to less than half, or more than neutralising the doubling, so that we learn the factor 13 is not yet admissible. Next consider an increase as 11 : 12, by removing the last factor of N, and substituting $2^2.3$. This will alter the first two factors of D from 4.3 to 6.4, just double, or just restoring the product that would be halved by the loss of its last 2; so that we learn the augmentation of 27720 by an eleventh will leave its D unaltered. The next change, as 10 : 11, is at once seen to be useless, because it would quite remove the factor 5, while higher ones remain; and, moreover, would give 11 a higher index than the 5 or 7 before it; both of which we have seen to be impossibilities in a noble number. So again, a change of 9 into 10 would wholly remove the factor 3, while increasing the index of 5. Next, a change as 8 : 9 (that is, removing 2^3 to insert 3^2) would leave the higher factors of N without their base 2 to stand on; and one as 7 : 8 would leave the 11 without its support 7. And if we removed 6 (*i.e.*, 2.3) to square the 7, this latter would carry a higher index than the 3 or 5 preceding it. And similar objections, quicker seen than written, will prevent the changes of 5 into 6, or 4 into 5, or 7 into 9. As for removing a 3 to insert a 4 (that is, 2^2), it would alter the first factors of D from 4.3 into 6.2, leaving just the same product. Then the changes 5 : 7, or 7 : 10, will be seen to transgress our rules. Next consider 11 : 15—that is, removing the last factor of N to augment the indices of 3 and 5. The last 2 of D will be lost, while its 3.2 becomes only 4.3, thus leaving D unaltered. Again, we might, instead of this 15, introduce $16 = 2^4$, making the first factor of D from 4 into 8, and thus merely compensating the loss of the last 2.

We now come to the step of altering a 2 of N into 3; but this would only transpose the first two indices of N, or first two factors of D, leaving the product the same. A change of 3 into 5 will have the same objection. But a change of the 11 into 18 (that is, into 2.3^2) makes the first factors of D from 4.3 into 5.5 (more than double), and thus more than compensating for the loss of the final 2. Thus we find the smallest increase of 27720, that will gain it more divisors, is an increase as 11 : 18, making the factors of the next N—

$$2^4 . 3^4 . 5 . 7 = 45360, \text{ and}$$
$$\text{its } D = 5 . 5 . 2 . 2 = 100,$$

so large an increase of N only adding 4 to the number of divisors. I have chosen, in explaining the method to Mr. Box, this step, the most troublesome one in the table, because of the unique property of this number, 27720, the only one in my table, or, I believe, possible beyond it, that requires more than half doubling to yield the next noble number, and yet does not require doubling. Now if he observes how this comes to happen just this once only, immediately on the introduction of the factor 11, and notes that no two successive primes above 11 can bear so high a ratio as these two, 7 : 11, he will see on what principles to prove that there can be no king number above 2520. This 27720 we may call the only one that is more than semi-royal, the latter term applying to those that cannot gain divisors without half doubling (or being increased as 2 : 3) and these become less and less frequent, till at some step, I cannot say where, but above a billion, the last of them will occur.

The series of these numbers resembles on the whole a geometrical one of a rate slowly decreasing, so that between successive powers of any high number there will be more and more terms. Thus, between 1 and 1000 are 14 noble numbers, between 1000 and a million are 23; between this and a milliard 31, and so on. Hence, as the ratio 1 : 2 occurs but 7 times, so that of 2 : 3 will have a limited number of occurrences, some one beyond billions being the last. And 3 : 4 will similarly, at some unknown point, occur for the last time; and so with 4 : 5, and every lesser ratio definable.

E. L. G.

IMPROVED DIRECTING POSTS.

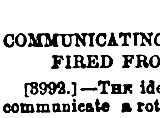
[3991.]—THE suggestion of "Jannifred" (let. 3930, p. 94) might be profitably extended by having the directions of cast iron, with the letters in high relief, painted white on a black ground; these should be fixed not higher than 5ft. from the ground.

I remember some years back, when going along a strange country road on a pitch dark night, I came to a spot where two roads branched off; I was at a loss to ascertain which to take; there was no house apparently near; it was raining heavily, and a direction post was there, but it was too dark to read, and considerably above my head. Now, had it been within reach, I could have felt, if I could not have read, had the letters been raised, and I lost a quarter of an hour, when a countryman came along and set me on my way. The cost would be a trifle dearer than the ordinary methods, but the increased durability would soon repay the extra cost. With regard to your editorial note, it was stated some time back that the Postmaster-General kept one clerk, whose duty it was to hunt the newspapers for suggestions and ideas; perhaps he may come across the ENGLISH MECHANIC, and so improve his mind, as well as the departmental service.

CANIS MINOR.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[8992.]—THE idea has struck me is it possible to communicate a rotary motion to a ball fired out of a smooth bore? I suggest the following:—The diagram shows a section of the ball, the internal black space is filled with a slow burning composition, such as is used for Catherine wheels, &c.; this is ignited by firing the gun, and, escaping by the holes A B, gives by its reaction a rotary motion to the ball.



If a hydraulic ram were secured afloat—so as to admit of an up and down motion capable of adjustment to the height of the tide—could the waves rushing through it produce power for raising salt water for baths, &c., thus dispensing with manual labour?

PHILANTHROPIST.

ORNAMENTAL TURNING.—IX.

[3993.]—In ornamenting turning many devices are used, simple in themselves, but with a good result; many parts of cabinet work, if less cumbersome, could be ornamented in the lathe, and with better results. Those who have noticed ornamental chair-tops may have seen circular rosettes, flowers, &c. These are done in two ways—First, by carving out the same from the solid; second, by boring a hole with a centre-bit, and fixing a turned palley, glueing in the same; in some instances carving it afterwards; in others, it is left as turned. Some few years ago I suggested to a chairmaker that I could turn the palleys out of the solid, thus giving strength to the chair. I turned a great quantity, both tops and splats. I send a sketch of the same. Fig. 1: The chuck made from a piece of dry beech, front view A A; slot cut in the chuck to fix the article C, which is in this instance, as shown, a chair leg, fixed for the purpose of ornamenting the ball. Fig. 2: Side view of chuck; A is the hole to fix or screw on the nose or screw of the iron chuck, already described in my last; B B thumb screws to hold the article secure; C, side view of the slot; the chuck can be made any convenient size.

FIG. 1 FIG. 2

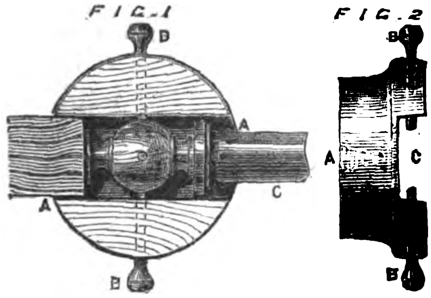
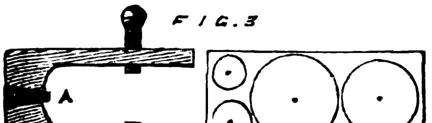


Fig. 3 is a chuck of the same description, only deeper, for the purpose of ornamenting balls, or the intermediate part of table pillars, side view only is shown. Take a piece of dry beech, say 6in. long by 4in. square, rough out the shape between centres; bore the hole for the screw chuck to hold by; screw it up tight, then finish off the shape shown in sketch; then bore a hole with a centre-bit through the wood at A; draw a line from the mouth to the hole already bored; cut down the lines with a fine saw; by that means the inside of the chuck will be even. The hobs for the thumbscrews should be bored half way betwixt the chuck and tapped with the ordinary tap. I find ⅝in. tap and box the most useful size. In ornamenting eccentric work, care should be taken to fix the work true and secure before commencing to turn the same, otherwise the wood may be spoilt, as it is almost impossible to refix exactly the same afterwards. The speed should be slow, to prevent jarring. In my next, I will send sketch of table pillar, with ornamental ball, showing how fixed, &c. I have sent sketch of a set of till blocks, very useful articles for the amateur to turn. The block should be of dry pine, planed up true, and to fit the till-drawer, then marked out as shewn Fig. 4. When marked out, a piece of wood about 6in. diameter should be screwed upon the iron screw chuck, just thick enough to allow the nose of the screw to project ¼in.; a hole ¼in. in depth should be bored with a bit in the centre of each circle to fix; unscrew the iron chuck from the mandril; place the chuck upon one of the circles (the largest first should be turned); then fasten to the till-block with ordinary screws, having previously bored holes for the same in the circle of wood, by this means a bowl can be turned with only a ⅛in. bottom; a breakfast cup is a good pattern for the inside. The holes should be turned and finished with a ⅜in. gouge; oval holes can be made by turning two circles or bowls one half over the other, and finished off with a carving gouge. In turning articles, if the lathe is weak, it should have a

FIG. 3



temporary prop from wall to mandril; only a slow motion should be used. Turning the larger holes first enables one to use more speed upon the smaller holes. Several correspondents of late have inquired how hammer handles are turned. I do not know how they are made in the country, but I have made some, as well as bradawl handles, by turning them same as usual, only leaving a flat each side of the larger part, and finishing them off in the vice with a rasp and glass paper, but no doubt this plan would not be quick enough for the trade. Samuel Smither.

COLLIERY EXPLOSIONS AND THEIR PREVENTION.

[3994.]—"Arley Mine," in his last letter, says that all parts of a coal-mine may be ventilated by a proper arrangement of the colliery from the commencement. If "Arley Mine" is acquainted with any method whereby the large "goaf" of a colliery can have the gas always removed and made safe, he will be conferring a benefit to humanity by explaining it, because (as I said before) this has been the great problem hitherto unsolved by mining engineers.

"Philo," in one of his former letters, advocates a colliery owner being made liable for injury to his own men, and instanced the case of railway companies as an example. I maintain the cases are not analogous; a railway company carries passengers by virtue of a contract between itself and the public; if any injury occurs in performing that contract the company are liable to pay compensation for any such injury, the same as in an ordinary business transaction; but does "Philo" know of cases where injury to the paid servant of a company has been compensated? I very much doubt if he does.

This, I maintain, is the parallel case—and not injury done to passengers; in each case the workman receives pay for his work, but the passenger pays money for his ticket.

I have observed that a colliery proprietor in Staffordshire has been lately fined £20 for keeping his pit badly ventilated. In evidence, some of his men said they had to "brush away the gas with their coats" from their working places; yet these very men went day after day to work at the same pit, knowing how dangerous it was. This shows that colliers are heedless of danger to themselves; if they had been the "model colliers" that both "Philo" and myself wish to see, every man would have refused to work in that pit again until better ventilated. King Coal.

ATMOSPHERIC DUST.

[3995.]—I head this communication in accordance with a very useful rule, though it has nothing to do with atmospheric dust. I merely wish to point out to "Saul Rymea" that dangerous dissecting wounds are contracted only when the subject is fresh, that is to say, shortly after death; but that in a little time, when putrefaction has fully set in, these wounds are attended with immunity. I have been twice nearly killed from accidents in making post-mortem examinations, but never suffered from a cut contracted in the dissecting room. F. R. C. S.

CASTING METAL IN AIRTIGHT MOULD.

[3996.]—In casting metal into an airtight mould, such as fire-clay, a tube must be provided through which the air can escape, and a figure cast by this method (called by the Italians with whom it is much in vogue, "cera perduta," or lost wax, the wax figure being melted out) presents the annexed appearance. A, the aperture into which the metal is poured; B, the opening of the air tube; C, the overplus metal to cause pressure on the figure. Now, when the metal is poured, and the git C, the hollow figure and the pipe B are all full, and the metal in a molten state, is the pressure on the figure equal to that of the column C, or to that of the thin tube B? C, we will suppose being double the weight of B. It is by this method that lizards and everything that can be burnt or melted out, are cast in Rome and Florence. They use for their moulds an earth called Tripoli, but differing, I suspect, from the substance sold here under that name, as it bakes into a sort of brick. They also use two parts brickdust, one plaster of Paris, mixed into a cream. Proven.

CHEAP OBSERVATORY CLOCK.

[3997.]—I wish to thank your correspondent C. B. Fennessy (let. 3859, p. 40) for the suggestion which he offers, as an improvement of the A 1 clock described at p. 630, of Vol. XIV.

It seems to me, however, that the proposed pulley would virtually restore (and in an objectionable form, from its greater friction) a species of "dial work," the entire suppression of which was a leading feature in the clock designed by me. It would also sacrifice the contrivance of showing the sidereal time, which is so constantly required in an observatory.

I have just added to its convenience in this respect, by marking upon the sidereal time-band the position of all the most useful stars for transit observations, placing opposite each star its declination (+ or −) to the nearest degree. The sidereal hour-hand, therefore, not only shows what stars are approaching the meridian, but points to the proper setting of the declination circle, so that their transit may be observed without even looking at the *Nautical Almanac*, which may be referred to any time afterwards to ascertain the exact clock error. I can imagine nothing more convenient than this is for observatory work.

I have felt as much surprised as gratified by the amount of originality which has been very generally credited to my simple clock arrangement, considering, as I do, that it contains nothing really new in horology.

The Astronomer Royal has kindly informed me that the celebrated Franklin contrived a clock in which the "dial work" was suppressed, though by other and less convenient means than in mine, to which he gives the preference in this respect.

I may add that my first clock continues to perform so perfectly, that I feel little inducement to proceed with a second clock, which I had commenced upon the same model, but with higher finish, the 'scape wheel being made of aluminium bronze, and the pendulum being nearly twice the weight of the first.

I have been looking in your pages for the promised description of the "New Maintaining Power" by your correspondent "Regulator" (query 11250, page 677). John F. Stanistreet

Abercromby-square, Liverpool, April 12.

NACASCOLO OR DIVI-DIVI.

[3998.]—Some time ago I replied to a query about the nacascolo of Honduras, that I believed it was the pod of a species of *Cæsalpinia*, and that it deserved an investigation in order to ascertain if it was not good for dyeing or for tanning purposes. A further inquiry has taught me that the *nacascolo* is the same as *divi-divi*, and is nearly neglected in Honduras, though it might afford a good article for exportation. Bernardin.

SELF-ACTING BLOWING APPARATUS.

[3999.]—I send a sketch of a self-acting blowing apparatus which I saw in use the other day, and with which I was much pleased. I should think it would entirely supersede the old blow-pipe, its advantages over which would be obvious on a single trial. It is

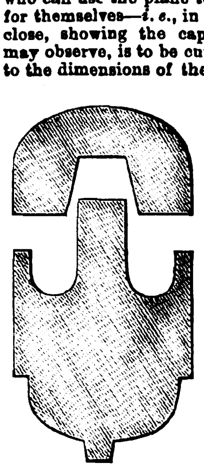
much cheaper than the ordinary method of blowing, does the work more quickly, and as the flame is smokeless the best work is not discoloured.

Painters will find it a beautiful apparatus for blistering off old paint, it being adapted for that purpose by a jet of peculiar structure, by which the flame is flattened and spread out so that the heat is dispersed over a broad surface. It is easily managed by half filling the boiler with spirit, and filling the lamp with the same, using a piece of lamp cotton as a wick; in about a minute from the time of lighting, the blast will be emitted, and can be directed to any point. By pulling up the wick with a sudden jerk, a stronger blast is emitted. I may mention a safety valve is adapted to the apparatus. H. B. E.

IMPROVED METHOD OF GLAZING.

[4000.]—There is no trade carried on—as far as the earth is concerned at least—in which a greater amount of humbug is put forth to bamboozle the public than that which deals with matters horticultural. Whether seeds, manures, lawn-mowers, boilers, or hot-houses form the subject of the advertisement, you invariably find that the advertiser is the only maker of the genuine article. We are now gravely informed by Mr. Peter Wallace (let. 3950, p. 98) that Mr. Ayres is the only person who has coped, or can successfully cope, with a difficulty, more or less imaginary, supposed to attach to the use of iron in horticultural erections.

I am pleased to hear that Messrs. Rendle and Burrows' patent cannot be maintained, because that at once leaves the way clear for those of your readers who can use the plane to make the improved sash-bar for themselves—*i. e.*, in wood, a section of which I inclose, showing the cap lifted half off. This cap, I may observe, is to be cut at an angle in lengths suited to the dimensions of the glass, so that where the latter overlaps, the cap is made to ride, so to speak, on the piece above it, thus allowing for the double thickness of glass, and at the same time affording entrance to the gutter cut in the sash-bar. If any of your readers feel inclined to try the iron sash-bar described in my previous letter (3840, p. 88), I hope they will not be deterred by Mr. Peter Wallace's assertion that it acts as a refrigerator (!). Snow-broth running in the gutters of the iron sash-bars would, undoubtedly, carry off some of the heat obtained from the inside of the house; but if this is to be taken into consideration, what are we to substitute for the glass itself, which, presenting a far larger area, must get rid of an amount of heat compared with which that conducted away by the iron sinks into insignificance? And although glass does not conduct heat so rapidly as iron it must be recollected that it radiates it much quicker, especially if the iron is painted white, which it would be. According to the most reliable experiments on the conducting power of various materials, it was found that, taking silver at 100, iron was only 12; while the radiating or emissive power of glass was 90, lamp-black being 100. It should be remembered also that white lead radiates as much heat as lamp-black



so that colour for steam-pipes, iron sash-bars, &c., should be made of some other material than the usual pigment employed for light-coloured paints. I observe that Mr. Peter Wallace does not explain, except vaguely, the construction of the truly wonderful and imperishable (!) hothouses he mentions.

Saul Rymea.

HARMONICON PIANOS AND HARMONICONS *A LA* DULCIMER—METAL, GLASS, AND WOOD.

[4001.]—Mr. Bottone (No. 11893) is quite mistaken in describing the metal harmonicon as a mere toy: on the contrary, it may be so constructed as to be a powerful musical instrument, sufficiently powerful, indeed, for its sounds to be audible in the largest of concert-rooms. I well remember the late M. Jullien used it very effectively about twenty years ago at his promenade concerts, probably the best shilling's-worth of good (and other) music then to be purchased for the money.

Although, like its ordinary glass congenor, the metal harmonicon is usually made in such proportions as to be a mere toy, it can, like bells, be constructed on a scale which affords sounds of great power and pleasing quality, because, as in the case of bells, loudness, *cæteris paribus*, depends on the mass of material in vibration. There is no novelty in the principle of this instrument. The gender, a Javanese instrument described by Sir Stamford Raffles, is, if I rightly remember, a true harmonicon, the sounds of whose metallic bars, or plates, are augmented by the resonance of masses of air contained in bamboo tubes, which are veritable musical pipes, whose lengths have harmonic relations to the sounds of the metallic bars. A yet more ancient kind of harmonicon is that with wooden bars, common among the African and other "niggers." This old thing was, a few years ago, brought out as a novelty—there is nothing new under the sun—and publicly performed on by clever Master Bonny, under the Greek title of Xylophone. (N.B.—There is nothing so effective as a mouth-filling Greek, or yet better, a compound barbarous Græco-Latin polysyllabic word for arresting the attention of the unlearned. Some thirty years ago I well remember exciting the wonder—it don't take much to do that—of my fellow cockneys by knocking "God Save the Queen" out of that Asiatic mystery—the xylophone, alias wooden harmonicon, in the East India Museum, then "situate, lying, and being," as my legal friends say, in Leadenhall-street. So, a late fellow correspondent who said the wooden harmonicon was invented by a German organ builder, is of course mistaken, unless, indeed, the said organ builder was guilty of the same folly too often committed by the writer of reinventing ancient things. (N.B.—He is not the only unwise person who has committed this folly, as the patent rolls only too plainly testify.)

All harmonicons proper consist of elastic bars—metal, wood, or glass—supported at their two nodes so that their supports may not damp their vibrations. They, therefore, form a class of musical instruments (which might fairly be designated dulcimers without strings) apart from those whose sounds are caused by the vibrations of elastic bars on springs fixed at only one of their ends, the other being left free to vibrate. The tuning-fork, however different from a straight bar in mere form, belongs to the former class, for it really is supported at its two nodes, which (by bending the bar into a fork) are brought near each other. Mr. Crawford's pianoforte without strings (see his patent of 1862), lately advertised so extensively by Messrs. Cramer, belongs to the latter class. However excellent (its treble is really fine), it is but one of many examples of this class—one of the earliest being that patented by Dr. Cleggart, A.D. 1778. Groll, 1812; Goldsworthy-Gurney, 1838; Pape, 1850; and Matthews, 1853, have produced variations on the same tune—I mean instrument—which has the great advantage of never requiring retuning. The novelty of such instruments may be estimated when I mention that a true harmonicon was constructed—with glass bars—upwards of forty years ago, by Messrs. Chappell, with a hammer-action and keys *à la* piano—which, indeed, it then became, just as the same mechanism converts a stringed dulcimer into a pianoforte.

The great defect of all I have heard is the weakness and bad quality of their bases. Probably, if their spring bars or vibrators were of much greater size they might—like big bells—be made to yield satisfactory tones, but the sound of a bass drum or even that of a grand pianoforte long bass string, can hardly be expected from a steel spring or vibrator 5in. or 6in. long, even when helped by the resonance of a soundboard. Groll, and also Goldsworthy-Gurney, employed spring bars of much greater length; the former, if I remember correctly, used bars about 25in. long for his lower bass notes, but then their sounds were not assisted by the resonance of a soundboard. Pape had so little faith in the bass tones to be obtained from spring bars that he employed covered strings made of fire-hardened and spring-tempered steel wire, which he said hardly ever required retuning, but for doing this he provided an apparatus in which an index pointed to the name of the note on an arched segment when its pitch was correct—at least, he said so. In the absence of experience I will say nothing to the contrary, although how he compensated for the variations of pitch caused by alternate expansions and contractions of the frame (*i.e.*, the bracing) of his pianos which result from changes of temperature, is rather more than any ordinary "fella" can understand. Being an old-fashioned "fella" myself, I prefer tuning strings by ear to tuning (or untuning) them by sight.

The Harmonious Blacksmith.

LANTERN PINIONS.

[4002.]—I fully appreciate "Tubal-Kain's" politeness in not contradicting me (see reply 11123, p. 101), but it would not make the slightest difference if he had done so ever so flatly.

I thought "trussells" might be a local name for "trundles," and as the word had nothing to do with the question I took no notice of it.

I have only one notion of the meaning of "pitch" as applied to wheel gearing, and that is the distance of centres of teeth or trundles, measured, not straight, but along the curve of the "pitch line," and if I am to be obliged to use it in his sense—viz., as the actual distance in a straight line, then I must reverse what I said before, and say instead, "Tubal-Kain" is not right in saying that the pitch of wheel and pinion should be the same.

I do not understand what is meant by "diametrical pitch," or any other sort than the one mentioned above.

I have never read, or even seen, "Camus on the Teeth of Wheels;" but I have read, and carefully too, Professor Willis's "Principles of Mechanism," which is a much more modern work, and also Binns's "Second Course" of orthographic projection. And I am pretty confident if "Camus" told "Tubal-Kain" to set out wheels in the way he says his practical daily

Fig. 1.

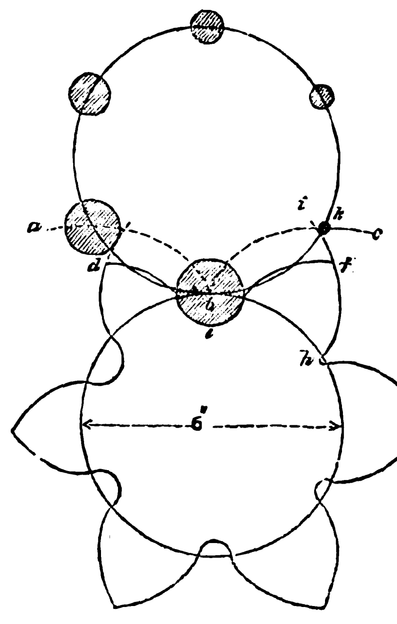
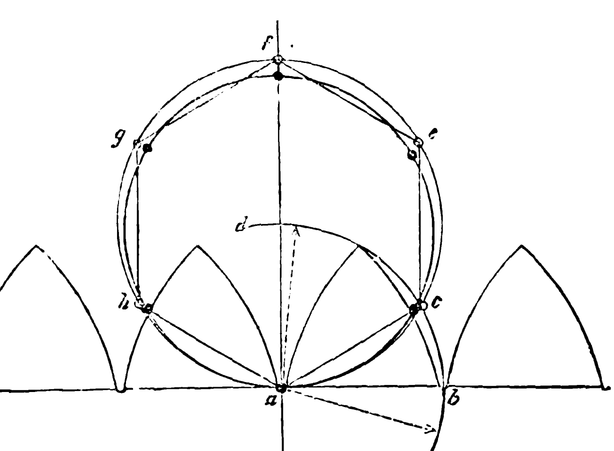


Fig. 2.



experience leads him to do, that either Willis or Binns would have pointed out the absurdity of his teaching long ago.

My own very first exercise in wheel-making was a pair of 6 teeth each only—viz., a wheel of 6 teeth, 3·14in. "pitch," as I call it, driving a lantern of the same size, only with the trundles varying from ½in. to 1½in. diameter. Of this I send a sketch (Fig 1). The biggest trundle is shown bottoming the largest space between the teeth; *a b*, *b c* are the sides of the true epicycloid tooth, supposing the trundles had no thickness. *d e f* shows the form of tooth for the trundle *b* when a piece half as wide as the trundle has been gauged off from the true epicycloid, which is the proper way of doing it. *h f i* is the reverse side of the right-hand tooth suitable for the small trundle *k*. It does not require much puzzling to find out where *k* would be if the distance from *b* to *k* were 3·14 instead of 3in. exactly. The result may be mentioned—viz., that we should have ·14 or $\frac{1}{7}$ in. backlash between the face of the tooth *h f i* and the trundle *k*, and the working of such gearing would be charming to listen to.

The object of the task of making such a pair as mentioned was to show first the true form of tooth; secondly, the possibility of driving with a wheel of only 6 teeth; thirdly, that lantern pinions are suitable for trains like clock trains, where the lantern is always driven, but never has to drive the wheel under any circumstances; fourthly, to show that the epicycloid tooth drives a trundle exactly at the same speed (whether the teeth be large or small), with the same smooth action as if the pitch lines were merely rolling on one another, and fifthly, that the trundles may be thick or thin, if the teeth are only gauged right. The epicycloid itself will do for very thin trundles; but for thicker ones the curve ought to be gauged off, which amounts to the same thing in practice as putting the template that you have cut to the true epicycloid rather nearer the centre of the wheel, as well as half the thickness of the trundle back from the centre line of the tooth space. If it is not put nearer the centre of the wheel (in drawing full pointed teeth, at least) the curve is not so true as it might be.

Fig. 2 shows a portion of a very large wheel of many teeth (to wit, 2,000) geared with a pinion of 6 trundles, the teeth being shown large and the trundles small for distinctness. The black dots show the trundles of a pinion of 6in. diameter, and, therefore, what I call 3·14 pitch. The teeth are true cycloids, also 3·14 pitch. Now, having shown by the black dots what I call the right way of doing it, I proceed to set out a pinion on "Tubal-Kain's" plan. He says, make the pinion a polygon, each side being equal to the pitch of the large wheel. I have done so—viz., taken *a b* as a radius, and drawn the arc *b c d*, which gives us *d*, the centre of "Tubal-Kain's" enlarged pinion, and then from that centre *d* drawn the pitch line of the pinion *a c e f*, and set off *a c*, *c e*, *e f*, the pitch (as he calls it) of the trundles which are shown by circles. I need now only call attention to the position of *c* and *h* relatively to the sides of the teeth to make any one used to a drawing appreciate the amount of backlash the gearing would have as made thus.

I know I am not likely to convince a practically experienced man like "Tubal-Kain," so I have only written the above to prevent learners and young hands running a-muck.

J. K. P.

SUN'S DECLINATION.

[4003.]—If Henry Woods (q. 11578) will turn to the pages in the *Nautical Almanac* for 1872 headed "Phenomena"—pp. 510-512—he will find that the summer solstice occurs at June 20d. 15h. 32m., and this will be the time at which the sun has attained his greatest declination north. At p. 241 he will see that the apparent obliquity of the ecliptic for this time is 23° 27′ 23·6″, which would be the sun's declination, assuming that at this time he had no latitude. On reference to p. iii. of June he will find that his latitude at this time is − 0·4″, which, applied to the obliquity, will give 23° 27′ 23·2″ for the sun's declination at the summer solstice. It may also be obtained approximately from pp. i. and ii. by interpolation, thus from p. ii. the daily differences of declination commencing from June 19 are + 28·2″, + 3·4″, and − 21·2″, giving a mean second difference of 24·7″, which divided into 3·4″ gives 3h. 18m. This quantity must be added to June 20d. 12h. (because + 3·4″ is the sun's daily motion at this time), and will give June 20d. 15h. 18m., differing only a few minutes from the time previously stated. If the declination be computed for this time, and corrected for second difference, it will produce 23° 27′ 23·1″. Or it can be computed from the declinations at apparent noon thus:—The difference of the hourly motions (not *second* differences, as stated by Henry Woods) is 1·03″, which, divided into 0·66″, gives 0·641 of a day, or 15h. 23m. from apparent noon of June 20, which is June 20d. 15h. 25m., mean time. If the sun's mean hourly variation (0·33″) for a time midway between noon and the apparent time required be multiplied by 15·42h. it will give 5·2″ to be added to the declination at apparent noon, and will produce 23° 27′ 23·2″, and with which I trust Henry Woods will be satisfied.

With regard to indicating the change in signs, the cases stated are not analogous—the equation of time being a primary quantity, and the variation merely the hourly motion of the declination. If Henry Woods turns to p. 122 he will see no line placed to indicate that the equation of time has attained its maximum, and is then getting less. The line is placed to read with the precept at the head of the column, and changes of motion must be recognised by the augmentation or diminution of the quantities themselves. I may here remark that our nautical friends up to the present time have been averse to the introduction of algebraical signs, which only tend to confuse them, and pp. i. and ii. are essentially sailors' pages.

If Henry Woods knows anything of computation, he must be aware that it would be utterly impossible, with the present staff of the *Nautical Almanac*, to give lists of occultations for any other place than Greenwich. A list as long as that there given would be required for *every place on the face of the globe*. It is, therefore, left to those interested with these phenomena to work out for themselves a list specially adapted to any given place, and the elements of occultations are given with this view.

With respect to the query about the transit of the moon's upper limb, I presume he means the moon's upper transit. The time of transit (upper or lower) at any place can be readily obtained by the usual method of interpolation. ALTAIR.

SIMPLE WEATHER-GLASS, BURSTING OF AIR CHAMBERS, ELECTRICAL, & SPIRITUALISTIC.

[4004.]—INSTANTLY I saw the not very picturesque engraving accompanying letter 3901, page 69, it recalled to memory the severe strictures passed upon Squire Baxter's papers in one of our earlier volumes, although, like a real genius, he gave us not only the "crude notion" which had appeared before the public long before, but he improved upon it, and when he last addressed us upon the subject left details of a weather-glass which would not cost more than eighteenpence if the work was done out, and one, too, from my experience of the past five years (for of course I made one) far more reliable as a mere weather indicator than a 30s. mercurial barometer. I have not time just now to refer W. Bright to Mr. Baxter's last, as it appeared in "ours," but I trust he will refer himself to back numbers, and then try his hand at something equally "simple," and, I must say, far more beautiful.

(3904.)—PSYCHIC FORCE PEOPLE, &c.—"M. S. A." should read "Spiritualism Answered by Science," by Ed. W. Cox, S L., F.R.G.S., and then develop himself for a medium for a few months; he will then probably write less lightly upon so serious a subject. We do not purify gold by submerging it in iced water, since the means are inadequate to the end, so if darkness is insuperable for spiritual manifestations, why should we judge those who can and have produced the phenomena satisfactorily by a standard in direct opposition to that required for the test? Probably one of the severest tests of a true diamond would be a darkened room, although it may require light to determine its full value. I might also instance the circumstance that probably not the most sensitive subject of Reichenbach could discern the phosphorescent Od emanating from his person while he was exposed in the full glory of sunlight. True, more than eighteen hundred years ago One said that "men loved darkness rather than light," and assigned a not very complimentary reason therefor, but then that was only directed against a certain class of men, and could not be intended for the mediums or psychics of our time, as they did not exist in those days. "M. S. A." is evidently too nearly a kin to Thomas Didymus ever to become a medium, and I therefore venture to advise him not to attempt to develop further than learning to sing "Home, Home, Sweet Home."

(11294.)—DIVIDING METAL DISC.—"G. F. H." has reproduced a very neat solution (geometrically) to this query which appeared in the *Mechanic's Magazine* about the year 1848, but then as now, without demonstration. Will "G. F. H." kindly supply this desideratum? I for one think it well worth the trouble and space it would occupy.

(11442.)—OLD WIVES' SCIENCE.—If "A., Liverpool," will make up his fire with the same care, and pay the same attention to it as he would on a day when the sun is under a cloud, he will get just as much heat from the fuel consumed, and cook a joint just as rapidly when the sun's rays fall full upon the fire; he will not have the perception by means of his eyes that the fire is as bright, but the heat will be there, and the coals will burn just as long in the one case as the other. Supply oxygen, and the fire will "never say die" even under the direct gaze of Phœbus while any carbon is left.

(11444.)—BURSTING OF COMPRESSED AIR CHAMBERS—I apprehend that no comparison can be formed between the bursting of a compressed air chamber and that of a steam boiler. True, they are both elastic gases, and if nothing else was present there is every probability that *cæteris paribus* the results would be equal, but in the steam boiler there is another element—viz., water, and that overheated beyond the point necessary for the formation of steam, and only prevented from doing so by the pressure of the steam already generated, and the strength of the containing vessel. Now if a given volume of the steam is removed by any outlet, its place is instantly supplied by fresh evaporation, and with a scarcely perceptible diminution of temperature in the whole mass, but if the retaining vessel gives way at a weak point then there is not only the sudden rush of imprisoned gases, but the instantaneous conversion of a great portion of the overheated water into steam, and that not merely endeavours to escape through the weak spot, but brings with it the particles of water not yet converted into the gaseous state; then (if the other portions of the boiler are not sufficiently strong to resist it) comes the crash a larger orifice is formed, and the whole, or nearly the whole of the water, flashes into steam, at a lower pressure, granted, than that it sustained in its confined state, but sufficiently great to account for any boiler explosion yet recorded.

Some people can "read sermons in stones," and as the subject is one of a rather momentous nature, allow me to lay before your readers one of the many calculæ whereby I have thought myself worthy occasionally to give an opinion upon the matter of "boiler explosions." Nearly twenty years ago a labouring man, who was employed under me, was in the habit of warming his coffee for breakfast in a tin can by placing the can on a piece of red hot iron previously prepared for the purpose. On one occasion, to which I now advert, he had forgotten to remove the cork from the mouth of the tin. All of a sudden we had a miniature boiler explosion; the cork was violently ejected, like a bad paying tenant, there was a tolerable volume of steam, and on the ceiling, which was at least 15ft. high, there was a nearly circular patch about 5in. diameter, the sole relic of nearly a quart of coffee infusion, for nowhere around or about was the slightest trace of a single drop having fallen or been dispersed, and yet the can was perfectly dry and empty, but no longer on the hot iron plate: it was capsized, but not burst.

Leaving the study of this curious instance of the effects of vaporisation to our friend "Lyons," and believing that he must have witnessed somewhat analogous effects produced on opening indiscreetly a bottle of lemonade or soda-water, I will proceed to

(11445.)—ELECTRICAL.—Don't do it, "J. H." If you have not enough of No. 22 to complete your coil, sell what you have and buy No. 32 to use with "the further length you possess," how much further you do not state. But even then you will not have a medical coil. These things are not made for the purpose of "affecting three persons at the same time," any more than is electricity suited to become a universal nostrum under all conditions or idiosyncrasies of a patient. "J. H." may not know why, but he may, in the exuberance of his philanthropy in displaying his electrical attainments, be actually killing one of his patients while he is curing the other two; and the proposition equally admits of the obverse hypothesis: he may kill two in trying to cure one. Electricity, so far as we know it, is not a panacea for all ills, but, judiciously applied, is one of the great boons Heaven has granted to its creatures; but it must be used with intelligence and the skill that a master mind, properly directed by experience, can alone use to render it available. To any one who can show that he possesses these primordial requisites I am always "at home," and only too happy to give any information, in my poor way, in the constructive department, and now and then the theoretical, but in the wholesale destructive department of kill or cure three patients at a time I respectfully beg to withdraw until "J. H." can assure me that he really understands the full nature and extent of what he asks for.

(11446.)—SMALL COIL.—This query is so directly the antithesis of the preceding, that it merits a line if only for its foppishness. "An Anxious Mechanic" wishes for an induction coil that he can deposit in the same receptacle as he usually places his toothpick! Now, some over-ardent electricians might come out with Pio Nono's "Non possumus" in replying to this query, but I cannot do so, since I have seen a working model of a steam-engine, with boiler complete, exhibited in the window of one Bramah, an optician, &c., of Bristol, the whole of which was contained in half a walnut shell, and I have read of an ingenious blacksmith making a chain of thirty links which was fastened with a lock consisting of eleven parts round the leg of a flea which drew the whole with marvellous rapidity, the chain, key, lock, and flea, weighing eleven grains. I have further heard of things even more wonderful, but as I have never done any such feats nor even attempted them, "An Anxious Mechanic" will readily pardon me for my want of ability to help him out of his present difficulty when I assure him that if he asks for any information that is worthy of occupying your space and my time, he will find no one more ready to assist him to the full extent of my power.

(11465.)—PROBLEM.—"Puzzled" may well be in a quandary if he attempts to read this query as it is written. The first hypothesis assumes that the trains, unequal in length, "move with uniform velocities," and, in the second case, that they move with the same (that is, uniform) velocities, and yet one is a faster train and outstrips the other in six seconds! Surely there is a want of uniformity and coherence of thought in the propounder of such a problem, and small reason to wonder that "Puzzled" is puzzled.

(11472.)—PLASTER OF PARIS.—"C. B. B." must have been imposed upon by the person who sold him, under the guise of plaster of Paris, some old ill-used, or it may be originally worthless, material. It is not suited for continuous exposure in the Daniell's cell; but if originally good of its kind, it answers admirably as a substitute for the ordinary porous cell, being very cheap, always to be obtained, and, though not lasting long, will give good results, and it is also so easy to make the cells at home. Some of the finest medallions I have yet been able to make I achieved with a little battery of six cells, with plaster of Paris porous cells; but they require great care in handling when thoroughly saturated, and hence when I could obtain biscuit ware I discontinued the use of plaster. I have even used porous cells of this material for Grove's when I wanted "effect" for a limited period, but I had to pay for brilliancy in zinc coin.

WM. TONKES.

INFLUENCE OF COLD ON VEGETABLE GRAINS.

[4005.]—I was pleased to see our friend "Sigma" put his foot down on "L. C. E.'s" rather "unwise" letter; but I hope he will not misunderstand me if I inquire what is the use of the experiments of M. Duclaux detailed by "A. B. M." in letter 3928, p. 94? The conclusions arrived at by M. Duclaux are not very clearly stated by "A. B. M.," for in the first place it is said that "the cold of winter has a real influence on the germination;" secondly, that "grains kept all winter in a heated chamber germinate *none the less* in their season;" and thirdly, that "the discovered (?) influence of the winter's cold on some [grains] is a presumption that the others do not entirely escape it." I cannot hope to point out what is really meant, and must, therefore, appeal to "A. B. M." There are, however, one or two things in this letter which attract my attention, and appear to show that the experiments of M. Duclaux have not been conducted in a very scientific manner. For instance, if his object is to show that an exposure to a very cold temperature is absolutely necessary to the germination of seeds, why select those of marvel of Peru and convolvulus? the first a native of the West Indies and the second, I believe, of the warmer parts of America. I submit that, growing in their native habitats, *Mirabilis jalapa* and *Ipomœa purpurea* are never subjected to the intense cold of a glacier, nor their seeds either; therefore, all that can be truly said of the experiments of M. Duclaux is that cold has no effect on these seeds. The reason that none of the grains unexposed to the influence of cold germinated requires explanation, and I have a suspicion that that explanation must be found in the method of carrying out the experiment. I perceive that of six grains of *M. jalapa* which had endured two months' cold, five germinated; of six exposed one month, only three; while of six not exposed at all *none* germinated. A somewhat contradictory result attended the experiment with the seeds of *I. purpurea*. Of twelve seeds exposed two months, *none* germinated; of a similar number exposed one month, two germinated; while of those not exposed, *none* germinated. But these seeds were all sown in pots and placed side by side in a *heated* chamber on Nov. 10, and germination did not commence till Jan 25, 76 days afterwards! This fact, I think, nullifies the whole experiment, and points to improper sowing or treatment of the seeds. We all know that many seeds germinate almost as soon as they fall from the pod; others will remain exposed to the winter and germinate in the spring, though thousands of the same species are destroyed. But seeds of the same plants may be taken when ripe, kept on a shelf in the hot-house, or stored away in the drawer of a seedsman's shop where they are exposed to air heated by gas, and yet, properly sown (no matter when, so that the requisite heat is applied), never fail to germinate. If further experiments are made I would suggest that seeds of the Antirrhinum and the poppy should be tried.

SAUL RYMEA.

EXTRACTS FROM CORRESPONDENCE.

Australian Meat.—I have seen various communications, some approving, and some disapproving, of the preserved meat. I have used it for a length of time, and I must say I consider it a great boon. It is not much more than half the expense of butchers' meat, and as to the nonsense some talk about the nourishment being abstracted, it is quite absurd. It is cooked in almost a close vessel, and not boiled in a quantity of water, which does abstract a deal of goodness from meat; and then, look at the mottled appearance of the beef. Where, in England, except at Christmas time, do you get meat like it? It is pure grass fed, natural meat, which cannot be said of butchers' meat with all the artificial food with which animals here are obliged to be fed. True, they become very fat, but I have great doubts whether it is altogether healthy fat or lean either. When we look at the diseases prevalent, I often think this wants consideration.—E. T. S.

The Oxyhydric Light.—The oxyhydric light has not proved a success in Paris, and it has been discontinued in the public lamps on the Boulevard des Italiens. It is not generally known that a carburating apparatus is always employed in conjunction with oxygen, which adds to the complication of the apparatus as well as the cost of the light. There are but few, remarks *Le Gaz*, who will consent to have installed in their houses two meters, two regulators, a carburator, and two distinct systems of pipes. For this reason alone, the system was certain to fail, even if the alleged economy were proved, which has never been the case.

Adulteration of Aniline Colours.—The intense tinctorial power of the aniline dye seems to offer irresistible temptation to dishonest dealers to imitate or adulterate them with worthless ingredients. A sample of fuchsine (an aniline red) lately placed in our hands by Dr. Genth was composed entirely of sugar crystals saturated with the colouring matter. To any one familiar with the peculiar arborescent appearance of the pure fuchsine particles, the sugar crystals, with their rhombic prisms, would betray the imposition at a glance; but without this knowledge the detection would be attended with some difficulty, since the colour of both genuine and counterfeit samples is equally intense. One of the simplest methods to detect this and similar impositions is simply to digest a sample of the suspected substance in ether or absolute alcohol, when the colouring matter will be dissolved with ease, and the sugar, crystals, or wood fibre (which is also used for dishonest purposes) will remain undissolved.—*Journal of Franklin Institute.*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10414.]—**Retrievers (U. Q.).**—As sportsmen do not seem to patronise (?) the ENGLISH MECHANIC AND WORLD OF SCIENCE, I should advise your correspondent to train thus:—First, they must learn to obey implicitly: that done, with such dogs everything is easy. I should teach a dog first to carry and then to fetch a stick, half a dozen lessons will teach that much; the lesson once learnt every act of disobedience must be punished; take him by the ear, scold him, then give three or four cuts with a light switch, no more; no act of disobedience must be overlooked, and the dog will soon cease to disobey. Most gamekeepers for the first season chain the dog to their belt, for a young dog when he sees a hare always bolts after it; but if during the next four months "A Subscriber" can take his dogs where game is, he will soon teach them not to move when they see game; they will at first, but punish each time. Retrievers ought to be fed on oatmeal and bran made into cakes, and then made into a sort of rough mash with milk; but I feed mine on the scraps of the house; she is perfectly healthy, only rather too fat. These dogs are as intelligent as most children, and think more of a scolding than a flogging apparently.—HEDERA.

[10609.]—**Separating Iron from Brass (U.Q.).**—We generally melt it, not very hot, skim it off clean and ingot it, and when it is used skim it off again. I heard of a machine like a grindstone-box, with magnets fixed on radiating arms in place of the grindstone, the filings being removed by coming in contact with a brush.—ANGLO-AMERICA.

[10617.]—**Watchmaking (U. Q.).**—Isochronism is meant when the watch is truly balanced and beats precisely equal.—ANGLO-AMERICA.

[10830.]—**Fern Printing on White Wood (U. Q.)**—One method of doing this is to fasten, with gum or fine pins, fern fronds, or other suitable leaves, on the surface to be ornamented, which is then "spotted" over with Indian ink or sepia, rubbed thick from a tooth-brush or a small nail-brush. The spotting must be done evenly, and gradually shaded off to the outside. A good effect is produced by taking off some of the larger leaves before the completion of the operation, and slightly spotting over thin places, which makes them appear in the background.—Q. Q. R.

[10873.]—**Tooth Stopping.**—With respect to this I do not agree with H. G. Young. No sensible dentist would use more silver than tin; if so, the stopping is almost sure to discolour. I certainly erred in not mentioning chemically pure mercury.—DENTISTE.

[10882.]—**Damp Walls.**—Not knowing all the circumstances, and failing to elicit any detailed statement, it is somewhat difficult to give a direct reply. But taking for granted circumstances are otherwise equal in both gables, the inference is that aspect has something to do with it, for although a driving rain may not be sufficient to saturate a 9in. brick wall, it may be of considerable assistance to that which falls vertically, the wet being absorbed by two faces at the same time, for the same reason exposed angles are liable to damp. Another place especially liable to damp is under windows, where there is no projecting cill, as is generally the case in "R. J.'s" class of house. In a driving rain all that which falls on windows is sent on to bricks beneath, increasing the liability to saturation twentyfold.—T. H. SAUNDERS.

[10913.]—**Screw Cutting (U.Q.).**—If "Persevering Screw-Cutter" will adhere to the following plan he will not fail to accomplish what he requires. Having run back his saddle close to the poppet head, and fixed his tool about a quarter of an inch from end of work, he must turn the lathe round until the saddle is in gear with the leading screw, then take a piece of chalk and mark top of faceplate and top of leading screw; now set your lathe in motion, then having run the required distance, ungear the saddle, run her back, and then turn the lathe round as before until the marks appear on the top.—F. HUME.

[10917.]—**Power (U.Q.).**—It is difficult to say what would be the exact gain by simplifying the driving gear; but the friction of so many wheels, pinions, and bevel-wheels, to say nothing of straps and journals, would be considerable, and if they are large might amount to one horse-power.—Q. Q. R.

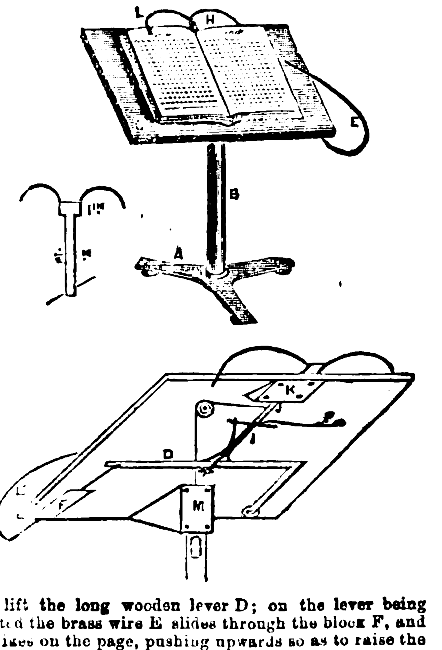
[10922.]—**Engine Query.**—I should read the indicator diagrams thus: Front end has ample lead on the steam side, steam cut off about ·5 of stroke, steam expanded to less than atmospheric pressure. The exhaust is too slow, or has too much lap on the exhaust ports, therefore bad. The vacuum (as it is termed) is very inferior at the commencement of the stroke, whereas, from the reduced pressure of the steam at the end of the stroke it should be very much better. It would appear to me, without the data relating to the slide valve or valves, that the motion is very sluggish, and the exhaust ports too small to give good results. Back end—lead too small, the steam cut off about ·20 of stroke, the same remarks as to the exhaust here also apply. It would appear that a misprint is in the formulæ, 1-20in. = 1 horse-power. It is intended, I presume, 1-20in. = 1lb. pressure. If that is the correct scale for the pressures, the gross steam pressure at the commencement of the front side of stroke would be 7¼lb. expanded to 1·5lb. below the atmosphere at the end of the stroke, and the commencement of the vacuum only 2½lb. below the atmosphere, ending at 5lb. at completion of stroke. The back end, 6¼lb. steam pressure at beginning of stroke, and is expanded to 1·75lb. below the atmosphere at end of stroke, the vacuum commencing at 3lb. pressure below the atmosphere, and ending at 4¾lb. at completion of stroke. Now, if the boiler pressure is 34lb., surely 7¼lb. on the piston at commencement seems a great contrast. The lead of the valve should be equal at both ends, and the exhaust ports opened out larger to give a freer passage to the condenser. You can do so by narrowing the bars between the steam and exhaust ports on valve face. The velocity of piston being 324ft. per minute, the lead of slide valve on the steam sides at ends of stroke should be ·103 of the width of the port.—TUBAL-KAIN.

[10941.]—**Spontaneous Combustion.**—This question seems to me to have met with an amount of discredit which is scarcely consistent with known phenomena. I have never had an opportunity of witnessing the fact myself, probably through the precautions I have always taken in order to avoid such an accident, for I thought it was generally admitted that such might happen. Nor are we unaware of its rationale. I should have thought that most of the objectors were acquainted with certain substances which go under the name of pyrophorus, which inflame upon mere exposure to the air. Notably among these is iron when reduced to a state of very minute division, and which, on being thrown into oxygen gas, immediately ignites, and, if my memory serves me rightly, manifests the same action on being scattered in the air. I do not suppose there are many regular courses of lectures on chemistry where this is not exhibited; at any rate, I witnessed it in those I attended—namely, of Professors Thénard and Gay Lussac in Paris, and of Professors Turner and Graham at University College, London. The minute division of the substance is the cause of the action as favouring its rapid oxygenation, and herein, essentially, combustion consists. Now, I suppose we all know that some oils have an aptitude for oxygenation; perhaps, for aught I know to the contrary, linseed oil more than others, since this is the one selected for the manufacture of boiled oil and dryers, as known in commerce. We know, further, that when we wish to burn oil in a lamp we do so through the intermedium of a wick, which effects the segregation of the separate particles of the oil, and thus conduces to their more rapid oxygenation (combustion). But if the oil is taken up by loose cotton it will diffuse itself into a much more minute state of division along each hair of the cotton, and I see no reason why it should not become, like other substances so situated, an effective pyrophorus, especially if aided by some other and extraneous source of heat.—F. R. C. S.

[10954.]—**Circulation of the Blood.**—My answer on this subject, at page 18, was intended for the requirements of "Corien," as expressed on p. 597, of Vol. XIV., where he wished to know how respiration aids circulation. There had been several replies, but none of them were calculated to afford the querist satisfaction, for most of them denied that any such aid exists, and some diverged altogether from the matter in hand. I, therefore, ventured to step in, strictly confining myself to answering the question, and in as few words as possible. I mentioned that there are many forces that contribute to the circulation of the blood, but the majority of these were left on one side as being irrelevant to the question before us. I was, indeed, so reticent as to speak of what we will, for convenience, call "the suction power of the chest" as being exercised at only the very last stage of the circulation—viz., when the two currents of blood had met from the junction of the ascending and descending *venæ cavæ*, and I adduced the instance of a wound in the chest to show that such a power really exists. I now find myself met by "M. R. C. S.," at page 74, who invites me "to reconsider the case," in order "to give up the old and still prevalent opinion," &c. I doubt not that "M. R. C. S." will feel that I have already well considered the case, when I inform him that I have been for many years a licensed teacher of anatomy and physiology, whose lectures are recognised by the examining boards, and that it is, therefore, my duty to keep myself acquainted with the most recent discoveries, and to test their accuracy. It often happens, in scientific research, that a theory that has subsisted for some time, finds an opponent who brings forward a plausible experiment, which secures to him a decent following of converts, till a flaw is found in the argument, when all are content to resume the original creed. Now this is just what has happened in the case mentioned by "M. R. C. S." There was a general belief in a suction-power in the chest during inspiration, which was thought to favour the return of the blood to the heart. But an objector was found who based his opposition on the following experiment. If we take the jugular vein of a horse, or a portion of the intestine of a fowl, and connect one end with an exhausting syringe, and then place the other end in water, we shall find that on drawing up the piston the air in the tube will be withdrawn, when the atmospheric pressure without will cause collapse of its sides, and no fluid will pass through it. It was, therefore, argued that the chest could exercise no suction action on the veins. But there was grave oversight in this proceeding, for the tube was inert, dead, and empty, while the veins are living and constantly full, so that the conditions not being identical, the experiment was worthless. There is no necessity for rings to keep the veins patent, because they are not only always full, but the current through them is always in the same direction: these conditions do not obtain in the windpipe, and hence the difference in structure. The whole vascular system is so full, in fact, that we cannot prick the skin with the finest needle without blood flowing from the puncture, and there would be no circulation at all were there no gap in the circuit, but such is furnished by the diastole of the heart, or the right side from the systemic to the pulmonary circle, and, on the left, from the pulmonary to the systemic. I trust this will be deemed a sufficient justification of what I have advanced; at any rate, I decline any further controversy, as this would, most probably, only lead us further and further away from the consideration of the function in question, and necessitate the bringing forward of esoteric matters which are scarcely calculated to edify the general reader. Should, however, any such desire a purely mechanical illustration, the following may be adopted:—Having procured a pair of bellows, remove the nozzle and screw into the larger end of this nozzle a tube of two or three inches in length, to the free end of which attach a flaccid bladder. Now introduce the bladder and tube through the nose of the bellows, and fit the nozzle in its place as before. The valve in the under leaf of the bellows being stopped, we have a representation of the lungs in the chest, the bladder standing in lieu of the aggregate of the air-cells, and the pipe as the windpipe. The bellows being worked the air will be admitted to and expelled from the bladder through the bellows pipe, but has no access to the walls of the bellows. If we now make a hole in the lower leaf of the bellows and fix a glass tube in it, and then place the lower extremity of the glass tube in water, we shall find that on continuing the action of the bellows the water will ascend into them. The analogy would be more perfect if the upper end of the glass tube communicated with a hollow indiarubber ball within the bellows.—F. R. C. S.

[10993.]—**Mildew in Old Engravings (U. Q.).**—The plan I find answer best is to put dried salt on the engraving, and with a thick slice of bread (not too stale) to scour it well, and then to place it between blotting paper, after having shaken off the salt and bread crumbs.—ESMEY.

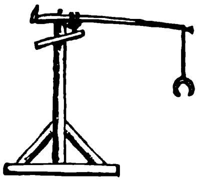
[10996.]—**How to Use a Book Without Hands.**—I believe there are contrivances for this purpose, but I don't know what they are. The following will answer the purpose. A stand, B stem, made of gas-pipe, C desk. The movement is as follows:—Connect a pedal



to lift the long wooden lever D; on the lever being lifted the brass wire E slides through the block F, and strikes on the page, pushing upwards so as to raise the leaf at H, and the point I pushes up the wooden spindle J, which slides through the block K, so that the brass wire arm L is pushed back off the other page, and is instantly turned round by the string, which passes over two small sheaves (one of which is in the block M), and is tied to a 6lb. sashweight moving in the stem B. The two stops now come into contact, one of which is adjustable by a thumb screw, so that the arm is just opposite the pushed up leaf. The pedal is now released, the spring P then brings the wire arm under the page, the stops are disconnected and the string pulls round the spindle, turning over the page. Each revolution of the spindle turns over two leaves. The weight may be wound up by the arms L, it may run through the stand to get a good fall. The wire E should be about fifteen degrees angle with the face of book, and the point must be very obtuse so as not to bite through into the next leaf; try this part of the dodge with a dry pen. The mechanism may be covered with a board.—ANGLO-AMERICA.

[11058.]—**Red Stain and Polish for Kitchen Chairs (U. Q.).**—I find the best thing is to paint with Indian red, and varnish if necessary. But John Moore will find they look very well not varnished.—H. B. E.

[11059.]—**Spinal Complaint.**—A boy of my acquaintance was cured of curvature of the spine in the following way, and he is now a "crack" oarsman:—Procure a round wooden (or iron) rod about eight or nine feet long, and support it vertically, as sketch—Drive a smooth iron pin in at the top, and over it put a tapering horizontal piece, so as to revolve freely. It will require a small washer and some grease under it. To the outer end attach a short strap and padded collar of leather to fix round the boy's neck comfortably; the strap behind.

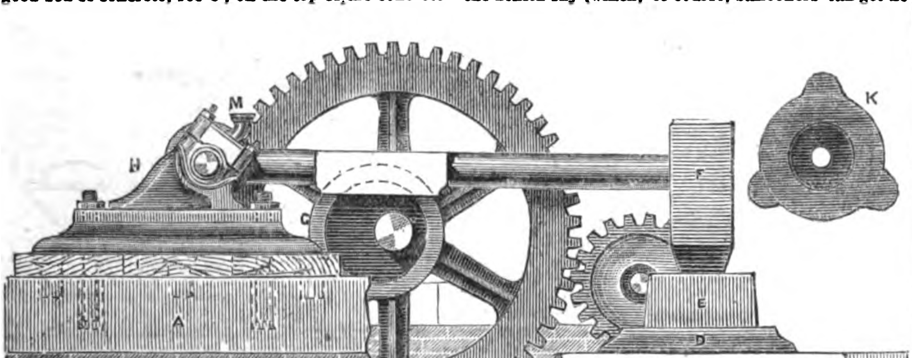


To the under side of the inner end, about six inches from the upright pole, screw any kind of a chair or sofa caster, so that its wheel may run on a round piece of wood like a little table fastened under it. This round piece has a hole in the centre of it, through which the upright rod passes, and it must be firmly fixed in a slightly sloping direction, as shown. The machine acts as follows:—When the collar is tied round the patient's neck (strap behind) he is made to walk round the pole, of course bringing the horizontal bar round with him. Whenever the caster is treading the lower side of the sloping disc the strap is only just kept straight by the flexibility of the bar to which it is attached (all wood is flexible enough) but on the opposite side it will be raised up so as almost to lift the boy off his feet—thereby giving a regular intermitting stretch and release to the spine. Care must be taken that the vertical pole does not move, but, above all, the boy must keep his arms and legs down straight whilst walking, and not be allowed to get tired.—W. J. HOWARD.

[11095.]—**Microscopic Deposits on Bricks (U. Q.).**—Eggs of stone mite (*Trombidium lapidum*).—G. W. R.

[11101.]—**Mortices in Hard Woods.**—I am pleased to find "Jack of All Trades'" kind reply to my query as above. May I beg for fuller explanation? It will not be wasted. I really cannot make anything out of the sketch and description. I wish to apply the application to a lathe, for which the writer, "Jack of All Trades," says it is applicable. I do not see how, or where, to fasten it to face plate, nor how the chisel is held; in short, I fail to recognise or understand either the application or mode of working the apparatus. Could a mortice be cut with it? To what does the letter F on Figs. 1 and 2 refer, and C on Fig. 1? I have benefited very much by one of "Jack of All Trades'" kind replies, and I hope he will overlook my ignorance in this matter, and favour me with a more explicit description.—LEANDER.

[11108.]—**Tilt Hammer (U. Q.).**—The diagram sent, I think, will explain itself, but as I have set them out after my own fashion, and am no engineer or mechanical draughtsman, any little imperfection must be excused. My idea would be first to make a good bed of concrete, see C; on the top of the concrete I should build brickwork in separate layers or cells, crossing and re-crossing in party divisions, each division to be well rammed down with sand, or filled in with concrete; on this I should bed my stone blocks (see A), the screw sockets I should run in with molten lead. Between the oblique pedestal or plummer blocks I have introduced 8in. timber; the whole, with the plummer blocks, is firmly screwed down to A (see H). The hammer F is worked by an eccentric motion with flanges on each side (other motion might be substituted) by a boss with 8 cams (see K). The anvil is marked E; the bed plate, D; L, is sand well bedded around block for anvil; M, lubricator to bearings.—JOSH. WM. FENNELL.



[11120.]—**A Question of Sight.**—"Touchstone" is right. Sound travels through air at velocity of 1180ft. per second, a speed but the one hundred and seventieth part of that of light. Sound travels through cast iron at 11,090ft. per sec., and through glass at 18,000ft. per sec. "E. L. G." says we know nothing about the comparative nearness of atoms; and says the velocity is the same irrespective of their distance. Such assertions are easy, and may save him trouble of opening his eyes; but let him suppose a single needle to extend from his eye to the source of light, would not, I ask, the impulse at one end be instantly carried to the other, and the transmission of force be thus instantaneous? But cut half the needle off and divide the other half into ten parts spread over equal distances in the former line, thus—

1 2 3 4 5 6 7 8 9 10

The impulse imparted to No. 1 has to travel over nine gaps, which, if occupying but a second each, will occupy nine seconds before they reach No. 10. So is the transmission of light and sound quicker or slower, or, rather, of longer or shorter period, according to the total amount of space or vacuum that exists between the total of the atoms in the whole line. What other reason can possibly be given? Though through the pores of glass the luminiferous ether vibrates with as much ease as the late Daniel O'Connell could drive a coach through any Act of Parliament, yet so close are its atoms or molecules that sound travels through it sixteen or seventeen times more quickly than it does through atmospheric air; through steel sound travels 17,000ft. per second, its atoms or molecules being slightly further apart. And this point of distance of atoms or particles apart being measurable by the degrees of transit speed of the sound or the sight they convey is what I wish to impress on "E. L. G." and all students of science, for I have not found it noticed by any one but myself; and it is ridiculous of "E. L. G." to reply to me that the velocity is just the same if the atoms be twice as near or twice as distant; discoverers despise no rational theory. Why are we in total darkness the moment flame is extinguished if light ceases not instantly that combustion stops? Of course I speak not of the light from stars, which to reach us occupies a thousand years; but if a flame exists just a minute the light from it exists just a minute likewise, neither more nor less. "E. L. G." says our shadow is longest on July 1st and shortest on January 1st. Can he prove this? The nearer we are to the light the more rays we intercept, and shadow is nothing more than the absence of intercepted rays; and whatever hinders us from seeing the flame or any part of it is the intervening object that intercepts the rays, and in whose shadow we are; and I take it a shadow in space has no precise boundary, but pales gradually till, to our feeble sight, it becomes imperceptible, but rays once cut off I take it cannot reappear; and if a shadow has no focus or diminution of size it darkens an extent of space in length immeasurable, if not illimitable. I may ask "E. L. G." how he proves the earth's shadow to extend to but four times the moon's distance. Its size will not diminish with the square of the distance whatever its intensity may.—J. BARWICK.

[11120.]—**A Question of Sight.**—"Fiddler" may be quite sure that what he calls "illuminated space" and "infinite" is only the denser bottom layer of air; that the main sky-light all comes from within four miles of the ground, or rather of the sea level. Humboldt and all climbers who have approached 4 miles, or even the 3½ that comprise the lower half of the aërial mass, have spoken of the indigo or black darkness of the zenith sky (which, of course, balloonera can get no sight of), and if "Fiddler" could be corked up in a big soda-water bottle of oxygen, and raised 30 miles, he would doubtless find it at all hours equally black and equally starry as on a moonless midnight. If sky-light came from aught beyond the shallow, watch-glass-like lens of air above us, why should the zenith at any time be any less bright than the horizontal layer? Would not a photograph of sky be all of even tint, and the day sky give, like the nocturnal, the idea of a hemisphere or cupola, rather than the wide, slightly-raised watch-glass ceiling that it does?—E. L. G.

[11122.]—**Strength of Boiler.**—"Data" not sufficient to answer this query. What is the thickness of plates—¼in. or ⅜in.? Surely the strength depends a little on the thickness and condition of the material of which the boiler is made.—E. M.

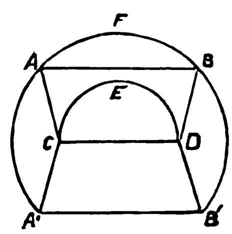
[11123.]—**Lantern Pinions.**—See "J. K. P.'s" letter.

[11129.]—**Greek "Upsilon."**—"A Harrow Fellow" (p. 75) is clearly wrong, when he states that the English *u* is the Greek upsilon; and "E. L. G." appears also to be in error, when he writes *y* for upsilon. The Romans not having the Greek *u*, which is u French, or *ü* German, adopted the letter *y* to represent its sound when they Latinised Greek works; but our *y* has quite a different sound, and it would be just as absurd to write "Müller" as Miller or Myller, as tupto typto, or drus drys; the *y* in these cases being no nearer the *u* than *i*. "E. L. G." seems to be confusing Latinised Greek words with transliteration. If we really wish to represent the Greek sound, we must do what the Romans did, use a new character, and we might, therefore, write *tüpto* without offence.—M. PARIS.

[11137.]—**Repairing Concertina.**—There is no difficulty in tuning the reeds of concertina notes; file the free end to sharpen, and near the rivet to flatten. Different metal may be made to give a note of the proper pitch, but the timbre of the tone will not be the same exactly as the notes of another metal. A different quality of the same metal can be rectified by filing.—E. M.

[11146.]—**Lamp for Forcing Pan.**—I never tried anything of this kind, but as no one has answered the query, I may say that the best lamp of all is a Bunsen burner; but that means gas also. If "Seedsman" has not the gas laid on, a paraffin lamp with a squat chimney will probably answer. Colza oil would be better, but rather expensive. I find no difficulty in germinating tender seeds by placing the pots near the kitchen fire, sometimes on the oven itself.—SAUL RYMEA.

[11166.]—**Area of Segment of Circular Ring.**—I cannot help acknowledging that the word "segment" was loosely or even incorrectly used by "Thankful," and that I did not notice the mistake. I do agree, however, with "E. L. G.," Vol. XV., p. 76, that any one reading the question could misunderstand the meaning, or that the sketch, Vol. XIV., p. 650, fails to indicate what was desired. Following "E. L. G.," p. 675, let us make the inner arc C D a semi-circle of 25 radius, and see what A B or A' B' comes out like; see Fig. Now, by "E. L. G." A C BD being supposed a segment AC, CD, and BD, must be in one straight line, as they are all parts of the chord, or in this case of the diameter, which they do not appear to be, to any serious extent. In fact, work it how you will, I do not see any other conclusion to arrive at than that "Thankful" meant, and fairly represented a portion of an annulus bounded by lines AC, BD, pointing to the centre, or that although he said "segment," anything but "sector" could be understood.—J. K. P.



[11168.]—**Area of Segment of Circular Ring.**—I gave my solution (p. 675) believing, from the figure given by "Thankful," that A E B was a tangent, and I afterwards saw in that case the conditions were incompatible; I employed the term apothegm for radius of the circle inscribed to a regular polygon. The apothegm of the hexagon cannot be expressed exactly.—BERNARDIN.

[11202.]—**Transfer of Prints to Wood.**—The only varnish I have used in transferring has been the white or brown hard spirit varnish of commerce. The pictures were printed on transfer paper, and what I did was for the purpose of furniture ornamentation before French polish was introduced, which I notice is now becoming very common in the trade, with the difference that it is now done with polish instead of varnish. Great care must be taken to have well seasoned wood. Give two coats of the varnish and let the second coat be nearly set before placing the picture in position; slightly damp the picture with methylated spirit, do not rub it down too hard, or you will rub some of the varnish into the fibre of the paper, which will make it difficult to remove the back. When it has all set hard, after which, and the picture having been well developed by careful rubbing off the back with damp cloth, give two or three coats of the varnish, each coat being allowed to well dry before the other is applied. As a last process we would sometimes rub the surface of varnish down with the palm of the hand, or, for a large surface, with a smooth cabinet-maker's cork with chamois leather over it, rough side out, and finish off with sweet oil and flour, which, when done, was equal to French polish. Why should not the most beautiful ornaments be transferred to wood in the same manner or by a similar process as the willow pattern is given to our common plates, and even others of a better quality and appearance by the picture being printed on prepared skins, and afterwards immediately transferred?—SQUARE.

[11206.]—**Defective Plating Solution.**—It is only for needles and similar goods I wish to silver. Watts says it can be done (see p. 118, fourth edition) by simply dipping a sponge in the solution, and rubbing it over the steel. As "J. A." has kindly offered help, I beg to say that it is only small steel goods I cannot silver or gild and copper. I make all the solutions by battery process. I have tried both Gore and Watts.—COBBLER.

[11276.]—**Extracting Glass Stopper.**—A very refractory case of the above complaint was once brought to me. The stopper of a handsome decanter was broken short off at the plug, and resisted all attempts at its extrication, though oil was used, the neck warmed and rapped to jar it, a handle having been cemented on the broken part. All being in vain, I drilled a hole $\frac{1}{8}$in. diameter through the bottom of the decanter in the centre on an ornamental engraved star. A straight steel wire was introduced through the hole, and a few taps on it with a hammer soon drove out the stopper. The hole was plugged up with a small piece of vulcanised indiarubber, and by cementing together the broken parts of the stopper the decanter was made perfectly usable, and has been in constant use for twelve years since the operation.—Q. Q. R.

[11313.]—**Setting Lathe.** — I beg to thank "J. K. P." for the notice he took, on p. 48, of my query, but I am afraid I did not render myself sufficiently explicit; if not, I will now endeavour to do so. The lathe which I work is somewhat similar, both in shape and size, to the one advertised in "our" journal by Blackett, and the mandril head is cast with a narrow piece in the centre, for a set screw, made just the length of the width of gap in the centre of lathe bed, so that if you turn the screw it will shift the head either way; there is one at either end of the head. Now, you will perceive the inconvenience I am put to; after turning anything conical, I am obliged to take a cut down the next article I have to turn for the purpose of knowing whether I have got the lathe parallel or not. Would "J. K. P." give a design of his little contrivance for turning taper screws as offered? for I quite agree with him with regard to the work being drunk, but I do not see how it would act on a large lathe for such work as engine connecting rods.—F. Hume.

[11314.]—**Polishing Oak Floors.**—The French, who indulge in polished floors, whether of oak or red tiles, more than we do, have an easy method of effecting their object. They use beeswax, and brushes attached to the soles of their feet, by a simple strap over the back of the brush, through which the foot is passed. This not only gives facility of motion, but the weight of the operator adds to the effect. In fact he skates about the room. Some use but one foot, women especially, but this is but a limping sort of affair. When a man servant is engaged in a good establishment he is always asked if he is a good *frotteur* (rubber). In more modest houses a man is hired, the same as we do for beating carpets. I shall never forget the surprise I experienced, as a youngster, shortly after my first arrival in France, on beholding a man in an empty room on the opposite side of the street, tearing about with the wildest gesticulations imaginable. I, of course, drew the attention of those in the house in which I was residing, to the strange sight, when I learned that my supposed madman was merely polishing the floor. Persons may dance for a whole night on a floor which has been so prepared, with much more comfort and less fatigue than on one that has been chalked, or is covered with a carpet, but beware, ye novices, for you have to buy your experience at the cost of some mortification, whether you be young lady or young gentlemen, as you will, on setting out, in all probability perform that sudden transition from the perpendicular to the horizontal which is not considered a meet or acceptable sacrifice to Aglaia, Thalia, and Euphrosyne.—F.R.C.S.

[11359.]—**Casting Brass Solid.**—The metal should not be run any hotter than is necessary to insure sharp castings, which practice will show. The probable cause of the honeycombing of the castings is that the air cannot get out of the way, and should have proper vents made for it from the highest part of the mould. The metal should run in near or at the bottom of the mould. By attention to these points good castings may be obtained, but a little practical teaching is very necessary in such a case, and would save much after trouble and disappointment.—Q. Q. R.

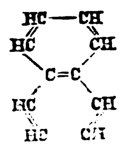
[11366.]—**To Mr Tonkes.**—It is not my opinion, nor is it my belief, that $\frac{1}{0} = \infty$. For if $\frac{1}{0} = \infty$, then is $\frac{1}{\infty} = 0$, and hence we have $0 \times \infty = \infty \times 0 = 1$—a most truly absurd conclusion to arrive at. You may probably desire to know what $\frac{1}{0}$ is equal to. Permit me to assert and to prove that $\frac{1}{0} = \frac{1}{0}$. For as $1 : 0 :: 1 : 0$, and $1 : 1 :: 0 : 0$, $\therefore \frac{1}{0} = \frac{1}{0}$ the which was to be shown. Neither Liebnitz's nor De Morgan's "Differential Calculus" do I desire to look at in relation to the arithmetical subject under consideration. In addition to E. A. Poe's poetical effusions, "Fear not the Raven," &c., I have some slight recollection of a few words in one of P. B. Shelley's published works, even after forty years' neglect of such "metaphysical" stuffing, as per example: "Thou canst not find one —— on earth whereon," &c. To your adherents I have only to remark that I decline to be drawn by W. L. Giles into the differential maze; and as to "Excelsior's" equational pun, I fear that he has not yet so carefully studied as he may now be led to do the mathematician's trinity, formed of 1, 0, and ∞.—S. J.

[11371.]—**Steel for Tools.**—I really must point out an erratum or two in my answer on p. 102. I am not so shaky in my grammar as to say that Stubs's steel or Vickers's "*are* first-class," however funny it may sound to say "Stubs's *is*." Also, "Buck keeps Sanderson's *small* (not *all*) sizes."—J. K. P.

[11378.]—**Killing Beetles.**—When "Sempervivo" has constructed a "suffocating" box, with its tin-foil, cotton-wool, and chloroform, which complication will doubtless effect its purpose, he will find that the easiest way to kill beetles, especially the larger kinds, is to immerse them, legs downwards, for an instant in boiling (212° F.) water. This simple method is founded on the knowledge that the nervous system is located on the underside of beetles, and it has at the same time the advantage of being the least painful mode of death, the heat of the water destroying sensation and life at the same instant. See that the water is boiling: a little practice will soon show the fraction of a second necessary to immerse to kill. I believe it varies a little with different kinds of beetles—a simple dip being sufficient for most.—Saul Rymea.

[11382.]—**Parrot.**—I should advise "Cygnus" to discontinue milk for a time, as this is heating to the blood, and makes the parrot pull its feathers off.—Menelaus.

[11386.]—**Crystals in Gas Tar.**—These were, in all probability, crystals of naphthaline. This body is contained in large quantity in some samples of tar, and crystallises out when the tar loses its more volatile constituents, which dissolve the naphthaline. Napthaline is a hydrocarbon of the composition of $C_{10}H_8$, probably linked together in the following mode:—



It is now used in the manufacture of artificial alizarine.—S. Bottone.

[11393.]—**Scent from Violets and Roses.**—The scent of these and other flowers is obtained by placing thin layers of butter in closed boxes or drawers, together with shallow trays full of the fresh leaves of the flowers, which are renewed when their scent is gone. The butter absorbs the scent, which is then extracted by treating the butter with spirit, or in some similar manner.—Q. Q. R.

[11398.]—**Stinging of Bees, Hornets, and Wasps.**—The sting of a bee is generally more virulent than that of a wasp, and with some people attended with very violent effects. The bee sting is barbed at the end, and, consequently, always left in the wound. That of a wasp and hornet is pointed, so that they sting more than once, which a bee cannot do. When a person is stung by a bee let the sting be immediately pulled out. The longer it remains the deeper it will pierce, and emit more poison. The pulling out of the sting should be done carefully, with a steady hand, for if any part of it breaks in, all remedies will be, in a great measure, ineffectual. When the sting is extracted, suck the wounded part, if possible, and very little inflammation, if any, will ensue. If drops of hartshorn are immediately rubbed in, the cure will be complete. Sweet oil, bruised parsley, &c., appear, on various trials, to be of no use or benefit.—H. B. E.

[11409.]—**Canine.**—If the pup has lost all its hair, and its body is covered with dark patches and large pustules, commence by freely puncturing the dark patches to allow the venous blood to escape. This produces no pain, and the punctures soon heal; also, open the pustules. This done, tenderly wash the bare skin with warm water and a soft sponge; then smear the body with an ointment composed of equal parts of camphor powdered, mercurial ointment, and elder ointment. Repeat this daily. This kind of mange requires some months' good nursing. Don't allow the pup to lie on barley straw, or to subsist entirely on flesh food.—Monte Cristo.

[11434.]—**Salmon Spawn as Bait.**—First, let me state that it is now illegal in this country to have it in your possession. But if "Kingfisher" wishes to use it in some country where it is legal, he may. The broken roe is the best, and must first be well washed in several waters (cold) until all greasiness disappears, then spread upon a cloth, or placed in a bag, and hung up for a day or two to drain all water away; then rubbed with salt until it feels tough in the teeth, when it may be put into jars for use, and will keep for years in a cool place.—Goat.

[11435.]—**Bootmaking.**—When leather is soaked in water, and "beat" well, it is more durable than if worked dry. To work leather dry, means wet feet to the wearer.—Cobbler.

[11438.]—**Lemon Marmalade.**—Pumpkin marmalade is thus made:—Take vegetable marrow or pumpkin, young or old, rather old preferred. Boil till quite tender, and peel or scoop the pulp from the rind with a spoon; put the pulp into a cloth and wring it to remove the excess of water; put the pulp into a preserving pan; to each pound of pulp add 4oz. preserved lemon peel, cut thin, or fresh lemon peel boiled till quite tender and cut in shreds; to each pound of pulp add $\frac{3}{4}$lb. sugar, boil and stir until a sufficiently firm consistence is obtained; stir the whole time if you wish to be quick over it and have the preserve keep well; this rule holds good in all soft fruit preserving. If the flavour of orange is preferred, preserved orange peel or well boiled Seville orange peel with the unboiled juice may be added; a drachm or $\frac{1}{2}$oz. citric acid to the pound will improve both.—Dixi.

[11438.]—**Lemon Marmalade.**—To each pound of lemons allow 18oz. of fine loaf sugar. Pare the thin yellow rind off all the lemons except four, which are to be grated. Cut the parings into as thin chips as possible, and put them into a muslin bag. Cut the lemons in four, take off the white skins and remove the seeds. Put the pulp in the pan, and break it thoroughly with the hand or a potato beater. To each pound of lemons add half a pint of cold water, put in the bag of chips, and let all boil for half an hour. Pour a little boiling water over the gratings, and let it stand until the other is boiled; then pour the pulp through a hair-sieve into a basin. Wash the pan and the sieve, and pour the juice back again through the sieve into the pan; remove the chips from the bag, and put them into the pan also, add the sugar and let all boil together; the gratings are also now added. Boil for half an hour or until it jellies, which may be known by putting a spoonful into a saucer, and setting it in a cool place. Pot it, then eat it.—Champagne Charlie.

[11442.]—**Old Wives' Science.**—Mr. Tomlinsen's experiments referred to are very inconclusive. The weights of candle consumed in equal times, in sunshine and in "a dark cupboard" were compared, the cupboard having, of course, a flat horizontal ceiling, that is, an air-mixer adapted to send down all the carbonic acid, and as rapidly deoxygenate the store of air, and keep it as unchanged as possible with the given inlets! In fact, an English builder's indoor atmosphere was compared with an out-of-doors one! I have always held, with the "Old Wives," that the sun puts out flame, because I used to try, as a boy, to make paper, wood, or linen blaze with a burning-glass, always in vain; and though the lens or mirror be capable of melting iron, never have I found this possible. The wood or rag may burn with incandescence quite visible in the sun, and if there be a current of air, burst into flame the instant the focus is off it. But never can I make it do so in the concentrated rays. I mean to attempt it again, however, with yellow glass, filtering back the chemical blue rays.—E. L. G.

[11444.]—**Bursting of Compressed Air Receivers.**—The effect depends very much on the material; cast iron is usually broken in fragments. Boiler-plate, I think, would be affected pretty much the same as by an explosion caused by steam. Copper is not so brittle, and is more likely to open. In the case of a steam-boiler exploding (say) at 60lb. to the inch, the temperature corresponding to this pressure being about 300°, when the pressure is removed by the bursting of the boiler, the water in the boiler, which was at 300°, cools down almost immediately to 212°, the boiling point at atmospheric pressure, and thus about one-thirteenth of it is suddenly flashed into steam, the sum of the latent and sensible heats of steam being about 1,200°. Of course, scalding with steam or hot water in the case of an air reservoir is avoided.—Philanthropist.

[11448.]—**Chronometer Balance Spring.**—"O. M." has got an inferior article, as the low price might have told him, for £6 5s. is a low price for such an article. He is rightly informed that a good watch with chronometer balance cannot be had unless he gives a good price for it. I, myself, a short time back inquired the price of a first-rate silver watch of this class, having its balance scientifically adjusted (without which they are almost worthless), and was informed that the cost would be £15 or £16. I have no doubt, however, that "O. M." may procure a good timekeeper of this class for (say) £12.—Excelsior.

[11450.]—**Adjusting Equatorial.**—Declination being reckoned from the equator does not require any correction for difference of latitude. It is only the altitude which increases or decreases by going north or south.—O. M. 94021.

[11451.]—**Weight for Safety-Valve.**—The lever seems to me to be very weak, only 12$\frac{1}{2}$oz. weight. The weight to be placed at the extremity for the steam to blow off, at 40lb. pressure, will be 8lb. 6oz., and the ball shifted 2in. in each case towards the fulcrum for the other pressures.—Bob J.

[11456.] — **Saw Sharpening and Gulleting Machine.**—I believe the saw sharpening machine is a patent; but if "F. T. S. S. D." requires one for his use, he could manufacture a rough one that would answer his purpose. The working gear, he will, no doubt, understand, that is, if he is a working sawyer or engineer. The wheels are made of wood, and covered with emery and glue. One or two things have to be considered in these machines. First, is the sharpening required sufficient to eventually repay the outlay; second, the saws require touching up after leaving the machine; thirdly, the use of the machine on the saws hardens them, so that an old file will not touch them. On the other hand, if a number of saws are in use, it will repay the cost very soon, also the regular depth of the gullet enables the saw to perform its work in a superior manner. What I have here stated is from hearsay, not having given the machine a trial. I know of a mill proprietor, in my immediate neighbourhood, who purchased one, but did not find it answer either for circular saws or frame saws, nevertheless, if I could procure a machine to sharpen band saws, if found to answer, I would readily purchase the same.—Samuel Smither.

[11457.]—**Motive Power for Amateurs.**—I have seen lately a machine which, I think, con[illegible] serviceable for that purpose. It consists of [illegible] connected springs, inclosed in dent barrels with each other, the last of those acting by [illegible] dent wheels and pinions on a pulley with [illegible] strap. The springs are wound up very [illegible] handle, and their elasticity is moderated by a fly. The motor I saw is applied to a sewing machine, and, indeed, many readers of the English Mechanic may have seen it also, since there were two of the said machines at the International Exhibition, 1871 (French section). But, that motive power can, of course, be applied to a great many machines which are now worked by the hand or the foot, I am aware—for instance, those connected springs have been of late adapted to the "Hughes' Printing Telegraph," as a substitute for the heavy weights which the telegraph clerk had to lift up with his foot at every moment.—Novi, Amiens.

[11457.]—**Motive Power for Amateurs.**—Is "Zoo Andra" poking fun at "our" readers? The lever—*i. e.*, his weighted pendulum—will, no doubt, give a certain amount of power to his saw; but this I know from practice (not theory), that I will produce more power from a fly-wheel than he can with the pendulum; that is to say, for the same person to exert his strength in turning a fly-wheel as will swing the pendulum; as for ratchet-wheels it would be a great mistake. The best motive power for amateurs is the treadle, unless they can incur the cost of a fly-wheel, horse-mill, or steam-engine. If "Zoo Andra" is actually fitting up a bench in the style sent, when complete, will he use it for a week together, and let the readers of the Mechanic then know as to its practibility?—Samuel Smither.

[11459.]—**Printer's Ink.**—Red Brasil wood four ounces, diluted acetic acid one pint, alum half an ounce; boil for one hour, strain, and add an ounce of gum.—H. B. E.

[11459.]—**Printer's Ink.**—Linseed oil boiled to a thick varnish, and a sufficient quantity of vermilion or Prussian blue ground with it to give the required depth of colour.—William H. Hey.

[11459.]—**Printer's Ink.**—"W. J. H." can buy what he wants cheaper than he can make it. The finest dark blues are Prussian, Chinese, and Antwerp; they are very hard to grind, and when used too thin have a greenish hue. Vermilion (pure) is, of course, the best "red," but a little bright drop lake improves it, where richness of tone is wanted. These require to be ground on a clean slab with a clean muller and clean varnish—the very best. I hope "W. J. H." is a modern Hercules, for he will find it a tough job; but they may be ground in turpentine first, and mixed with the varnish afterwards. This saves a little labour. If only a small quantity is required, and very fine, use Canada balsam as the varnish. I have seen excellent work produced by taking an impression with gold size and dusting on the colour required in a very fine powder—specially prepared, I think. This latter method is by far the quickest for a small quantity, and the pigments retain their colour well.—Saul Rymea.

[11462.]—**Steel Hardening Paste.**—The red paste must have been "J. Fielden's Rouge Steel Paste," which is used to improve cutting tools and to restore burnt cast steel, or for case hardening small iron castings. We have given five shillings per pound for it. We dip all our cutting tools, and find that a few pounds will serve a long time if the dust cover is kept upon case supplied with "rouge paste." If "A. B. C." will advertise his address in these columns I shall be pleased to let him know where the "rouge steel paste" may be purchased.—Halifax.

[11464.]—**Spring Beds.**—It would be a trade advertisement if I sent the address of a maker, but if "Associate" will look at the London Directory, or apply at some large bedding manufacturer he will procure what he wants, I have no doubt.—Samuel Smither.

[11469.]—**Air and Warmth.**—From 700 to 1000 cubic feet per head; from 55° to 60° Fahrenheit.—Excelsior.

[11471.]—**Bow.**—Yew is the wood used to make the best bows. Should "Archer" not be able to procure it apply at a respectable coach builder's for a piece of lance wood, let it be quite sound and dry; one inch by three quarters of an inch will be about the size; taper at each end to five eighths of an inch by one half inch, rounded on the outside. A sharp steel scraper is very useful to an amateur for the manufacture of the same.—Samuel Smither.

[11471.]—**Bow.**—Bows of Yew-wood won Cressy and Agincourt; why should they not win at archery matches now?—Hedera.

[11472.]—**Plaster of Paris.**—"C. B. B." has evidently been using the common plaster used by builders. He should get either fine or superfine plaster and keep it in a dry place, it will soften when left in water for a long time, but does not fall to pieces. Porous pots are sometimes made of it, but only as a temporary appliance.—Dentiste.

[11478.]—**Silver Bath.**—"F. C. C." should get a good manual of photography. In reply to his question no definite number of plates can be given, it is quite possible to continue preparing plates with the 8oz. silver bath until there is not sufficient left to cover the plates in the bath. This, however, is not very likely to be the case, as "F. C. C." will doubtless find he cannot get good photographs after having used his nitrate of silver bath till about a third of it has been wasted. By this time he will find it has got somewhat out of order. The best way to set it right again will be as follows:—1. Pour the solution into a clean dish and set it in the oven, or on the stove, till it has nearly all evaporated, having first made it slightly alkaline by adding a drop or two of strong liquor ammonia. 2. Add sufficient distilled water to make up to 8oz. once more. 3. Set it in the sun for a few hours, or even a few days. 4. Filter, and then add sufficient pure nitrate of silver to make the strength up to 35 grains to the ounce. 5. Try a plate; if it does not work well add a drop or two of dilute nitric acid.—G. Avery.

[11482.]—**Algebra**:—

$$x : y :: z : t$$
$$x + t = 14$$
$$y + z = 11$$
$$x^4 + y^4 + z^4 + t^4 = 24929$$

Let $x = a$; $y = a + d$; $z = n(a)$; $t = n(a + d)$. We have—$a : a + d :: n(a) : n(a + d)$. By addition—$a + n(a + d) + (a + d) + n(a) = 25 = (n + 1)\cdot(2a + d)$. By subtraction—$a + n(a + d) - (a + d) - n(a) = 3 = (n - 1)d$. As $5 \times 5 = 25$ ∴ $n + 1 = 2a + d = 5$, and $n = 5 - 1 = 4$, $d = \frac{3}{n-1} = \frac{3}{3} = 1$, and $2a + d = 4 + 1$. That is, $2a = 4$, and $a = 2$.

$$\therefore \text{the analogy is } 2 : 3 :: 8 : 12$$
$$2 + 12 = 14$$
$$3 + 8 = 11$$
$$16 + 81 + 4096 + 20736 = 24929$$

—Thetamu (Horsham).

[W. R. Kemp, William Hughes, and "A New Subscriber," have also answered this question.—Ed.]

[11483.]—**Dyeing Parchment.**—Dye it blue by brushing over with a solution of pearlash, two ounces to the pint. For dyeing red, boil a pound of Brazil wood and an ounce of pearlash in a gallon of water, and while hot brush over the parchment until of a good red colour.—H. B. E.

[11484.]—**Manures and their Values.**—If Mr. Richardson is within carting distance of sea-weed, he will find it a rich and stimulating manure when dried, burnt, and the ashes, mixed with sand, wood or coal ashes, hand-spread over his land.—Manus.

[11486.]—**Arithmetical Question.**—This is most easily accomplished. For the

length, 4 lengths of each	$4 \times 5 + 4 \times 7$	$= 48$
breadth, 6 of the 5 less 1 of the 7	$6 \times 5 \quad - 7$	$= 23$
heighth, 3 of the 7 less 2 of the 5	$3 \times 7 - 2 \times 5$	$= 11$

—William Hughes.

[T. P. Lucas, "H. H. C.," "Excelsior," and "Philanthropist," have also answered this query.—Ed.]

[11486.]—**Arithmetical.**—Surely any man in such a position would first measure off 2ft. on the 7ft. rod, by the assistance of the 5ft. rod (7 − 5 = 2), and then divide the 2ft. into two parts; or, having got the 2ft. length, he would mark off from each end of the 5ft. rod, 2ft.; the interval between these marks would, of course, be 1ft. What more would he want?—Hedera.

[11487.]—**Preventing Rust.**—One part white-lead to two of tallow will answer the purpose, and rub off easily with a little turps.—Manus.

[11487.]—**Preventing Rust.**—Bright work is generally covered with a compound of tallow and white-lead.—Excelsior.

[11489.] — **Weight of Cattle.**—(Shepherd's "Problem").—As it is not likely that all his heifers would live to breed for twenty years, what would he allow for deaths?—T. P. Lucas.

[11493.]—**Indiarubber Overcoat.**—"W. P." can repair his overcoat with indiarubber solution; clean the seams with a little coal naphtha; then with the finger put a thin coat of solution; let stand for two hours; make warm a smoothing iron, with which iron down the seams; cut up 1oz. bottle rubber; put into 4oz. coal naphtha. A wide mouthed bottle is best to make the solution in. When dissolved, use it.—Cobbler.

[11499.]—**Zymotic Diseases.**—It seems to me that M. Paris has answered his own question by the very designation he has given to the diseases. Zumé (Greek) fermentum, leaven. If I take a mass of dough, to which I add a portion of leaven, I shall cause the whole mass to ferment. I may now remove successive portions, and add others of unfermented dough in their stead, and the process will still go on, though the aggregate of portions removed may embrace the whole of the original mass. So much for diseases that are zymotic; if there be any such. I give no opinion.—F. R. C. S.

[11503.]—**Stair Noses.**—Nail a little oil canvass on the edges, or if you have canvass on the stairs make it double at the edges; this is if you have carpet down; if not, nail lead on, but don't on any account put lead under the carpet.—H. B. E.

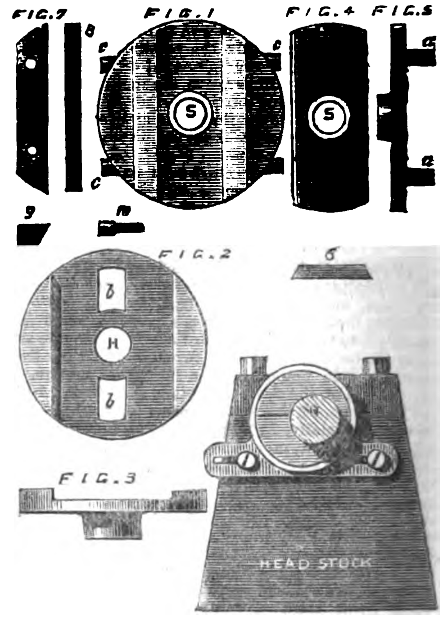
[11504.]—**Photographic.**—I would suggest to "Cornubiensis" the use of cocoa fibre matting for the covering of the floor of his studio. He will find it durable, of nice appearance, noiseless, and should he work with a tripod stand, there is no fear of the legs moving on the floor.—W. Phelps.

[11505.]—**A Wooden Pump.**—"Cornubiensis'" friend may set his pump in good order by either of the following methods:—First (if not already done) shorten the spear or rod that is connected to the top bucket, so as to allow the bucket to work higher up. Or he may get a large gauge with a long handle and open the mouth of the pump sufficient to allow a new bucket to be substituted. The chips will come out with the bucket.—H. D.

[11511.]—**Rubber Tires.**—I cannot conceive any "suction," but, perhaps, there may be a little more adhesion with the rubber than with the iron tire, but the result is that with the rubber tires scarcely half the fatigue is experienced as with the iron—indeed, there is no comparison.—T. P. Lucas.

[11511.]—**Rubber Tires.**—If the roads are very smooth there is little advantage to be gained with rubber tires. The case is different, however, on most of common roads, where the iron tire is always grinding away among the dust and small stones; the difference being equal to the amount of power wasted in grinding said stones. Soft roads and rubber tires bear no resemblance to one another, inasmuch as soft roads are not elastic; and as regards suction, it is only in wet fields and mossy ground that it impedes locomotion, places where few velocipedists will think of straying.—G. Smith.

[11512.]—**Lathe Chuck.**—As a further description of my oval chuck seems wanted by some of "our" readers I give details:—Fig. 1 shows the face of the chuck, S being a hole tapped to screw in any kind of poppet required; Fig. 2 shows the chuck plate before slide, and justing bars are added; H hole tapped to screw upon the spindle of lathe, *b b* slot holes, through which two pins or gabs work, marked *a a*; Fig. 5, Fig. 3, cross section of chuck without slide-bars; Fig. 4



shows slide-bar face side; Figs. 5 and 6 sections of slide-bar; Figs. 7 and 8 are justing bars fixed from back with two screws, each same as Fig. 10; C C C C are justing screws to make slide-bar to work right. The headstock shows how the ring is fixed to it, with two screws, outside of which the two pins marked *a a* revolve. The other end of the shaft works upon the dead centre, and of course round, which is an advantage when making sprig bit handles to get the ferrule on. The drawing is made to scale quarter size of mine.—Goat.

[11514.]—**Brunswick Black.**—Recipes for this, under the names of Berlin black, japan, &c., have been frequently given. See No. 367, reply 11357.—S. Bottone.

[11517.]—**Lathe Queries.**—"H. E." will find a description of index pegs for counting in Vol. XII, p. 180.—J. K. P.

[11524.]—**Pitch of Roof.**—The only "measure" of the pitch is the number of degrees of a roof's inclination. Certain pitches in fashion at different times have doubtless had names, and I believe, among English workmen, "old" or "common pitch" has, for ages, meant that of Westminster Hall, the great typical old English roof, whose internal span is 4 standard perches, and corresponding rafter-slope 3 perches. This gives the inclination about 48° 13', and the lowest of "high" or "gable" pitches, that is, of those above 45° or the "square pitch;" for so unsightly has this latter seemed to all races that nowhere have roofs of this pitch, or within several degrees thereof, above or below, been either common or tolerated in buildings of any pretension to dignity. Though there may be even cathedrals (as Langres) with a square-pitched roof, yet, as Ruskin says, men have everywhere made a great gulf between the two kinds of roofs—the "low-pitched" (*i.e.*, below 37°), and the "high" (*i.e.*, above 53°). The above Westminster pitch, beside being too near the "square," is inconvenient from having the height incommensurable with the base and slope. Carpenters would always have saved themselves much trouble (or the architects for them) by keeping, like the ancients, to angles whose functions are all commensurable (as slope 13 to bases 12 and 5, or slope 25 to bases 24 and 7). The simplest of all, known as "Plato's triangle" (of 3, 4, and 5), turned one way, makes what is rightly the lowest high pitch (or lowest tolerable on Gothic buildings), approximately 58° 7' 48" 38''', or, as I would write sexagintals compactly, $5_8{}^\circ 0_7 4_8 3_8$; and the other way, the highest low pitch (or highest tolerated on non-Gothic buildings), $3_6{}^\circ 5_2 1_1 2_2$. This latter (which is hardly low enough to be called a "pediment" pitch) seems to have been universal from the decline of Rome till the grand twelfth-century movement that originated "Gothic" architecture, and which Viollet le Duc attributes to the anti-clerical spirit of the "Communes" and other lay guilds then arising. It certainly was a Radical or anti-traditional, and therefore anti-churchmenly movement; and the new cathedrals were a protest against the abbeys. This movement was weakest in England, and our Gothic building the most timid; and it seems never noted that the high roofs distinctive thereof were from the beginning higher in all Continental countries than here. I do not know of a single Old English roof so steep as 60°; while all over Germany and France, even south of the Loire, it is doubtful if they were not oftener above that pitch than below it. Another point overlooked is that the builders of the great times, instead of regulating their roofs by particular pitches (or proportions of height to width), aimed at some simple ratio of their vertical height to that of the walls they crowned—either making heights of wall and roof equal, or as 2 : 1, or as 3 : 1, in their grandest erections. As examples of their equality, we have the two noblest secular buildings remaining of old England and France—Westminster Hall, and the exquisite Palais de Justice of Rouen. Of course, plenty of humble churches also illustrated this, especially in England (they having probably noted, from the Book of Exodus, that the Mosaic Tabernacle did so); but I doubt if more than one cathedral is thus roofy (to coin a much-needed adjective)—that of Vienna. Then, of the next degree of roofiness—the roofs half the height of whatever bears them—you have the noblest of all civic buildings, the Stadthouse of Brussels; and of cathedrals, that of Rheims, and, perhaps, other first-rate (but many second-rate) on the Continent; though in England, I think, only Lincoln. The general proportion for grand churches, both French and English, was the roof a third of its supports. In the decline of building, the first architects, by some centuries, to return to low roofs were our English, who depressed them first on side aisles (as at Westminster, 1300; Winchester, 1400); and the first nave, again, made low-pitched (as in pre-Gothic times) was York, about the latter date. From low they came to make them invisible, to mimic, I suppose, the effect of the platforms of castles; and at length, for the three centuries preceding the present, no English building could be held respectable that did not appear roofless. In no other land did this idea gain absolute sway, even in the maddest swing of Classicism; and though St. Peter's, at Rome, set the example, Louis XIV., indeed, seems to have held that only sacred buildings ought to show any roof, as appears by the wondrous contrast between the Versailles Palace and its chapel.—E. L. G.

[11530.]—**Violin Construction.**—"Reed Maker" has touched upon the principal point to be considered in the construction of the violin—viz., the divergence of tone to be produced by making the breast and back dissimilar. The last article in "ours" did not state that Savart's fiddle had a maple back in opposition to the deal breast, and I am in doubt whether he has satisfied himself so as to have two deal resonants opposite to each other. The old box fiddles were all made with hard backs, mine (to inflict punishment on some and create joy in others) had a soft back. I found no difficulty in tuning my pieces of wood, for I made them all a different thickness. Now, if I am not understood, I beg to say that everything has a sound or tone of its own, and many of us have heard music hammered out of pieces of hard wood of different sizes and thickness, and was it not Lulli who, while a scullion, knocked airs out of the cook's stewpans? I have also heard that Handel broke Corelli's violin over his head because the latter did not understand the French style of playing. There is a great difference in producing tones by bowing (that's polite) or hammering. Percussion is easy in comparison with bowing, but I have reason to believe does not affect the senses so enjoyably. I think I am right when I state that two strings of the same calibre, on the same bridge, soundboard, and of the same tone, do not increase the power but produce a whirr, also heard in the organ accordion, when the two rows of vibrators are sounding together. These are all distinct, and so add to the power. I cannot say what the effect would be if two vibrators were placed close together in the same pan, probably no increase of power, but if I am wrong here, could not the flageolet be made more powerful by blowing through two reeds into the same tube? I do not think so. We have the tone increased in the piano by doubling and trebling the wire, but beyond four I think we should miss any further extension of power without more soundboards, or a more violent method of bringing out the tone, viz., moving the soundboard. Now, in the violin we hear tones produced by the weakest method of moving a soundboard—therefore, the various parts must be made of different sizes and thickness, so as to form a variety of centres or tones (or rather they become places for tones to sound on or in). I wish some of "our" contributors would kindly inform us about the harp, especially the construction of the soundboard, whether the strings would sound as well if they were strung at right angles with or to the soundboard, and what kind of tone would bowing produce? I fancy very poor. I fear the harp is not so fashionable as it used to be, more's the pity. If we make the breast of the violin larger we require a thicker string to move it, and the thicker the string the lower the tone must be; if we make the breast smaller we reduce the plane in which the tones can be produced, thus we have only one size for the violin proper, and so only one amount of power. This is true with all instruments, they have their limits, although, of course, all are open to improvements—for instance, the drum could be made a formidable if, instead of strained skin, a vibrating sheet or face of metal was substituted. It may be said, but this would not be a drum—true, and if we alter the violin ever so little we lose the violin tone. Then the question will always remain, how can a bowed instrument be made to sound louder than the violin, yet having the same notes? In a back number the "Harmonious Blacksmith" has presented to our notice a fiddle without a back, a great curiosity, and perhaps a shadow of good things to come. As it has no back it could easily be joined to a series of breasts, one under the other, but here is the difficulty, a gut string would not move more than one breast, no matter how the string was placed or fixed, with a bridge, or, weaker still, harp fashion. A steel wire would sound well, but only by pulling and not by bowing. I have noticed in the toy harps (all wires are used) that when played in a box suited to its size the tone is considerably increased, yet when the violin is substituted in its place no increase ensued. Then it comes to this, can one performer play on many violins at once and so command an increase of tone? Shall we ever get a practical method of playing a series of violins, &c., by means of a keyboard?—FIDDLER.

[11535.]—**Small Wheel Cutting Machine.**—"A Horological Mechanic" will find full description of dividing apparatus for lathe in Vol. XII., p. 277, and of the cutter-frame, for use with slide-rest, in Vol. X., No. 245, p. 281. To answer q. 10859 would require a treatise, and at least half what you want you will find dispersed through the last four volumes. You cannot get a "recipe" to make cutters, like a dose to cure a bellyache, and it requires as much knowledge, of a sort, to do it properly, as a medical man would require for his purpose. Moreover, "simple" working drawings can only be made by those who thoroughly understand the job, and know how to draw thoroughly well too. If you want cut wheels you can get them in Clerkenwell better cut than you can do them, and if you want cutters you can buy them, I believe, for less than 21s. each at Holtzapffel's.—J. K. P.

[11547.]—**Bass's Beer.**—Some years ago Mr. Cooper, of London, analysed some water taken from a well at the brewery of Messrs. Bass & Co., in which he found—

	Amount of ingredients in imperial gallon represented in grains.
Carbonate of lime	9·93
Sulphate of lime	54·40
Chloride of calcium	18·28
Sulphate of magnesia	0·83
	78·44

—YOIZA.

[11579.]—**Blue Billy.**—It was owing chiefly to the presence of arsenic that I expected hard iron to be produced. I imagine that it is prevented from escaping by being picked up in the upper parts of the furnace by the lime, and thus continually brought back. At all events it does not escape. The copper is in great part volatilised, and colours the flame of the furnace. By hard iron, I did not mean the technical term for "strong forge" iron, but a brittle nature. The iron produced was very small grained, whitish in colour (not white iron), and brittle. I tried reducing some by itself in a cupola furnace, and produced a pig, the fracture of which was more like bad steel than pig iron, so much so that I had it tried for forging, but it broke up at the first blow. I am informed that it is used a good deal by some furnace owners, and that they get a fair iron from it. But, in my case it was not worth while trying to do anything with it, as the carriage made the material as dear as others at command, and the make of iron being one of the best in England, it was not worth while to run any risk of damaging it.—SIGMA.

[11585.]—**Chemical.**—To prepare chlorine from chloride of sodium, in such a manner as to obtain at one operation sodium also, is a most expensive affair, as it necessitates the employment of a powerful battery. But it is easy to proceed in such a manner as to prepare hydrochloric acid from the sodium chloride (see second process, paragraph 54, of the Lessons), and from the hydrochloric acid chlorine may be easily obtained, as explained at paragraph 51. The residue obtained by acting on sodium chloride with sulphuric acid is a sodium sulphate. From this sodium sulphate sodium carbonate is prepared by heating it strongly with a mixture of chalk and slack, and dissolving and crystallising. The carbonate, when dried, may be mixed with finely-powdered charcoal, and strongly heated in a cast-iron retort, when it is resolved into sodium and carbonic anhydride. The changes, results, &c., of these operations are briefly expressed in the following equations:—1. Separation of chlorine and sodium from sodium chloride by means of electricity—

$$NaCl = Cl + Na.$$

The results of this mode of procedure are, therefore, nothing but chlorine on the one hand, and sodium on the other. 2. Separation of chlorine and sodium from sodium chloride by chemical means. (a) Separation of the chlorine from the sodium by the action of sulphuric acid—

$$NaCl + H_2SO_4 = NaHSO_4 + HCl.$$

Here we obtain hydrochloric acid and hydrogen sodium sulphate. (b) Separation of the chlorine from the hydrochloric acid by means of manganese dioxide—

$$4HCl + MnO_2 = 2H_2O + MnCl_2 + 2Cl.$$

Here we obtain free chlorine on the one hand, and a solution of manganese chloride on the other. (c) Preparation of sodium carbonate from the residue of the preparation of hydrochloric acid—see (a)—by the action of carbon (slack) and calcic carbonate (chalk)—

$$2NaHSO_4 + 4C = 4CO_2 + H_2S + Na_2S, \text{ then}$$
$$Na_2S + CaCO_3 = CaS + Na_2CO_3.$$

From this mixture of calcium sulphide the sodium carbonate is separated by lixiviation with water, and crystallisation. (d) Separation of the sodium from its carbonate—

$$Na_2CO_3 + 2C = 3CO + Na_2.$$

—S. BOTTONE.

[11587.]—**Cleaning Scarlet Cloth.**—Take 8oz. of sal ammoniac, 1½lb. of nitric acid, and heat the mixture slightly. Then add, little by little, 8oz. of pure tin. When the tin is entirely dissolved, add 6oz. of water. This constitutes the famous "eau écarlate," so much used for revivifying faded colours. It may require further dilution with water.—S. BOTTONE.

[11592.]—**Medical.**—The protosulphate, the protonitrate, and the acetate.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Hedera" has answered 10414; "Anglo-America," 10609, 10617; "Q. Q. R.," 10830, 10917; F. Hume, 10913; "Esmey," 10993; "H. B. E.," 11058 "G. W. K.," 11095; J. W. Fennell, 11103.

11118 Malt from Oats, p. 649
11121 Dr. Blair's Fluid Object-Glass, 649
11124 Dissolving Cotton, 649
11127 Refining Olive Oil, 649
11130 Centrifugal Pumps, 649
11135 Edinburgh Preliminary Examinations, 649
11140 Reducing Gold to Powder, 649
11153 Charcoal Dust, p. 650
11156 Marsella, 650
11159 Bisulphide of Carbon Engine.—To Mr. R. H. Garth, 650
11160 Private Study, 650
11161 Fixing Screw Valves and Taps in Lathe, 650
11167 Optical, 650
11169 Household Bones, 650
11170 Harris's Mill, 650
11174 Purifying Oil, 650
11177 Screw Press, 650
11178 Hair Nets, 650
11180 Power Loom for Weaving Silk, 650
11189 Cotton Reeling, 650
11190 Copying Ink, 650

QUERIES.

[11595.]—**Starlings.**—Acting upon "Joe's" advice, although not "a young lady," I have resolved to try the experiment of rearing one of these magnificent birds, and, if possible, teach it to talk. Will "Joe" kindly give his valuable opinions on the following queries:—(1) What kind of cage is the best? (2) At what age should the bird be caged? (3) Ought the cloth to be kept over the cage all day and until the bird will talk? (4) Should food be given at fixed periods, or left in the cage? Other hints will be gladly received by—RARA AVIS.

[11596.]—**Photographing Engravings.**—Would some one inform me the easiest method of photographing an engraving the same size as the original (which is 5in. by 3in.), and what sized camera will it require?—VERITAS.

[11597.]—**Mean Longitude of the Sun, &c.**—Will any kind reader inform me (1) What is the mean longitude of the sun? (2) Its variation in 100 years? (3) The longitude of the perigee, and its variation in 100 years? (4) The obliquity of the ecliptic, and its variation at any epoch in the latest astronomical tables (say, Leverrier's)? (5) Also those of the moon? I am possessed of the tables of Delamtre and Burg, but they are not sufficiently accurate for modern astronomical calculations.—W. H.

[11598.]—**Long and Short Rifles.**—I have a rifle 28½in. long. I want to cut it at 26in.; if I did so would it shoot as well after being cut as it does now? If I put higher sights on, (the sights are 2in. from the back end of the barrel), what height would they require to be to shoot well at 100, 200, and 300 yards after being cut?—A. G. MILLER.

[11599.]—**Lint.**—How can it be most easily made, and what is the best material?—LOAN GOCH.

[11600.]—**Analysis of Water.**—Can some correspondents give me a method of estimating the comparative wholesomeness of different waters for domestic purposes, or tell me in what work I can find the subject satisfactorily treated? I am used to making analyses, but the books I have say very little on this subject. I want a process that shall be both quick and accurate, if any such process exists.—ANALYST.

[11601.]—**Cracked Oven.**—My oven is cracked down the side and across the bottom, is it possible to mend it, and how?—DENTISTE.

[11602.]—**Ligurian Bees.**—I should be . . . of my fellow readers would be kind en . . . me from their own experience, whethe . . . the Ligurian bees superior to the E . . . Also how to unite a queen (Ligurian) t . . . rock. I have thought it would be a . . . after the first swarm has just left, as . . . be no difficulty in getting rid of the . . . old hive would be greatly helped in . . . soon as it swarmed. I know this is . . . common black queens with late great advantage. I should also like to know how it is that these Ligurian swarms are so very dear. £3 2s. seems to be the lowest, and 12s. 6d. for queens.—G. M.

[11603.]—**Dinas Firebrick.**—The Dinas firebrick is made out of coarse ground stone. Can any of your readers recommend me a machine for making these bricks? Much pressure is not required, but owing to the silicious nature of the stone, the wear and tear in any elaborately constructed machine would be very great. At present they are made in hand presses—a slow and expensive process.—Dinas.

[11604.]—**A Task for Chemists.**—To "Busy Bee."—In reply to query 10510, "Busy Bee," in speaking of getting the resinous and silicious matter from wood, thinks to accomplish it by boiling in caustic of 18° Tw., for three or four hours. If he has succeeded in getting the resin out this way, will he tell me how to proceed, for I have been working at this subject for upwards of six months, and I have been unable to get the resin out except that which was superficial, by such a method? I could also show "Busy Bee" a piece of wood which has been soaking in a bleaching-liquor cistern for upwards of eight months, and when the outer layer of ½in. is shaved off, the wood is just as tough and resinous as ever underneath.—George E. Davis.

[11605.]—**The Organ Built.**—Will "J. D." please to further explain Fig. 7, p. 638, Vol. XIV., as I have got into a fog at this point? What is that part of the leather (Fig. 7) for that projects inside? By so doing he will oblige.—W. C. Mannin.

[11606.]—**Organ Pipes.**—Will some correspondent inform me what should be the diameter of the foot-hole for a pipe 4ft. in length, measuring 4in. by 3½in. internally, and for one half that size? and what should be the height of the mouth of each pipe?—C. F. S.

[11607.]—**Ebonising Wood.**—Can any one describe the process and materials required for ebonising furniture in the best manner, to be polished afterwards in the usual way? I have tried the logwood and copperas solution, but cannot succeed in obtaining a good black, such as seen on ebonised articles.—W. C. W.

[11608.]—**Boiling by Steam.**—Can any reader inform me how to boil by steam? The contents to be boiled would be 50 gallons, and the mixture must be kept stirred all the time, so that a steam coil passing through would not answer.—A. W. B.

[11609.]—**Screw Cutting.**—Will some practical screw cutter give me a little advice? I want a rule for getting five or six change wheels, for cutting 14, 16, 18, or 20 threads per inch, left hand. I can get plenty of wheels for cutting right hand, but the quadrant is so small it will not allow for another stud with the ordinary wheels for cutting right-hand threads. The leading screw is 3 per inch. I have cut many left-hand screws with wheels in single train; also I can get 4, 6, or 8 wheels to cut coarse pitches, but the wheels have to be very small.—Young Hand.

[11610.]—**Defective Battery.**—I have a Smee's six-celled battery with coil, which I use as an invalid. Recently it became unworkable, and the coil was taken to a maker and repairer, who supposed something must be wrong with the battery. The silver plates have been replatinised, and the zinc ones re-amalgamated. When the connections were completed, the vibrator immediately acted, but when the two handles were held, there was only a sensation felt two or three seconds, and, occasionally, none at all. A few days ago, on trying it, the sensation continued for about five minutes, when the vibration ceased, since which time there is no action whatever. Has the insulation been destroyed, or may the cause be polarisation? and how should I proceed to discover and remedy the evil? If "Sigma," or Mr. Tonkes, or any competent fellow reader, would kindly direct me, I would feel greatly obliged. The distance (40 miles) from a repairer, and the expense are serious obstacles.—G. F. L.

[11611.]—**Opaline Photographs.**—Will any subscriber help me out of my present difficulty? Having coated the albumenised plate with chloridised collodion when dry, I find it has settled in rings, presenting a very ugly surface. Will any one explain the cause?—is my collodion at fault? A formula will oblige.—Opaline.

[11612.]—**Injury to Vacuum Tubes.**—I have two vacuum tubes, which have the platinum wires broken off at one end. The wire is broken off close up to the glass, but the tubes are not damaged in any other way. Will some one please tell me how I can remedy it? I have passed the current through them by placing the broken wire in mercury—is there any better plan?—Zeta.

[11613.]—**Stuffing and Preserving Animals.**—Would any one of your numerous subscribers give me some information as to the stuffing and preservation of dead animals?—H. S.

[11614.]—**Gums.**—Will some correspondent give me a list of those gums which are soluble in methylated spirits of wine?—Menelaus.

[11615.]—**Teeth.**—Will taking tincture of iron and quinine for strengthening purposes, as recommended in the Mechanic, tend to loosen the teeth if persevered in for some time? What will set them fast again when loosened?—Menelaus.

[11616.]—**Engraving.**—What is the liquid used in aqua tinting?—Menelaus.

[11617.]—**Numismatical.**—I should be glad to know something about the value and origin of the following coins:—1. Copper coin.—Obverse, elephant and castle; legend, "Coventry Halfpenny;" reverse, horseman, legend, "Pro bono Publico, 1792." 2. Copper coin.—Obverse, shaft of a mine; legend, "Cornish Penny, 1811;" reverse, fish; legend, "For the Accommodation of the County." 3. Brass coin, very small.—Obverse, head of king; legend, "Carolus Rex;" reverse, a crown, "X. S."—C. Colman.

[11618.]—**Deadening Sound.**—Will any one tell me the least inexpensive method of deadening sound between two rooms, which are divided only by a boarded partition?—Wickliff.

[11619.]—**Electrical.**—Will some correspondent kindly inform me why I can only get exceedingly faint shocks from my Leyden phial, when it is charged with 90 or 100 sparks from an electric machine which generates well? The phial is a pint jar, and is coated with tinfoil two-thirds of its height inside and out; the coating is gummed on; the connection between brass and interior coating is perfect; the stopper is of baked wood, covered with shellac varnish. I may add the glass is free from crack or break of any kind. The shock it gives is about equal to that of a good spark from prime conductor.—F. T. Z.

[11620.]—**Capturing Moths.**—I have heard that entomologists attract and capture moths with a composition they call sugar. Will any one kindly tell me how it is made? Also how, when, and where, to use it for that purpose?—Entomologist.

[11621.]—**Killing Roots of Trees.**—What acid or other stuff will kill trees if emptied into a hole bored into them? I am troubled by large willow tree roots closing up drains and making mischief.—A Gardener.

[11622.]—**Chaldron.**—What is the exact value of a chaldron?—Merci.

[11623.]—**Bell Pianette.**—I should be much obliged to S. Bottone (11393) for details of the Bell Pianette.—J. R.

[11624.]—**Photography.**—I live in the country where rain-water may be had purer, probably, than in many places, as I can collect it in the fields, and I wish to know whether in such a case, filtered rain-water may not be used for the same purposes as distilled water is prescribed, and, if not, whether there is anything short of a distilling apparatus, by which it can be made pure enough, and, if so, how? The experience of some practical photographer or chemist on this subject would be valuable, I have no doubt, to others besides—A Constant Reader.

[11625.]—**Deaf Dog.**—We have a dog that is almost totally deaf (nine months old). His ears are not cropped; I can see nothing peculiar about them; he can hear a loud whistle if close to him. Could any reader give a remedy?—Spot.

[11626.]—**Electric Bells.**—I would be much obliged to some kind reader of the English Mechanic, who would give me a little information upon the construction of electric bells and their mode of working. I have made various electric machines from information received in these columns, for which I am thankful, and I have no doubt that with the information I shall receive upon the above subject I shall accomplish my object.—Thomas Whalley.

[11627.]—**Gilding Strips of Wood.**—Whenever I am in a difficulty of a certain nature, I fly to the pages of "our" Mechanic, with the certainty that if I state my difficulty or question with moderate clearness I shall find some one of the many kind contributors to its columns who will help me to a solution. Well, I want some help now. I wish to gild some flat strips of wood about 1in. broad, and ½in. thick, so as to give them a dead gold look, all but one edge, which must be burnished. How am I to prepare the wood for gilding? and how am I to gild it?—Ironsides.

[11628.]—**Violin.**—Would Mr. Davidson (the author of "The Violin") oblige by telling me if an old violin, made by Ursula Collier, at the sign of the Correlli's Head, on old London Bridge, is of much value?—T. R. Willis.

[11629.]—**Skeletons.**—How can the skeletons of small animals (up to, say, a cat) be obtained, without a knowledge of anatomy, or without a very great deal of trouble?—Hedera.

[11630.]—**Compendious Perpetual Calendar.**—Would any of your correspondents tell me the best way of making a compendious perpetual calender?—James South.

[11631.]—**Income-Tax.**—A maiden lady formerly had an annual income of about sixty pounds. Two-thirds came from the "Albert" Insurance Office, and one-third from money in the funds. The first is apparently lost, and upon paying the other, income-tax has been invariably deducted by the Bank of England. How must a third party proceed to claim exemption, and can he recover any of the former deductions?—Helpless.

[11632.]—**Debility.**—I have been unable to follow my employment as a blacksmith for five years, from giddiness, singing in the head, indigestion, and general debility. Would any homœopathic doctor kindly give me a prescription to meet my case? I have tried allopathy and hydropathy without any benefit.—Westmoreland.

[11633.]—**Fever Tree.**—The fever tree of Tasmania has been cultivated in the south of France, and seems very prosperous there. I wish to know the scientific name of that tree, and if it is adopted in the pharmacopœia?—Quinquina.

[11634.]—**Tudibi Gum.**—Is the tudibi or black boy gum of Australia a kind of kino? What are the uses of that gum?—T. G

[11635.]—**Davis's Refrigerator Car.**—A few particulars about that car will oblige the querist? It is employed in the United States for conveying light perishable victuals.—D. R. C.

[11636.]—**Desert of Sahara.**—Many authors say the Desert of Sahara is under the level of the sea. A Frenchman, at a recent meeting, pretended the average height was 400ft. or 500ft. above that level, and that there were no shells nor any other marine remains found there. A few particulars about such statements will oblige many readers, and—W. W.

[11637.]—**Cormona Wood.**—I read in Payen's "Traité de Chinise," that cormona wood contains 55 per cent. of carbon. What kind of wood is this? and where is it obtained?—Guillaume.

[11638.]—**Silkworm Disease.**—Is there a credible cause assigned to the plague which affects silkworms in several countries?—Bombyx.

[11639.]—**The Rock Inscriptions.**—Will "E. L. G." or others explain how it is that the Sinaitic cuneiform inscriptions remain so neglected? Ever since my first acquaintance with the reports concerning them, it has been a matter of wonder and disappointment that they have not been energetically explored and transcribed. If there is only a colourable probability that they were the work of the Israelites in their exodus, why are they not eagerly deciphered? If they are veritably coeval and autographic records, how insignificant are discoveries in Nineveh, Babylon, Moab, or Palestine, scripturally considered, compared with the flood of light which might be extracted from these, either corroborative or corrective of the Mosaic accounts, and illustrative of language and letters. A tithe of the money and time spent in triangulating Palestine or groping the sewers of Jerusalem, would secure photographic transcripts, upon which linguists and archæologists might operate. If the lawless nomads of the desert cannot be reached by firmans or edicts, why should not a strong covering force be organised? Such a crusade would find plenty of volunteers. Excursions to Sinai are not uncommon now that the Red Sea is a highway. But whence the apathy about them? Are there doubts about their reputed genuineness, or are there apprehensions lest their revelations may interfere with the Mosaic traditions?—H. E. H.

[11640.]—**Photographing Sun.**—Is it possible to photograph the sun with a 3in. achromatic telescope mounted on pillar and claw stand without slow motions of any kind?—X.

[11641.]—**Observatory Clock.**—How can I make use of an ordinary clock as a sidereal clock for astronomical purposes?—X.

[11642.]—**Romsey Observatory.**—Has any one ever built an observatory on the Romsey principle, using sheet iron for the walls? Can it be recommended for cheapness and effectiveness?—X.

[11643.]—**Estate Agency.**—I shall be glad to have any information on the subject of estate agency. What are the duties of the profession, &c.?—L.

[11644.]—**Mending Copper.**—Will any subscriber inform me how to put a patch on a copper and make it watertight, without common solder?—M. B.

[11645.]—**Bees (Managing Old Stocks).**—I have kept bees in a small way for some years, but don't know how to manage my old stocks. Soon after they have swarmed they get very weak, and do not get enough food to keep them through the winter. I feed them, but all to no purpose, for they generally die the early part of the next summer. I have a stock now in a Woodbury hive in just such a condition. I am trying to feed them but they will not take the food. I have been told that bees will not stay in a hive more than three years, but I can't think that is true. If Mr. Abbott or any kind reader will tell me the reason and remedy, I should be much obliged.—J. O. Y.

[11646.]—**Electrical Apparatus Wanted.**—Will "Sigma," Mr. Tonkes, or some other contributor on electricity, kindly help a non-electrician in a fix? I want to obtain an electric spark ⅜in. long, by bringing the ends of two copper wires together, to the distance above named (⅜in.), the wires to be brought together and separated again, four times in a second, and the spark not to pass between them when at a greater distance than ⅜in. What will be the cheapest and most effective apparatus to produce the above result for the space of (say) six hours? I have a rotating shaft at my disposal, this can be taken into consideration when comparing cost. What will be the cost of such apparatus, and cost of working per hour? How long would it keep in good order?—J. Hicks.

[11647.]—**Cabbage Plants.**—Will some brother reader tell me how to prevent cabbage plants from running to seed?—Anon.

[11648.]—**Bee Management.**—I commenced bee-keeping near London last year, and as I am away from home during the day I have no one to attend to my bees in my absence. I am anxious to overcome the difficulty of the swarming season by artificial swarming. I shall, therefore, be obliged to some of your astute correspondents, for information as to the best mode of procedure to obtain a swarm from a common hive—the bees being a second May swarm of last year in a healthy and prosperous condition. I intended to try the plan of placing the present hive of bees over an empty hive, and, reversing the positions of the hives, driving the bees into the empty hive, leaving the nurse bees and brood in the old hive. The instructions I have had from bee books are not sufficiently clear. I wish to know whether I am to wait for appearances of swarming, before I commence operations—whether I should raise the hive of bees from the foot-board in the same night as I attempt to drive them? How long the hives should be left together after the bees are driven into the upper one, before they are separated for removal—the old hive to a new place, and the new hive to the old stand? Whether it is advisable or necessary to wear a bee dress? and any other information suitable to the approaching time that may be kindly given. Is it necessary that any stupefying material should be used, as when I formerly kept bees I have not been successful in the application, a great many bees dying from the effects of it, and the stocks never thriving after.—Apis.

[11649.]—**Astronomical Formula.**—Will some astronomer show practically the method of working out the following formula from the *Nautical Almanac* for 1873? Latitude 53° 48′ north, longitude 1° 50′ west. For any place not far distant from Liverpool, the Greenwich mean time of the beginning of the solar eclipse, May 25th, 1873, may be computed by the formula cos. ϖ = 2·0892 − [0·18987] sin. l × [9·98326] cos. l cos. (λ − 114° 0·1′) t = 20h. 58m. 18s. − [3·59312] sin. ϖ · [3·42434] sin. l − [3·82088] cos. l cos. (λ × 16° 26·0′) contact on the sun's limb, ϖ × 23° 38·9′ from the north towards the west.—G. Lennox.

[11650.]—**Annealing Steel.**—I shall be glad to learn from any of your numerous contributors a good process for annealing steel so as to insure free and easy turning with a fine cutter. My present process sometimes results in failure, and gives much trouble in wear and tear of cutters, and greatly retards the work in its progress.—J. A.

[11651.]—**Analysing Ash of Cane Sugar.**—I wish to ascertain the quantity of ash left by burning a sample of cane sugar, but I find great difficulty in burning the sugar away. If, however, I add a small quantity of SO_3, all goes well, and the operation is easily and quickly performed. I do not know what allowance to make in the resulting ash for the SO_3 added. Can Mr. G. E. Davis help me?—Uncertain.

[11652.]—**Tasmania.**—Will any of the numerous readers of the Mechanic inform me of the prospects of an emigrant to Tasmania? What clothing, &c., would be necessary for one who intends to start farming? and would it be advisable to take a gun or rifle to the colony? Any information regarding the above, will trust, be acceptable to more of your readers than to— TASMAN.

[11653.]—**Carving.** — Will some experienced wood carver inform me how long it takes to learn carving? I mean to say, to get a good start in the art. I am very fond of carpentering and turning, and fancy I should like to try carving. On what wood, and with what sort of designs should I commence? Any hints on the subject will be gratefully received.—A. H. COOKE.

[11654.]—**Cleaning Violoncello.**—What is the best way of improving the appearance, without injuring the tone, of a violoncello that has long lain by and become grimy? I was thinking of removing the dirt by turpentine, and then polishing, but having just heard of a violin that has been made "tubby" in sound by polishing (with furniture restorer, and not previously cleaned!) I would rather have some advice before putting my idea into practice.—SCRAPER.

[11655.]—**Making Gold and Silver Leaf Adhere to Fabric.**—Would some reader tell me how to make metal and silver leaf adhere to silk and cotton fabrics. The methods given in No. 359, page 542, do not act very well, and are too expensive.—J. B. SHARPLY.

[11656.]—**Boiler for Small Steamboat.**—Having an iron boat 21ft. long, 4ft. 6in. beam, I am desirous of fitting it with about 1½ horse-power steam-engine, and shall be glad if some of "our" brethren will kindly give me the benefit of their experience in advising as to the best form of boiler to make. It must be rather low, as the stability of the boat is not good.—L. M. F.

[11657.]—**Thorough Bass.**—I was very much rejoiced when you commenced publishing the treatise on music by Mr. Evans, having a desire to become acquainted with the rules of harmony, but I have been disappointed (owing to my obtuseness) in not being able to comprehend much that is therein written. My object in writing this is to ask whether any of our gifted correspondents can point out a work of a more elementary nature that will prepare me for the more effectual study of your treatise, which is "a little before my time." Any hints for my guidance will be most thankfully received.—L. M. F.

[11658.]—**Power to Drive Crown Printing Machine.**—Will some kind correspondent please inform me whether a quarter horse-power engine will drive a crown printing machine? The machine is turned easily by a boy of fourteen. The engine could possibly be arranged so as to work direct with a band from the engine to the machine (thereby saving shafting). If quarter horse would not do, what size would be sufficient? Also, the best form of engine and boiler. Could I raise steam by gas, and what description of boiler (dimensions, &c.) would be required for gas. Also, the amount of gas required per hour. Also, whether using a gas boiler would increase the insurance on the whole house? Any information with regard to above will be gratefully received.—AMPERSAND.

[11659.] — **Black Varnish for Microscopic Objects.**—I have been trying to put a rim of black varnish about my microscopic objects, and failed to come up to those that are done by other preparers. Would any readers furnish me with their method of doing the same?—J. T. A.

[11660.]—**Lead Pipes.**—I purpose laying on the gas in my greenhouse, which is 120ft. from the meter. Will some one kindly inform me if I can convey it through leaden pipes underground (by far the cheaper way), or must I have iron? If so, what is the cost per foot for a small tube?—FLACTEM.

[11661.]—**Photography (Background).**—I wish to make a background of canvas, I should like it a dark slate or lead colour. Will any able reader kindly inform me the best way to commence?—A BEGINNER.

[11662.]—**Colouring Walls.**—I live in the Peabody dwellings, and we have permission to colour or stencil the walls, which are at present a very light cream colour, almost white. I coloured mine last September with a colour in powder, mixed with ordinary size and whiting, but I find after six months' wear it soon rubs off in patches. I should feel obliged if some correspondent will tell me how to colour the walls with a hard or glazed surface, if possible, so that they can be dusted without rubbing off the colour. The surface of wall is Roman or Portland cement, very hard, and tolerably smooth. Will soluble glass do? and if so, how is it to be mixed with colour?—STENCIL.

ERRATUM.—On reading my query (11578, p. 107) over, I find that I have asked "why it is that the meridian passage on p. 4 is only given for the upper limb of the moon." It should have been the meridian passage for the upper transit. I trust that you will insert this correction in your next issue.—HENRY WOODS.

USEFUL AND SCIENTIFIC NOTES.

Formation of Ozone.—Dr. Pincus states that ozone is formed during the burning of hydrogen; and that if a flame of this gas is allowed to burn from a fine point, the smell of ozone can be distinctly recognised. This statement recalls to mind the announcement made some time since by Loew, of New York, that ozone might be obtained in sufficient quantity for purposes of lecture demonstration, by simply blowing the heated air on the edge of an ordinary Bunsen flame, with the aid of a glass tube, into a glass receiver, containing the ordinary reagent for testing an oxidising agent—iodide of potassium, acetic acid and starch—when the blue colouration of the iodide of starch almost instantly makes its appearance. At the time, Loew's announcement met with some objectors, who sought to explain the phenomenon by assuming that the oxidising process originated with certain oxidised nitrogen compounds formed by the heat of the flame. From the fact, however, which is well-known to chemists, that it is impossible to unite nitrogen and oxygen directly, by any means short of the electric spark, the explanation of Loew would seem to appeal correct one.—*Journal of Franklin Institute.*

Waterproof Leather.—An ingenious patent is now being worked, by which leather for the soles of boots and shoes is rendered impervious to wet and damp by exhausting the air from the pores of the leather, and filling them up with a substance which unites with and adheres to the fibre, thereby strengthening without impairing the elasticity of the material. It is stated that the patent, known as "Fanshawe's Waterproof Leather," is not only likely to be largely employed for the purpose to which we have referred, but that when asphalte pavement becomes more general, it will be possible to shoe horses with a material as hard as the asphalte itself, and which will prevent them slipping.

Road Locomotives.—We believe that Lord Dunmore intends to introduce his Road Locomotive Bill into the House of Lords this session. Some unfortunate non-compliance with standing orders prevented its introduction last year; but as no difficulties stand in the way this session, we may hope for at least a discussion on the advisability of relieving road locomotives from the, as we think, absurd regulations which at present hamper their use, and tend to retard their development and improvement. The bill will seek to abolish the regulation which prescribes the use of the red flag in advance of the locomotive, and will allow of a speed of four miles while passing through towns, and eight when on country roads.

Abyssinian or Talmi Gold.—According to Dr. Winkler, writing in *Dingler's Journal*, this is a brass composed of about 91 parts of copper to 8 of zinc. The appearance of gold is obtained by causing a very thin sheet of that metal to adhere by passing the compound through rollers. This gilded sheet is then cut and formed into ornamental articles by means of ingeniously-constructed steel tools.

Conductivity of Copper Wire.—It appears that a very inferior kind of copper wire is finding its way into the market, and has been used extensively in the construction of the coils for use with electric bells. Sir William Thomson has recently tested a large quantity of cotton-covered wire of this character, and found its resistance per metergramme to be ·439 of a B.A. unit, good wire being about ·16 of a B.A. unit.

V. C. A., or Velut Cera Adhaerescens.—Under this rather fantastical name we have received a preparation which will doubtless be found of use by many of our readers in various ways. It consists of sheets of paper gummed on one or both sides and perforated in squares or strips so as to be readily torn up to the desired size. It will be found useful by those who do not keep a gum bottle, or keeping that article have so little occasion to employ it that the gum becomes thick and dirty, and is often not to be found when wanted. For fixing scraps in albums, cuttings from newspapers, and periodicals in an "Index rerum," for mending torn leaves in books, and in many other ways, this prepared paper must be handy, as it can be carried in the pocket-book or kept in the writing desk, and is always ready when wanted. The inventor has also prepared a "glue muslin" and a "glue paper," which merely requires dipping in boiling water to render it as serviceable as the ordinary glue-pot for numerous little "odd jobs," such as mending the binding of books or securing the corners of cardboard boxes, fixing handles on umbrellas, or knobs on drawers. According to the inventor the glue-paper when thoroughly wetted forms a kind of "pulp" that is even stronger than glue when dry. Mr. G. P. Hill, of Redhill, the inventor, says he has no desire to keep the process of preparation secret, but will communicate it to any of our subscribers—the best way of doing which would be to publish it in these columns.

Destroying Aphides.—The black-fly is the greatest enemy to cherries. We append two recipes for its destruction, which, it is said, are effectual in ridding plants of the aphis pest. The first is a mixture of pitch, with one-sixteenth part of powdered orpiment and one-sixteenth part of sulphur, dissolved over a slow fire in an earthern pipkin, until they are well incorporated; when cold, divide it into small pieces about the size of a hen's egg, and burn it under the trees with damp straw, directing the smoke, as much as possible, where the insects are most numerous. A spare piece of sheeting, suspended from the top of the wall, will keep the smoke in position; or if the trees be in the open air quarters, draw on the caps on a moist, mild, quiet, evening, which will keep the smoke a little under. A good syringing or two afterwards will bring down the dead or dying aphides. Mr. Rivers's recipe is a more simple one. He says:—The best remedy is a mixture made by boiling 4oz. of quassia chips in a gallon of soft water ten minutes, and dissolving in it as it cools, 4oz. of soft soap. It should be stirred, and the trees syringed with it twice or thrice. The day following they should be syringed with pure water.

THE ENGLISH MECHANIC LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	..	£333 18 4
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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, April 16, and unacknowledged elsewhere:—

Odgen and Gibbs.—J. Gillingham.—Wm. Hill.—Wm. Brown.—John Walton.—Fletcher and Sinclair.—G. R. Prole.—W. F. Healey.—W. H. Cnell.—E. S. Hunter.—Alex. Gilles.—Alex. B. Macdowall.—Soui-Hong.—Geo. Parson.—W. Marden.—C. N. Abbott.—F. C. Richardson.—C. B. Bostock.—Major J. N. Beasley.—Rob. Allen.—A Housekeeper.—Charles Fletcher.—R. A. Proctor.—A Horological Mechanic. — Ginger Beer. — C. S. — Aceticum.—Hector.—F. N.—Apiarian.—A Yorkshire Pivot.—R. S. H.—A. Tabraham.—Comet.—S. Bottone.—Atlas.—R. T.—Loach.—Para.—Farmer.—E. W. J.—F. A. R.—Hydraulican.—Linum.—C. W. M.—P. W. H. J.—Ignoramus.—Joe.—J. X. T.—Gymnast.—Jannifred.—Proudfoot.—Youngster.—Sulphur.— S. B.—J. S.—W. Nicholson.—Bed of Stone.—E. H.—Rev. E. L. Berthon.—Jack of All Trades.—Musa.—Khoda Bux.—Tubal-Kain.—J. D. H.—J. M. Taylor.—C. P. E.—F. L.—Samuel Smither.—M. Paris.—J. L.—J. Kilpax.—C. P.—F. Gray.—W. R. Birt.—Fantail.—E. Barber.—J. H. B.—Journeyman Painter.—Science.—Charles George Payne.—J. F. E.—G. E. H.—Brightonian.—A., Liverpool.—Sorius.—M. A. B.—F. R. Rohn.—Mrs. F.—D. W.—H. T. C.—Inquiring Mind.—S. W.—C. T. B.—F. C. S.—T. A.—An Engine Driver.—J. D.—J. J. Knight.—Hy. Franklin.—Z. A.—S. T.—Neville.—York.—Linea.— C. J. R.— Thetamu.— A Reader.— John Pearson.—A. P. S.—Cincinnatus.—Tinsmith.—A Young Beginner.—Milled.—G. S.—Jasper.—J. H. Graham.—Philo.—Saul Rymea.—P. E. M.—A. M.—E. Parker.—J. S.—A. Macdowell.—W. H. Lockwood.—C. Williams.—James Slater.—W. P.—James Northorp.—Wee Pet.—A Novice.—An Old Subscriber.—Paper Maker.—J. K. P.—An English Mechanic.

? ?—We have not heard of the spiritualistic wonder, and don't believe in it.

ANXIOUS, S. BOTTONE, G. S.—See "Hints to Correspondents," No. 4.

C. G. P.—You would oblige by sending us the letters and post cards referred to in your letter.

NUMISMATIST.—Just seriously ask yourself the question why you should endeavour to injure men who would not injure you?

A SUFFERER.—Ask a chemist and druggist.

J. FOSTER.—We don't know, but you might ascertain by advertisement.

E. G.—We have certainly caught one, and shall administer such punishment as may be deemed advisable.

GEO. HY. SHIEK.—You inclosed no postage stamps.

MUSICAL MONEY-BOX hopes Henry Newman or some one else will give the proffered information on Model of Church, query 11031, p. 672.

UN FABRICANT.—There is no review in England devoted to paper-making.

W. H. PENNY.—See "Hints to Correspondents," Nos. 4 and 6.

R. E. SMITHSON.—No P. O. O. inclosed.

YOIZA.—Optional on the part of writer.

W. KIRKMAN (Nottingham).—Mr. Wallace's pamphlet was printed for private circulation. His address is A. R. Wallace, Holly House, Barking, E. John Beardsley's pamphlet came to hand, but it was simply unworthy of a passing thought. What would you think of a man offering himself as a professor of mathematics, who had never mastered the first rudiments of arithmetic? You might laugh at him, certainly. But might he not be more worthy of pity?

T. BUCK, Jun.—The agent is trying to impose upon you. Cases for any volumes can be had at 1s. 6d. each.

A CRIPPLE.—We cannot assist you. You could only obtain the information by personal inquiry of the proprietors of such establishments.

A COUNTRY PLUMBER.—We do not recommend manufacturers.

Communications which can only appear as advertisements to hand from J. Franklin, Paul Gill, A Joiner, Cincinnatus.

WHITAKER.—A printer's error.

JACK FACE.—Your reply is an advertisement.

J. W. H.—See replies 10696, in last number.

TREBOR.—We do not see how you can dye them white. For other colours use Judson's dyes.

ROBERTUS REEKUS.—Make and try your model engine yourself first.

LEGATO.—Buy the indices to our last five volumes, and you will not again send such a simple question.

MOXLEY.—The Agent-General for New Zealand is J. Morrison, 3, Adelaide-place, London-bridge.

A LEEDS MAN.—Write to the makers, or employ a patent agent to make a search.

J. UNWIN.—Such private communications can only be effected by means of an advertisement.

ANGLO-SAXON.—We have given in back volumes all the recipes for copying ink we have space for.

J. O. J.—Yes; buy the indices. Pianoforte keys will do.

BOOKWORM.—No.

A. M. FESTING.—The letter appears, but it is too late to review the book.

WOODSTOCK.—The queries you refer to are all of a homely but very useful nature; yours is only of use to few.

E. W. S. says he hopes Mr. Denning will commence these problems soon.

W. L.—Yes; please send.

W. C.—We do not remember your reply; probably the others that appeared were already in type. Anything sent on the subject must be sent as all other contributions are, *unconditionally*. We do not encourage you to expect the insertion of any *lengthy* contribution on phrenology.

B. H. H.—Various methods of destroying bugs were given in Vol. XIII. See pp. 394, 423, 445, 468, 647. We cannot repeat a query that has been so recently answered.

"PRIAM" is "glad to see the remarks of 'Manus' concerning the habitual tone assumed by Mr. Tonkes in addressing his fellow contributors." Priam says:—"Humility is the best test of wisdom," and "he who is wise is cautious of his own opinion, and tender to that of others."

A POOR MAN.—Consult a medical man.

M. L. L.—No doubt something will be done in the way of forming a piano alliance before long.

A. O. and R. SPENCER.—Your queries are advertisements.

W. A. WHITE.—Advertise.

KHODA BUX expresses his sorrow that so many personalities have crept into the ENGLISH MECHANIC recently through "Philo," Wm. Tonkes, and "E. L. G.," and hopes that correspondents will constantly remember two things: first, that they are writing on scientific questions; and, secondly, the space of the ENGLISH MECHANIC is precious.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING APRIL 9, 1872.

963 J. J. F. Manent, Paris, for improvements in the principal organs of pumps of all kinds, allowing to apply them to purposes to which the pumps in actual use would be unfit.

964 W. E. Gedge, Wellington-street, Strand, for a new or improved system of hygienic elastic spring bed or mattress. A communication.

965 T. Lowe, Brampton, Derby, for improvements in the manufacture of paper pulp or half stuff.

966 J. B. Croskey, Portsdown-road, Maida-hill, for an improved system or process for making asphaltic or bituminous pavements.

967 C. Delattre, Roubaix, France, for applying potatoe starch or its derivates for the sizing of woollen or worsted warps or yarn.

968 W. R. Lake, Southampton-buildings, for improvements in paper rag engines. A communication.

969 B. Platt, Widnes, Lancashire, for improvements in purifying turpentine and resin or resinous substances and obtaining the the spirit therefrom, and in apparatus employed therein.

970 T. Don, Redhill, Surrey, and R. A. Wright, Homerton, for improvements in treating fibrous, ligneous, and textile substances and fabrics for the production of substitutes for leather, gutta-percha, papier-maché, and other manufacturing materials, and for other useful purposes; also in manufacturing articles from such substitutes, and in preparing agents used in the said treatment, and in apparatus employed in the said manufacture.

971 J. H. Johnson, Lincoln's Inn-fields, for improvements in liqueurs or cordials and other beverages, and in apparatus to be employed in their manufacture. A communication.

972 W. Benson and J. J. Hetherington, Northumberland, for improvements in machinery or apparatus for washing and dressing ores.

973 J. H. Johnson, Lincoln's Inn-fields, for improvements in the treatment of hair bristles and feathers. A communication.

974 J. Ashbury, Sussex-place, Hyde-park, for improvements in apparatus for propelling and steering vessels for inland navigation. A communication.

975 F. Prudencio and J. F. Cotterell, Bath, for an improved apparatus for stoppering bottles.

976 W. E. Hodgson, Kennington-park-road, for improvements in the manufacture of bread and other farinaceous food.

977 W. R. Lake, Southampton-buildings, for improvements in apparatus to be used in combination with a gas burner for concentrating the light of the same. A communication.

978 J. Gowans, Edinburgh, for improvements in machinery used in the construction of tramways and railways and applicable to other purposes.

979 W. R. Lake, Southampton-buildings, for an improved compound for cleansing carpets and other woven fabrics. A communication.

980 A. R. D. Mackenzie, St. James's-square, for an improved construction of iron steam-ships for trading purposes.

981 H. Young and A. Kitt, Horseferry-road, Westminster, for improvements in the purification of illuminating gas, and in apparatus to be used therefor.

982 B. Boby, Bury St. Edmunds, for an improved construction of cultivator or scarifier.

983 J. F. M. Rigod, Paris, for an improved apparatus for carburetting air.

984 J. L. Casartelli, Manchester, for improvements in pyrometers.

985 R. H. Huch, Brunswick, Germany, for improvements in coffee machine.

986 C. G. Hill, Nottingham, for improvements in machinery for goffering, fluting, and crimping fabrics.

987 J. O. Hanctin, Paris, for improvements in machinery for pounding, grinding, and mixing moulding sand and other substances.

988 J. G. Pembery, Carlisle-street, Lambeth, for a new or improved application of machinery or apparatus for propelling canoes and small boats generally.

989 J. C. Sellars, Chester, for improvements in obtaining hydro-carbon liquids, gas for illuminating and heating purposes, and coke.

990 A. A. Rossignol, Paris, for an improved apparatus for reporting music played on the pianoforte, organ, harmonium, and other analogous musical instruments.

991 F. C. B. Robinson, Teddington, for detaching both tackles simultaneously from ships' quarter or other boats when being lowered, by means of disengaging tumblers.

992 W. R. Lake, Southampton-buildings, for an improved subsoil implement chiefly designed for making trenches or ditches for drainage and other purposes. A communication.

993 W. Whittle, Harborne, Staffordshire, for improvements in the manufacture of nails and spikes, and in machinery to be employed in the said manufacture.

994 J. F. Lafrogne, Paris, for improvements in the manufacture of gas for lighting and heating, and in apparatus employed therein.

995 W. E. Newton, Chancery-lane, for improvements in packings for the working parts of steam engines and other machinery and apparatus. A communication.

996 J. H. Johnson, Lincoln's Inn-fields, for improvements in machinery or apparatus for sewing boots and shoes. A communication.

997 C. Delattre, Roubaix, France, for improvements in cotton-sizing machines for the purpose of rendering them applicable for the sizing of woollen or worsted warps.

998 J. Baynes, Manchester, for improvements in headings and borderings for woven fabrics.

999 J. F. Warbrick and J. Clegg, Bolton, for an improved apparatus for ascertaining and registering the number of persons entering in or upon a vehicle or into any place of public entertainment.

1000 S. E. Asquith, Leeds, and F. A. Greenwood, Bradford, for improvements in machinery for spinning silk, cotton, wool, and other fibrous substances.

1001 J. Reynolds, Belfast, Ireland, for improvements in roving or slubbing frames, partly applicable for imparting motion in other machinery.

1002 W. R. Lake, Southampton-buildings, for an improved method of and machinery for utilising the butts and other parts of railway rails. A communication.

1003 C. Stevenson, Milngavie, N.B., for improvements in apparatus employed in converting esparto, straw, wood, and other similar substances into pulp.

1004 B. Hunt, Serle-street, Lincoln's Inn, for an improved speed indicator for railway and other similar purposes. A communication.

1005 W. Wright, Sheffield, for improvements in valves and apparatus for flushing water-closets and other purposes.

1006 J. Ormerod and D. Speirs, Waterfoot, Manchester, for improvements in the mode or manufacture of a certain colouring matter.

1007 G. Tidcombe, jun., Watford, Herts, for improvements in apparatus for the cutting of paper, which improvements are also applicable to other apparatus requiring changes of speed.

1008 W. Walton and J. T. Fallows, Denton, Manchester, for improvements in and machinery for rolling wire for making wire cards and for other purposes.

1009 J. Cochran, New Barnet, for improvements in valves, applicable to use on the overflow pipes of water and other cisterns or vessels.

1010 H. Reeves, Bratton, Wiltshire, for improvements in the construction of elevators for stacking hay, corn, and straw.

1011 E. G. Brewer, Chancery-lane, for improvements in the construction of railways, in rolling stock for same, and in other apparatus connected therewith. A communication.

1012 A. V. Newton, Chancery-lane, for an improvement in the mode of and apparatus for obtaining and metallicising electrotype moulds. A communication.

1013 F. Coales, Chicheley, Bucks, for an improvement in the manufacture of beer.

1014 W. Clay, Birkenhead, for improvements in tools for cutting and shaping metals, and in the means of keeping the same cool while in use.

1015 J. R. Wigham, Monkstown, Dublin, for improvements in illuminating lighthouses, beacons, harbour lights, and light ships.

1016 G. T. Bousfield, Brixton, for sewing and other machine treadles. A communication.

1017 R. S. Wright, Inner Temple, London, for improvements in obtaining motive power, and in the apparatus or means employed therefor.

1018 J. H. Johnson, Lincoln's Inn-fields, for improvements in heating and in apparatus employed therefor. A communication.

1019 W. R. Lake, Southampton-buildings, for improvements in theodolites. A communication.

1020 E. Feldtmann, Mark-lane, City, for a new or improved universal mandril. A communication.

1021 W. N. Nicholson, Newark-upon-Trent, for improvements in horse rakes, part of such invention being applicable to other machines.

1022 J. W. Smith, Oxton, Cheshire, for an improvement in the ventilation of sewers and drains.

1023 A. B. Wimpenny, Hayfield, Derbyshire, for improvements in the construction of smoothing irons.

1024 J. Worrall, Manchester, for improvements in the process of scouring, dyeing, washing, and drying piece goods, and in apparatus to be employed therein.

1025 W. E. Newton, Chancery-lane, for improvements in governors or apparatus for regulating the speed of steam or other motive-power engines. A communication.

1026 A. Pilling, Rochdale, for improvements in ventilating mines.

1027 J. Webster, Birmingham, for improvements in the manufacture of iron and steel, and in the recovery of certain gases resulting from the operation.

1028 M. Tildesley, Wolverhampton, for an improved oven for annealing cast iron.

1029 M. Tildesley and M. Barnard, Wolverhampton, for improvements in the manufacture of door fasteners and like articles.

1030 J. A. Telfer, Campbell-terrace, Bow, for improvements in the construction of borders, edgings, or moulding for tables and other similar articles of furniture.

1031 S. Norris, Lombard-street, City, for an improved pavement.

1032 A. M. Clark, Chancery-lane, for improvements in the manufacture of illuminating gas and in apparatus for the same. A communication.

1033 H. A. Laurence and L. A. Laurence, Lower Clapton, for improvements in the manufacture of hats, bonnets, and shapes, and in apparatus for such manufacture.

1034 A. Friedmann, Vienna, for a new method of collecting sediments of tubular steam boilers and apparatus employed therein.

1035 T. Nutting, Rhode Island, U.S., for improvements in machinery for spinning wool or various other fibrous matters.

1036 F. Hurd, Wakefield, and S. Firth, Leeds, for improvements in machinery for excavating coal and other minerals and in the permanent way for the rails of the same.

1037 F. E. Saxby and J. Winnington, Lorn-street, Hulme, for improvements in machinery or apparatus to be used for the purpose of regulating the supply of cotton and other fibrous material to machinery used in the preparing, manufacturing, or finishing of the same.

1038 J. H. Mills, College-street, City, for improvements in apparatus for generating heat by the combustion of gas.

1039 J. H. Mills, College-street, City, for improvements in steam boilers.

1040 J. B. Muschamp, Kensington, for a new or improved aërating egg beater and mixer.

1041 L. Herrmann and A. Laurent, Belgium, for improvements in the manufacture of lamp shades made of porcelain, ceramic, or other plastic materials.

1042 T. Mitchell, Cullingworth, Yorkshire, for improvements in machinery for doubling and twisting two or more yarns or threads of fibrous substances.

1043 A. M. Clark, Chancery-lane, for an improved loom for weaving. A communication.

1044 W. R. Lake, Southampton-buildings, for improvements in the manufacture of pulp from vegetable fibres for making paper and other materials. A communication.

PATENTS SEALED.

2618 E. V. Neale, for improvements in apparatus or appliances for stopping and regulating the extent of angular motion, and intended, though not exclusively so, to be adapted to doors and French and other windows.

2633 N. Wilson, for improvements in sewing machines.

2641 J. P. Furness, for an improved mode of fixing teeth or knives to the rod or back of reaping and mowing machines.

2646 J. Ball, for improvements in the manufacture of reaping hooks and sickles, and in the means or apparatus to be employed therein.

2647 G. L. Scott, for improvements in ventilating mines and tunnels.

2651 W. R. Lake, for improvements in grain elevators, chiefly designed for the loading and unloading of ships and similar vessels.

2654 G. Stevenson, for improvements in apparatus for the preparation and manufacture of iron and steel.

2657 J. Darlington, for improvements in steam and pneumatic engines.

2661 M. Tossell, for an improved mode or means of ventilation.

2666 J. Stockley and M. Stainton, for improvements in and applicable to steam engines and boilers.

2674 T. Walker, for improvements in the construction and working of lithographic and letter-press printing machines.

2675 H. Hughes, for improvements in apparatus for attachment to windows, doors, and steps of buildings.

2694 J. Flower, for improvements in or connected with "smiths'" forges.

2706 J. E. Holmes, for improvements in teeth for saws and in devices for securing the same, partly applicable to saws for cutting stone.

2709 J. S. Templeton, for improvements in apparatus to be used in weaving looped-pile fabrics.

2726 W. Leatham, for improvements in ambulance carriages and other vehicles for the removal of the sick or wounded, being also applicable for field hospitals and other purposes.

2728 H. Williams, for improvements in tents and other weather protectors.

2741 G. Loughton, for improvements in balances or weighing machines.

2745 R. Pinkney, for improvements in the production of colours from aniline in dyeing and printing.

2749 J. S. Crosland, for improvements in steam boilers or generators.

2812 H. Jackson, for improvements in apparatus for heating water by means of steam or for condensing vapour.

2821 W. Haworth, for improvements in machinery for rolling tea leaf.

2857 G. Camp, for improvements in the construction of harmoniums.

2868 W. Gossage and F. H. Gossage, for improvements in the manufacture of sulphate of soda by the decomposition of chloride of sodium, and of sulphate of potassa by the decomposition of chloride of potassium.

2875 W. R. Lake, for an improved method of preserving wood.

2943 A. V. Newton, for an improved construction of twine cutter.

2979 C. Fairbairn, for improvements in bolt-making machinery.

2993 J. Macintosh, for improvements in waterproof compounds for covering roadways, footpaths, floors, or other surfaces.

3169 D. Stewart, for improvements in sugar-cane mills.

3317 E. H. Bentall, for improvements in machinery for manufacturing screw bolts and nuts, part of which improvements is applicable to the working of other automatic machinery.

3415 H. Ashworth, for improvements in the construction of shuttles.

3477 J. W. W. Shaw, for an improved depilatory composition for hides and skins.

3494 J. C. Mewburn, for improvements in the manufacture of dolls and other like figures for the amusement or instruction of children, or for artistical purposes.

50 J. H. Johnson, for improvements in the regeneration of heat for furnaces, and in the apparatus or means to be employed therein.

59 J. H. Johnson, for improvements in melting furnaces.

80 J. H. Johnson, for improvements in discharging or tapping molten metal from furnaces or crucibles, and in casting the same into moulds.

419 J. H. Johnson, for improvements in steam generators, and in the mode of applying heat thereto.

420 J. H. Johnson, for improvements in refrigerating apparatus.

491 W. R. Lake, for improvements in mowing and reaping machines.

447 J. A. Hodgson, for an improved apparatus or gear for driving a screw propeller when the engines are broken down at sea.

463 T. Bear, for the adaptation of mica or talc to water gauges to steam and other boilers.

500 W. R. Lake, for improvements in the manufacture of boots and shoes, and in machinery therefor.

530 D. G. Low, for an improved sail hank.

538 W. R. Lake, for an improved lawn mowing machine.

2677 W. Yates, for improvements in miners' lamps.

2681 J. Tagell, for an improved automatic nut-screwing machines.

2683 J. M. Joannides and L. M. Adutt, for a new or improved apparatus for ventilating and protecting or preserving goods when packed.

2683 W. Clark, for improvements in steam boilers and in cleaning apparatus for the same.

2680 W. Simmons, G. W. Simmons, and G. Smith, for improvements in the means, method, and apparatus for printing zincographic and other impressions.

2692 W. Bowker, for improvements in drilling machines for drilling the holes in guide plates, card cylinders, and other parts in connection with Jacquard machines, part of the improvements being also applicable for punching metal plates.

2695 W. H. Ronald, for improvements in umbrellas, sunshades, and parasols.

2708 G. A. C. Bremme, for an improved construction of wheel for traction engines and other vehicles.

2720 E. Heywood, for improvements in washing machines, part of which is also applicable to other squeezing rollers.

2721 G. Zanni, for improvements in magnetic bells and signals to render the same more simple and economical for telegraphic and domestic purposes.

2727 S. Moorhouse and W. J. Kendall, for improvements in mechanism or apparatus to be employed for signalling on railways.

2733 J. Horrocks, for improvements in pickers used in looms for weaving.

2734 J. R. Macfarlane, for improvements in apparatus for charging and drawing gas retorts and for other purposes.

2737 C. Randolph, for improvements in common road steam carriages, and in part applicable to railway locomotives.

2775 J. R. Napier, for improvements in water-pressure speed indicators.

2793 W. R. Lake, for improvements in the pistons and slides valves of steam engines, and in apparatus connected therewith.

2797 A. Guattari, for improvements in pneumatic telegraph apparatus.

2805 L. M. Casella, for improvements in maximum registering thermometers.

2810 J. Webster, for the manufacture of metallic lead paint.

2890 A. M. Clark, for improvements in electric telegraph apparatus.

2904 G. W. B. Edwards, for improvements in drills or machines for setting corn and seeds.

2910 A. M. Clark, for improvements in rollers used in spinning machinery.

3008 H. Wells, for improvements in railway permanent way applicable to the passing of drainage and irrigation waters.

3033 C. G. Johnson, for improvements in apparatus for drying and burning bricks and other similar articles.

3125 J. Castle and C. Turton, for improvements in the manufacture of aickles.

3234 J. Oldroyd and M. Oldroyd, for a new or improved carpet

3298 R. Booth, for improvements in apparatus employed in manufacture of British gum and other artificial gums.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 26, 1872.

ARTICLES.

METALLURGY OF IRON AND STEEL.*

(*Continued from p.* 111.)

PIG-IRON is essentially iron and carbon; when these two things are heated together strongly they combine, and if the temperature be high enough to fuse the product we get pig or cast iron. There are some remarkable properties about this pig-iron, essentially it is iron and carbon combined in certain proportions; with other proportions of carbon we get various kinds of steel. If we take pig-iron containing a large proportion of carbon, say some four or five per cent., and melt it in mass, and then allow it to cool very slowly, on examining the product we shall find it to be gray pig, having a granular, dark-grayish, white appearance. The carbon in the mass after melting, if allowed to cool slowly, separates throughout the entire substance, in the form of graphite (crystallised in cubical system); acids do not attack it. Gray pig-iron is, therefore, essentially metallic iron with graphite diffused through it, and we may make it so that nearly the whole of the carbon is separated as graphite by the act of slow cooling.

If we take a mass of gray pig-iron, melt it, and instead of allowing it to cool slowly, cool it rapidly, then it is possible to get a product so entirely different in appearance from gray pig-iron that we can hardly believe that one may be transformed into the other. This is white pig-iron. In some cases we can get a product partly white and partly gray. The fracture of white pig iron is very different from that of gray, so also is the colour, being a uniform white; it is likewise much harder and highly crystalline. If the white pig be acted on by an acid, as common muriatic, &c., we get a brown residue quite different in appearance and chemical composition from that which is left in the other case, with no graphite or no sensible portion of it. Yet it consists chiefly of carbon in a totally different state from graphite. If graphite be treated with caustic potash or soda no action occurs, but this residue is dissolved if so treated. In the white pig the carbon is in a state of combination. If gray pig-iron is cooled very rapidly we get a particular kind of pig-iron called Spiegeleisen (from the German word spiegel, meaning a mirror), now in great demand for the Bessemer process, and imported in large quantities from Germany, and some from Sweden, and we also make a small quantity ourselves, but we have only a limited quantity of suitable ore. It contains a large proportion of manganese, in some cases as much as 10 per cent. It contains also 5 per cent. carbon, and although other matters are generally present, about 85 per cent. of iron. When manganese is present it is found that the whole, or nearly the whole of the carbon, is retained in combination. This variety is exceedingly hard, and when freshly broken is very bright. Perfectly pure iron would not be acted on by acids. If we take white pig and act on it by acid, and cool the gas evolved, it is possible to get some remarkable products from it, or at least one product from which others can be obtained. If, for example, the hydrogen evolved when iron is acted on by oil of vitriol be produced by iron containing carbon in combination, then union between the hydrogen and carbon takes place, and the result is a volatile oil. The lecturer exhibited a quantity of liquid hydrocarbon obtained from Spiegeleisen in the metallurgical laboratory connected with the institution.

Conversion of Pig-Iron into Malleable Iron.

In former times the process adopted was very simple, and charcoal was always the fuel employed. Usually a square forge-like hearth was employed for that object, with one jet of blast s in a blacksmith's forge. A given quantity of pig-iron was put into the furnace along with the charcoal, and by means of a powerful blast the r was enabled to reach the surface of the metal. e iron was burnt immediately into the oxide, and so was the carbon in that portion of the iron. The result was the formation of the oxide of iron, and the workmen then used to stir up the whole mass and mix it up thoroughly with the molten pig-iron, and finally bring out of the furnace a lump weighing about three hundredweight, exactly similar to the lump produced in the Catalan forge. All the malleable iron in this and other countries was, until recently, produced in this manner.

In the above case there was direct contact between the charcoal and the molten iron. Now, charcoal is devoid of one impurity which exists in all coal and coke—namely, sulphide of iron. This ancient mode is still carried on in South Wales, and extensively in some parts of Staffordshire. The best kind of iron known for tinning is called charcoal plate, and is manufactured by this process, being the only stage of the process in which charcoal is used at all.

If we take some pig-iron and pound it, or otherwise finely divide it, and then mix with it oxide of iron (the scale of iron seen on the surface of iron after a red heat is oxide of iron), and heat the mass so as to melt it, we should get a vigorous action between the carbon and the oxygen. If we took a given weight of pig-iron and reduced it to coarse powder, and knew the exact quantity of carbon it contained, then if we added a proper quantity of oxide of iron to supply the oxygen requisite to burn the carbon into carbonic oxide, we should get wrought iron. So that by intermixing the oxide with it in the right proportion and exposing to a high temperature we could burn up the whole of the carbon. The same principle is employed in the process of "puddling;" in both cases the oxide of iron is used, being either added or generated.

The question is how to accomplish the conversion of pig into wrought iron economically on a large scale. It would incur a great expense to reduce the iron to powder, &c. When wood became dear, and consequently charcoal scarce, attempts would be made to substitute coal or coke for the charcoal. If coke were applied in the former process in the same manner as charcoal a very bad article would be the result. It became essential to devise some means of using coal so as to prevent contact between the solid fuel and the pig-iron operated on. That was accomplished in the so-called reverberatory furnace where the two are kept completely apart. A reverberatory furnace is one where the flame is reflected or reverberated down on to the material to be heated. If we make the flame from one of these furnaces to act upon the pig-iron, the latter may be satisfactorily and economically converted into malleable iron. That is done in puddling.

Puddling.

This process is ascribed to a Mr. Cort, who took out a patent for it in 1784. The process is known as Cort's puddling process; the history of it is very interesting and somewhat painful. Cort spent his private fortune, about £20,000, in carrying out these investigations. After this a gentleman employed in the Admiralty advanced him money, which subsequently was found to be not his own, but the nation's. Thereupon the Government came down upon Cort. The other unfortunate individual died, and the Government, instead of allowing Cort to work his way and pay off the money, which he would soon have done, stopped the whole thing, and gave what advantage there was to certain ironmasters, whereas they might have recouped themselves a hundredfold. Cort died a ruined man, depending for subsistence upon a small bounty from the public purse. Here was a man who systematically developed this process by which not only private individuals, but the nation at large, has been immensely benefited, yet that man was allowed to die only just out of the workhouse.

Other persons had puddled iron by much the same process as Cort shortly before him, but it is perfectly certain that these persons did not appear to be aware of the value of that process, and Cort was the first to develop it on systematic ground. Remember, the principle is the removal of carbon from pig-iron in a reverberatory furnace so as to prevent contact with the solid fuel

A reverberatory furnace consists essentially of three parts—the fireplace, the bed, and the "stack" or high chimney. The fireplace is separated from the bed by a wall of fire-bricks—the "bridge"—reaching up some distance towards the roof, and often a little wall separates the bed from the flue, where it is much contracted. All these must be made of good fire-brick, or other highly refractory material. Underneath, the wall rests upon an iron girder. About the bridge the temperature is very high, and must consequently be kept down. This is done by placing a cast-iron girder, anchor-shaped, and protected from the fire by fire-brick, opposite it is another girder, and over the top another piece of cast iron, the whole encased in fire-brick, somewhat overhanging, and thus affording means for a free circulation of the air.

In former times, when Cort lived, the bed was made of sand, agglutinated together by oxide of iron, but this did not answer well. In 1819 Mr. Rogers substituted the use of iron bottoms, which has proved to be a very important improvement. Like Cort, he died in great poverty a few years ago. Since then these bottoms have been everywhere adopted. They consist of two parts, one called the frame, of cast iron, and laid between the fire-bridge and the flue wall; the other portion consists of four flat plates of iron dropped into the frame. These latter are supported by girders of wrought iron running along and resting on standards of cast iron. All underneath this bottom is left perfectly clear, so as to allow of a free contact with the air, and thus the intense temperature is kept down, which would of course otherwise be sufficient to fuse the bottom itself as well as the materials laid on it. The walls of the furnace somewhat overhang the bed, and also certain stops are put so as to make a border running round, except facing the door.

The bottom of the furnace is covered with "fettling," and for this purpose we cannot do better than take some kinds of iron ore, or of slag, the latter well calcined—"bull dog;" take the fettling right under where the walls overhang. The door is an iron frame, filled in with fire-brick, and suspended on a lever worked between two projecting ribs. The door may be wedged up, leaving a draughtway between the chimney and the edge of the door; there is also a small hole in the bottom of the door. The door drops upon a piece or bar of iron, called a fore plate, and the puddler has to work a long iron rod resting upon this fore plate. The action of this rod soon wears away the fore plate where it acts, and this is to some extent provided against by cutting out a piece of the iron from the plate at this place and putting in a piece of much harder iron, which can be renewed from time to time. The fore plate rests on a vertical plate of cast iron containing a hole with a plug, through which the slag is from time to time tapped out. The whole of the furnace is cased in plates of cast iron, supported on standards, tied at the top by tie rods. It may be observed how large the fireplace is in comparison with the bed. The roof of the furnace dips down towards the flue.

Now, let us suppose the furnace in working order, being heated ready, the last charge having just been drawn off. The puddler is there—it takes a good strong man to be a puddler. Now take a charge of pig-iron, weighing (say) about 4cwt., the iron to which the common name of forge pig is applied. Put in the furnace along with this, or rather previous to the iron, on an average about 1cwt. of smithy scales—in fact, oxide of iron. The iron is melted, and after a time we are struck by the appearance of boiling in the metal, and it rises up considerably and swells up so as sometimes to come out at the hole in the door. This phenomenon is called pig boiling, and the process is comparatively modern. The boiling is caused by the generation of carbonic oxide gas and its escaping through the molten metal. After a time the boiling subsides, and in proportion as the cast iron loses carbon it becomes less and less fusible, and wrought iron is produced in bright grains, multiplying very rapidly, and by-and-by the puddler will collect all those small portions into a series of balls, each weighing about 80lb., and in one hour and twenty minutes these balls are drawn from the furnace in succession, and subjected to mechanical treatment, and made into bar iron. There is also produced a very infusible silicate of iron, being the combination of the silicon in the pig-iron and iron, every one part of silicon carrying off not less than four of iron.

What is known as "puddle-bar" is nothing more than a spongy mass of malleable iron, containing slag in its pores; when the balls are taken out of the furnace at an exceedingly high temperature they are pressed in a squeezing apparatus at a welding temperature, the slag is squeezed out, and we get a bloom or metallic mass. It is next passed under grooved rollers and drawn out, into puddle bar, which is a comparatively impure bar iron.

(*To be continued.*)

* An abstract report of a course of lectures by Dr. ...cy at the London Theatre of the Geological Museum.

CAPILLARITY.

When the end of a capillary tube is thrust into a liquid, such as pure water (the tube having been previously moistened with water), the liquid rises in it, quickly at first, and the rate of rise is gradually diminished as the liquid approaches its ultimate limit, which it is very slow of reaching in tubes of small diameter. M. Decharme is investigating this spontaneous upward movement, and he proposes the following points for inquiry :—Is the motion retarded uniformly or irregularly? What is the nature of it? How do the rate of ascent and the space vary, by the end of a determinate time, with the diameter and inclination of the tube, the nature and temperature of the liquid, and with such physical and chemical properties as density, specific heat, boiling point, equivalent, &c.? What liquids rise most rapidly? and do these reach the greatest height, or is the opposite the case? What relation does this kind of rise bear to that of liquids moving in a tube under constant pressure? What is the relation between this capillary motion and the endosmotic motion of the same liquid?

With regard to the nature of the motion, he finds from experiment that it is not uniformly retarded. If a curve be drawn to represent the numerical results connecting the space with the time, each liquid being under identical conditions of experiment, it appears that while the curve has for some liquids some analogy to a parabola in the first part of its development, it departs from this more and more in proportion to the time, its latter part approaching to a hyperbola. It belongs to the category of logarithmic curves, and M. Decharme has not yet satisfied himself as to its formula.

He gives the following general results from his experiments :—

1. Each liquid has its own rate of motion in a capillary tube (say) one millimetre in diameter, the liquid and tube being kept at a fixed temperature—zero (*e.g.*).

2. For the same tube, kept at the same inclination, and for different liquids taken at the same temperature, the rates of rise are not in direct proportion to the ultimate lengths of the tube occupied. Viscous liquids, such as sulphuric acid, glycerine, or oils, have a slower initial and continued motion than very fluid liquids like alcohol, sulphuret of carbon, or ether, and yet the former rise higher than the latter. The rate of rise is, moreover, neither in an exactly inverse proportion to the entire time occupied, nor to the density of the liquids. The law appears to be somewhat complex.

3. Of the liquids submitted to experiment (more than 150, chosen principally from the chlorides, iodides, bromides, and the salts of ammonia, potash, lithia, glucina), the aqueous solution of hydrochlorate of ammonia had the quickest rate of rise—a rate which increased in proportion to the salt dissolved, and which exceeded that of water in proportion as the temperature was raised. Chloride of lithium in aqueous solution, the only liquid which, after the solution of sal-ammoniac, rises higher than pure water, has a rate of rise considerably less than that of water, which is surpassed by those of a large number of liquids. It is to be remarked that an alcoholic solution of sal-ammoniac, in conditions identically similar, always rises less rapidly than anhydrous alcohol, while at the same time it reaches a greater height ultimately. Chloride of lithium diminishes similarly the rate of rise of its solvent, but the alcoholic solution does not rise so high as the pure alcohol.

4. For all liquids, rate of rise in a capillary tube increases with the temperature. Even water, when near its maximum density, is not an exception to this law. It may be stated, however, that if the rate increases in a continuous manner, between zero and 10° or so, it increases much more rapidly if the temperature is further raised. The increase in rate of rise due to temperature varies besides with the rate of rise peculiar to the liquid. This rate, in some cases, is even doubled for an elevation of temperature 50°.

5. For each liquid, and the same inclination of the tube, the motion by the end of a unit of time, or, more simply, the space passed in a second, increases in proportion to the diameter of the tube.

6. For the same liquid, and the same tube, the rate of motion increases with the inclination of the tube. In proportion to the time, these differences in rate of motion successively diminish, then disappear, then show themselves in the contrary direction, and the heights ultimately reached are inversely as the diameters. So that the curves relating to one tube and one liquid do not cut each other, while the curves relating to one liquid and to tubes of different diameters, placed at the same inclination, cut each other at points which are nearer the initial point, in proportion as the difference of diameters is greater.

A. B. M.

ASTRONOMICAL NOTES FOR MAY.

By a Fellow of the Royal Astronomical Society.

The right ascension of the Sun at Greenwich mean noon on May 1st is 2h. 35m. 46·82s., and his declination north is 15° 15′ 21·6″. He will consequently form a roughly equilateral triangle with the two small stars, π and σ Arietis. He rises in London on the 1st at 4h. 33m. a.m., and sets at 7h. 21m. p.m.: while on the 31st his rising and setting will take place at 3h. 51m. a.m., and 8h. 4m. p.m. respectively. On and after the 22nd there will be no real night, inasmuch as, even at midnight, the Sun will never descend more than 18° below the horizon, and twilight does not cease until his angular distance from it exceeds that quantity. The equation of time is subtractive during the whole of May. On the 1st 3m. 6·03s. must be taken from the instant of apparent noon to obtain the time which a properly-regulated clock ought to show; while on the 31st, 2m. 34·28s. must be subtracted from the time shown by a transit or sundial to get true mean time. The semi-diameter of the Sun at his Greenwich transit is, on the 1st, 15′ 53·8″, and this occupies 1m. 6·09s. of sidereal time (convertible into mean time by the subtraction of 0·18s.) in its transit. On the 31st the Sun's semi-diameter will have diminished to 15′ 48·2″, and the meridian passage of such semi-diameter will take 1m. 8·37s. of sidereal time (or 1m. 8·19s. of mean time, to complete. The sidereal time at mean noon on the 1st is 2h. 38m. 52·87s., and on the 31st, 4h. 37m. 9·57s.: the mean time at sidereal noon—or mean time of transit of the first point of Aries being 21h. 17m. 37·25s., and 19h. 19m. 39·93s. on those days respectively. The absence of Solar activity, as indicated by the paucity and small size of spots, &c., continues.

The Moon will be New on the afternoon of the 7th at 1h. 18·7m.; enter her first quarter at 4h. 5·6m. on that of the 15th; be Full at 11h. 8·3m. on the night of the 22nd; and enter her last quarter on the 29th at 2h. 12·4m. in the afternoon. She is 23·5 days old at noon on the 1st, and so on until the same hour on the 7th, when her age will obviously be 29·5 days. Then on the 8th at noon her age will be 0·9 day, and, increasing *de die in diem*, 23·9 days on the noon of the 31st. Libration will, at 7 in the morning of the 5th, render more of her S. W. quadrant visible; and at 3 a.m. on the 19th it will cause additional surface in her S. E. quadrant to come into view; while again on the 31st, at 9 at night, the same cause will operate in once more bringing an extra portion of her S. W. limb into view. The Moon will be in conjunction with Venus at 8h. 48m. in the evening on the 5th; with Mercury at 2h. 44m. a.m. on the 6th; with Mars at 5h. 9m. in the afternoon of the 7th; with Jupiter at 1h. 54m. a.m. on the 13th; afterwards with Uranus at 7h. 58m. a.m.; and, lastly, with Saturn at 5h. 34m. a.m. on the 26th.

There will be a small partial eclipse of the Moon, visible at Greenwich, on the night of May 22nd; but even at the time of greatest obscuration, the magnitude of the eclipse will only amount to 0·116, the Moon's diameter being taken as = 1. The first contact with the shadow will happen at 177° from the north point of the Moon's limb, towards the east (*i.e.*, in point of fact, almost at the southern part of the lunar limb), the last contact at 143° towards the west. In each of these cases we assume the Moon to be viewed with the naked eye, or with an ordinary terrestrial telescope.

		h.	m.
First contact with penumbra, May 22	...	9	9·8
First contact with shadow	„ ...	10	40·9
Middle of the eclipse	„ ...	11	18·2
Last contact with shadow	„ ...	11	55·5
Last contact with penumbra	„ ...	13	26·6

The Moon will occult no less than twelve fixed stars during May, and come almost into contact with three others, as viewed from Greenwich :—First, on the evening of the 12th, B.A.C. 2514 will disappear at her dark limb at 6h. 59m.; reappearing at her bright limb at 8h. 10m. Then on the 16th, just as 42 Leonis is setting, at 2h. 1m. a.m., it will disappear at the Moon's dark limb; it will emerge (below the horizon) at 2h. 36m. from behind the bright limb; but will, as a matter of course, be invisible here. On the evening of the 17th, at 8h. 5m., ν Virginis will disappear at the dark limb; reappearing at the bright one at 9h. 20m. At 9h. 15m. on the night of the 19th 65 Virginis will disappear at the dark limb of the Moon; as will 66 Virginis at 10h. 8m. 65 Virginis will reappear at the dark limb at 10h. 25m., and 66 at 11h. 20m. Then, at 2h. 44m. the next morning, l^2 Virginis will be occulted by the dark limb, but will set ere its reappearance at the bright one at 3h. 41m. On the evening of the 20th, at 8h. 28m., κ Virginis will disappear at the dark limb, reappearing at the bright limb at 9h. 8m; while at 2h. 54m. the next morning 2 Libræ will be similarly occulted, setting, however, ere its reappearance, at 3h. 36m. At 9h. 15m. in the evening on the 21st the Moon will pass quite close to ν^1 Libræ. On the night of the 22nd ω^1 Scorpii will be occulted at 9h. 26m., and ω^2 Scorpii at 9h. 52m.; in each case at the Moon's dark limb —which, however, in this case, will be very close to the enlightened part. ω^1 will reappear at 10h. 34m., and ω^2 at 10h. 59m., both, of course, at the bright limb. At 1h. 13m. in the early morning of the next day (the 23rd) B.A.C. 5395 will disappear at the Moon's bright limb; reappearing from behind her dark limb at 2h. 24m. The moon will pass quite close to 39 Ophiuchi at 2h. 26m. a.m. on the 23rd. Afterwards at 4h. 10m. θ Ophiuchi will disappear at her bright limb. Its reappearance from behind the dark one will take place at 4h. 49m. after it has set. Lastly, at 2h. 49m. a.m. on the 28th the Moon will be almost in contact with 37 Capricorni.

So unfavourable a month for the observation of planetary phenomena as May, 1872, is hardly within our recollection.

Mercury, having passed his inferior conjunction on the 24th of April, is now travelling towards the west again; but his proximity to the Sun during the earlier part of May, and his consequent rising, southing, and setting in the glare of bright twilight and daylight, will render him invisible. On the 22nd at 9h. 5m. a.m. he will attain his greatest elongation west (25°) from the Sun; but, inasmuch as his declination north will be considerably less than that of that luminary, he will even then rise in twilight too bright for him to be discernible save by the aid of an equatoreal. He will be, as before, observed in conjunction with the Moon at 2h. 44m. a.m. on the 6th, and with Venus at 10h. 52m. a.m. on the 8th.

Venus is moving towards her superior conjunction. Her diameter diminishes slightly during May; being about 11″ at the beginning and about 10″ at the end of the month. *Mutatis mutandis*, all our remarks with reference to the bad position of Mercury in the sky apply with equal force to this planet too. She will, as just remarked, be in conjunction with Mercury at 10h. 52m. a.m. on the 8th, and with the Moon at 8h. 48m. on the evening of the 5th.

Mars is invisible during the whole of this month; being in conjunction with the Sun at 3h. 50m. on the afternoon of the 17th. He will be in conjunction with the Moon, as previously intimated, at 5h. 9m. on that of the 7th.

Jupiter is the single conspicuous object in the sky during the earlier part of the night, and may be seen in the west and north-west part of the heavens up to about 1 a.m. at the beginning of the month, and until a little after 11 o'clock at the end of it. He rises on the 1st at 8h. 55m. a.m., souths at 5h. 0·6m. in the afternoon, and sets at 1h. 7m. the next morning; while on the 31st his rising, southing, and setting takes place at 7h. 23m. a.m., 3h. 22·5m. p.m., and 11h. 23m. p.m. respectively. He is now travelling slowly from Gemini into the confines of Cancer, and the crooked line which he forms with Castor and Pollux during the early part of the month approaches to a straight one towards the end of it. He will be within a degree of μ^2 Cancri on the night of the 31st, and almost exactly south of that star; and will, further, be in the immediate neighbourhood of Uranus, which will be very slightly to the west of him at this date.

As a matter of course, the phenomena exhibited by Jupiter's satellites are becoming fewer and less perceptible. Beginning with the 1st evening of May. Perhaps the ingress of the shadow of satellite 2 at 7h. 43m., and the egress of that satellite itself at 8h. 13m. may be caught in the twilight. When it gets darker, the ingress of satellite 1 will begin at 9h. 52m., the egress of the shadow of satellite 2 will take place at 10h. 40m., and the ingress of the shadow of satellite 1 at 11h. 5m. If Jupiter be not too near the horizon satellite 1 may be seen to leave his disc 11 minutes after midnight. On the night of the 2nd satellite 2 will reappear from eclipse at 10h. 35m. The egress of the shadow of satellite 1 at 7h. 34m. in the evening of the 3rd, and the occultation of satellite 4 at 12h. 28m. the same night, may perchance be perceptible. On the night of the 6th the egress of satellite 3 will take place at 9h. 13m., its shadow not entering on to Jupiter's opposite limb until 10h. 30m. Perhaps the beginning of the transit of satellite 2 may be discerned at 8h. 1m. p.m. on the 8th. Its shadow will afterwards enter on to the planet's face at 10h. 21m., and the satellite itself pass off at 10h. 57m. Afterwards at 11h. 50m. the ingress of satellite 1 may possibly be detected. This same satellite 1 will disappear in occultation at 9h. 2m. on the night of the 9th, to reappear from eclipse under very unfavourable circumstances for observation 30m. 28s. after midnight. It is possible that satellite 2 may be seen to reappear from eclipse at 8h. 3m. 42s. on the evening of the 10th. Afterwards the egress of satellite 1 will take place at 8h. 39m., and that of its shadow at 9h. 49m. If it be not too light, the ingress of the shadow of satellite 4 may be seen at 7h. 54m. in the evening of the 12th. On the night of the 13th satellite 3 will begin its transit at 9h. 55m. The ingress of satellite 2, on Jupiter's disc, will occur at 10h. 46m. on the night of the 15th. On that of the 16th satellite 1 will be occulted at 11h. 1m. During the evening twilight of the 17th satellite 3 will reappear from eclipse at 8h. 6m. 38s.; and the transit of satellite 1 begin at 8h. 18m. Subsequently at 9h. 24m. the ingress of the shadow of satellite 1 will occur; while the egress of the satellite casting it will happen at 10h. 37m. Immediately afterwards at 10h. 38m. 30s. satellite 2 will reappear from eclipse; and finally, if Jupiter be not too low down, the egress of the shadow of satellite 1 may, perhaps, be caught at 11h. 44m. On the next night, that of the 18th, satellite 1 will reappear from eclipse at 8h. 54m. 41s. Satellite 4 will be occulted in bright twilight at 7h. 51m. on the evening of the 20th. Under similar unfavourable circumstances, the reappearance of satellite 3 from occultation at 7h. 57m.; the occultation of satellite 2 at 8h. 18m., and the disappearance of satellite 3 in eclipse at 8h. 37m. 44s. will occur during the evening of the 24th. Later, satellite 1 will begin its transit at 10h. 16m.; and its shadow at 11h. 18m. The observation of the latter phenomenon is problematical. The same may be said of the reappearance from eclipse of satellite 1 at 10h. 50m. 3s. on the night of the 25th; of the egress of its shadow at 8h. 7m. on the evening of the 26th, and lastly, of the occultations of satellites 3 and 2 on the 31st at 8h. 44m. in the evening, and at 11h. 2m. at night respectively.

Saturn is now coming into view again, but is only above the horizon for a short time and at very inconvenient hours. He rises on the 1st 49 minutes after midnight; souths at 4h. 54·1m. the next morning; and sets in bright sunlight at 8h. 59m. a.m. On the night of the 31st he rises at 10h. 43m., souths at 2h. 48m. 8s. the next morning, and sets at 6h. 53m. He remains in a very barren region in Sagittarius; and is still far too low down for effective telescopic scrutiny. He is, as mentioned previously, in conjunction with the Moon at 5h. 34m. a.m. on the 26th.

Uranus, very slightly to the east of the position which he occupied last month in Cancer, is so near to Jupiter that, for all practical purposes, the observations which we have made above with reference to the rising, southing, setting, and general visibility of the latter planet, will apply equally to him. He will be precisely south of μ^2 Cancri about the middle of May. His conjunction with the moon at 7h. 58m. a.m. on the 13th has been before referred to.

Neptune is much too close to the Sun to be visible.

It is exceedingly debateable whether anything like a well-determined shower of meteors occurs during this month. If such a one exists it should happen about the middle of May.

Peat Fuel in Canada.—Prepared peat has been used as a substitute for wood on the Grand Trunk Railway of Canada with a result that 100lb. of the peat lasted longer than half a cord of wood. It is reported that those concerned are satisfied of the superiority of the new fuel, the supply of which is practically inexhaustible.

METEORITES.

THE following is the substance of a lecture by David Forbes, F.R.S., delivered at St. George's Hall, London:—After giving a sketch of man's knowledge of the subject from prehistoric times, the lecturer referred to the superstitious ideas which commonly associate the appearance of these bodies with impending calamities, or even the destruction of our globe, and showed that in ancient times amongst the Greeks and Romans, as well as in later times amongst the Tartars and Negroes, meteoric stones were regarded with extreme veneration, and even worshipped as representatives of the gods themselves. The idea of their containing within them treasures, which often, even in this century, led to their being broken into fragments, might, he thought, have originated from the practice, common in still earlier periods, of concealing valuables within the statues of the gods to protect them from pillage. If this custom had prevailed in prehistoric times, it would have led to the discovery of a metal far more valuable to man than gold—viz., native iron, which composes the mass of many meteorites. He believed that iron had been known as a meteoric product ages before it had been extracted from its ores, and he regarded the fable that Vulcan forged the thunderbolts of Jupiter as evidence that the ancient Greeks knew fallen stars or meteorites to be composed of iron; and that the similarity of the Latin word "sideres," the stars, with the Greek "sideros," iron, was more than a mere accidental coincidence. Mention was made of several Asiatic and American nations who, without knowing the art of smelting iron ores, used meteoric iron for their weapons and tools, such as the Mexicans, Esquimaux, and Jakuts. Coming down to historical times, the Chinese were stated to have kept elaborate records of meteors from as early as the seventh century before Christ, which had now been translated and found to be of great value to European astronomers. Allusions were then made to those meteorites mentioned by the ancient Greek and Roman writers, and to the apathy with which this subject was regarded during the middle and last centuries. The modern study of meteorites was stated to date from the publication, in 1794, of Chladni's memoir on the great Siberian iron meteorite, which, although at first received with derision from his advocating the celestial origin of these bodies, directed the attention of the learned to their examination. A description of the phenomena attendant on meteoric falls was next given, with explanations of the causes of these appearances, and it was stated that, besides those which fall at sea or beyond the reach of observation, it had been estimated that 700 must fall per annum on our sphere, or about one each year on a tract of country as large as Great Britain and France. The mineralogy, chemistry, and physical structure of meteorites were next entered into by the lecturer, who remarked that in these respects meteorites are totally distinct from any known terrestrial products, natural or artificial. Of the sixty-four chemical elements which compose our globe, nineteen have been found in meteorites, and as no single element has been discovered in them which was not previously known on earth, it is supposed that the more distant parts of the universe are similar in composition to our sphere. The discovery that meteorites contain hydrogen occluded within them proves this gas to predominate in the space from whence they have descended, and consequently that the atmospheric conditions there must be totally different from those which obtain on the earth. The different theories which have, from the oldest time downwards, been propounded to account for these bodies were next inquired into, and shown to prove that the most probable, and now most generally received, explanation has its germ in a crude hypothesis of the ancient Greeks, and that the united labours of later scientific men, amongst whom Schiaparelli was the most prominent, lead to the conclusion that falling stars, meteors, meteorites, and comets are all similar bodies, differing only in size (probably composed of fragments of planetary bodies drawn within the influence of the sun's action), which from their extraordinary elongated orbits do not form part of our system as at first constituted, but are falling stars bearing the same relation to comets as asteroids bear to planets. In conclusion, the lecturer drew attention to the question of the utility of meteorites in the economy of nature—the two suppositions advanced being, first, that of Mayer, who maintained that by their falling into the surface of the sun they restored to it the heat which it loses by radiation to this earth and other parts of the universe; whilst the second is the startling hypothesis advanced last year by Sir William Thompson, that the origin of life on our globe, and introduction from time to time of new species, is due to the arrival of aërolites, which, being fragments of other worlds upon which life already existed, have carried with them the germs of seed, or even "living plants and animals." This later hypothesis the lecturer strongly protested against, both because the received theory of meteors teaches that they are bodies which have been revolving, probably for countless ages, in space devoid of atmospheric conditions; and because we find that meteorites have been so heated as actually to melt and vitrefy their external surface: so that no vegetable or animal seed or germ, could be expected, under such conditions, either to retain its vitality, or to reach the earth unconsumed.

THE NEW PHOTOGRAPHIC PROCESS.

THE new urano-bromide emulsion process, devised by Colonel Stuart Wortley, was made the subject of a paper recently read before the Dry-plate Club, from which we abstract the following details:—

It will not be necessary for me to occupy much of your time in giving you the formula, as simplicity is one of the most prominent features of the process; and you are all so well versed in the various technicalities of dry-plate photography, that the minor details need not have much time wasted over them. My search has been particularly directed to two points—one, the obtaining of a negative by a dry process which should have as much delicacy and quality as a wet negative, in opposition to the hardness usually associated with dry plates; and another, the preparation of an emulsion which will keep in a highly-sensitive condition, without change, for a month or six weeks. To do this I have availed myself of certain properties possessed by the nitrate of uranium.

A long series of experiments undertaken when I was working the Wothlytype process convinced me that a delicacy of image greater than could be obtained by other means was secured by the use of that salt; and as the collodion prepared and sensitised for Wothlytype remained in a sensitive state for years, I felt sure that I should obtain important results by using nitrate of uranium in combination with bromide and nitrate of silver. You will remember how strenuously I advocated last year the necessity of a very large excess of nitrate of silver if great sensitiveness were required in an emulsion, and I do not depart in any way from anything that I then said. In point of fact, every grain of nitrate of silver that is added to an emulsion up to saturation increases the sensitiveness of the resulting emulsion. Although nitrate of uranium is capable to a certain extent of replacing nitrate of silver, I do not prefer to use it in that way where great sensitiveness is required; on the contrary, I still use plenty of silver, and use the nitrate of uranium to give stability to the emulsion, extra sensitiveness, delicacy of image, and a power of restraining fog analogous to that possessed by free bromide, but without the loss of sensitiveness and other injurious tendencies which accompany the use of the latter.

Another remarkable point in connection with nitrate of uranium is the great advantage it has where redevelopment is required, as the uranium in the film is acted on by the silver in the developer, and great additional power is thereby obtained. I have made many experiments as to the use of the nitrate of silver and uranium separate, but have not succeeded so well as by combining them in an emulsion. I recommend you, if you wish to try the process, to commence with the following formula:—

Plain collodion	1	ounce.
Pure anhydrous bromide of cadmium..	7	grains.
Nitrate of uranium	30	„
Nitrate of silver	18	„

Samples of nitrate of uranium vary considerably, and I purify what I use in the following manner:—Dissolve one part of uranium in two parts of ether, and let stand for some hours; the water of crystallisation that is in the uranium will fall to the bottom of the bottle, leaving a top layer of ether containing pure uranium, and it is this top layer which is used for the preparation of the emulsion.

I think it is desirable that the nitrate of uranium should be acid; and should it not, after solution in ether, give an acid reaction to test paper, it will be advisable to add to it a minim or two per ounce of acid. Both nitric and acetic have answered in my hands, and, on the whole, I should be inclined to recommend the former. It must be remembered that great caution is to be exercised in the use of a mineral acid in collodion, as if too much be used the film becomes rotten and breaks up in washing.

This brings me to a point which I am anxious to impress strongly upon you—viz., that to succeed with an emulsion process the first and most essential requisite is to have a collodion suited to the work. Some kinds of cotton give a collodion from which a good result cannot be obtained, and I feel sure that many experimentalists fail in getting an emulsion to work satisfactorily from the use of a collodion unsuited to this peculiar work.

I hope this process may have a fair trial at your hands, and I must ask you not to forget that it is one of entire novelty, and that the conditions of its working are somewhat different to those of any process with which I am acquainted. I say this because there is an unfortunate tendency among photographers, when they try and do not succeed to their satisfaction with a new process, to throw the blame of their failure upon it; whereas, in truth, the blame should be laid upon their own imperfect acquaintance with the conditions of the process, or, what is still more likely, that they are using chemicals which are unsuited to the peculiarities of the process.

With regard to the development, I think I need not take up much time on that subject. I will say, however, that I prefer to use a strong alkaline developer. And here, again, nitrate of uranium has its use, as it certainly enables one to use (combined with its other good qualities) a developer sufficiently strong to render the development of a dry plate no longer a tedious operation. One point I must here ask leave to impress upon you strongly—namely, the great latitude allowable in the development of a plate with this emulsion, whether used wet or dry. In either of these cases the amount of bromide in the developer has a marked effect on the result. If, then, very sensitive negatives are required, or very rapid development, use bromide in the developer in minimum quantity. If, on the contrary, you like to be slow and sure, use plenty of bromide, and take your time about the development. Again: always intensify, if intensification be required, before fixing, so as to utilise the uranium in the film. One last point:—The light in your dark room must be as orange as possible, and a light which is quite sufficiently orange for the wet process will not be orange enough for working the emulsion process.

I may mention that, having been consulted by many friends as to the peculiarity of various dry plates that they were experimenting on, I found out in many cases that the failure was due to the weakness or badness of either the pyro. or the carbonate of ammonia. The pyro. that is used should certainly be of the best kind, and the carbonate of ammonia, as you are doubtless aware, varies much in its qualities, and in an old sample it frequently happens that but little ammonia is present.

I will not occupy your time with a discussion on preservatives, particularly as every one has, in all probability, a pet one of his own. I am somewhat pleased with my own latest one, however, as it possesses two peculiar advantages—one, in that it keeps any time after it is made; and another, that it obviates any tendency to blistering of the finished plate. I have brought down this negative to show you what, in my opinion, is the quality of negative we should seek for in a dry plate. It was taken with fifty seconds' exposure in my studio, with Dallmeyer's rapid rectilinear lens for 18 × 16 plates, of 28in. focus, and yet you will notice that under those adverse circumstances it has borne a somewhat pushing development without losing the delicacy of its lights, or bringing any fog into the shadows.

SOME RECENT IMPROVEMENTS IN ENGLISH AND AMERICAN BOILERS.*

By W. Forsyth Black.

ANOTHER most important enemy to combat is incrustation. In all cases it is a bad conductor of heat, and prevents the contact of the water with the plates of the boiler, so that they become overheated, and are, consequently, rapidly destroyed. Circulation of water in a boiler depends on the difference in weight of two columns, the lighter of which is displaced by the heavier. To produce this we must have one column or body of water exposed to the heat, by which means it becomes lighter, and the other protected from the heat, that its descent may not be prevented; as thus it remains heavier than the former by its lower temperature.

The following may be considered the essential principles to be observed in the construction of a good boiler, both for the economical raising of steam-power, and for the prevention of destructive explosions.

1. A steam-boiler should be constructed of the greatest practicable number of parts, or, as Mr. Miller calls them, "units," so that the giving way of one of these through excessive pressure will relieve the whole boiler.

2. Each part or unit should constitute, so to speak, a complete boiler, having its water space exposed to the fire, its steam space above the fire, and a receptacle for sediment below the influence of the fire.

3. All heating surfaces should be as nearly vertical as the principle on which the boiler is constructed will permit to the plane of the fire.

4. Free and perfect circulation of the water should be secured by exposing thin films of water to the heat, which water shall ascend, and large spaces for the water not exposed to the immediate action of the heat, which water from its lower temperature shall descend.

The most striking feature in the boiler I shall now proceed to describe is that cast iron is the material employed in its construction. This description of metal is an excellent conductor of heat, and when the material itself, or the form of the boiler, may be imperfect, a timely warning will be given by cracking, even under low pressure, when fire is applied, and when it breaks or gives way the fracture that ensues is sharp and square.

The strength of a boiler does not ultimately depend on the tensile strength of the material of which it is constructed, it depends primarily on the adaptation of its form to resist internal pressure, not on the strength of its weakest part to resist rupture. The extreme strength of Low Moor plates is 65,000lb. to each square inch of cross section, and that of cast iron of good quality is 40,000lb. Sir William Fairbairn has given it as the result of careful experiment that 25 per cent. must be deducted for even perfectly riveted joints, which approximates it more nearly to the cast iron strength. There is another element of weakness in wrought-iron boilers of the ordinary form which should not be lost sight of, and that is the great strain and even distortion to which several of the plates have to be subjected to bring them into the desired form. The plates so treated are stretched, pulled, and hammered sometimes more than the iron can bear, and their strength is, consequently, much diminished before they are fixed in the boiler.

There are few, if any, explosions which are not traceable to ignorance, carelessness, or cupidity on the part of somebody—the engineer, the manufacturer, or the purchaser of a boiler either known to be insufficiently and poorly constructed, or of which nothing whatever is known. It is impossible to guard against such things, but it is surely not impossible to construct a boiler of such form and material that its explosion shall occasion the least possible disaster to life or property, and that such explosion shall be localised, that this most essential end shall be obtained; and, in addition, that by such localisation, repairs shall be effected at the least outlay of labour and money.

The American cast-iron safety boiler, designed by Mr. J. A. Miller, of New York, has been proved successful from an experience of three years in this country, not to speak of what has been done in the United States, where it has been very largely employed. This boiler, as shown in the engraving (Fig. 2), is formed of cast-iron sections or units of two kinds. A series of one of said sections or units is employed over the firegrate, and a series of the other for the portion beyond the firegrate. Each section or unit is cast in one piece, and tested separately to 500lb. by hydrostatic pressure. The front units (Fig. 4) are arched, and are shaped like a U turned upside down, with a pipe at top for conveying the steam to the steam connecting pipe. The rear units (Fig. 5) consist of five vertical tubes cast in one piece, united by a transverse horizontal tube at top and bottom, and finished at top with a flange joint, to which is fixed a cover from which small pipes take the steam on to the steam connecting pipe. The several sections are bolted together at the bottom by flange joints, the front arched units at one leg, and the rear units a single connection in the centre; these connections form continuous longitudinal tubes at the bottom of the boiler, which are closed by flanged cap at each end, as shown in the drawing. The tubes of the front of fire-box units are 7in. diameter inside at bottom, and 6in. at top, and 2ft. 4in. wide in the arched opening; the vertical tubes of the rear units are taper in form, 4in. diameter inside at bottom and 6in. at top, and they are 2ft. 6in. long in the vertical portion, with an average of 2in. clear space between the tubes. The connecting flanges of the rear units are placed out of centre with regard to the tubes, so that simply reversing the units when fixing them together brings the space between the tubes of one unit opposite the tubes oi the next unit for the purpose of more effectually intercepting the flame and heated gases. The castings are ¾in. thick, the rear units weigh about 10cwt. each, and the front arched units about 5cwt. each. Special provision is made for maintaining the circulation in each part of the boiler. In the front arched units a feather is cast in each leg of each unit, and extends from nearly top to bottom, and by this means the ascending current of heated water on the inner or fire side is separated from the cooler water on the outer side of this diaphragm.

In the rear units an internal circulating tube is suspended in each of their component vertical tubes, causing the heated water to ascend through the outer annular space, and the cooler water to descend within the circulating tube, which is of cast iron, and is held in its central position by circular snugs cast on it.

The steam is carried from the top of each of the units by a 2in. wrought-iron pipe branch bent at right angles. These branch pipes are connected to a main horizontal steam pipe of cast iron ... diameter, which extends the whole length of the boiler, and is carried outside the brick setting.

The branch pipes are connected with thi...

FIG. 2

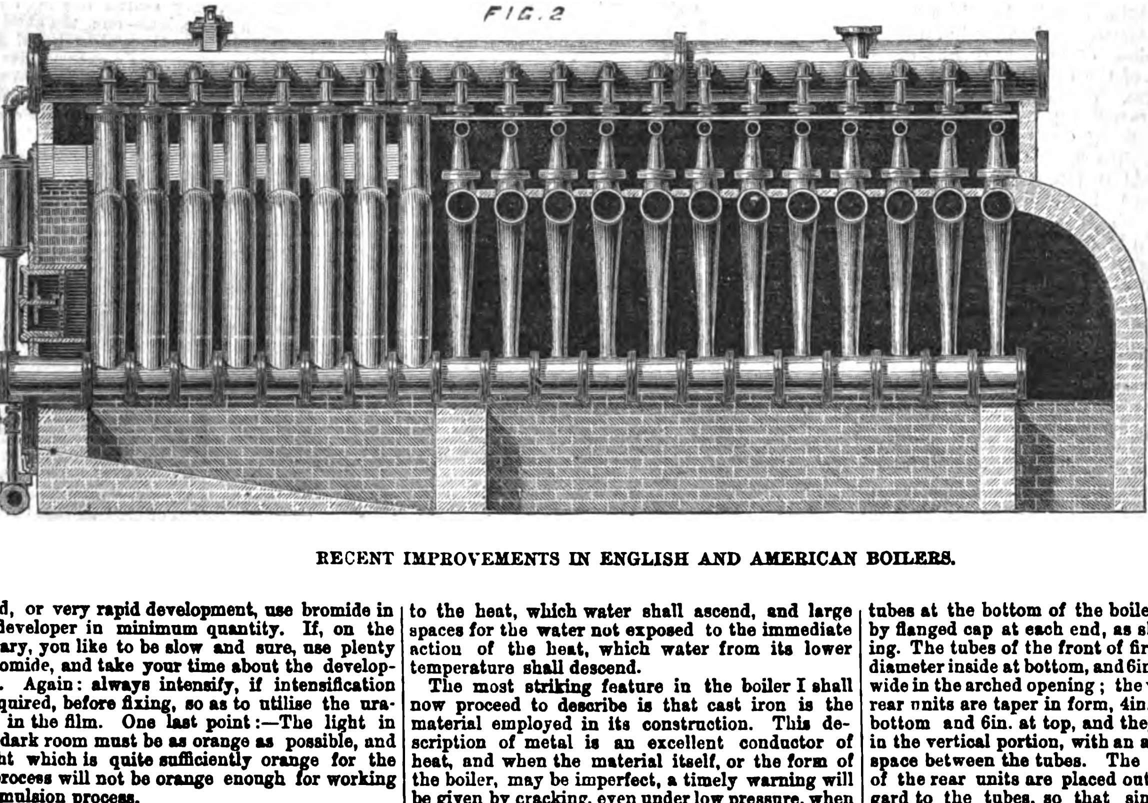
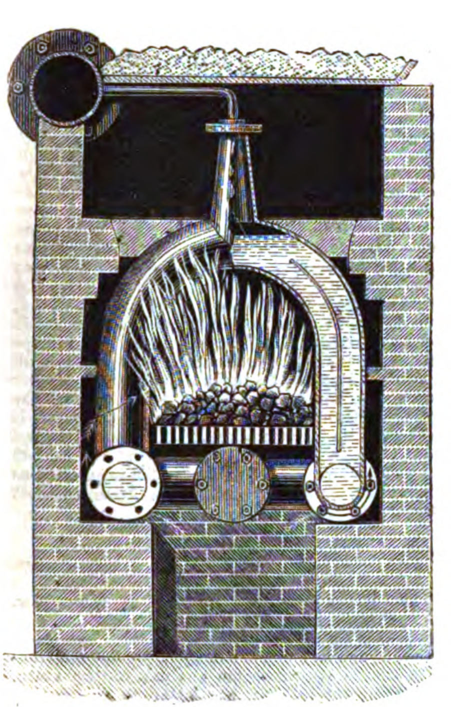


FIG. 3

RECENT IMPROVEMENTS IN ENGLISH AND AMERICAN BOILERS.

* Read before the Civil and Mechanical Engineers' Society.

Fig. 4.



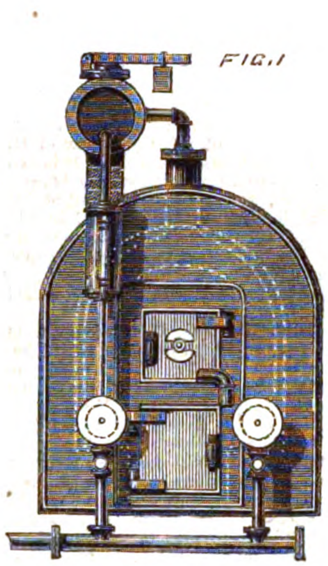
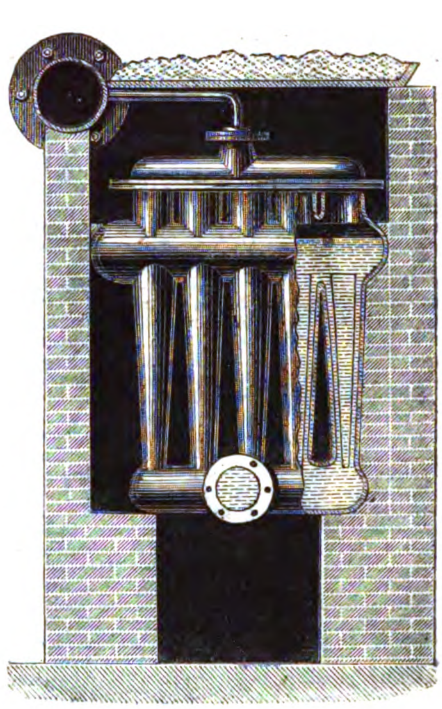


Fig. 5.



RECENT IMPROVEMENTS IN ENGLISH AND AMERICAN BOILERS.

connecting pipe and with the several units by flanges. The expansion of the cast-iron units when these are heated does not affect the joints, because in the case of the rear units the separate castings are connected together at the bottom only by a single joint, and are thus free to expand without any injury. In the front arched units the effect of expansion is to widen the arch to the extent of about three-eighths of an inch; the arched units are connected to the first of the rear sections for the purpose of affording a continuous water-way through the whole length of the boiler, but as this connection is at one end only they are left otherwise free to expand. The wrought-iron pipe branches connecting the units at top to the main horizontal steam pipe readily spring to a sufficient extent to allow for the excess of expansion of the units without throwing any objectionable strain on the joints.

The joints of the flanges are all carefully and truly faced, and put together with wire gauze and red lead; so that they can be readily separated and re-made if required; they are all finished to a standard template, so that any portion of the boiler can be readily removed and replaced, without disturbing the other units; for the front units are all duplicates, as are also the rear units. The front units are all to the same length of 11in. at the bottom joint, and the rear units to 12in. All joints are so placed that they are thoroughly protected from the fire, and are found to continue steam-tight. The bottom connecting joints are all below the level of the fire, those of front units being below the firegrate, and those of the rear units are covered by the deposit of dust in the bottom of the flue. The joints at the top are protected by a layer of brickwork which rests on the castings (Fig. 2), and the rear units are cast with a small projection which fills up the small spaces between the round parts at water-line, and thus a close top to the flue is formed. The whole boiler is inclosed by side walls of brickwork, which are carried up above, and the top is covered in with loose cast-iron plates that can be readily removed for inspection. A large sight hole with cast-iron cover plate is made in one side wall opposite every alternate unit, which allows of all the surfaces of the cast-iron tubes being cleaned from soot and dust by means of a jet of steam introduced by a flexible pipe through each of the holes in succession; this operation is repeated daily.

Blow-off cocks are fixed on the front ends of the two bottom side tubes, by which means all sediment forming in the boiler is regularly blown out at frequent intervals; the boiler is usually completely blown down once a week, and a small portion of the water is also blown off three times each week. Any deposit accumulating in the bottom portions of the boiler can be raked out when necessary by taking off the flanged bottom covers at the ends of the boiler. The feed water is introduced at the bottom of the boiler below the fire-level. The feed pipe is connected to one of the bottom main pipes of the first arched unit and to that of the first rear unit. The experience of three years' continuous working of this boiler has proved that when it is periodically blown out under pressure, sediment does not injuriously collect in any of the parts that are exposed to the heat of the fire or flue; and the crowns of the arched units which are directly acted on by the fire are found to be completely free from scale. In one instance one of these boilers had not been blown down for a period of seven months, and during that time had been kept at work almost constantly night and day; and the first of the rear units became entirely choked with scale in all the vertical tubes save one, and a crack took place in that tube at about the middle of its height. The fracture, being in cast iron, had a clean sharp edge. The water escaped through the crack, and the steam pressure was eased by this means without any other injury being inflicted, and without any of the brickwork being displaced.

The cast iron bears the heat without injury, because the steam is carried off as quickly as it is generated, and an efficient circulation is constantly maintained, so that the metal of the tubes is constantly protected by having solid water always in contact with it. This boiler has also been applied to balling and re-heating furnaces at iron works, and it appears to stand their great heat without injury.

(To be concluded next week.)

POSITIVE PHILOSOPHY AND MEDICINE.

M. LITTRE has lately published, under the title of "Médecine et Médecins," a series of fragments which had already appeared in various periodicals. He relates in his preface, says a writer in the *Pall Mall Gazette*, that, although he has no medical title and is not a doctor, he has none the less been half a physician all his life. He had completed his medical studies in 1827, and was about to go in for examinations, when the death of his father stopped his medical career by obliging him immediately to seek remunerative occupations. He soon devoted himself almost entirely to the dictionary of the French language undertaken by M. Hachette, but the curiosity of his philosophical mind, his early studies, the personal ties which bound him to famous physicians, always brought him willingly back to medical questions, especially to these in their relation to general science and Positive philosophy.

"Medicine," says M. Littré, "was at the time I began to study undergoing a considerable amendment in doctrine; until then pathology had been considered as a phenomenon which had its cause of being within itself; it was held that disease, fever, inflammation, cancer, was something possessed of independent existence, and having laws of its own. Thus, no connection was supposed to exist between the pathological condition and the physiological; the first was merely superinduced on the second, and the second did not lead to the first. This view was inevitable so long as physiology had not become positive; but it became so at the beginning of this century, and after the interval of time necessary for spreading the influence of the great methods it renewed the whole doctrine of medicine. It became established that no new and peculiar law is manifested in disease; that pathology is nothing but disordered physiology."

"This saying," observes a critic in the *Temps*, "is decidedly happy, and well describes the present state of science. It is certain that there is not, from a philosophical point of view, any sharply defined boundary between health and disease.

Nascentes morimer, finisque ab origine pendet.

The idea of development has not only been followed in the chain of organised beings, in the successive phases of the individual, it has been sought in the history of each anatomical element. Disease is but a disturbance in the development of certain anatomical elements determined by various causes. The experimental method has, of late years, been led into new ways unknown to Auguste Comte; the works of Claude Bernard and his school lead us much further into a knowledge of the organised being than the works of the medical men who have been M. Littré's contemporaries. And yet is not M. Littré surprised that M. Claude Bernard's conceptions have gradually assumed a character which differs more and more from those of the Positivist school. There are phenomena which seem withdrawn from any explanation derived from the purely descriptive and experimental method. Great surprise, for instance, was felt at first on seeing that if a fragment of periosteum be grafted on any fleshy part of the body, the fragment receives nourishment, assimilates the sanguineous elements it requires, develops itself, and becomes a rudiment of bone. Up to this point the phenomenon seems wholly favourable to the materialist school; anatomical elements appear to have a life of their own—a life independent of a more general existence, of a geometrical design, or of a functional arrangement. But what happens? Nature, deceived for an instant, so to speak, soon resumes her rights; that beginning of bone which has no part to play, which would be monstrous if it lasted, does not last; life undoes what it had itself begun; little by little the anatomical elements put out of place become atrophied, are reabsorbed, are drawn into the circulation, and rejected. How is such a phenomenon to be explained? May not the so-called spiritualist school find its account herein? Has it not a right to proclaim that life, that its forms, are subject to laws the expression of which cannot be found in simple contact and in the properties of anatomical elements alone? Is there not here an appearance of a design, of a pre-established anatomical harmony? I merely state the problem. I well know that the Positive philosophy disclaims being either spiritualist or materialist, it has given up searching into causes, and studies only phenomena. But the medical school which has sought its patronage is generally much more inclined to materialism than to spiritualism; and the most serious reproach one can make to it is a dogmatic tone and habits of assertion which seem to exclude all doubts, all hesitations. There is nothing, and perhaps there can be nothing, finished and perfect in the sciences which relate to life. In M. Littré's fine essay on Magendie will be found the most complete exposition of the principles of Positive philosophy in the matter of biology stripped of the exaggerations of some of its disciples. Magendie loudly confessed his ignorance when it came to explaining those vital phenomena which he observed with such rare penetration: 'If I know by what mechanism a membrane imbibes a liquid, I seek in vain that which makes the muscular fibre contract or renders the nerve sensitive.' M. Littré adds that Magendie was quite right to confess his ignorance of this, but this ignorance is neither accidental nor provisional. It is necessary and permanent. The physiologist is not, in regard to the property which renders the muscle contractile and the nerve sensitive, in any other position than the physicist in regard to the property which renders matter electrical, heavy, hot, or luminous. According to M. Littré, no more explanation can be given of physical or chemical qualities than of vital qualities. Science has completed its work when it reaches irreducible things—weight, electricity, life. Life is not in itself more capable of explanation than electricity or heat. One may also invert the proposition, and say that it is not in itself less explicable, and when one is imbued with this thought one is drawn into seeing nothing more complex and more marvellous in the phenomena of life and thought, than in the most ordinary phenomena of inorganic nature. A man who thinks, a stone which falls, are two irreducible phenomena; they exist, and that is all that can ever be known about them. Does not Positive philosophy, which has waged such a war against occult qualities, bring them to life again under another name, and without intending it?"

COAL-CUTTING MACHINERY.

THE importance of adapting machinery to the winning of coal, which, for the most part, has hitherto been accomplished by manual labour, has again, says the *Engineer*, been forced upon inventors and patentees by Mr. W. Firth, of Leeds, who has generously offered £500 to be given for the machine that will bore or hole in the most perfect manner, so as to reduce the quantity of manual pick labour to the minimum. This seems to be about the third attempt which has been made by prizes to induce patentees to develop and perfect this class of machinery. In 1864 the South Yorkshire Coalowners' Association announced their intention of subscribing £500 towards the cost of putting down three machines at as many district pits. The choice fell upon that of Mr. G. C. Jones, of the Elaina Ironworks, Monmouthshire, which consisted of a cylinder bedplate and bearing all in one casting supported on four wheels, the pick was so arranged that it could be fixed in any position, by which means vertical, horizontal, or angular grooves could be cut. After a time the machines were, however, withdrawn. From this time to 1867 no pecuniary inducements were held out, but patentees still contended against the innumerable difficulties which surrounded their track; some of them, as Mr. Firth, of Leeds, expending thousands of pounds in order to perfect as much as possible their own machines. Towards the close of 1867 the members of the South Lancashire and Cheshire Civil Association announced their intention of giving £800 divided in three prizes "for the best machine which, in the opinion of the committee appointed for that purpose, shall be most suitable to the requirements of the trade." To all appearance the progress and development which coal-getting machinery was likely to derive from this liberality promised to be great. This, however, was not the case, as when the conditions were announced it was found that patentees would not contend in consequence of the following clause:—"Inventors taking a prize must be bound by the following conditions, viz., that no annual payment or tonnage royalty as patent right shall be charged to any present or future member of the above association, but that such member shall pay a patent right on the purchase of each machine, to include the working thereof, which patent right shall in no case exceed 50 per cent. of the cost of the machine." This and other conditions caused only three competitors to send machines to be tested, and the committee withdrew the money prizes and substituted three medals. After a period of nearly five years another incentive is offered by Mr. W. Firth, who has deposited £500 in the names of three trustees with Messrs. William Williams, Brown, and Co., bankers, Leeds, pending a trial. That gentleman has expressly stated that the charge made by the owner for royalty or license shall not be a matter for the judges to consider, their decision being founded solely upon the relative merits of the machines produced for competition, so that the rock upon which the Lancashire and Cheshire competition foundered is clearly pointed out, or rather removed. Having pointed out the inducements, we might give a long list of machines which have from time to time been patented or otherwise produced. Many of the oldest pitmen in Northumberland are well acquainted with what was termed "Willie Brown's Iron Man," a machine now being used in the district collieries, as well as in the Scotch coal-field. In 1859 Messrs. Johnson and Dixon, of Newcastle-upon-Tyne, invented a machine which was successfully tested at the Broomhill Colliery, Northumberland, although the pit was worked on the pillar and stall system. In 1862 Messrs. Firths, Donisthorpe, and Ridley, took out a patent for a machine which was set to work in these pits, and, we believe, has remained in use, with the exception of short intervals, when repairs, &c., were necessary. The machine has from time to time been improved, and has stood the test remarkably well. Amongst the more recent inventors may be mentioned Messrs. Copley and Gillot, of South Yorkshire; Mr. Bartholomew, of Doncaster; Mr. Rothery, of the Waterloo Main Colliery, near Leeds; Mr. S. P. Bidder, of Harecastle Colliery, Stoke; Mr. Hurd, Wakefield, &c. Mr. Chubb's coal-breaking machine, which has recently been introduced into several of the Yorkshire collieries, is also working very successfully.

THE BISULPHIDE OF CARBON ENGINE.

THE following remarks on Ellis's bisulphide of carbon engine (illustrated on p. 526) were made by Dr. Vander Weyde at a meeting of the New York Polytechnic Club:—Mr. Ellis, of Boston, has lately constructed a bisulphide of carbon engine, using the waste steam from the engine to heat the bisulphide of carbon, and work another piston attached to the same engine. There have been two objections made to this, which I wish to answer. One objection is that we might just as well have two steam cylinders, making a compound engine, the steam from a high-pressure engine working a low-pressure engine. The other objection is, that if we are to use the bisulphide of carbon, we do not need the steam, and I will reply to this objection first. Volatile substances require very little heat to convert them into vapour. Water requires a temperature of 212 deg. to vaporise at atmospheric pressure, and 966 units of heat become latent. But ether will vaporise at 96 deg., and only 165 units of heat are required. That is an immense saving of fuel. On that idea, some 15 years ago, an ether engine was built at the Novelty Works, New York. But practical difficulties came up. First, it was difficult to get the joints tight; and when it leaked it took fire, and alarmed every one. Another difficulty was, that the latent heat was so much by weight, and the vapour of ether is nearly seven times as heavy as steam. It is a curious property of vapours, that whatever the temperature of vaporisation, and whatever amount of heat becomes latent, in units, the amount of latent heat in a cubic foot of vapour, is always the same; and as engines are driven, not by the weight of the vapour but by its volume, that takes away all the supposed advantage of volatile fluids with regard to their latent heat.

The first objection was, that we might as well use the steam from a high-pressure engine to drive a low-pressure engine. The simple answer to that is, that all the pressure you get from the waste steam becomes back pressure on the first engine, and you have all the machinery and friction for nothing. But if you pass your waste steam freely through tubes which heat bisulphide of carbon, there is no back pressure, and the pressure you obtain from the vaporisation of the bisulphide of carbon is a clear gain. Fairbank and Dunkin, in England, founded a method of judging of the performance of steam-engines, by measuring the water of condensation, as it was done in the recent trial at the American Institute Fair. In the best steam engine, the water of condensation is warmed somewhat, and that amount of heat is lost. Now let us see what is the pressure with different vapours:—

Ether.	Bisulphide of Carbon.	Water.	Pressure.
95 deg.	110 deg.	212 deg.	1 atmosphere.
115 „	130 „	250 „	2 „
125 „	119 „	276 „	3 „
133 „	148 „	291 „	4 „

Now, if we take the steam at 212 deg., you see that it will produce a pressure of much more than 4 atmospheres in the bisulphide of carbon. It is asserted that, by this engine, a nearer approach has been made to theoretic perfection, in the power produced, than ever before.

Another point. In heating water from 212 deg. to about 218 deg., you double the pressure; so that at least 2 deg. are necessary for every pound of additional pressure. But if you heat it to 500 deg., where the pressure is 50 atmospheres, then 15 deg. will produce 15 atmospheres more pressure, or a whole atmosphere for every degree. Here we have to keep the water at 500 deg. and upwards: but there are other liquids that do not require that temperature. Take the liquefied carbonic acid gas, which boils at 148 below zero. Heat it to 100 deg. below zero, and you have 2 atmospheres pressure; an additional atmosphere for about 48 deg. But heat it to 32 deg. and you have 32 atmospheres; and at 50 deg. you have 50 atmospheres, making a whole atmosphere for every degree. It is only necessary, then, to maintain the ordinary atmospheric temperatures, and in the summer all you have to do is to heat with the atmospheric temperature, and to cool with ice. Your engine will require no coal. But you will have this drawback, that melting ice only consumes 140 units of heat, whereas the combustion of coal gives out 14 000 units of heat. For every pound of coal, therefore, you will want 100lb. of ice; and ice is not so easy to keep, especially in the summer, as coal. Another difficulty is that the boiler must be strong enough to stand 50 to 65 atmospheres of pressure. Of course, this whole plan is intensely absurd; but as Cicero said that no theory was so absurd that no man would adopt it, so in mechanics, no plan is so absurd that no one will try to carry it out; and there is a young gentleman now endeavouring to carry out this plan. He will have a back pressure of 50 atmospheres on his piston—a very respectable back pressure.

SILICIAN STEEL.

A SERIES of very interesting steel-making experiments have lately been made in Cleveland, Ohio, which are said to have been completely successful. The materials used were "Silician" ore, mined in York County, Pa., and common Lake Superior pig, puddled together and making steel. Some time since, to solve its doubts, the Cleveland Iron Company ordered several tons of this ore for an experiment. The shippers gave directions as to how it should be used, and 12 per cent. of the pulverised ore was added to a furnace of common pig iron. The mass was worked in the same manner as if bar iron was to be produced, and in one hour after passing through the same operation as the bar does the company had several tons of very fair steel. Tools were made from it. A bar was sent to a manufacturer of springs, and he pronounced it the most tenacious and malleable he had ever tried, and the company immediately secured a contract with an Ohio railroad company for five hundred tons of steel rails. Last week, having procured a quantity of the ore, the Otis Works, of Cleveland, also made an experiment. The per cent. of the "Silician" ore was increased to twenty, the mass was put through the same process as common bar iron, and the result was steel, which has been pronounced equal to any which the cutlers of England can produce. A manufacturer of cutlery in that city gave some of the steel a thorough trial, and he says of it: "Although drawn from ingot to the small sizes we use for blades under very unfavourable circumstances, it comes out, when worked down and hardened, as fine almost as silver—finer even than the best English steel we ever used. It seems to work well all the way through; it works kindly under the hammer, scales well when hardened, polishes black when finished, edges right on the oil-stone, and cuts well and holds an edge. Could I get this steel in the right shape and size, I should like to use it for pocket-knives all the while." Desiring to make a further and severer test, a specimen of the steel was sent to the Remington Manufacturing Company, to see how it would work up in a gun-barrel. The barrel passed through the tests, and was only burst when filled with powder and discharged. It has been tried as springs for watches and clocks, and found to meet every demand required.

THE STAR DEPTHS.

MR. RICHARD A. PROCTOR, Hon. Sec. R.A.S., gave his second lecture on this subject last Saturday at three o'clock. The first portion of the lecture was devoted to the consideration of the spectroscopic analysis of the stars, and its interpretation; the latter to the double stars, and star systems generally. About twenty illustrations were exhibited by means of the electric lamp (worked admirably by Mr. Ladd). Some of the coloured illustrations were of great beauty. Five photographs of the eclipse of December 12 last, taken by Mr. Davis at Baicull, were exhibited, as illustrations of the appendages which we must conceive to surround all the stars regarded as so many suns.

THE DOMESTIC USES OF AMMONIA.

THE utility of ammonia in various domestic transactions is not unknown to many of our readers, nevertheless, it is not so widely recognised as it might be, save when presented under some fancy name at an exorbitant price. We extract the following remarks upon the subject from the *Country Gentleman* (U.S.), with the qualification, however, that the ammonia used for horticultural purposes is invariably the sulphate, which should be dissolved in the proportion of ½oz. to 2 gallons of water:—Ammonia is nearly as useful in housekeeping as soap, and its cheapness brings it within the reach of all. For many household purposes it is invaluable; yet its manifold uses are not so generally known as they should be. It is a most refreshing agent at the toilet table; a few drops in a basin of water will make a better bath than pure water, and if the skin is oily, it will remove all glossiness and disagreeable odours. Added to a foot-bath, it entirely absorbs all noxious smell so often arising from the feet in warm weather, and nothing is better for cleansing the hair from dandruff and dust. For the headache it is also a desirable stimulant, and frequent inhaling of its pungent odours will often entirely remove catarrhal cold. For cleansing paint, it is very useful

[Doubtful. Will it not gradually remove the paint?] Put a teaspoonful of ammonia to a quart of warm soap-suds, dip in a flannel cloth, and wipe off the dust and fly specks, grime and smoke, and see for yourselves how much labour it will save you. No scrubbing will be needful. It will cleanse and brighten wonderfully; to a pint of hot suds mix a teaspoonful of the spirits, dip in your silver spoons, forks, &c., rub with a brush, and then polish on chamois skin. For washing mirrors and windows, it is also very desirable; put a few drops of ammonia upon a piece of newspaper, and you will readily take off every spot or finger-mark on the glass. It will take out grease spots from any fabric; put on the ammonia nearly clear, lay blotting paper over the place, and press a hot flat iron on it for a few moments. A few drops in water will clean laces and whiten them finely; also muslins.

For cleaning hair and nail brushes it is equally good. Put a teaspoonful of ammonia into one pint of warm or cold water and shake the brushes through the water; when the bristles look white, rinse them in cold water, and put into the sunshine or in a warm place to dry. The dirtiest brushes will come out from this bath white and clean. There is no better remedy for heartburn and dyspepsia, and the aromatic spirit of ammonia is especially prepared for these troubles. Ten drops of it in a wineglass of water are often a great relief. The spirits of ammonia can be taken in the same way; but it is not as palatable a dose. Farmers and chemists are well aware of the beneficial effects of ammonia on all kinds of vegetation; and if you desire your roses, geraniums, fuchsias, &c., to become more flourishing, you can try it upon them, by adding five or six drops of it to every pint of warm water that you give them; but don't repeat the dose oftener than once in every five or six days, lest you stimulate them too highly. Rain-water is impregnated with ammonia, and thus it refreshes and vivifies vegetable life. So be sure and keep a large bottle of ammonia in the house, and have a glass stopper for it, as it is very evanescent and also injurious to corks, eating them away.

THE PROGRESS OF GEOLOGY.—CONTAMINATION OF WATER SUPPLY.*

(Continued from p. 116.)

IT has been already mentioned that below a certain level permeable strata are necessarily always saturated and water logged, and that any additional quantity added to this constant quantity cannot be held permanently. It follows that wherever, in all water bearing strata, after allowing for any abstraction, usually but comparatively small, by wells, the surplus rainfall must, when the stratum is full, find its escape by natural means, *i.e.*, by means of springs. The power and size of these are necessarily dependent upon the dimensions of the strata by which they are supplied. In the gravel they are small, in the Lower Tertiary sands moderate; while in the Chalk they are very large. The permanence of the spring depends on the lithological character, as well as on the dimensions of the strata. Thus, in sands, where the water can permeate the mass, the stores are large, and the delivery moderately quick; in Limestones, where the water is confined to cracks and fissures, the delivery is quick and not lasting, though often large; in rubbly Oolites, which are also practically porous, the springs are well maintained; while in Chalk, owing to the characters before named, the water delivery is slow, and the springs are large and very permanent.

At the same time the storage capacity increases with the resistance. Taking the extreme case of the Chalk, the transmission of the rain water is so slow, that, on the chalk hills, it takes four or six months to pass from the surface to the line of water level at the depth of 200ft. to 300ft., so that the heavy rainfall of winter is not felt in the deep springs until the summer, and Mr. Beardmore estimates that the minimum effect of a hot dry summer and autumn is not reached until at the end of about sixteen months, or that the storing power of the chalk is of sixteen months' duration. To estimate this power we have to take the height and extent of the hills, and to note the lithological characters of the permeable strata. If these latter are underlaid by impermeable strata at above the level of the rivers in two adjacent valleys, then the base of the underground water store will be coincident with the level of the impermeable strata, and its surface line will rise, as it recedes within the hill, in proportion to the resistance offered to the water's escape by the character of the permeable strata, and it will thus form a curve between those two points, the height of which will vary in proportion to the rainfall. When, on the other hand, the permeable strata continue down to a greater or less depth beneath the surface of the adjacent rivers, then, as there is no underground escape for the stored water, the line of water-level on these permeable strata will rise to, and be always maintained by, the level of the rivers, and therefore all the additional supplies furnished by the rain must, after traversing the interior of the hills, find an escape along the bottom of the valleys, and by the side or in the bed of those rivers.

The same general rules govern the springs of all the more varied strata of the upper part of the Thames basin, where, in place of the Cretaceous and Tertiary series, we have a series of Jurassic and Liassic strata. Omitting the drift or gravel beds, the following are the average dimensions, character, and superficial areas of each of these formations in that area:—

STRATA OF THE THAMES BASIN ABOVE WALLINGFORD.

	Area.	Average Thickness.	
	Square miles.	Permeable strata.	Impermeable strata.
Chalk (above Kingston 1047)	60	1000	—
Upper Greensands	62	100	—
Gault	129	—	130
Lower Greensands	23	200	—
Purbeck and Portland beds	46	60	—
Kimmeridge clay	132	—	300
Coral Rag and grit	103	40	—
Oxford Clay	307	—	400
Great and Inferior Oolites	327	450	—
Fuller's Earth	16	—	40
Lias	170	—	500

But although many of these water bearing strata are of large dimensions and well stored in the upper part of the Thames basin, none of those below the Gault, except the Lower Greensand, are available for a well supply at London. The Upper Greensand, so important in Wiltshire, is reduced to a few feet of comparatively impermeable argillaceous sands under London. The Oolitic series, so rich in springs in the district of the Cotswold Hills, have been ascertained to thin off as they range eastward; and Mr. Hull has shown that the inferior Oolite and underlying sands in particular die out, in all probability, under the Oxford clay about the centre of Oxfordshire. Even apart, therefore, from the discovery made at Kentish Town, we should now have excluded the Oolitic series as a possible source of supply to deep wells in the London district; although, as sources of springs' supplies, they contribute so important a share to the maintenance of the Thames. Few of those strata are, however, so homogeneous as the Chalk and the London Clay. The permeable formations often contain subordinate impermeable clays—seams which form water levels of more or less importance, whilst the impermeable clays sometimes contain subordinate beds of sand or of rock which constitute small local water bearing beds. It is for the geologist to assign its relative value to each of these subordinate features, and to distinguish the minor from the major sources.

Taking the Thames basin above Kingston, there is, according to Mr. J. D. Harrison, an area of 1,233 square miles of impermeable strata, and of 2,412 miles of permeable strata, and the mean annual rainfall in that district amounts to about 27in. From the impermeable strata the rain flows off immediately as it falls, and is carried at once to sea; whereas a large portion of that which falls on the permeable strata is, as we have shown, stored for a greater or lesser time, and discharged in perennial springs. It is these which give permanence to our rivers. The evidence taken before the commission showed that the daily discharge of the Thames at Kingston, even in the driest season after weeks without rain, never falls below 350,000,000 gallons, while the average for the year gives, according to Mr. Simpson and Mr. Harrison, 1,353,000,000 gallons, or, according to Mr. Beardmore's longer observations, 1,115,000,000 gallons daily, the mean of 1,250,000,000 gallons being equal to a fall of about 8in., or rather less than one-third of the annual quantity, the other two-thirds being lost by evaporation and absorbed by the vegetation. This seems the proportion usual under the like general conditions in these latitudes.

In districts where impermeable strata predominate, the total water delivery, therefore, will be greater; but it follows close upon the rainfall; whereas, where the permeable strata predominate, a large portion of the rainfall is stored in the hills, and its delivery is thereby spread over a greater or lesser period of time, according to the dimensions of those hills. This is well exemplified in the case of the basins of the Thames and the Severn, which latter is formed in large part by the slate rocks of Wales. The former has an area above Kingston of 3,670 square miles, with an annual rainfall of 27in.; whereas that of the latter above Gloucester has an area of 3,890 miles, with an average rainfall of probably not less than 40in., and the mean daily discharge for the year is for the Thames 1,250,000,000 gallons, and for the Severn about 1,600,000,000 gallons. Yet the summer discharge of the Thames averages 688,700,000 gallons daily, against 297,599,040 gallons of the Severn; and while the minimum discharge of the Thames in the driest seasons never falls below 350,000,000 gallons, that of the Severn falls below 100,000,000 gallons. Again, in the case of the Lea, where there is a still larger proportion of permeable strata, the daily discharge at Broxbourne for the year is, according to Mr. Beardmore, 108,000,000 gallons, while for the summer months it remains as high as 71,000,000, and in the driest seasons does not fall below 42,000,000 gallons.

Let us now look at one of the geological questions dependent upon the solvent action of the water on the strata it traverses. The analyses, made for the commission by Drs. Frankland and Odling, of the waters of the Thames and its tributaries in the Oolitic and Chalk area, show that every 100,000 parts or grains of rainwater has taken up a quantity varying from 25·58 to 32·95 grains of solid residue, or an average of 29·26, which is equal to 20·48 parts or grains per gallon; another analysis of the Thames water at Ditton gives 20·78 grains per gallon of solid residue. It was also shown by Drs. Letheby and Odling and Professor Abel that the unfiltered waters of the Thames Companies, which take their supplies above Kingston, contained 20·82 of solid residue. If from the average of 20·68 we deduct 1·68 grain for organic and suspended matter, we have 19 grains of inorganic residue for every gallon of water flowing past Kingston. This is, of course, apart from the sediment carried down in floods.

Taking the mean daily discharge of the Thames at Kingston at 1,250 million gallons, and the salts in solution at 19 grains per gallon, the mean quantity of dissolved mineral matter carried down by the Thames every twenty-four hours is equal to 3,364,286lb. or 1502 tons, or 548,230 tons annually. Of this daily quantity about two-thirds, or, 1,000 tons, consist of carbonate of lime, and 238 tons of sulphate of lime, while limited proportions of carbonate of magnesia, chlorides of sodium and potassium, sulphates of soda and potash, silica and traces of iron, alumina, and phosphates, constitute the rest. If we refer a small portion of the carbonates, and the sulphates and chlorides chiefly, to the impermeable argillaceous formations washed by the rain water, we shall still have at least 10 grains per gallon of carbonate of lime, due to the Cretaceous and Oolitic strata and Marlstone, the superficial area of which, in the Thames basin above Kingston, is estimated by Mr. Harrison at 2,072 square miles. Therefore the annual quantity of carbonate of lime carried away from this area by the Thames is 290,905 tons, or 797 tons daily, which gives 140 tons removed yearly from each square mile; or, extending the calculation to a century, we have 14,000 tons removed from each mile of surface. Taking a ton of chalk as equal to 15 cubic feet, this is equal to a removal of the 900th part of an inch from the surface in the course of a century, so that in the course of 13,200 years a quantity equal to a thickness of about one foot would be removed from our Chalk and Oolitic districts.

I had some faint hope that this wear might furnish us with a rough approximate measure of time in reference to some of the phenomena connected with the Quaternary period; but we are not in a position to apply it. Those curious funnel shaped cavities, called sand and gravel pipes, so common in many chalk districts, are the result of slow solution of the chalk by water at particular spots, whereby the superincumbent sand and gravel have been let down into the cavity so produced. Some of them are but a few feet deep, while others attain dimensions of 80ft. in depth by 15ft. to 20ft, in diameter at top, tapering irregularly to a point at bottom. It is, however, evident from the variation in size that the wear has been unequal; and it is also clear that the surface waters have been conducted through these particular channels, where they existed, to the underground water level, in preference to passing through the body of the chalk, so that the ratio of wear at these points is in excess. Nor can I see at present how otherwise to apply this measure. If it were possible to find a spot where the exposed surface of the chalk has been worn uniformly, and, from the quantity of flints left after the removal of the chalk and the known distance apart there of the seams of flint, to determine the number of feet or inches removed, we might have a base to proceed upon, provided all the quantities remained constant. But such is not the case. Also, although the annual rainfall in the Thames now averages 27in., and has probably not varied much from this amount during the present period, it was evidently much greater during the Quaternary period; for I have elsewhere shown that, in the South of England and North of France the rivers of those areas with the same catchment-basins were of much greater size than at present; and Mr. W. Cunnington had before pointed out the same fact in the upper part of the basin with respect to some of the rivers of Wiltshire. M. Belgrand has made an attempt to estimate this quantity with reference to the Seine and its tributaries, and he arrives at the conclusion that, during the Quaternary (or, as he considers it, the Glacial) period, the rainfall was so heavy that the discharge of the river was from 20 to 25 times greater than at present. I do not altogether concur in this view, but I can conceive that our rivers formerly were of five or six times the size they now are. This is an important element to be considered in all questions bearing on the denudation of land surfaces.

* An abstract of the annual address of the President of the Geological Society.

vital phenomena which he observed with such rare penetration: 'If I know by what mechanism a membrane imbibes a liquid, I seek in vain that which makes the muscular fibre contract or renders the nerve sensitive.' M. Littré adds that Magendie was quite right to confess his ignorance of this, but this ignorance is neither accidental nor provisional. It is necessary and permanent. The physiologist is not, in regard to the property which renders the muscle contractile and the nerve sensitive, in any other position than the physicist in regard to the property which renders matter electrical, heavy, hot, or luminous. According to M. Littré, no more explanation can be given of physical or chemical qualities than of vital qualities. Science has completed its work when it reaches irreducible things —weight, electricity, life. Life is not in itself more capable of explanation than electricity or heat. One may also invert the proposition, and say that it is not in itself less explicable, and when one is imbued with this thought one is drawn into seeing nothing more complex and more marvellous in the phenomena of life and thought, than in the most ordinary phenomena of inorganic nature. A man who thinks, a stone which falls, are two irreducible phenomena; they exist, and that is all that can ever be known about them. Does not Positive philosophy, which has waged such a war against occult qualities, bring them to life again under another name, and without intending it?"

COAL-CUTTING MACHINERY.

THE importance of adapting machinery to the winning of coal, which, for the most part, has hitherto been accomplished by manual labour, has again, says the *Engineer*, been forced upon inventors and patentees by Mr. W. Firth, of Leeds, who has generously offered £500 to be given for the machine that will bore or hole in the most perfect manner, so as to reduce the quantity of manual pick labour to the minimum. This seems to be about the third attempt which has been made by prizes to induce patentees to develop and perfect this class of machinery. In 1864 the South Yorkshire Coalowners' Association announced their intention of subscribing £500 towards the cost of putting down three machines at as many district pits. The choice fell upon that of Mr. G. C. Jones, of the Blaina Ironworks, Monmouthshire, which consisted of a cylinder bedplate and bearing all in one casting supported on four wheels, the pick was so arranged that it could be fixed in any position, by which means vertical, horizontal, or angular grooves could be cut. After a time the machines were, however, withdrawn. From this time to 1867 no pecuniary inducements were held out, but patentees still contended against the innumerable difficulties which surrounded their track; some of them, as Mr. Firth, of Leeds, expending thousands of pounds in order to perfect as much as possible their own machines. Towards the close of 1867 the members of the South Lancashire and Cheshire Civil Association announced their intention of giving £800 divided in three prizes "for the b machine which, in the opinion of the commit appointed for that purpose, shall be most suit to the requirements of the trade." To all pearance the progress and development which getting machinery was likely to derive from liberality promised to be great. This, ho was not the case, as when the conditions w nounced it was found that patentees wo contend in consequence of the following c "Inventors taking a prize must be bound following conditions, viz., that no annual or tonnage royalty as patent right shall b to any present or future member of the sociation, but that such member shall p right on the purchase of each machine, the working thereof, which patent rig case exceed 50 per cent. of the cost of t This and other conditions caused on petitors to send machines to be te committee withdrew the money priz tuted three medals. After a period years another incentive is offered b who has deposited £500 in the nam tees with Messrs. William Willia Co., bankers, Leeds, pending a tri man has expressly stated that th the owner for royalty or licer matter for the judges to consi being founded solely upon the r machines produced for competi upon which the Lancashire a tion foundered is clearly poin moved. Having pointed out might give a long list of ma time to time been patented Many of the oldest pitmer well acquainted with w Brown's Iron Man," a m the district collieries, as field. In 1859 Messrs Newcastle-upon-Tyne, was successfully teste Northumberland, alth the pillar and stall ... Messrs.

Firths, Donisthorpe, and Ridley, took out a pat for a machine which was set to work in these and, we believe, has remained in use, with the ception of short intervals, when repairs, &c., necessary. The machine has from time to been improved, and has stood the test rem well. Amongst the more recent inventors mentioned Messrs. Copley and Gillot, Yorkshire; Mr. Bartholomew, of Donc Rothery, of the Waterloo Main Co Leeds; Mr. S. P. Bidder, of Harecas Stoke; Mr. Hurd, Wakefield, &c. coal-breaking machine, which has r introduced into several of the Yorks is also working very successfully.

THE BISULPHIDE OF CARB

THE following remarks on E carbon engine (illustrated on by Dr. Vander Weyde at a meet Polytechnic Club:—Mr. Ellis, o constructed a bisulphide of car waste steam from the engine t of carbon, and work another same engine. There have b to this, which I wish to a that we might just as well making a compound engi pressure engine workin other objection is, that phide of carbon, we do will reply to this objec require very little he Water requires a ten at atmospheric pr come latent. But only 165 units of immense saving years ago, an ot Works, New Y up. First, it and when it one. Anoth was so mu nearly sev property of vapo comes l a cubic gines a by its vant hea T u a i

...nsumes 140 units of heat, wh ...bustion of coal gives out 14,000 units every pound of coal, therefore, you will

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...ous affair, his electro-
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...or long distances. Ex-
...e to simplify his arrange-
...rse Circuit" was thought
...857 the French Adminis-
...pted the Morse instrument
... Morse Code," the "Morse's
...s "Embosser," and Morse's
...nction currents are sufficient
...ly the American artist has
...ith the system of employing
... the messenger from man to
... under the sea.—*Athenæum.*

...es **Perfect.**—Mr. Bessemer, giving
...ommittee of the Society of Arts, the
..."I have observed the sleight of hand
...n various mechanical arts where they
...ng to do, and that only; and it is
... how, in three or four weeks, a man
...e what would have been pronounced
...bility. Take, for example, the forging
...an will take a bar of steel, which has to
...o an octagon shape, and he will pass it
...y hammer, striking about 300 blows a
... will turn it exactly one-eighth of a revo-
...ch stroke, and the whole of the bar is
... the greatest exactitude, though he has to
...gle every 300th part of a minute."

...**Mode... Washing.**—The ill effects of soda
... to a new method of washing,
...vely adopted in Germany, and
.... The operation consists in
... soap in about three gallons
...d can bear, and adding to
...rpentine and three of liquid
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SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE ordinary monthly meeting of this Society was held on Friday, April 12, 1872; Professor Cayley, President, in the chair.

Insufficiency of National Observatories.

Colonel Strange read an important paper entitled as above, and in introducing it he remarked that it might be considered as aggressive, when we had so efficient an observatory at the head of astronomical science in England, presided over so ably by the Astronomer Royal, but he hoped to show that the paper was by no means aggressive. Of late years astronomy had made great advances, especially as regards the physics of the bodies composing the universe. The Royal Observatory was founded in the interest of navigation, and well and nobly had it done its work. The unbroken series of meridional observations, made under the direction of the distinguished astronomers who had from time to time presided over its operations, had conferred an incalculable benefit on astronomy; but the branch which might be appropriately styled "the physics of astronomy" was beyond its present range of observation. He (Colonel Strange) had only to refer to the paper read at a late meeting of the society on devoting an observatory to the especial work of observing the eclipses and transits of Jupiter's satellites (see ENGLISH MECHANIC, No. 357, Jan. 26, 1872, p. 479), to bear him out in advocating the importance of the establishment of observatories for investigating "the physics of astronomy." During a comparatively recent period much had been effected in extending our knowledge of the physics of the sun. In addition to the earnest seizing and utilising of the few precious moments of the intervals of totality on the occasions of total eclipses of the sun, a large amount of time and money had been expended in obtaining a valuable series of photographic pictures of the sun which, he learned with regret, had been brought to a close. He need not mention the men who stood foremost in the ranks of earnest inquirers into solar physics; they were known to us all, but such was the nature of private effort, especially requiring pecuniary outlay, that at any moment a series of observations might suddenly be brought to a close, and to remedy this defect he urged upon the society the importance of placing such inquiries as he had alluded to on a stable footing. There were also men who had taught us how to map the moon, but such was the extent of work required that private resources were quite inadequate to complete it in any reasonable period. Colonel Strange in his further remarks adverted to the connection of meteorology with astronomy. All the variations of climate, alternations of temperature, &c., could, he said, be traced to the dominant influence of the sun, and he, therefore, deemed it expedient that an exhaustive systematic study of the sun should be set on foot, and that a national establishment should be founded for the daily registration of solar phenomena.

The Astronomer Royal, in commenting on Col. Strange's paper, remarked that he had had great experience in the history of observatories, and the general impression on his mind was that no observatory will stand unless it be connected with some secular object—an object of worldly importance. The Greenwich Observatory, he said, was founded for the benefit of navigation and the determination of the longitude, and for these objects steady observations of the moon were necessary, and it should be borne in mind that these observations were not undertaken and continued to the present time for elucidating the lunar theory, but primarily and essentially for the determination of the longitude, and collaterally for this object a branch of the observatory work, to which he had personally given great care, was the rating of chronometers, and no less important was the dissemination of time signals, which were transmitted daily from the Observatory. The Astronomer Royal further remarked that when the Royal Observatory was founded, the theory of gravitation was established, and to employ this theory in the vital question of the longitude needed an extensive series of observations of the moon. To show the importance of the connection of a subject of worldly interest with an observatory, the Astronomer Royal said that, speaking to a friend of the assistance rendered by the Government to the Harton Colliery experiment, the greater portion of the expense of which he had personally borne, his friend replied that as a taxpayer he should protest against the employment of public money for such purposes.

Dr. De La Rue, in connection with the paper read by Colonel Strange, called the attention of the meeting to the importance of establishing a daily record of solar phenomena. He said that the Government have gone to a great expense, no less than £10,000 annually, in obtaining meteorological data, with a view to prognosticating the weather, and issuing weather signals. Seven observatories have been established, at which self-recording instruments are continually at work, and in addition numerous other stations furnish information which is received in London at 8 a.m. daily. This information is published and distributed by 2 p.m. of the day of its reception. The observations thus accumulated are arranged and discussed in various ways with a view of ascertaining the laws of weather changes. This method Dr. De La Rue considered as very cumbrous; centuries, perhaps, might elapse before the laws were discovered, and he pointed out that a secular change of a quarter of a degree in solar radiation would materially affect all our climatic relations. It was his impression that a series of solar pictures during a period of thirty or forty years, at an annual expense of from £300 to £400, would be very important for the Government to take up at this juncture. A picture of the sun obtained every day, furnishing data for the study of sun spots, faculæ, and solar prominences, during cycles of ten or eleven years, would throw much light on meteorological phenomena, for while local influences had great effect on the weather, solar influence was by far the most efficient agent in determining its character.

In referring to the work of an observatory established by the Government, the Astronomer Royal said that it was not that of groping, as it were, in the dark after the causes of phenomena, but the making and collecting of observations for a definite object, immediately connected with some secular advantage to the State.

The Rev. Professor Selwyn announced that the series of sun pictures which had been taken under his superintendence during the last nine years, would be continued until February, 1874, completing the eleven years' cycle.

Discovery of Minor Planets.

M. Borelli communicated a paper containing observations of the newly-discovered minor planet Peitho (118), and of Ægina (91); also of six new nebulæ, and a new variable star. Telegrams had been received at the Royal Observatory from M. Delaunay within the last few days, announcing that two minor planets had been discovered at Paris (119) and (120). Referring to Peitho, discovered by Dr. Luther, Mr. Dunkin stated that this was the nineteenth minor planet which the doctor had discovered, being the greatest number yet discovered by one astronomer.

Binary Stars.

Papers were read from Mr. Hind on the orbits of ξ Boötis, and Σ 1938 (μ^2 Boötis). Observations of ξ Boötis during the next few years will possess great value, and also those of Σ 1938 during the next four years.

The Recent Solar Eclipse.

A paper was read from Mr. Tebbut, of Paramatta, containing observations of the partial phase of the eclipse of December 12, 1871, in which the times of bisection of spots on the sun's disc are enumerated, and on which the Astronomer Royal remarked that such observations were of no use whatever. As regarded the eclipse itself the Astronomer Royal took this opportunity of stating that he had received telegrams from India in the morning of the day of the eclipse, and had forwarded them to the London newspapers in time for publication in the afternoon of the same day.

Mathematical Papers.

The following were read or announced:—

On Proposition 38 of the Third Book of Newton's "Principia," by Todhunter.

The second part of a memoir "On the Development of the Disturbing Function in the Lunar and Planetary Theories," by Professor Cayley.

"On the Method of Least Squares," by J. Lee Glaisher.

At the close of the meeting Mr. Browning exhibited Lord Lindsay's photographs of the late solar eclipse, combined stereoscopically, and Mr. Brothers exhibited a negative of the eclipse of 1870.

Amongst the presents we noticed a fine portrait of the late Charles Babbage, one of the founders of the society.

Removing a Furnace-Shaft Bodily.—The great chimney of the Cabot mill, at Brunswick, Maine, ha been moved 20ft., to allow of the enlargement of the mill. The work was done by a process similar to that by which ships are launched, the chimney being slid along on greased planks. The chimney is 70ft. high and nearly 8ft. square at the base, and it was moved, the flues connected, and the fires started, in eight hours and a half.

Burnt-in Photographs.—The burnt-in photographs in enamel are well known to many of our readers, but it may not be generally known that the process is applicable to the ornamentation of glass. The pattern is drawn by hand on thin transfer paper, and the glass being prepared with a mixture of gum arabic and bichromate of potash, the transfer paper is placed over it and exposed to light. The colouring material is dusted on. This adheres to all parts not affected by the light, and a pattern is obtained which can be burnt in. Prints and woodcuts are by this method easily transferred to glass, but for portraits this process does not work fine enough.

There is yet another point which, although not in our direct field of research, yet depends so essentially upon the geological conditions we have discussed, and is one, in a public point of view, of such paramount importance, that I will say a few words on the subject. In an uninhabited country, the rain passes through the soil and issues as springs, bearing with it a certain proportion of mineral matter, and only traces of such organic matter as existed on the surface. This would be solely of vegetable origin, and the proportion would be in most cases very small. As man appeared, those conditions would be at first but little altered, for animal matters exposed on the surface rapidly decay and pass away in a gaseous form; but with increasing civilisation and fixed residences the necessity of otherwise getting rid of all refuse would soon be felt. I have shown how population followed the range of shallow permeable strata and the course of valleys, so as to obtain readily that indispensable necessity of life, a sufficient water supply. But with the art of well digging it soon became apparent that, let the well be carried down but half-way to the level of ground springs, it would remain dry, and that then, so far from holding water, any water poured into it would pass through the porous strata down to the water-level beneath, keeping the shallower well or pit constantly drained. So convenient and ready a means of getting rid of all refuse liquids was not neglected. Whilst on one side of the house a well was sunk to the ground springs, at a depth, say, of twenty feet, on the other side a dry well was sunk to a depth of ten feet, and this was made the receptacle of house refuse and sewage. The sand or gravel acting as a filter, the minor solid matter remained in the dry well, while the major liquid portion passed through the permeable stratum and went to feed the underlying springs. What was done in one house was done in the many; and what was done by our rude ancestors centuries back has continued to be the practice of their more cultivated descendants to the present day, with a persistency in the method only to be attributed to the ignorance of the existence of such a state of things among the masses, and to the ignorance of the real conditions and actual results of perpetuating such an evil—an evil common alike to the cottages of the poor and, with few exceptions, to the mansions of the rich.

Not a county, not a district, not a valley, not the smallest tract of permeable strata, is free from this plague spot. It haunts the land, and is the more dangerous from its unseen, hidden, and too often unsuspected existence. Bright as the water often is, without objectionable taste or smell, it passes without suspicion until corrupted beyond the possibility of concealment by its evil companionship. Go where we may, we never know when the poisoned chalice may be presented to our lips. The evil is self-generating; for the geological conditions supplying our necessities lend themselves to its maintenance and extension. The knowledge necessary to remedy it is of very slow growth, and the too frequent want of that knowledge, or disregard of the subject, even amongst able architects and builders, is such that, without legislative enactment, I do not see how the evil is to be eradicated for many a long term of years.

But even our deeper and apparently inaccessible springs have not escaped contamination. As before mentioned, the underground water will, when tapped by artesian wells, rise to or above the surface, according to the relative height of the surface of the ground at the well, and of the outcrop of the water-bearing bed or beds, so that if the former is higher than the latter, or if by artificial means the line of water level in a given area becomes lowered, then the surface of the water belonging to those great underground natural reservoirs will be established accordingly at a certain fixed depth beneath the surface. As each well deriving its supply in a stratum of this description represents a column of water communicating with one common reservoir, it follows that any cause permanently lowering the level of one well will tend to lower the level in the other wells in proportion to their number and distance. Further, it has been discovered that a well of this class can absorb a quantity of water equal to that which it can furnish; and as these wells give greater supplies than shallow wells, the absorbing wells of the same class are alike powerful in proportion to the others. The perverse ingenuity of man has here, again, taken advantage of these conditions to get rid of offensive waste waters by diverting them into such deep wells, whence they pass away in hidden underground channels, unseen and unsuspected, and mingle with those deep seated water sources feeding the artesian wells dependent upon them for their supply.

In Paris, where there are several alternating beds of permeable and impermeable strata, and the depth to reach them is not very great, this system of absorbing wells connected with factories became, until regulated by the municipality, very common, to the great injury of many of the underground springs. From this and the other causes before alluded to, a great number of shallow wells have there become so contaminated as to necessitate their abandonment. Our own system of surface drainage is generally too good, and the depth to the lower water-bearing strata too great, to have rendered the use of such wells here equally advantageous; nevertheless, I have reason to believe that they do exist, and that the sources even of our deep well water supply in the Lower Tertiary Sands and in the Chalk are thus to some extent polluted and injured.

Nor do the great and perennial springs supplying our rivers altogether escape the evils arising from these obnoxious practices. On the high Oolitic ranges and amongst the undulating Chalk hills, the line of water-level is often so deep below the surface, that only in few cases are wells made—the population being generally dependent on rain-water for their water supply. But this does not prevent the construction of dry wells for the disposal of sewage and refuse. It is true that the population in these hills is sparse—here and there a farm, a few cottages, and scarcely a village. Still, as the ground is everywhere absorbent, and there are no streams even in the valleys (I am now speaking of the higher districts), every dwelling contributes its quota; for the rain and all liquid matter absorbed in these strata necessarily pass down to the great underground reservoirs of water feeding the springs thrown out in the deeper river valleys. In these cases, however, the thickness of strata through which any liquid has to pass before reaching the line of water-level is such as to produce a more or less efficient filtration and complete decomposition; and as the injury caused is in proportion to the relative volumes of the water-sources and to the artificial additions, the great extent and dimensions of these water-bearing strata and the scanty population of such districts reduce it to a minimum.

Owing to these conditions, great as the evil is, experience teaches that it has, in some cases, its vanishing-point. It may be considered at its maximum in some of the wells of Paris; our own London shallow-well pumps follow next in order; in our river waters away from towns it is but slight; in some of the springs of the Chalk and Lower Greensands it is hardly appreciable, while in the deep well-waters, especially those of Caterham and Grenelle, it sinks to the minimum attained by any potable waters, with the exception of rain-water. It is also a fortunate circumstance that the wonderful powers of oxidation possessed by air and water, and the powers of absorption and decomposition by soils and earths, are such as, even in the surcharged gravel-bed of London, to remove all the more offensive characters, and leave its spring-waters at all events limpid and bright; whilst the quick eddy, the moving ripple, the bright sunshine, the brisk breeze, the living organisms, are ever at work in our rivers, destroying the almost inevitable accompaniments of the presence of man, and restoring the waters to that original state of purity so essential to his health and welfare.

With regard to the character of waters as dependent on the geological nature of the strata, while the evidence showed that the waters flowing off hard and insoluble rocks were, from their much greater freedom from mineral matter, more economical for many domestic and manufacturing purposes, yet that for drinking purposes waters such as those derived from our Chalk and Oolitic districts were, on the whole, as good and wholesome as those from any other sources; while as regards quantity and permanence, the conditions presented by a large catchment-basin of a varied geological structure presented the most favourable conditions for the large and maintained supply so essential for a great city. And if, from any cause, it should at some future time be thought desirable to have a supply of a yet more assured and undoubted quality than a river supply, the large springs of the Chalk and the Lower Greensand, or the great underground reservoirs of the most efficiently filtered water stored in those formations in Surrey and Hertfordshire, might, I believe, be resorted to with advantage, by means of ordinary and artesian wells, as auxiliary sources of supply for domestic and drinking purposes, supposing the engineering difficulties connected with a double water supply could be overcome—a difficulty which it, however, seems to me would possibly be less one of construction to our engineers than of cost to the public. But in a great health question there are other considerations than these which are of more primary importance.

(*To be continued.*)

GEOLOGY IN RELATION TO PLANT LIFE.

WHILE many branches of science—notably chemistry and vegetable physiology—have done much to further a better knowledge of plant life, and, in consequence, of plant culture, geology, from which we might have expected so much, has up to this time done comparatively little. The fact is, the majority of geologists, says the *Gardeners' Chronicle*, have occupied themselves with the study of the order and mode of deposition of the older strata, and have done comparatively little to unravel the mysteries of the superficial deposits, which are of the most importance to cultivators. From a geological point of view the London Clay and the Lias Clays are totally distinct formations, so are the enormous Limestone beds of the Oolitic and of the Cretaceous periods respectively. Yet for cultural purposes there is not that great difference between them.

We know that certain fields invariably grow, under proper culture, good wheat crops, while from the adjacent fields a good crop cannot be looked for. In the case of fruit trees, the difference between neighbouring gardens is often still more marked. A pear which in one garden produces fruit of first-rate quality, yields fruit of indifferent quality in the next, and this often without any obvious difference in management, or even exposure. The experience of every fruit grower and market gardener could furnish numerous examples of the differences we allude to, but the causes producing these differences are often not obvious. Botanists turning their attention to limited areas are often enabled to draw up lists of clay plants, limestone plants, sand plants, seaside plants, plants of boggy ground, and the like, and to a certain extent these differences hold good. But when the observations are made over a wider area, the distinctions are apt to break down. Many of our wild plants, which are confined to clay and limestone, or even to boggy wet places in this country, are found elsewhere growing in equal profusion and luxuriance in soil of a totally different character. The beautiful Chlora perfoliata is a characteristic limestone plant, yet we have seen it on gault clay, and abroad it is by no means limited to a limestone soil. Orchis latifolia, a bog or marsh plant with us, grows equally well on dry soils in Switzerland. It follows, then, that the rules laid down for one country will not always apply to other lands. Some years since we carefully compared the wild plants of Oxfordshire with those of East Kent, with special reference to the nature of the soil on which they grew, and we came to the conclusion that the large majority of the plants were ubiquitous or indifferent, so far as the chemical nature of the soil was concerned. Limestone soils, whether of oolite or chalk, produced much the same vegetation in the two districts; and, to a less extent, this was the case with clay plants or sand plants. The number of plants, however, that could be enumerated as peculiar to one or the other description of soil was extremely limited; and when a comparison was made with the observations of Continental authorities, these few dwindled down to insignificant proportions. Under cultivation, too, we see plants from all parts of the world, inhabiting various regions, and naturally growing in very different soils, all thriving in soil of much the same character. The first greenhouse one enters will afford abundant illustration of this fact. The common purple Loosestrife (Lythrum Salicaria) was long since noted by Mr. Darwin as a marked illustration of this indifference to the nature of the soil. Naturally growing by the banks of rivers, with its roots submerged, at least in very damp soil, it does just as well in any ordinary garden soil. The Osmunda is another instance: it does best in a bog, but it will grow almost anywhere. Rhododendrons, so commonly thought to require peat soil as a *sine quâ non*, will do equally well in a stiff loam, and, indeed, anywhere where there is not too much lime.

It seems obvious, then, that, setting apart extreme cases, the chemical nature of the soil has less to do with the quality of the vegetation it produces than the physical characteristics. The difference in the vegetation of drained and undrained land respectively supports this view of the case. It is even a question whether the mechanical changes produced by certain manures on the soil are not to the full as important, as a general rule, as the chemical ingredients supplied. See, for instance, the great changes produced in the texture of the soil in the case of such experiments as have been carried on so long and on so extensive a scale at Rothamsted. See how some manures applied as a top-dressing, or, at least, superficially, affect the subjacent soil to a much greater depth than the others; how certain manures get washed down, or by some means penetrate to a much greater depth than others, altering the character of the soil as they go to a corresponding extent. Note, too, the varying quantities of water that issue from the drains in adjacent plots drained to the same depth and to the same extent, but treated with different manures. In some cases a large proportion of the surface-water runs through, while in other instances, as where farmyard manure has been applied, the outflow is comparatively small. All these facts, and many others that might be cited, show how desirable it is for us to gain a greater insight than we have at present into the nature and diversities of the soil in which we grow our plants, and into the mode of growth or general habit of the plant itself, as modified by the soil on which it grows. To this end we seem to require, to a much larger extent than we have yet had, the co-operation of geologists with vegetable physiologists and chemists. The problem is a very complex one, and it is only by investigating it from different stand-points, and then comparing notes, that we can hope to solve it or draw useful practical inferences from it.

PROFESSOR MORSE.

SAMUEL FINLEY BRESSE MORSE has passed away from among us; he died on Tuesday evening, the 2nd of April, at the ripe age of 81. Professor Morse's name will be for ever so closely associated with the development of the electric telegraph that we feel it our duty to give some notice, though it be a brief one, of his life. He was the son of the Rev. Jedediah Morse, well known as a geographer, and was born in Charlestown, Massachusetts, on the 27th of April, 1791. Samuel Morse was educated at Yale College, but, having determined to become a painter, he came to England in 1811, formed a friendship with Leslie, whose portrait he painted, and in 1813 he exhibited at the Royal Academy a colossal picture of "The Dying Hercules." He returned to America and endeavoured to establish himself as a portrait painter, but without much success, until in 1822 he settled in New York, and painted for the corporation a full-length portrait of Lafayette, who was then on a visit to the United States. We find Mr. Morse again in England in 1829, remaining here until 1832, when he returned to his own country. His companion on this voyage was Professor Jackson, the eminent American chemist and geologist, who was then returning from Paris, where the question of the time occupied in the passage of the electric current through a good conducting wire was occupying the attention of scientific men. From Dr. Jackson Mr. Morse appears to have first learnt that the passage of the electric fluid was absolutely instantaneous, and it occurred to him that it might be used for conveying intelligence from one place to another. The friends of Professor Morse claim for him that during the voyage he had written out the general plan of his telegraphic arrangement. In 1835 he certainly placed in the New York University a model of his "Recording Electric Telegraph," and in 1837 he filed his *caveat* at the Patent Office in Washington. It was not, however, until 1840 that the patent was perfected, and then Professor Morse set about getting his telegraph used. Four years, however, passed away before he succeeded, the first electric telegraph completed in the United States being the line between Washington and Baltimore, which began to work in 1844. Since that time the recording electric telegraph of Morse has been adopted over the whole country, and at the time of his death there were not less than 20,000 miles of electric wires stretching over the States between the Atlantic and the Pacific Oceans. Mr. Morse's first telegraph was a chemical one, the electric current being used to decompose the acetate or carbonate of lead, or turmeric paper moistened with a solution of sulphate of soda. He, however, gave up this arrangement, and adopted the electro-magnetic system instead. This was, however, in his hands, a rather ponderous affair, his electro-magnet weighing 158lb., and the instrument was not sufficiently delicate for long distances. Experience enabled Mr. Morse to simplify his arrangements, and his "Simple Morse Circuit" was thought to be so complete that in 1857 the French Administration of Telegraphs adopted the Morse instrument before all others. The "Morse Code," the "Morse's Transmitting Plate," his "Embosser," and Morse's telegraph worked by induction currents are sufficient to show how completely the American artist has connected his name with the system of employing electricity to pass as the messenger from man to man, over earth and under the sea.—*Athenæum*.

Practice Makes Perfect.—Mr. Bessemer, giving evidence before a committee of the Society of Arts, the other day, said:—"I have observed the sleight of hand that men acquire in various mechanical arts where they have a certain thing to do, and that only; and it is really marvellous how, in three or four weeks, a man will do with ease what would have been pronounced an utter impossibility. Take, for example, the forging of steel. A man will take a bar of steel, which has to be forged into an octagon shape, and he will pass it under a heavy hammer, striking about 300 blows a minute, and will turn it exactly one-eighth of a revolution at each stroke, and the whole of the bar is forged with the greatest exactitude, though he has to alter the angle every 300th part of a minute."

New Mode of Washing.—The ill effects of soda on linen has given rise to a new method of washing, which has been extensively adopted in Germany, and introduced into Belgium. The operation consists in dissolving two pounds of soap in about three gallons of water as hot as the hand can bear, and adding to this one tablespoonful of turpentine and three of liquid ammonia; the mixture must then be well stirred, and the linen steeped in it for two or three hours, taking care to cover up the vessel which contains them as nearly hermetically as possible. The clothes are afterwards washed out and rinsed in the usual way. The soap and water may be re-heated, and used a second time, but in that case half a tablespoonful of turpentine and a tablespoonful of ammonia must be added. The process is said to cause a great economy of time, labour, and fuel. The linen scarcely suffers at all, as there is little necessity for rubbing, and its cleanliness and colour are perfect. The ammonia and turpentine, although their detersive action is great, have no injurious effect upon the linen; and while the former evaporates immediately, the smell of the latter is said to disappear entirely during the drying of the clothes.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE ordinary monthly meeting of this Society was held on Friday, April 12, 1872; Professor Cayley, President, in the chair.

Insufficiency of National Observatories.

Colonel Strange read an important paper entitled as above, and in introducing it he remarked that it might be considered as aggressive, when we had so efficient an observatory at the head of astronomical science in England, presided over so ably by the Astronomer Royal, but he hoped to show that the paper was by no means aggressive. Of late years astronomy had made great advances, especially as regards the physics of the bodies composing the universe. The Royal Observatory was founded in the interest of navigation, and well and nobly had it done its work. The unbroken series of meridional observations, made under the direction of the distinguished astronomers who had from time to time presided over its operations, had conferred an incalculable benefit on astronomy; but the branch which might be appropriately styled "the physics of astronomy" was beyond its present range of observation. He (Colonel Strange) had only to refer to the paper read at a late meeting of the society on devoting an observatory to the especial work of observing the eclipses and transits of Jupiter's satellites (see ENGLISH MECHANIC, No. 357, Jan. 26, 1872, p. 479), to bear him out in advocating the importance of the establishment of observatories for investigating "the physics of astronomy." During a comparatively recent period much had been effected in extending our knowledge of the physics of the sun. In addition to the earnest seizing and utilising of the few precious moments of the intervals of totality on the occasions of total eclipses of the sun, a large amount of time and money had been expended in obtaining a valuable series of photographic pictures of the sun which, he learned with regret, had been brought to a close. He need not mention the men who stood foremost in the ranks of earnest inquirers into solar physics; they were known to us all, but such was the nature of private effort, especially requiring pecuniary outlay, that at any moment a series of observations might suddenly be brought to a close, and to remedy this defect he urged upon the society the importance of placing such inquiries as he had alluded to on a stable footing. There were also men who had taught us how to map the moon, but such was the extent of work required that private resources were quite inadequate to complete it in any reasonable period. Colonel Strange in his further remarks adverted to the connection of meteorology with astronomy. All the variations of climate, alternations of temperature, &c., could, he said, be traced to the dominant influence of the sun, and he, therefore, deemed it expedient that an exhaustive systematic study of the sun should be set on foot, and that a national establishment should be founded for the daily registration of solar phenomena.

The Astronomer Royal, in commenting on Col. Strange's paper, remarked that he had had great experience in the history of observatories, and the general impression on his mind was that no observatory will stand unless it be connected with some secular object—an object of worldly importance. The Greenwich Observatory, he said, was founded for the benefit of navigation and the determination of the longitude, and for these objects steady observations of the moon were necessary, and it should be borne in mind that these observations were not undertaken and continued to the present time for elucidating the lunar theory, but primarily and essentially for the determination of the longitude, and collaterally for this object a branch of the observatory work, to which he had personally given great care, was the rating of chronometers, and no less important was the dissemination of time signals, which were transmitted daily from the Observatory. The Astronomer Royal further remarked that when the Royal Observatory was founded, the theory of gravitation was established, and to employ this theory in the vital question of the longitude needed an extensive series of observations of the moon. To show the importance of the connection of a subject of worldly interest with an observatory, the Astronomer Royal said that, speaking to a friend of the assistance rendered by the Government to the Harton Colliery experiment, the greater portion of the expense of which he had personally borne, his friend replied that as a taxpayer he should protest against the employment of public money for such purposes.

Dr. De La Rue, in connection with the paper read by Colonel Strange, called the attention of the meeting to the importance of establishing a daily record of solar phenomena. He said that the Government have gone to a great expense, no less than £10,000 annually, in obtaining meteorological data, with a view to prognosticating the weather, and issuing weather signals. Seven observatories have been established, at which self-recording instruments are continually at work, and in addition numerous other stations furnish information which is received in London at 8 a.m. daily. This information is published and distributed by 2 p.m. of the day of its reception. The observations thus accumulated are arranged and discussed in various ways with a view of ascertaining the laws of weather changes. This method Dr. De La Rue considered as very cumbrous; centuries, perhaps, might elapse before the laws were discovered, and he pointed out that a secular change of a quarter of a degree in solar radiation would materially affect all our climatic relations. It was his impression that a series of solar pictures during a period of thirty or forty years, at an annual expense of from £300 to £400, would be very important for the Government to take up at this juncture. A picture of the sun obtained every day, furnishing data for the study of sun spots, faculæ, and solar prominences, during cycles of ten or eleven years, would throw much light on meteorological phenomena, for while local influences had great effect on the weather, solar influence was by far the most efficient agent in determining its character.

In referring to the work of an observatory established by the Government, the Astronomer Royal said that it was not that of groping, as it were, in the dark after the causes of phenomena, but the making and collecting of observations for a definite object, immediately connected with some secular advantage to the State.

The Rev. Professor Selwyn announced that the series of sun pictures which had been taken under his superintendence during the last nine years, would be continued until February, 1874, completing the eleven years' cycle.

Discovery of Minor Planets.

M. Borelli communicated a paper containing observations of the newly-discovered minor planet Peitho (118), and of Ægina (91); also of six new nebulæ, and a new variable star. Telegrams had been received at the Royal Observatory from M. Delaunay within the last few days, announcing that two minor planets had been discovered at Paris (119) and (120). Referring to Peitho, discovered by Dr. Luther, Mr. Dunkin stated that this was the nineteenth minor planet which the doctor had discovered, being the greatest number yet discovered by one astronomer.

Binary Stars.

Papers were read from Mr. Hind on the orbits of ξ, Boötis, and Σ 1938 (μ^2 Boötis). Observations of ξ Boötis during the next few years will possess great value, and also those of Σ 1938 during the next four years.

The Recent Solar Eclipse.

A paper was read from Mr. Tebbut, of Paramatta, containing observations of the partial phase of the eclipse of December 12, 1871, in which the times of bisection of spots on the sun's disc are enumerated, and on which the Astronomer Royal remarked that such observations were of no use whatever. As regarded the eclipse itself the Astronomer Royal took this opportunity of stating that he had received telegrams from India in the morning of the day of the eclipse, and had forwarded them to the London newspapers in time for publication in the afternoon of the same day.

Mathematical Papers.

The following were read or announced:—

On Proposition 38 of the Third Book of Newton's "Principia," by Todhunter.

The second part of a memoir "On the Development of the Disturbing Function in the Lunar and Planetary Theories," by Professor Cayley.

"On the Method of Least Squares," by J. Lee Glaisher.

At the close of the meeting Mr. Browning exhibited Lord Lindsay's photographs of the late solar eclipse, combined stereoscopically, and Mr. Brothers exhibited a negative of the eclipse of 1870.

Amongst the presents we noticed a fine portrait of the late Charles Babbage, one of the founders of the society.

Removing a Furnace-Shaft Bodily. — The great chimney of the Cabot mill, at Brunswick, Maine, ha been moved 20ft., to allow of the enlargement of the mill. The work was done by a process similar to that by which ships are launched, the chimney being slid along on greased planks. The chimney is 70ft. high and nearly 8ft. square at the base, and it was moved, the flues connected, and the fires started, in eight hours and a half.

Burnt-in Photographs.—The burnt-in photographs in enamel are well known to many of our readers, but it may not be generally known that the process is applicable to the ornamentation of glass. The pattern is drawn by hand on thin transfer paper, and the glass being prepared with a mixture of gum arabic and bichromate of potash, the transfer paper is placed over it and exposed to light. The colouring material is dusted on. This adheres to all parts not affected by the light, and a pattern is obtained which can be burnt in. Prints and woodcuts are by this method easily transferred to glass, but for portraits this process does not work fine enough.

PHOTOGRAPHIC NOTES.

To Prevent Albumen Paper from Blistering.—Some brands of albumen paper are subject to blisters when taken from the hypo. solution. To prevent this remove the prints, when fixed, from the hypo. into a dish of salt water (a handful of salt to a gallon of water) before the regular washing; let them remain several minutes in the salt water.

Removing Organic Matter from a Bath.—A correspondent of *Anthony's Bulletin* says:—"A friend informed me that he had treated stubborn baths successfully in the following manner:—After filtering out the free iodide, and evaporating in the usual manner, add, while the solution is warm, from five to ten drops of ammonia. I did so, and in five minutes my sick bath turned black as ink. I then boiled it about half down, and set it aside to cool. The next morning I filtered out about a teaspoonful of black organic matter, and then added to the bath enough acid (chemically pure nitric) to turn litmus. It requires considerable to do this, and care should be taken not to get an overdose of acid. If you do, a small quantity of ammonia will remove it. After this treatment my bath worked splendidly, and was as good as new. I do not think this has ever appeared in print."

The Adulteration of Wax.—A method of detecting the adulteration of wax with tallow by means of alcohol is described by Dr. Hardy, in the *Journal de Pharmacie et Chemie*. He first prepared pure beef suet, and carefully determined the specific gravity of this substance, which he found to be 0·8863; next he prepared an alcoholic fluid of such a degree of concentration that a piece of the suet alluded to remained suspended (that is to say, sunk therein to a certain depth, and then remained at rest) in it. This alcohol was found to have a specific gravity of from 0·8882 to 0·8857 (between 71° and 72°); the specific gravity of wax is between 0·962 and 0·963; hence it follows that alcohol at 29° will keep wax suspended. Starting from these data, Dr. Hardy constructed a tabulated form, by the aid of which it becomes possible to detect adulterations of wax with suet (tallow).

Photographing Children.—A photographer of San Francisco has adapted to his camera an adjunct which he finds of use in taking children's portraits. Instead of the cloth or brass cap which covers the tube of the camera, he employs a disc of brass or other metal, consisting of two semilunar portions, which open and close like the blades of a pair of scissors. They are worked noiselessly and instantaneously by the slight pressure of a little knob on the top of the instrument, and the plate is exposed and closed again without any manipulations that can be seen by the sitter. The operator waits until the child assumes a favourable expression, when he presses the spring, exposes the plate, and takes the picture without making any motion that attracts the attention or causes a motion of his sitter. Like all useful inventions, this is exceedingly simple, and may be attached to any photographic camera.

Maynard's Collodion Filter.—This consists of a pear-shaped vessel with a stoppered mouth, the narrow end holding the filtering paper or wool fitting firmly into the neck of a cylindrical graduated pint measure. As our readers know, volatile liquids must be filtered under cover to check evaporation, and various plans have been contrived for effecting this. The especial claim of the filter under notice is the elegance and convenience with which the operation is effected. An indiarubber tube connects the two vessels, and when the filtered liquid passes from the upper vessel to the lower one, the air displaced must pass through the tube into the upper vessel to take the place of the liquid which has passed through the filter, the proper pressure being thus steadily maintained without any communication with the air outside the vessels. Collodion, varnish, and all volatile substances, are thus filtered with ease, and without loss or change. A pint of collodion or varnish, it is stated, may be thus filtered in ten minutes.—*Photographic News.*

The Chemical Influence of Solar Light.—It has been observed that the intensity of the diffused light of the sky (not of that reflected by the clouds) is proportional, within certain limits, to that of the sun. When the altitude of the latter above the horizon does not reach 10°, the intensity of the chemical action of its light is practically nothing, while the action of that which is reflected from the sky is quite appreciable. Now, we know that the chemical intensity of the solar light increases constantly and regularly according as its altitude increases, and that it reaches its maximum when it has passed the meridian. These phenomena are easily explained if we recollect that the higher the sun mounts in its apparent course, the less distance do its rays have to traverse in the absorbing atmosphere of our planet. As the sun sinks in the afternoon, we remark a corresponding decrease in the active power of its light, and the relation pointed out exists without reference to variations in the state of the atmosphere.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

ON AN ARTICLE IN "NATURE."

[4006.]—There was an excellent article in *Nature* lately about newspaper science. With nearly all contained in it I cordially concur, and especially with the denunciation of the advertising style of science-writing; an attack obviously suggested by the reports of a late scientific expedition in a daily journal of high standing, in which one name was repeated in a manner intended to be friendly, but most mortifying, doubtless, to the person thus obtruded *ad nauseam* on public notice. But I cannot agree with the writer of this capital article in commending the style of a paper entitled "A Voyage to the Sun," which appeared in the *Cornhill Magazine* for March last, as worthy of general adoption. Surely science should not be taught as in that fanciful narrative, in which inferences were presented as facts, and all the reasoning omitted on which those inferences have been based. The very nature of such a narrative rendered this absolutely necessary; but it is unsafe to recommend that style of writing for imitation.

I say this in no spirit of hostility towards the writer of the "Voyage to the Sun." Indeed, I write as I do with his full knowledge and with the sanction of his opinion. After carefully reconsidering the subject he takes quite my view of it; and, unless I mistake, he is unlikely to write again in the same style.

Richard A. Proctor.

TERRESTRIAL GRAVITATION.

[4007.]—I do not possess Thomson's and Tait's "Natural Philosophy," nor have I ready access to the volume. Would "F. N.," who refers to it (letter 3969, page 119), oblige by quoting the reasoning of the eminent Scotch mathematicians, or describing its general character? It is always possible, in trying to solve such problems by geometrical considerations, that a simple mode of proof may escape one's notice; but I certainly have long believed that there is no simple proof of the law of attraction for spheres on particles outside of them. That the relation may be established without using the symbols of integration I can readily believe—in fact, I am convinced that *so much* can be done in half a dozen different ways. But I should not consider that the integral calculus had been dispensed with *if* there occurred anywhere in the proof the device of dividing the sphere, or any portion of it, into n equal parts, obtaining an expression for the attraction in terms of n, and then evaluating this expression on the assumption that n is made indefinitely great. This is only the integral calculus disguised. Nor again should I consider that the integral calculus had been dispensed with if the elementary attractions were represented by ordinate elements of a plane space having curvilinear boundary, and so summed by a reference to the known area of such space. It was a fashion of mine when at Cambridge (most unfortunately, so far as examination successes were concerned) so to treat problems really involving the integral calculus; and I have in my desk at this moment a fruit of such labours in a geometrical (?) solution of the following problem, the last example in Todhunter's "Integral Calculus":—

A messenger M starts from A towards B (distance a) at a rate of v miles per hour; but before he arrives at B a shower of rain commences at A and at all places occupying a certain distance z towards but not reaching beyond B, and moves at the rate of v miles an hour towards A; if M is caught in this shower he will be obliged to stop until it is over; he is also to receive for his errand a number of shillings inversely proportional to the time occupied in it, at the rate of n shillings for one hour. Supposing the distance z to be unknown, as also the time at which the shower commenced, but all events to be equally probable, show that the value of M's expectation is, in shillings:—

$$\frac{nv}{a}\left\{\frac{1}{2}-\frac{u}{v}+\frac{u(u+v)}{v^2}\log.\frac{u+v}{u}\right\}$$

But I know *now* perfectly well that this laboured proof (which is very much at your readers' service if they would care for it) is based merely on a disguised integration; and that by a direct use of the integral calculus the above problem can be solved in half a dozen lines.

What I should consider a simple proof of the problem "T. A." is troubled about is such a proof as is given of the corresponding problem for the attraction exerted by a spherical shell on a particle within it. Here it is shown that if the particle be the vertex of a double cone of minute vertical angle, the parts of the shell included within the conical surface on opposite sides of the particle exert equal, opposite, and therefore counterbalancing attractions on the particle. Thence the counterbalancing of all the attractions exerted by the shell is inferred, for what is true for a conical surface is true for a pyramidical surface of small angle, and pyramidical surfaces may be made to include the whole substance of the shell. It is a direct and obvious proof such as this that I have again and again tried to find, and I shall be somewhat surprised, and a little disappointed with myself, if any such proof be shown to exist.

Of course "T. A." may rest quite satisfied that no *plus* sign has been changed by inadvertence into a *minus* sign in the solution. The problem, regarded as one of integration, is of extreme simplicity, and has been independently solved many thousands of times, always with one result.

His inference from the behaviour of drops is of a very unsafe character to begin with, for in drops cohesion is able to overcome gravity. But assuming that an oblate spheroid of water (say) as large as our earth and at rest in space, would take the globular form, then (though the polar parts of the oblate spheroid would retire from the centre, and the equatorial parts approach the centre) it by no means follows that the attraction on the polar parts is less than the attraction on the equatorial parts. "T. A." confounds the attraction at a point or on a particle with the resultant of the forces exerted on the particle. If a fluid in a U-shaped tube stands higher in one leg than in the other, the fluid in the former leg will descend, and that in the latter will rise, but the attraction to which the particles are exposed in the two legs are not therefore unequal.

Richard A. Proctor.

[4008.]—When writing letter 3304, p. 406, I fancied the statement there condemned as a glaring error would be so readily recognised as such by any one at all conversant with the subject, that the remark of so able a mathematician as Mr. Proctor, in letter 3386, p. 454, completely surprised me. To ascertain the nature of the reasoning upon which it was founded, I put query 10702, which elicited the opinion that, before we could attack the problem of the difference in weight of an attracted particle, at the equator and poles of a non-rotating oblate spheroid of equal density, it was necessary to calculate the exact amount of attracting force the spheroid exerted; which, being the special work of the integral calculus, could be undertaken by no one but an accomplished mathematician. The decided character of the answers of course precluded all discussion, but I fail to perceive the force of this objection.

If the difference in attractive power between two globes of unequal densities and volumes was the problem to be solved, then indeed it would be requisite to employ the integral calculus for their summation. But in the case of a particle upon the surface of a spheroid, the same amount of power is exerted at any point. This, however, is not the question, which is, whether a particle is drawn to the surface with greater force at the poles than at the equator. Here, I apprehend, the application of the integral calculus is useless, because a particle may be so situated upon the surface of a mass as to have the attraction of its molecules nearly neutralised—for instance, the centre of a flat disc; while if the same disc is rolled into a cylinder, the attractive force of all its molecules can be exerted upon the particle in one direction, for instance, at either end. The subject is, however, ably reasoned out in the last edition of Ganot's "Physics," section 127, p. 93, article "Capillarity." Those who are desirous of discovering the truth concerning this question are recommended to study chapter 2 of this excellent work.

T. A.

SUNDRIES.

[4009.]—There are so many subjects referred to in No. 369, in which some reference is made or question put to me, that I am compelled to write for once a sort of gossiping letter, just touching here and there upon a variety of matters as they turn up while running over the columns.

(3965.)—Concrete Multiplication.—"No. 170" has made a most extraordinary oversight when he states that the arithmetics give rules for multiplying concrete numbers by themselves. Now, this is one of those extraordinary absurdities which clever people commit. On the very face of the matter, multiplying pounds by pounds, or by pints, or by yards, is a proposition worthy only of a lunatic; it is a downright absurdity. But multiplying feet by feet is an entirely different matter, because there is such a thing as a square foot or a cubic yard, while even an idiot would scarcely imagine to himself a pound square or a gallon cube. It is difficult to speak with common patience of such absurdities as the multiplication by concrete quantities.

The Pound and the Metric System.—There would be advantages in the use of the dollar as suggested by "No. 170" (especially as our thin-skinned Yankee cousins might be so delighted as to set it off against the Alabama claims altogether), but the sovereign is an English institution known and highly respected all the world over; and while thinking, as a matter of personal opinion, that it would be well if the nations would agree upon some equal and exchangeable money system, I still think that the inconveniences of a money change would so overbalance the advantages that the sovereign would be best retained as the money unit, issuing decimal divisions of it to be used along with existing coins till the latter were gradually withdrawn; in fact, the florin was coined for this very purpose. The coin question is quite distinct from that of weights and measures, because it is mainly an internal one. Our money only requires a decimal division to make it suit with the metric system in accounts, and a very simple percentage correction would convert it into foreign decimal moneys. No such reasons apply to adoption of the metric measure system, which is complete in and by itself, and would equally adapt itself to any decimalised monetary system, while the dismay produced by the loss of the familiar sovereign, and the alteration of the values of vast money concerns, stocks, companies, &c., would prove a great obstacle to the adoption of the metric system if the public were once persuaded there was a necessary connection between the two.

"J. K. P." (let. 3977, p. 120) is in error in supposing his remarks were at all misunderstood. I quite read his letters as meaning what he now says in all respects; but why should he regret that we should think he asked "questions with a view to obtaining knowledge instead of taking the trouble of reading for it?" He gives a good deal of information, and has good title to ask for any he requires. I do not often ask questions myself, because in the various subjects in which I am interested I have the means of at once obtaining the knowledge I want; but if I desired some information out of my ready reach, I should surely ask for it in these pages, and feel that it was the right thing to do to avail myself of the more ready facilities or special information of others, whom in return I might instruct in my own special subjects. For instance, I have often thought of treating myself to a lathe, and when I do I shall very likely ask "J. K. P." some very simple questions, to save myself the trouble of finding out the answers.

ARE ANTS PIRATES?—W. Gaucho suggests a doubt whether this can possibly mean "do ants rob at sea?" I can very distinctly say that they do. I remember with a shipload of sugar being so swarmed with small red ants that they almost rendered the ship uninhabitable. I have left a basin of water containing sugar as a trap, and caught a pint of them in a night.

"Saul Rymea" (let. 4005, p. 126) doubts the utility of some experiments lately recorded as to the influence of cold upon vegetation, but if he considers for a moment he will surely see the utility of any experiments which seek to discover the processes by which Nature conducts her operations. Any given experiments may be erroneous or badly conducted, but even then they give some lessons, if only as to errors to be avoided.

In reference to the process for destroying aphides (given on p. 133), readers should be cautioned as to the very poisonous character of the smoke produced, and the necessity of care in avoiding the breathing of it.

SIGMA.

A BATCH FROM MR. BOTTONE.

[4010.]—FEW things have given me so much pleasure lately as the perusal of Mr. Geo. E. Davis's sensible, kind, and instructive letter. That gentleman has, in a most masterly manner, shown forth the absurdity of binding oneself to any one set form of belief with regard to theories or hypotheses. His remarks on Dr. Frankland in particular, and other examiners in general, are perfectly in accordance with my own experience; and I did my best to point out the same in my letter (No. 3426). With regard to the convenience of typic and graphic formulæ his ideas coincide with mine. Two or three slight misconceptions appear to have arisen (probably from some carelessness of expression on my part) as to my ideas of the valency of nitrogen, phosphorus, &c. I would wish it to be distinctly understood that I do not for a moment deny that these bodies *sometimes* act as if *pentavalent*. I have only sought to show that there is no *necessity* for considering them such, and that they cannot be considered as otherwise than *trivalent* when we measure their valency by direct reference to their compounds with that body (see letter 3470 *et seq.*). As I do not look upon hydroxyl as the replaceable part of acids, I feel that I should be placing myself in a false position were I to attempt to prove what I do not believe. I may be wrong, but I must plead guilty to a partiality towards considering *all* acids as being referable to the hydrochloric type, single, doubled, or trebled (see table).

—	Graphic Formulæ.	Salts with Monads.	Salts with Diads.	Salts with Triads.
MONOBASIC ACIDS:—				
Hydrochloric acid, 1 molecule (type)	(H }′ ′{ Cl)	(M }′ ′{ Cl)	(M }″ ″{ Cl, Cl }	(M }‴ ‴{ Cl, Cl, Cl }
Derivatives:—				
Nitric acid …………	(H }′ ′{ ON^O_O }	(M }′ ′{ ON^O_O }	(M }″ ″{ ON^O_O — ON^O_O }	(M }‴ ‴{ ON^O_O — ON^O_O — ON^O_O }
Iodic Acid …………	(H }′ ′{ OOOI)	(M }′ ′{ OOOI)	(M }″ ″{ OOOI, OOOI }	(M }‴ ‴{ OOOI, OOOI, OOOI }
DIBASIC ACIDS:—				
Hydrochloric Acid, 2 molecules (type)	{ H, H }″ ″{ Cl, Cl }	{ M, M }″ ″{ Cl, Cl }	(M }″ ″{ Cl, Cl }	{ M‴, M‴ }vi vi{ Cl′, Cl′, Cl′, Cl′, Cl′, Cl′ }
Derivatives:—				
Phosphorous Acid …	{ H, H }″ ″{ POOOH)	{ M, M }″ ″{ POOOH)	(M }″ ″{ POOOH)	{ M‴, M‴ }vi vi{ POOOH, POOOH, POOOH }
Sulphuric Acid ……	{ H, H }″ ″{ OO, S, OO }	{ M, M }″ ″{ OO, S, OO }	(M }″ ″{ OO, S, OO }	{ M, M }vi vi{ OO, S, OO — OO, S, OO — OO, S, OO }
TRIBASIC ACIDS:—				
Hydrochloric acid, 3 molecules (type)	{ H, H, H }‴ ‴{ Cl, Cl, Cl }	{ M, M, M }‴ ‴{ Cl, Cl, Cl }	{ M″, M″, M″ }vi vi{ Cl, Cl, Cl, Cl, Cl, Cl }	(M }‴ ‴{ Cl, Cl, Cl }
Derivatives:—				
Phosphoric acid ……	{ H, H, H }‴ ‴{ –O–O, –O–P, –O ⁄ }	{ M, M, M }‴ ‴{ –O–O, –O, –O >P }	{ M, M, M }vi vi{ OO, O^P, O — OO, O^P, O }	(M }‴ ‴{ OO, OP, O }
&c.	&c.			&c.

Far be it from me, however, to give these ideas, or the formulæ connected with them, as being absolute; I am so convinced that nothing in this world is capable of *absolute* proof, that when I find an individual make an absolute statement, I begin from that very moment to doubt his veracity. All our knowledge is essentially relative: hence if I and Mr. Davis agree to consider hydrogen as a monad, we are perfectly justified in saying that chlorine is a monad, oxygen a diad, nitrogen a triad, and silicon a tetrad; *relatively*. But were we to take iron (for example) as our monad, these relations would probably no longer hold good.

With regard to the valency of hydrogen, it is worthy of remark that a compound has been described (see Gmelin's "Dictionary") in which two atoms of iodine are supposed to be united with one of hydrogen. The name of this anomaly is hydriodous acid; its formula is given as I_2H. Now, until the existence of this body be disproved, we cannot look upon hydrogen as invariably monovalent; hence we are once more brought face to face with a grave objection to the valency theory as it at present stands.

Mr. Davis will, I am sure, pardon me if I venture to point out that I did not attempt "to make chlorine appear to be first a monad and then a dyad." I simply showed that, with hydrogen, chlorine forms only one compound—viz., HCl, and that with iodine, &c., it formed compounds, of which our usual idea of its valency gave no satisfactory explanation.

On the grounds of the varying valency of iodine, chlorine, bromine (I care not whether they be artiads or perissads), I must object to such compounds as triethylsulphurous iodide being brought forward as proofs of the quadrivalence of sulphur.

It would appear that *ammonium* has been isolated, for Professor Roscoe describes it as being a blue metallic-looking fluid, existing only at low temperatures. (See Roscoe's "Elementary Chemistry," p. 213, last edition.)

With regard to the metric system, I agree perfectly with Mr. Davis in every particular. Were we to attempt to introduce another decimal system, we should segregate ourselves from nearly all our Continental neighbours.

"The Harmonious Blacksmith" has mistaken my meaning in reply 11393. I stated that the *ordinary* metal harmonicon was a toy: I certainly did not allude to the *adaptations*, which both he and I have concurred to praise.

Spontaneous combustion of oily waste, rags, &c., is no myth. Many well authenticated cases have occurred, especially in Russia. (See "Natural Magic," by David Brewster.)

For Mr. Tonkes's edification, I may state that I bought, some time ago, from Fries and Bianco, of Turin, a small pocket medical coil and battery, each of which packed into a little cylindrical ebonite case, 1¼in. long by ½in. in diameter. Amused by the minuteness and efficiency of the thing, I made one on the same model, which worked equally well.

S. Bottone.

"F. R. A. S." AND GEO-MYTHOLOGY.

[4011.]—I can assure "A Fellow of the Royal Astronomical Society" that if he could not see anything has yet been *shown* him about contacts of comets with the earth (let. 3960, p. 117) there are other eyes as worth showing and that partly have been, and still more will be shown a little, before we have done. Also to Mr. Scrope I shall return, and we shall have some Scropiana and Lyelliana rather amusing when there is time. But, meanwhile, our "Fellow of the Astronomical Society" quite leaves his science and all comets (which are not mentioned in his letter, but only in its title) to thrust upon the thousands of your readers a bit of neither astronomy, geology, nor even Lyell or Scrope, but simply the most sensational line or two from the first "preface" of poor honest ignorant little Bishop Colenso, exactly copied with every blunder, as the Chinese copy a worn picture! Certain cones in Auvergne—there are something between 100 and 150, observe, in that province—certain of these are of Pliocene or Eocene antiquity as volcanoes. Granted. "And upon the steep sides of these cones lie, absolutely undisturbed, scoriæ, lapillæ, and pumice-stone, which anything in the nature of a flood, sixty thousand—to say nothing of *six* thousand—years ago—[my theory, and that of all the chief geologists of Europe puts it at *five*, observe, not six]—must inevitably have swept away"!! Admirable! But how long have the scoriæ been there to be swept away? What has the "Eocene" age of the cone they "cover" to do with it? Is not Primrose Hill, London, an Eocene clay hill and covered with grass? Are we to conclude the grass is Eocene, and prove some Lyellian wonder thereby? Or is not Stromboli a volcano of, at least, Pliocene origin, and is it not covered with loose matter that any flood would have swept away? Yes, but part thereof was only thrown out last week, and there has been no deluge since last week! The conclusion that "hence, wherever the Noachian deluge went it did *not* penetrate to the Valley of the Auvergne" (which, by the way, is the exact reverse of a valley; it is what Dartmoor is to Devonshire, or as the French say, the chief *massif* of their country) is amusingly unlike the conclusion I believe, the three first geologists living, De Beaumont, D'Archiac, and De Villeneuve-Flayox have now come to—namely, that if there should even have been *no* general cataract or skyfall of scouring deluge elsewhere, since Quarternary times, there certainly *has* been on that very province, Auvergne!

The parallel of me to "a certain man called Hampden" goes equally by contraries. Mr. Hampden, as "F. R. A. S." says, was to set *all the world* right, not a little English coterie and mutual admiration society, amusing themselves with the lightest of light science, and too careless even to note that their Sir Oracle keeps them as hopelessly behind and counter to *the world*, the real advancers of knowledge out in the civilised *orbis terrarum*, as Voltaire complained that Cartesianism had kept his countrymen when he began teaching them Newton. I am only siding with the majority, with continental men of science. What other country's cosmology and geography is it that Mr. Hampden seeks to introduce to us?

Now, as "A Fellow of the Royal Astronomical Society" has chosen to thrust again upon us this Auvergne myth (or whatever it be—myth, as far as yet appears) this famous cone and pumice-stone, which made some noise ten years back, may I venture to hope he will proceed to favour his numerous readers with what I have vainly sought from either Lyell or the whole Geological Society for at least eight years past, the situation of this famous cone, and the evidence as to how long its last ejectments have lain upon it? A cone in Auvergne is no more information than "a hill in Yorkshire." It must be in some parish, of some commune, of some canton. Even if it were in central Australia, instead of France, it must have ascertainable latitude and longitude. Am I to take it and believe in it, as the mediæval Jews did in the "sabbatical river," that every one knew was "in Tartary," that flows only six days of seven, and (as every Israelite knows) triumphantly refutes the Nazarenes by keeping its Sabbath not on Sunday but on Saturday? As our ex-astronomical correspondent puts it to us, and as Lyell and the geologers have left it all these years, their pumice-stone and this "sabbatical river" are exactly of the same value to science. One proves precisely as much as the other.

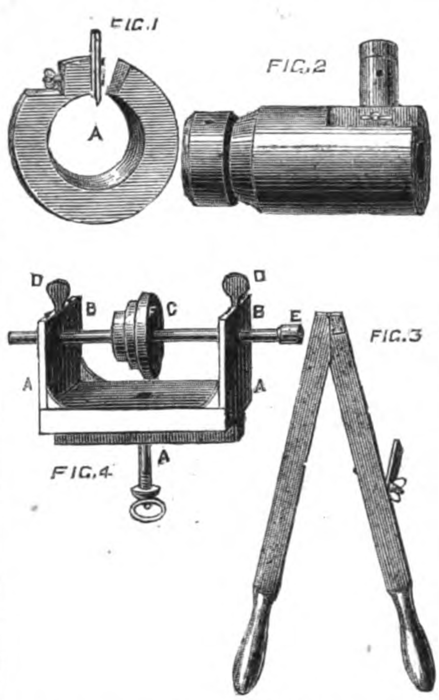
I may add that, about eight years ago, in a widely circulated paper, still well known, I so far adopted Mr. Hampden's method as to offer £10 towards the expenses of whoever would produce the evidences I now ask our "F.R.A.S." for—the situation, namely, of this pumice-stone, and the tangible facts that may indicate it to have lain *in situ* (say) fifty centuries. I could not afford to offer more personally, the intention being that others interested might add similar offers, and make up a sufficient bribe. To my great surprise (especially as the paper chiefly circulates among the clergy) no one has followed, or offered a single shilling! However, as I have not changed either my name or residence, here I am, to be sued for the £10 by "F.R.A.S.," or whoever may answer this request for him, and think it worth claiming. Of course, I must in any case be sued for performance of the contract, the whole object being to bring the evidence, or whatever and whoever is essential to it, before a jury of Englishmen, the only test of the power of evidence that I acknowledge, or the law acknowledges.

Our correspondent has chosen to make statements. I must press him to give the particulars and proof of them precedence before any other work. Even the planetary positions for next month, I would suggest, can wait if necessary.

E. L. G.

ORNAMENTAL TURNING.—X.

[4012.]—According to promise, and in answer to a correspondent ("Joiner," qy. 11168), I send sketch of a chuck by means of which a rod, the size of a penholder, or less, up to a cornice pole, could be turned. The chuck can be used on the ordinary mandril, but only for short lengths; if long lengths are required, then a hollow mandril must be used. I may here state that a hollow mandril is constructed from a piece of tube steel, and running in two bearings, it has no back centre. In some respects same as ordinary mandril, but being hollow, allows the work to pass through after being converted from square wood into circular. 1. Front view of chuck. The hole of the chuck, A, must be but little larger than the rod required when finished, but must taper inwardly for 1in. past the mouth; the cutter is an ordinary jack plane, iron; set fine it for hard wood; not so fine for deal or other soft woods. Fig. 2. Side view of the chuck, and ordinary wood chuck fastened into the ordinary iron chuck described in No. 368, p. 98. Rods 1ft. long can be made in this chuck, but if required longer I advise a hollow mandril. I have made taper articles in a chuck



similar to the one described. I had a quantity of spiles or vent pegs to make—the pegs are sold to the warehouses at 2s. 6d. to 8s. per 1,000, wood included, and made by hand in a kind of lever machine. The work being too tedious for me, I made a chuck as described; the only alteration was that the iron cutter, instead of being fixed square with the chuck, was fixed taper to the angle required. The wood was split up into nearly the size, and held with a pair of pincers. In making rods I advise the same, but as the rods may require to be longer, I send sketch of a tool called a trap, and also sketch of a temporary hollow mandril I constructed for my own use. The sketch of the trap will partly explain its use. The wood to be converted into a rod is fixed between centres, the corners previously being taken off with a plane; the trap placed over the wood and worked gently, end for end. Do not use much speed at first, and do not close the trap all at once, but gradually. It is a very quick way of making small rods. If very long, 3ft. or more, use a back steady, and only work one part at the time. Fig. 4. Sketch of temporary hollow mandril. A, frame made of dry beech; at B B cut and bored for bearings to allow the mandril C to revolve; the bearings are cut after boring and fastened with coach screws, so that as the wood bearings wear they can be screwed tighter or renewed. To make the mandril, proceed as follows: Obtain a straight piece of steam tube, about 1ft. in length, fix it in the lathe, and having previously marked where the bearings will run, turn a groove in the tube the width of the bearings, and three-sixteenths deep. The groove should be slightly bigger in the centre to allow more freedom in working. D D, lubricators when at work. I find nothing to beat the needle lubricator. E, a socket to fit the tube; it will be given with the tube on purchasing the same. To fasten the chuck, turn a hole the reverse side of the chuck, and drive in the socket, having previously judged the same, not forgetting to put an iron ring round the end of the chuck to prevent splitting. F, the pulley. The quicker the speed the cleaner the work, if by steam power or fly-wheel. A vast quantity of rods can be turned, and one great advantage is that it matters not the wood being warped, as the distance in the chuck is so little that it will turn to the shape of the wood. For light work a 1¼in. iron will answer, but for heavy work a 2¼in. iron will be required.

A mandril of this description can be made by an amateur, and need not cost more than a few shillings. If for small articles, and to be worked by the foot, I should advise the steam tube to be what is called ¾in. steam tube. If steam tube cannot be procured, gas tube will answer. Dry oak or mahogany is best for the frame, or, better still, teak wood, not being so liable to warp out of shape. In cutting rods, it is advisable for two to work at the mandril, as when it passes through the mandril a boy can hold and steady the remaining cut after leaving the hand of the operator, and also allow the rods to be entered quicker.

Samuel Smither.

ANNEALING STEEL, LINT, AND GILDING STRIPS OF WOOD.

[4013.]—(11650.)—Annealing Steel.—Heat to a dull red in the forge, and bury in the ashes, so as to allow it to cool very gradually. When cold it will be sufficiently soft for all practical purposes.

(11599.)—Lint.—Old linen sheets, &c., are preferred to new cloth on account of the softness of the fibre. It is generally cut in pieces 10in. or 12in. broad, washed and dried, then taken to the lint machine. This machine consists of a steel knife-blade, with parallel sides, the edge of which is blunt, but perfectly straight; this knife is fixed in a horizontal position in a frame, which is made to reciprocate by means of a pedal. When this pedal is pressed by the workman's foot it causes the blade to descend vertically with its edge across a board, covered with leather, upon which the linen is placed; on taking the pressure off a pedal the knife is lifted from the work by the agency of springs. The linen is rolled very evenly upon a cylindrical stick, with the weft in the direction of the stick; a few inches of the cloth being uncoiled, and a few threads of the weft pulled off at the end, leaving a fringe of the warp projecting; the roller is held steadily with both hands by the operator, who begins by placing the end of the cloth in such a position upon the workboard, that when the knife descends by the pressure on the pedal its edge shall pass between the first and second thread of the weft and press across all the warp threads; whilst the latter is thus held down to the table, the operator pulls back the stick through a space of from a quarter to half an inch; the weft thread is thereby pushed further along the warp threads, and from them is scraped the lint by their being drawn under the edge of the knife. The foot being lifted from the pedal the knife ascends, and the operator pushes the cloth forward again to take the next thread, which, by the pressure of the knife and the pulling back the cloth at the same instant, is moved along the threads of the warp after the first, and thus raising more lint. In this manner the operation is conducted thread after thread, until all the cloth on the stick is worked off, and thus is produced, when the work is dexterously performed, a sheet of thick downy lint. The difficulty of the operation consists in making accurate movements by the hands with great quickness; for if a weft thread is crossed by the knife, the work is checked or spoiled instead of forwarded.

(11627.)—Gilding Strips of Wood.—First prime your wood with two or three coatings of boiled linseed oil and white lead to fill up the pores of the wood, and to render the surface smooth and even. When the priming is dry, lay on a coat of gold size. When the gold size is sufficiently dry cut leaf-gold into strips, take up on the point of a brush, and apply to the parts already sized; press gently all over with a ball of cotton wool; the gold adheres to the sticky surface, and after a few minutes the superfluous gold can be wiped off with a camel's-hair brush. For burnished gilding proceed to cover the surface to be gilded with parchment size; after the first coat drying seven or eight more must be applied, consisting of the same size mixed with fine plaster of Paris or washed chalk; and when the whole is perfectly dry a moderately thick layer of size mixed with bole or yellow ochre must be applied. Before this last coat drys the gold-leaf is applied as before, and while the size remains the parts intended to be bright must be burnished with a dog's tooth or agate burnisher. Wm. Hamilton Hey.

THE HOLLIS OBSERVING SEAT.

[4014.]—I write to thank the inventor of this very excellent seat, which is advertised in your columns. It is of very simple construction, but very neat and effective; it affords support for the head, as well as the rest of the body, keeping it perfectly steady in any position, and is therefore a great assistance in making observations. Its price is so very low that I should imagine it would be well within reach of any who possess even a £5 telescope, and I can say from experience that it would be a most valuable addition to such an instrument. As I happen (unfortunately for myself) to live in a smoky atmosphere, my observations are necessarily confined to short distances from the zenith, and I greatly appreciate anything that enables me to examine a vertical object, not only without dislocating my neck, but as comfortably as if lying on a sofa.

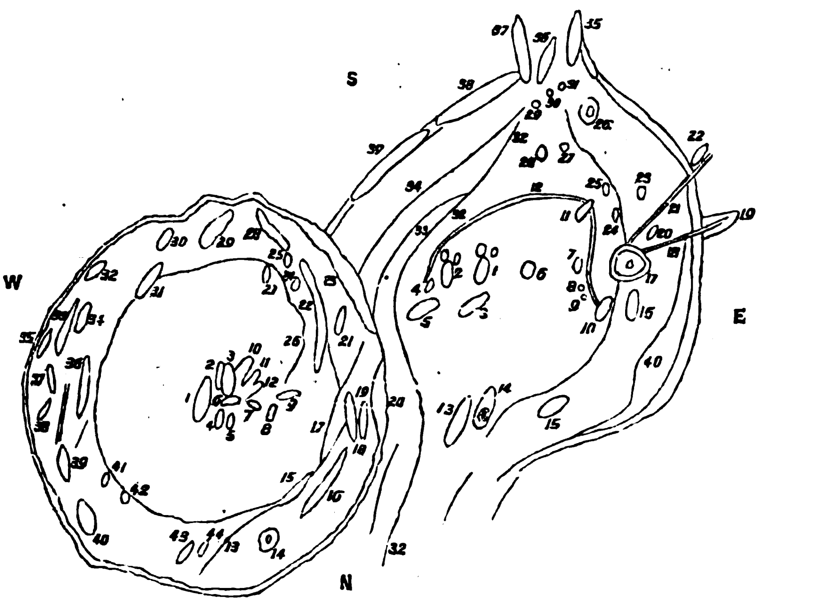
Sirius.

THEOPHILUS AND CYRILLUS.

[4015.]—I SEND you a sketch and description of the two craters, Theophilus and Cyrillus, in the hope they will be of some use to a few of your readers. I observed these objects on April 14, 1872.

THEOPHILUS.—THE FLOOR.—1 is the principal central mountain; 2 and 3 are also two mountains, but 2 is partly hid by, and lower than, 3; 4 and 5, on the N. are two hills, and 6 is another hill lying in direction at right angle with 3; 7, 8, 9, are also hills. The object E. of 3 and 6 seems to me very suggestive. Suppose a mountain, uplifted by an interior force, and its materials rushing down in a S.E. direction, the result would be very much like this object. It terminates by the three digits 10, 11, and 12, but the two last are not so easily seen as the first. On this object, between the digits 10 and 11, is a small lacuna or a marking of that kind, I think, and shown in the sketch by two short parallel lines. The line 26, S.E. of the central hills, shows the boundary of a depression W. of it.

THE INTERIOR SLOPE, N.—The line 13 shows the boundary of a large mound occupying all this portion of the slope, and upon which is the crater 14; 15 and 16 are mounds with a longitudinal form. The portion of the slope between 17, 18, and 20 stands in contrast with 23, where the border is well defined. At first sight it looks like a roundish form, with no particular marking on it; but, on closer examination, three mounds, 18, 19, and 20, with corresponding valleys, reveal themselves and give a sort of satisfaction for the steady gaze they require (would "L. C. E.," let. 3884, believe it?). 21 a mound; 22 a ridge; 23 is the well-defined border of the crater; 24, 25, 27, mounds; 28 to 44, mounds of various sizes. Between 36 and 38 a short valley or cleft runs in a somewhat N. and S. direction. Also E. of this valley there is another, but not so well seen, and shown in the sketch by a single line.



CYRILLUS.—THE FLOOR.—1 and 2 central mountains, having each two small hills at their S. end; 3 and 4, mountains belonging to the same group; 5, large low mound; 6 and 7, two mountains; 8 and 9, two very minute hills with power 227; 10, a mountain, on the S.W. of which emerges a cleft which runs in a southward direction with a gentle curve, until it reaches the mountain 11, behind which it disappears. It emerges again on the W. foot of mountain 11, takes a western direction, and, with another gentle curve, turns towards the N., and ends near mountain 4. This cleft, which I have seen before, is marked 12 on the sketch.

THE INTERIOR SLOPE, N.—13, low mountain or mound; 14, a mound on which is a crater on the N.; 15 and 16, mounds; 17, the largest crater in Cyrillus, with a peak in its interior; 18, a cleft cutting across the slope and ending in a depression; 19, E. of Cyrillus; 20, a mound; 21, another cleft running from crater 17 across the slope, and ending N. of a mound 22, E. of Cyrillus. This is the first time I have seen these two clefts; they seem formed by confluent craterlets, as their borders are very rugged. As the silver of my mirror is now much worn out, I had some difficulty in seeing these two clefts satisfactorily. 23, 24, and 25, mounds; 26, a crater; 27 and 28, mounds; 29, 30, and 31, small hillocks. The lines 32, 33, and 34, show the places of three large terraces; 35 on the S., to 37, are mountains; 38 and 39, higher portions of S.W. border of Cyrillus. The line 40 on the E. is intended to show the place of a long sinuous valley between two terraces.

I am glad Mr. J. Birmingham (let. 3917, p. 91, Vol. XV.) has seen the valley shown in my sketch of Tycho, and thank him for what he says on this occasion with regard to myself. I the more fully agree with him in his remarks about that valley, that a perusal of my letters 3485, p. 508, and 3698, p. 616, show that I would myself rather call this object a valley than a cleft. And here allow me to correct a mistake contained in my letter 3698 towards the end, where it is stated that the end of this valley reaches the east of Street. It must be "the east of crater *a* of Beer and Mädler, west of Street."

Jumet-Hainaut, Belgium. G. GAUDIBERT.

ATMOSPHERIC DUST.

[4016.]—MY reasons for thinking that comparatively recent sewage is more dangerous than sewage which has undergone putrefaction or is actively decomposing (let. 3918, p. 92) are the following:—

The substances excreted by an animal, although worn out by the wear and tear of its machinery, do not die immediately; they possess a sort of vitality, and in that state are active poisons to the animal, if retained, or again taken into the system. An instance of this may be found in the danger of dissecting wounds when the subject is not perceptibly tainted, the danger passing away when putrefaction has taken place. We are not only constantly generating poisons and throwing them out by natural processes, but are most probably taking such animal poisons in, and are for the most part saved from the consequences by the power which indubitably the organism possesses of ridding itself of injurious substances, and doubtless we are indebted more frequently than we are aware to a smart attack of dysentery or diarrhœa for deliverance from the consequences of such poisoning. There is not a shadow of evidence to show that zymotic or infectious diseases are in any way caused by vibrios, bacteria, or the other small deer that disinfectant-mongers alarm us with; but there is a mass of evidence to favour the theory that these diseases are produced by what may be called the degraded constituents of our bodies. I especially dislike the word "germ," and with the permission of "L. C. E." would propose instead the term "Nosogen," which is elastic enough to suit any of the theories put forth to explain the origin of zymotic diseases. Now, if we take the case of small-pox, we find the matter produced by the disease is an active nosogen not only during the life of the patient, but long after death. For it has frequently occurred that medical students have caught the disease by merely standing about a subject whose death had been the result of this malady. And here let me remark that Dr. R. D. Thomson does not appear to think that any gases or vapours, the composition of which is known to the chemist, cause zymotic diseases, although he considers it certain that the nosogens possess a condition resembling the vaporous, for how otherwise can he account for catching these diseases when no contact takes place? I believe that these nosogens are allied in nature to cadaveric poison, to depraved secretions, like that of rabies—perhaps of syphilis; and that the maladies caused by mere putrefaction are totally different, taking the form generally of boils, more or less malignant, having no regular symptoms nor well-observed course. Considering the horrible stenches from privies and cesspools in which the greater part of the population lives, I think it is evident that these odours, however disagreeable, are not dangerous like the emanations and excreta thrown off from the bodies of even healthy persons, which, when concentrated by want of ventilation, act with deadly effect. It is not at all necessary for persons to be sick to produce such poisons. They are constantly being generated and being thrown out by natural excretion, and give rise to what are called sporadic cases, on any other theory perfectly unaccountable. Infusoria are no more poisonous than oysters, and moreover, do not exist in the virus of small or cow pox—*par example*—except when decomposing, when, observe this, "Saul Rymea," it ceases to inoculate, but in the latter case gives rise to symptoms which produce the feeling in some quarters so hostile to the Vaccination Act. M. PARIS.

ARE ANTS PIRATES?

[4017.]—IN the article on ant piracy (let. 3778, p. 667), signed "Saul Rymea," is a warning given to show no mercy to ants in our gardens. But a plea for the insect may be put in: ants prey upon all kinds of larvæ, &c., and in woods the large ant attacks the blossoms of shrubs and trees only when extreme dryness cuts off all other supplies of food. I have never seen a blossom touched when sufficient moisture kept animal and vegetable life going on the soil.

GERARD SMITH.

LIGHTNING.

[4018.]—MR. TONKES does not explain (letter 3922, p. 93) the *modus operandi* of lightning. If we call to mind the extraordinary pranks played by flashes, it appears to me we must grant that if steam plays no part, at least the sudden expansion of air, and, perhaps, volatilisation of the substances disrupted, may produce the effects. Some time ago I saw a tree that had been struck: a great part of the trunk had been converted into small strips like lucifer matches. When we bore a hole through a sheet of glass by means of a spark I think there is no thickening of the edges of the hole. If so is not the glass vaporised? The lightning must use some tool to bore with, and I believe this instrument to be, generally, enormously heated air. In the majority of the cases I have noted there does not appear to have been steam at work. M. PARIS.

AURORA.

[4019.]—ON the evening of the 10th April there was a rather fine display of aurora. As the twilight faded the northern and north-western horizon was occupied by a pale blue homogeneous light extending to a height of about 15° above some remarkable branching dark cirrus clouds, which appeared to radiate from the magnetic north. These clouds were almost stationary, and the same form of clouds had been persistent all day, especially at about 3h., when some streamers of thin light haze radiated in a remarkable manner from a point above the WNW. horizon, and were so sharply cut off on their south sides as to appear almost solid matter. (The same remarkable branching cloud polarised in the magnetic meridian was visible in front of the fine aurora of April 9th, 1871.)

At 9h. 30m. numerous fine streamers shot up, all perpendicular to the horizon, and in a few minutes merged into one another, and assumed a pale rosy glow. The light in the north brightened, and at 11h. 30m. became very intense in the magnetic north, where some superb blue and carmine streamers shot up to within 15° of the zenith. The aurora was still in the north at midnight.

On the 11th extraordinary bands of haze radiated from points in the NE. and SW. (in which places the sky was exceedingly luminous), and stretched across the sky in gigantic arches.

Champion Hill, April 12. HERBERT INGALL.

INFLUENCE OF COLD ON VEGETABLE GRAINS.

[4020.]—I OBSERVE "Saul Rymea's" criticism (p. 126) of M. Duclaux's experiments, and my account of them, and would make a remark or two in explanation.

The conclusion drawn by M. Duclaux was, that cold had some influence on the germination of those grains of Belle-de-Nuit and Volubilis. Some of the grains that had been exposed to cold had germinated; none of those not exposed had germinated; and, although in one of the Volubilis pots none of the grains had germinated (though previously exposed to cold), yet this did not destroy the preponderance of evidence on the other side. Well, then he adds that some grains that have not been exposed to cold—that have been kept all winter in a heated chamber—germinate, nevertheless, at a certain time (and, perhaps, if I had said nevertheless, for none the less, it would have been more accurate). Germination takes place spite of non-exposure to cold, so that the cold is not indispensable to the germination. Nevertheless (and there is nothing now stated which conflicts with this inference), the fact that those grains experimented upon have their germination affected (in some way) by exposure to cold is a presumption that other grains do not escape the influence in some way or other of cold, when they are exposed to it. The fact of germination in some cases, where there has been no exposure to cold, does not preclude the possibility of some influence of cold on the mode of germination where exposure has taken place.

A. B. M.

GLAZING CONSERVATORIES.

[4021.]—THE plan recommended by our friend "Saul Rymea," at page 38, under the heading of "Improved Method of Glazing," is an old, tried, and costly one. I am of opinion that the old putty system equals it. Knowing a glass-house constructed on the iron system, it has not answered well or anything like one efficiently glazed with putty. The chief objection is the expansion, I know, but there are other ones besides this. In fact the owner told me he would not have another roof glazed on the principle on any account. It is well enough for "Rat-Tat" to raise a pane for ventilation; let him try it. I am afraid he will break some in the experiment. I maintain a conservatory glazed well on the putty system, well sprigged, &c., drives all iron and glass slate roofs into the shade. I should like to hear "Jack of All Trades'," and a few able correspondents' opinions. H. B. E.

BOILERS—CASTINGS—ROTATING SHOT.

[4022.]—There have lately been several designs of engines for amateurs in our Mechanic, but hardly anything has been said about boilers, a part of the subject which seems to me to require quite as much attention, and afford almost as much scope for design, as the engine itself. Indeed, I suspect it often happens that the amateur, having completed a highly-finished engine, finds himself "stumped" by the want of a boiler which he does not feel sure he can make safely himself, and of which he does not quite know the most suitable kind to order. I should think that a vertical boiler would be the best, and, if possible, fired with gas, burnt through wire gauze, as recommended by "Houblon" some time ago. Some small field-tubes might be added, or a few tubes bent to the shape of a U, with one leg longer than the other. The shorter leg being fixed in the crown of fire-box, the bend would hang down in the fire, and the longer leg would reach nearly to lowest water-level. I should think there would be a rapid circulation set up. Would this be so? Would it also be practicable to make the steam-pipe go down inside the boiler, and, if possible, through furnace? This would superheat the steam, and very little pipe would be exposed to the air. Have any of "ours" tried a boiler, illustrated in one of the first volumes, formed of a sheaf of tubes connected top and bottom to two tubes encircling the whole? A few particulars as to cost (if admissible here) would be acceptable.

I hope "Proven" (let. 3996) will favour us with some more particulars about casting with cera perduta. I have often thought it would be just the thing for an amateur with the aid of a Griffin's gas furnace. Is common beeswax used, and how are the moulds made and baked?

I believe that the plan suggested by "Philanthropist" (letter 3992) is employed to rotate stickless military rockets, which have in the rear end a central hole for the propelling jet, and a circle of oblique ones for rotating. Faber.

HOUSEHOLD ELECTRICITY.

[4023.]—Under this head one of your Transatlantic contemporaries makes the following statements, which bear upon a discussion recently carried on in the English Mechanic. The moralising which follows them is not of a character to interest your readers, so I merely send this portion of the article, and can only express the personal opinion that Boston must be a favoured city indeed. No need of Pulvermacher's chains there—or even lamplighters:—

"During the extraordinary clear cold weather which prevailed in February and March the electrical phenomena observed in some houses excited much interest. In our own dwelling, for many days, no member of the family could walk across a room and come in contact with a metallic substance without receiving an electrical shock, accompanied with a spark and report. The door knobs, stop-cocks connected with steam radiators, gas-cocks, registers, &c., were so electrically spiteful that they were handled with caution. Our children amused themselves in the evening by lighting the gas with their fingers, and altogether the electrical condition of the atmosphere was quite unusual. In order that this exhibition of household electricity may be witnessed in perfection, it is necessary that the weather be clear and cold, and that the rooms be carpeted with heavy carpets, and these should be insulated by paper mattings beneath. Under these favourable conditions, a person scuffing or even walking across a room becomes so charged with electricity that he can ignite a gas-jet readily by applying to it the tip of his finger."

G. J. H.

NEW DOUBLE STARS.

[4024.]—I have not been able to do much recently in the way of finding new double stars, and have only the following to report:—

Geminorum.—Weisse VII., 689, 7h. 24m. 51s., N. 33° 7′ : 8, 11½ : 155° : 7″. About one degree *s* of Castor, and 1m. 25s. *p*.

Aurigal.—L 10696, 5h. 34m. 10s., N. 29° 47′ : 8, 11½ : 200° : 6″. This is 3m. 52s. *f* 26 Aurigal, and about 37′ further *s*. It is nearer Σ764, which is about half a degree *sp*. This pair is similar to the one in Gemini, neither of which are difficult or very interesting. I notice a second companion to 26 Aurigal not mentioned by Struve or Webb, but it is too easy an object to have escaped observation entirely. It is about 12m., the position angle being 115°, and the distance a little more than double that of Struve's companion, or in the neighbourhood of 30″.

Crateris.—L 21697, 11h. 17m. 11s., S 9° 42′ : 7½, 10½ : 80° : 2″. A very pretty double star about 30′ from *ι* Crateris *np*; seen but once; but, probably, only moderately difficult.

Hydræ.—L 19393, 9h. 47m. 26s., S. 18° 52′ : 7½, 9½ : 90° : 5″. A fine, but very easy pair; about 35′ *sp*, a 5m. star. The bright star is omitted on Proctor's maps, but given on Argelander's. Having loaned the catalogue accompanying the "Uranometria Nova," I am unable to give its designation there, but it is No. 19433 of Lalande.

Canis Minoris.—7h. 55m. 44s., N. 3° 26′ : 8, 12 : 180° : 2·5″. The only difficult pair for a 6in. aperture in this list; found on the same evening with *γ* Canis Minoris, and probably more difficult than that pair. It is about 1° *s* of P VII., 289, a star visible to the naked eye a short distance following 14 Canis Minoris; both shown on Proctor's maps, the first without designation. The double is *nf* a 7m. star, both being in a low power field. There is an exceedingly minute pair about 100″ *np* this pair, similar to that near *γ* Canis Minoris, but much fainter and closer.

Sextantis.—10h. 15m., S. 9° 7′ : 8, 10½ : 190° : 1·75″. I open my letter to add this fine pair, found last evening. I have not ascertained its place exactly, but give the nearest minute in R.A. It is some distance *f* 17 and 18 Sextantis, but 1° 20′ *s*. It is also *sf* a 6m. star the designation of which I am not certain.

I am obliged to Mr. Knott for his measures of some of the double stars. I have recently obtained a micrometer, but for want of suitable clockwork can do nothing in the way of measuring double stars. I have been agreeably disappointed, however, in finding that minute points of light near brighter stars are rather better seen with the instrument illuminated than otherwise. I have never before seen a micrometer attached to a telescope, but had the impression that the light from the lamp tended to extinguish faint stars. Possibly the fact that I have been obliged to illuminate in a way never intended by the maker may have something to do with it.

Chicago, April 9. S. W. Burnham.

ALLINGHAM'S PROPELLER.

[4025.]—I would be extremely obliged to Amos Appleyard (letter 3919), if he would inform me where there is any published account of a method of propulsion similar to mine, as I have never met with anything similar, although well read up on such subjects, and used all precaution before commencing to patent same. Would also suggest to him that it is, to say the least, foolish to pass a sweeping assertion relative to any apparatus which he has never witnessed in operation. I have exhibited a model, 7ft. long, propelling quickly against the ebb tide of the river Mersey, running out at, perhaps, five miles per hour, as well as the united force of the wind and waves, all three forces against her, and am ready to show it to any one interested in such matters. There were scores of people saw it do so, and engineers declared that no steam-engine fitted to a boat same size could accomplish it. Size of boat, 7ft. × 8in. beam, and draught, 2in.; depth of blades from surface, 20in. This apparatus would be invaluable for lifeboats, as the time they are most needed is that in which the singular advantages of my invention are brought into play—viz., against a head wind.

John James Allingham.

HORTICULTURAL JOTTINGS.

[4026.]—I send a few clippings which may be of interest to many of your readers. Some time back I spoke of the advantages which accrue to the persevering horticulturist in a commercial sense, as well as the pleasure afforded in watching the growth and development of new varieties of plants. This was, I think, in connection with a discussion on the possibility of obtaining a change in the colour of primroses by means of chemicals, or of raising plants of certain kinds with flowers of a colour at present missing—*e.g.*, blue roses or dahlias. In reply to this it was asserted that there is no genus of plants which yields blooms on its different species of the so-called three primary colours, blue, yellow, red. One of your correspondents immediately pointed out the incorrectness of this statement, but as Mr. Sowerby has recently published a list of the genera having species of these three colours I copy it for the benefit of those interested in the question. He says:—An assertion is often made respecting the colours of flowers of plants which is scarcely verified by facts. It has been said that plants with flowers of the three primitive colours, red, yellow, blue, are not found belonging to the same genus; the following, however, contain species with the three colours more or less distinctly defined, and if pink be included as a red colour, the list might be much extended. The list is copied from a catalogue of plants, but many of the genera are familiar to all growers of plants:—

Ajuga	Hibiscus	Phaca
Allium	Hyacinthus	Polygala
Aloe	Ipomœa	Pourretia
Amaryllis	Iris	Rondeletia
Auchusa	Ixia	Salvia
Anemone	Justicia	Scutellaria
Aquilegia	Lachenalia	Sedum
Asterocephalus	Lælia	Senecio
Astragalus	Lathyrus	Solanum
Babiana	Lavatera	Stachys
Billbergia	Linum	Statice
Bromelia	Lobelia	Symphytum
Centaurea	Lupinus	Tephrosia
Cereus	Martynia	Teucrium
Chorozema	Meconopsis	Thunbergia
Cineraria	Miltonia	Tillandsia
Clitoria	Mimulus	Trichonema
Convolvulus	Monarda	Trifolium
Curcuma	Ononis	Trigonella
Eranthemum	Orobanche	Tropæolum
Erinus	Orobus	Vanda
Eupatorium	Oxytropis	Verbena
Goodenia	Pelargonium	Vicia
Heliophila	Pentstemon	Viola, &c.

The Magnolia conspicua deserves to be grown much more extensively than it is. A magnificent specimen is to be seen at Hatfield House (Lord Salisbury's). The girth of its stem close to the ground is nearly 4ft.; it covers a space about 35ft. in height and over 20ft. wide, and is covered with blossoms from bottom to top, so thickly placed that 50 flowers may be counted in a square yard. Considering their size and colour, this plant must be a picture of beauty while in bloom. This Magnolia, where it has attained anything like the size to which it is capable of growing, is certainly one of the most attractive plants that it is possible to behold, and Mr. Record, the gardener at Hatfield, says truly:—"I am much afraid that in these sensational times, gardeners—many of them, at any rate—are committing an error when planting, by not assigning a place to some of our old servants, and especially to this beautiful and noble-looking Magnolia."

Blood manures, phosphated ditto, and sundry others which, in the "unhappy" position of their elements are exceedingly offensive, become serviceable friends when their powers are exercised in helping the rose to manufacture its perfume. After pruning the heads of rose trees, dress with a mixture of soft soap and black sulphur. This is said to make the buds less inviting to those caterpillars which bore into and eat out the hearts of the buds just when they should be bursting into leaf. Light-coloured roses are especially appetising to these little posts. Saul Rymea.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4027.]—"Philanthropist's" idea would be of no practical use. Even supposing that the projectile could be rotated in a satisfactory way, the line of trajectory would be too high, and the shot would travel too slowly. In "Philanthropist's" plan the interior of the shot is shown as being filled with a slow-burning composition—how would he contrive a shell? It is a *sine quâ non* that a gun must fire a shell; in fact, in our light guns we seldom use anything else. The idea is, in reality, the same as what we see in Boxer's rockets, in which the rocket is rotated during its flight by the escaping fire acting on a metal fan in rear; in fact, it is the principle of "Barker's Mill."

The second query might certainly do. The Germans have floating corn-mills on the Rhine, which, being moored fast, have their paddle-wheels turned by the force of the stream, and so work the machinery inside. Artillery Captain.

THE DECIMAL SYSTEM.

[4028.]—"An ounce of practice is worth a pound of theory." I fairly confess I do not understand a good deal of the talk your learned correspondents indulge in about the decimal system; but then I do understand the system itself, ay, and use it and have it here in mine own house. Some years ago I went to the United States (I am sure if I had read anything like the learned disputations the opponents of the decimal system indulge in, I should not have ventured); I fell in with the mode of notation there easily enough, and worked with it without giving it much thought or theorising about it. When I came home I had, of course, to adopt our barbarous style. But I soon found I was using a mass of figures much greater than I had found necessary in the States, and that in many cases I could not get the nice accuracy I required. I returned to decimals, and now never use anything else, except where compelled by the usage of those around me. As a manufacturer, in estimating cost of production I find it exceeding useful—in fact, I do not see how I could get along without it. Having this experience I marvel at the stupidity of the people who oppose the introduction of the system here. To speak after the manner of women, "it's awful!" About as bad, in fact, as our railway carriages. C. J. H.

CO-OPERATIVE SOCIETIES.

[4029.]—Having propounded a definite and practical problem of vital importance to co-operators, I am not going under this head to fill your columns with diffuse generalities, nor be led away from my subject into the untried paths of social science with "E. L. G." Let me, therefore, make this, my last letter, as concise as possible.

"Philo's" "check system" is the commonest, simplest, and best that has come under my notice; but there is a flaw in it, as in every system yet tried. It is that many purchasers do not take their vouchers, especially if they are non-members, or the amount of their purchase is insignificant. In these cases, if the shopman be dishonest, he has merely to pocket the money, and omit to make the entry.

"Philo's" system is chiefly useful as furnishing the data for a proportionate re-partition of profits (so called), but, as a "check system," it may be easily evaded, except the delivery of a voucher (of which copy is kept) can be insured in every case. In practice, I believe this to be impossible, unless a clerk is kept to take the money.

The metallic check system is open to the same objection. I would refer "Philo" and any other reader interested in this subject to the *Co-operative News*, special edition, April 4, wherein a full account of the various systems in operation is given, as discussed at the Co-operative Congress. I still fail to comprehend "E. L. G.'s" "check system," if his letter be supposed to give any. Is he not aware that if a shopman were to be responsible for the invoiced weight of goods, he would have to bear the loss in retailing (which is an unknown quantity)? It is not merely the profit (so called) which has to be checked (that is not an easy matter), but also the loss from retailing, technically termed leakage. If you make the shopman's allowance sufficient to cover this loss, you offer him a premium to give the purchasers short weight and measure. On the other hand, if you let this leakage loss fall on the society, it is a very difficult thing to determine what amount of cash profit the shopman ought to hand over I am not discussing "E. L. G.'s" definition of co-operation. In another place I should try to show that his definition is false, his elaborate schemes chimerical, and his social theories both immature and pernicious; but, as far as concerns this discussion, "Philo" has sufficiently vindicated the commonplace Co-operative Society from the attacks of the "roaring lion" in his admirable letter, No. 3166, Vol. XIV. F. C. S.

[4030.]—I AM afraid "F. C. S." will not derive much advantage from the replies to his appeal for a description of an effective check system; whether he pays "E. L. G.'s" secretary, or pays the stationer for "Philo's" rather expensive cash-book, the result will, from a pecuniary point of view, be, I fear, equally unsatisfactory. But the difficulty may be got over (not by a check system), and has been got over by more than one large firm I could name, who have to employ managers of branch retail businesses where constant personal supervision is impracticable. Let "F. C. S." take a ledger—enter on the debit side the stock on hand (taken for the purpose) at selling prices, adding afterwards from time to time the amount of invoices for goods received at selling prices. Enter on the credit side the amounts of cash handed over by the manager. After a convenient interval take stock again, enter the amount on the credit side, the balance will show the amount of loss by—well, we will call it waste—during the interval between the two stock-takings. Now, the manager must be made responsible for this waste, that is, he must be engaged subject to the liability of making good all loss which may arise, which cannot be accounted for—*i.e.*, not arising from bad debts, legitimate deterioration in stock, &c. Of course, this liability would have to be considered in the salary offered, but I venture to say that if "F. C. S.'s" present loss is 5s. per week, and he offers an increase of salary to the manager of 2s. 6d. per week on the above conditions, the manager will make 1s. 6d. per week out of the transaction. LOACH.

PIANOFORTE ACTIONS.

[4031.]—PROBABLY the subjoined observations on the actions engraved in No. 368 of the ENGLISH MECHANIC may tend yet further to elucidate this subject, which is of great importance to both musicians and pianoforte-makers.

I did not think it worth the space it would occupy to send a diagram of the continuation of the sticker O, Fig. 1, downward, showing its connection with the lever and the hopper, by which the latter is lifted. These parts of the common cottage action—of which Fig. 1 is but a modification—are so familiar that it seems needless to illustrate them; but I may remark that I much prefer to connect the sticker O with the lever on which it rests by a bird's mouth, because of the facility it affords for removing it. I know no better method of checking the hammer in a sticker action than that patented by Stewart, 1843, which is, however, only a method of applying Stumpff's modification of Erard's inside check—*i.e.*, placing it on the hopper. Some better way of setting off the hopper than the usual clumsy one of employing the motion of the key to "drag" it off would seem very desirable. Probably cranking the hopper and causing the cranked portion to impinge against an adjustable stop, *à la* Erard, is the very best method now in use, nor do I think it can be improved on.

The butt in this action has its lower part forked to receive projections from the hammer-rail and sticker in which the centre wires are supported. That projection P which connects the sticker O with the butt E may, if preferred, be made in two parts, embracing the centre wire of the sticker joint. This method, which is a very good one, is often employed by French makers, because it enables the parts to be disconnected. I have, for cheapness, represented the projecting piece P a cylinder five-sixteenths of an inch diameter (glued into an oblique hole bored in the sticker O), flattened at its sides where it enters between the fork of the butt E. If made in two parts, that portion which projects must be made of rectangular section, and deep enough to afford sufficient hold for the clamping-screw. The top piece, which clamps the centre wire, may either be of metal—as the French makers prefer—or of hard wood, say beech or hornbeam.

Should it be preferred to attach the damper to the hammer, the butt must be extended ⅜in. below its centre—*i.e.*, sufficiently to receive the damper wire, and the projecting piece P made long enough to bring the sticker O sufficiently forward to allow room for the damper behind it when the hammer strikes the strings.

Fig. 2. This diagram shows that besides the advantage of enormously increasing the force of the blow without adding to the weight of the hammer—a very important consideration in the treble—another great advantage results from the hammer being propelled through rather more than half its path by the last third of the key's descent, because it necessarily follows from this that when the key is allowed to rise the same quantity—viz., one-third of its path—there is nothing to prevent the hammer from falling back from the strings as far as the last third part of the key's path propelled it towards them—to wit, rather more than half its path. Now, just mark the practical consequence of this fact. Under these circumstances there can be no necessity in this action to check the hammer very near to the strings, although this is a necessity in ordinary actions for obtaining the power of repetition without much rise of the key. If—as is the case in this action—a rise of the key equal to one-sixteenth of an inch allows the hammer to recede from the strings about one inch, and the hammer be checked at (say) 1¼in. from the strings, it follows that but a comparatively small portion of its weight can remain supported on its centre. Practically, the hammer's centre of gravity recedes so far from the vertical plane of its centre that its own weight causes it to fall so rapidly that it requires but little assistance from the counterweight D to compel it to "follow the finger," as a pianist would express it. I need hardly add that this is very important indeed when the treble hammers are returned by counterweights, because the lighter the latter can be made for them to act effectually the less "thuddy" the blow, and consequently the less "blocky" the tone will become.

While writing on the subject of these actions, I may as well add that I found it possible to make a yet cheaper satisfactory action than either by making the sticker O rest in a socket formed in the key, as shown by L, Fig. 4. When the regulating screw was adjusted so that the key raised the hammer to within ⅜in. of the strings, I found the momentum of the hammer quite sufficient to carry it through the remainder of its path, and to cause it to strike the strings with sufficient force even when playing pianissimo. No doubt the hammer could not have reached the strings unless some separation between the clothing of the bottom end of the sticker and the head of the adjusting screw had occurred, but that separation was of so small amount as to be quite imperceptible, at which we need not be very much surprised, when, by the study of Fig. 2, we have learned that the vertical rise of the sticker during the last ⅜in. of the hammer's path is almost inappreciable. For forming an elastic connection between the key and the sticker I made a saw cut in the side of the latter, inclining downward at about 30°, on the bottom of which a very weak wire spring rested, similar to that of an old grand jack, but not so stiff, the other end of which spring was inserted in the key. The sticker and the hammer to which it was hung were thus compelled to descend with the hinder end of the key whose rate of descent could be determined by loading it sufficiently.

I think it would be difficult to make any upright action which can surpass this as a repeater or excel it in cheapness. How it will work with very heavy hammers I cannot say, not having tried, but if the strength of the tie spring and the loading of the key be proportionally increased I see no reason why it should not act at least as well in the bass as the common action does. With the very light-headed treble hammer (the sticker also being made as light as it can be with the needful rigidity) in the model it answers admirably, the hammer exhibiting no tendency to return to the string and again strike it—in fact, it is almost as steady as it would be if held by a check.

In this model the confining rail M M, Fig. 4, does not exist, it not being required. Only about ⅜in. of the lower end of the sticker is rounded to enter the socket in the key. By lifting the tie-spring out of the saw cut in which it normally rests, the key may be taken out, as also may any one sticker if made so that it can be disconnected from the hammer butt. When needful to take this action out of the instrument leaving its keys, all the tie-springs must be disconnected from the stickers by pushing them aside, which may be a slight disadvantage, but after all the doing of this, and their after replacement when the action is reinstated, is but the work of a few minutes. So this "mechanick" is not very bad; indeed, the greatest defect I discovered in it is the difficulty of silently stopping the key's motion in time to prevent the hammer blocking against the strings. However, not liking to be beaten, I succeeded in overcoming this difficulty by employing a back touch, about 2in. wide on its lower surface, which was inclined at about 10°. On the top of the key an inclined plane at the same angle was fixed, and by sliding this plane to or from the key balance the key was silently stopped "dead" in the required position. Of course the cloth washer under the front of the key was packed up by paper discs until the descending key came in contact with it a trifle earlier than its hinder part impinged against the back touch, because the clothing of the latter was considerably thinner than the cloth washers beneath the fronts of the keys.

In Fig. 2 the proportions are about those which I think would be generally preferred, but it must be obvious to any mechanic that those proportions may vary, so that the force of the blow may be increased in the treble if thought desirable, or diminished in the bass. The first may be effected by allowing the notch or shoulder in the hammer butt to travel further back towards the plane of the hammer centre, so that the leverage may be yet more diminished, and thereby the hammer's velocity yet further increased. It is obvious that, if at the instant it strikes, the leverage be diminished to one-half that represented—*i.e.*, from one-eighth to one-sixteenth of an inch, the hammer's velocity must be doubled, and the force of its blow increased in proportion. Under these circumstances the rise of the hopper would not be sensibly increased, but it would impel the hammer through more degrees of the circle—in other words, the length of its path would be increased.

There is no reason why the radius of the hammer should not exceed 4in.; hammers 5in. and even 6in. long, have been employed. Now, *cæteris paribus* it is obvious if the hammer's length be increased from 4in. to 5in., its head must travel ⅝in., and if increased to 6in. 1¼in. further, thus increasing the hammer's velocity 25 and 50 per cent., without causing its centre wire to rotate through a larger number of degrees.

As the centre of gravity in such long hammers must be further from the vertical plane of the hammer centre, the finger will necessarily be more resisted at the commencement of the key's motion than it is by the preponderance of a 4in. hammer, but if the same additional velocity be imparted to the 4in. hammer — to effect which its total path must also be increased—the additional resistance to the finger, caused by the greater distance which the 4in. hammer's centre of gravity is in front of the vertical plane of its centre, will not be nearly so much felt, because it then becomes needful to commence the hammer's motion with the notch or shoulder in the butt considerably lower. Now, the lower that shoulder descends—until it descends to the level of the hammer centre—the further in front of the hammer centre it must be, which is only saying, in other words, the greater the leverage becomes at which it acts on the hammer. This lowering of the notch is a necessity if the distance the hopper rises be not diminished—a thing which can only be done without altering the relative velocities of the key and hammer by reducing the depth of the touch, doing which might be unpleasant to a performer accustomed to touches from five-sixteenths to three-eighths of an inch deep; but after all, this is merely a matter of what you are used to, and, for anything to the contrary with which I am acquainted, old Bach, Mozart, Clementi, and others of the old school of pianists (who are commonly supposed to have been tolerable executants) may have played none the worse in consequence of the fact that the keys of their ancient pianos only descended about ¼in. On the contrary, I find a rather shallow touch is much easier for the performance of rapid runs, shakes, trills, &c.

The hopper in Fig. 3 is sufficiently cranked to allow the path of the hammer to be increased to 2½in., quite as long, I think, as it is desirable to make the path of a heavy middle C hammer. Of course, as we ascend towards the treble the dampers may be made shorter. The more this is done the further the hammer can descend without being stopped by the damper block touching the back of the hopper before the hammer arrives at the string, until we arrive at C above the lines, 7½in. long in my scale, above which note it is not customary to employ dampers. There will then be nothing to prevent the hammer being allowed to descend until it recedes to 3¼in. from the string. This will require the hopper to be lifted three-tenths of an inch, exactly 50 per cent. more than it rises when the path of the hammer is only 2¼in., as represented in Fig. 3, the hammer in which is impelled about eighteen times faster than the key descends under the finger. By increasing the path of the hammer to 3¼in., and diminishing the leverage, at which the hopper acts on the butt shoulder or notch, to one-tenth of an inch, the velocity of the hammer (in consequence of that diminished leverage combined with the increase of 50 per cent. in the total rise of the hopper) becomes rather more than doubled. It is, in fact, driven about forty times faster than the descent of the front end of the key. Of course the head of a hammer driven at this velocity must be comparatively light, or the touch must become heavy.

THE HARMONIOUS BLACKSMITH.

COLOUR.

[4032.]—I DENY Mr. Benson's right to assume certain "doctrines" as "accepted," as he does at p. 97. There cannot, as yet, be said to be any "accepted" doctrine regarding colour sensations. To my mind his experiment with red spots on black and white surfaces is quite inconclusive as regards the point in question, for he may make the spots gray instead of red with similar results; gray being, according to my view, not a colour, but merely complete light of a certain intensity.

Mr. Benson speaks of my mentioning only one thing in support of my views. I, however, indicated that other facts might be brought forward, and of one of these, which is well-known, Mr. Benson has in his books attempted an explanation, but not, to my mind, a satisfactory one. When the eye is for a considerable time subjected to light of one colour—for example, in a room lighted only by windows of some one colour—a gradual change seems to take place, which is commonly described by saying that the eye becomes less sensitive to that colour. This, however, is accompanied by the remarkable circumstance to which I would draw particular attention, that the strength or quantity of the light does not seem to diminish. The light becomes apparently whiter; but how can this be if white is a compound colour? The window is supposed to exclude those very rays which the entering rays require to combine with, on the composition theory, to make white. Then, in all attempts to measure the relative intensities of the different coloured rays composing daylight a very considerable preponderance is assigned to the yellow rays, and we have every reason to believe that daylight is really very yellow, but yet we regard it as pure white.

What Mr. Benson refers to in his third paragraph presents no difficulty in connection with the non-compound views as to white. I have not suggested that the rays combined in white light are not heterogeneous, and it is easy to understand that if the sensitiveness to certain of those rays has from any cause been diminished, other rays tending to produce an opposite disturbance will produce a colour sensation. In my former letter I suggested that any ray giving rise to the simplest colour sensation also always produced accompanying whiteness.

The first sentence in Mr. Benson's last paragraph is peculiar; he describes a certain fact in two different ways, and apparently imagines he has stated the effect in one description and the cause in the other! The remainder of the paragraph calls for no particular remark, as it is not "difficult to imagine" a great many things.

Since I last wrote on this subject in January certain facts have come to my knowledge which, I think, favour the theory of five simple colour sensations—red, yellow, green, blue, and violet. Formerly green was held to be compound, because it was supposed to be producible by mixing blue and yellow; but is now held to be simple. We should, therefore, be warned against hastily assuming that yellow or blue are compound, because they can apparently be produced, one by mixing green and violet light, and the other by mixing green and red light. When one looks through a prism at a strip of white on black, which is wide enough to show some white, the white is seen in the middle, dividing the colours into two different sets, one set having red shading rather suddenly into yellow and finishing with a slightly greenish yellow, and the other set having violet shading into blue and finishing with a slightly greenish pale blue.

A person of my acquaintance, with a good eye for colour, and who normally sees the colours under the stated circumstances as just described, has recently had his eyes peculiarly affected after taking a strychnine tonic. Without noticing any particular difference in the colours of objects generally, excepting that he seemed to miss seeing some of the finer and richer shades of blue, this person had his attention (one day recently) drawn to a broken cut-glass gaselier pendant, and accidentally looking through a prismatic part of it towards a window was at once struck by a remarkable difference he observed in the colours exhibited as compared with what he was accustomed to. He, of course, at once got a proper colour prism, but still found the same difference. The series of colours beginning with red did not appear altered, excepting that the red seemed, if anything, a little more than usually inclined to crimson; but in the other set of colours the violet seemed richer and more like purple, the blue almost absent, and the light blue inclining to green, changed to the ordinary rich green seen in the spectrum of a narrow slit. On looking through the prism at a shaded lamp, in which was burnt an oil believed to be photogene or petroleum spirit, blue was entirely absent, although seen ordinarily, and a rich violet was seen graduating quite suddenly into a rich green. These peculiarities seem difficult to explain on any assumption, excepting that the sensitiveness to simple blue was much reduced, and that, therefore, the normal eye must be capable of transmitting separate simple sensations for green, blue, and violet, at any rate, and in that case it is obviously most probable that it can also transmit separate simple sensations for both yellow and red.

Why should we (mentally) recognise these five distinct colours and no others? It is useless for the "three-primary" theorists to say this or that colour can be made by mixing two of the three primaries, for the "three-primary" theory requires six distinct colours, and six distinct colours do not exist. There is no distinct colour between pure blue (untinged with violet) and pure green, between green and yellow, or between yellow and red; and although violets, purples, pinks, and crimsons are spoken of as between blue and red, blue and red are suggested by every one, and the only colour that can be called distinct between blue and red is one, whatever be its name, in which neither blue nor red preponderates.

Glasgow. E. H.

DOOR HANDLES OF RAILWAY CARRIAGES.

[4033.]—Permit me through your columns to throw out a small hint relative to railway carriage doors generally. It is simply this: That a handle (similar to those now in common use in most private carriages) be fixed inside the doors of all the three classes—viz., first, second, and third; in connection with the one outside; so as to obviate the necessity, when opening the doors, of putting the windows down when up, as well as being obliged to put the hand and arm outside; thus avoiding at the same time a certain amount of risk. It is an easy matter, and might be done by all railway companies at a very little extra cost when constructing their carriages; and would also be conferring a great convenience to the vast multitudes who travel upon our iron roads. I hope that you will insert my letter, and that the idea may meet with approval.

Nathaniel Waterall.

AMATEUR TURNERS' SOCIETY.

[4034.]—What is now wanted is mechanical instruction to amateurs by competent workmen, so that they may acquire an amount of skill and practice not to be attained in private. Many of our readers (this I can answer for from my own personal knowledge) are employed by firms or in offices year by year, and naturally enough take to mechanics as a pastime and recreation. If a society is started in London, as nearly central as possible, open to any respectable man on payment of the usual fees (as moderate as possible, and payable at the option of the member—monthly, quarterly, or yearly), I have no doubt it would succeed. I would propose something like the following: That a suitable place be hired annually, and, as before stated, tools, &c., fixed; that honorary members be admitted at a lower premium; that two or more meetings take place in the year, on which all business should be brought forward; and further, that the committee should place themselves in communication with private firms (for premiums) to allow a few members at a certain time to visit the manufactories, and by that means gain practical knowledge. The advantages to the members would be numerous. They would gain real knowledge and practice in the handling and working of the lathe and its accessories, also an insight into the art of cabinet-making, polishing, &c. Should any member require advice—such as recommending or purchasing any article for the use of himself relating to turning, cabinet-making, &c.—it should be given gratis. Any articles that should be turned out in a finished state by the members should be sold, and the profits arising be carried to the society, unless the same has been finished throughout by one member only. In a few weeks I will advertise an address, whereby I can be communicated with by post only.

Samuel Smither.

A TRAVERSING SCREW CHUCK.

[4035.]—A traversing mandril for cutting short screws with accuracy and certainty would be coveted by many amateur turners were it not that its cost and, still more, its injurious action upon the lathe for general purposes more than counterbalance its admitted advantages for that one purpose.

I have lately designed and made a tool which seems to possess all the advantages of a traversing mandril, without its defects; and as it can be adapted to any lathe, I hope it may be generally useful. I propose to call it "the traversing screw chuck." The following is a description of the apparatus, with reference to the accompanying drawing:—

A. A steel cylindrical holder, which screws upon the nose of the lathe mandril, having a longitudinal key-groove *a a* (or it may have a left-handed spiral key-groove of one turn per inch, which would probably work even better than the parallel key-groove; but the latter, as I have made mine, is sufficient).

B. A gun-metal cylinder fitting nicely, and without shake, upon A, having a key (*b*) which enters the groove *a a* and prevents it from turning upon A, though it is free to traverse longitudinally. The cylinder B ends in a boss, having at its extremity a screw exactly like the screw upon the nose of the lathe mandril, and upon this screw any of the ordinary chucks for holding the work to be operated upon can be screwed so as to run true in the lathe.

C. A steel guide-screw (of which there may be several of various pitches) fitting tightly and keyed upon B.

FIG. 1

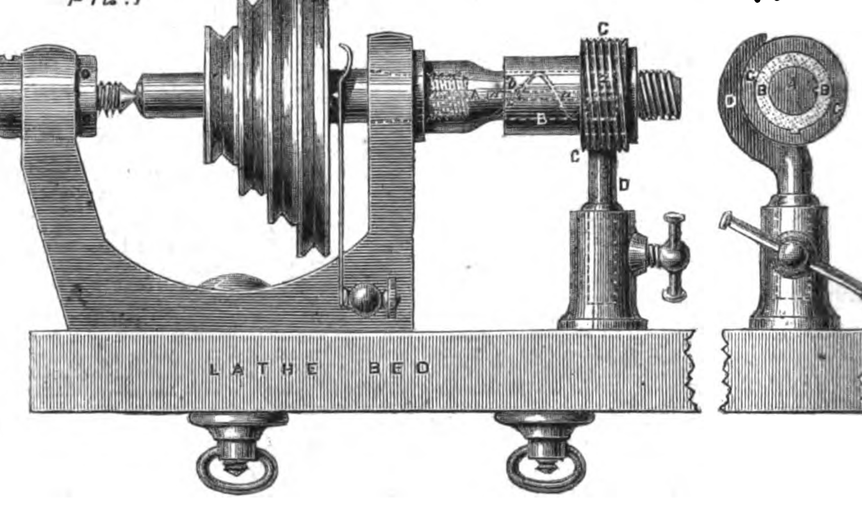


FIG. 2

D. A fixed screw-guide (of brass or gun metal) fitting the thread of the steel guide-screw C, and partly embracing its periphery, as shown in the cross section Fig. 2.

The screw-guide is here shown (as I have made mine) held fast in the socket of the T hand-rest, but a better plan would be to have the several screw-guides formed on portions of the circumference of a brass or gun-metal disc, about ⅜in. thick, centred upon an eccentric or cam, on which it could be turned and made to gear with the corresponding screw-guide C, just like the brass screw-guide fixed at the back of the head-stock of Messrs. Holtzappfel's best ornamental lathes, having traversing mandrils.

Note.—When this apparatus is used the proper screw-guide D is put into gear with the steel screw-guide C, and compels the latter, with the chuck and work which it holds, to advance at the rate required for cutting a screw upon the work by means of a single point tool or chaser, held in the slide-rest or by hand. The resulting screw will be an exact copy (as to pitch) of the steel guide-screw C (except that if a spiral key-groove is adopted in A it will have one turn per inch less than the guide-screw). John F. Stanistreet.

Abercromby-square, Liverpool, April 16.

THE "TURRET" TRICYCLE.

[4036.]—As I know several of your readers are interested in the bicycle and tricycle movement, I forward you a sketch of a tricycle I have designed and constructed. I drive direct off the crank without the intervention of connecting rods. I form a slot in the lever which pivots on an arm bolted to the frame. The lever is bent at right angles so that the feet may assist in working; cords lead from the handles to pulleys attached to the angle of lever, up to the frame, and thence to guiding axle. By employing rollers on the crank pin the friction may be much reduced, travelling in the slot. I mark the various dimensions on the sketch. The arms on which the levers pivot, as well as the stay, should be strong as well as the levers themselves. I have thought of replacing the pair of guiding wheels by a single wheel in a fork under the seat, steering it with the cords, but fear it might be difficult to preserve a balance. I believe you could spin along at a great speed with a single guider.

The handles are attached to a disc of hard wood in which the cord runs in a groove. The length of crank arm is 4in. The end of arm on which the lever pivots must be directly under the axis of the wheel, so that the levers may travel to and fro equally.

C. Townley.

A NEW AND EXCELLENT SUN-SCREEN FOR ALL TELESCOPES.—CENTREING THE FLAT OR PRISM OF NEWTONIAN REFLECTORS.

[4037.]—The following mode of defending the eye in viewing the sun is the most perfect that can be conceived. A film of silver is deposited either on the field lens of the eyepiece itself or upon a concave lens inserted where the Barlow is usually placed: in either case the silvered side should be turned away from the eye. The interposition of this partly transparent film of pure silver, as brilliant as any mirror, has the effect of turning back all the rays of heat, while it allows light enough to pass to produce the sharpest definition. The film may be made so thick that the eye can bear the whole aperture of any telescope, but it is better to have it only of such a density as to require a rather pale glass screen to be used with it. The action of this simple contrivance is so perfect that the eye-lens is not heated in the slightest degree, nor is there any heat upon the eye.

The process of silvering is extremely easy, and may be done by any one in a few minutes. I find the cost of chemicals for three lenses is one farthing. A still better place to insert the silvered concave is between the flat and the big speculum, close to the former.

The following will be interesting to all who use Newtonian reflectors. The want of perfect adjustment in the secondary mirror, whether a flat or a prism, is one of the chief causes of their frequent imperfect performance. I have never till now been satisfied with my centreing, nor have any of the published methods been absolutely perfect. The following mode leaves nothing to desire.

Together with my dynamometer is sold a very simple and inexpensive microscope which clips on to any eyepiece for reading this power-gauge, which it does to the one-thousandth of an inch; around the little bright image of the aperture seen thus in front of the eye-lens are certain darker circles which are the images of the inside of the tube, the rim of the flat-holder and the eye tube. If these are not all exactly concentric the fault is in the flat (or prism), which must be re-adjusted till they are so.

Though not so important this little contrivance detects the slightest want of coincidence between the axis of the great tube of a refractor and that of its eye-tube.

If any of the readers of the English Mechanic desire any further information upon either of the above hints I shall be glad to give it.

Vicarage, Romsey. E. L. Berthon.

P. S.—Since writing the above I have received a letter from Mr. Browning, to the effect that five years ago he tried silvering the second lens of an eyepiece, and a Barlow lens for viewing the sun. I am surprised that so admirable a plan has remained so long unused. Mr. Browning says that he found it better to insert a plane of glass silvered on both sides, and placed at an angle of 45°; but it must be very difcult to obtain such a piece of glass with *perfectly* flat and parallel surfaces, and it was this difficulty which led me to prefer a concave lens. I do not find the heat reflected back into the tube productive of any of the supposed disturbances, or that it impairs definition. Mr. Browning's method requires a hole in the side of the tube for the escape of the heat, and this is not always convenient. Let any amateur observer silver a concave spectacle-glass, and after fixing it in a paper tube, insert it inside his adapter, and he will see sun-spots, &c., as he never did before.—E. L. B.

SOLAR PHENOMENA.

[4038.]—As it is my custom to make a daily sketch of the solar surface, when clouds do not hide the sun from view, I have been able to trace the progress of several phenomena of great interest. Not the least remarkable among them were the shifting movements of a small spot, which I perceived for the first time on April 12th. It lay to the south of a tolerably large opening, situated upon the west limb, in the northern hemisphere. On the days mentioned below, the position angles (the intersection of the wires being at the centre of the larger spot) were as follows:—

April 12th	5h....................................	242°
,, 13th	,, ...	233°
,, 14th	,, ...	152°
,, 15th	,, ...	158°

On the 16th the pair were so advanced towards the extreme edge of the disc that I was unable to find any trace of them, with a power of 140.

It will be noticed that, with the exception of the slight retrogradation on the 15th inst., the motion was from west to east, by the south. This direction was also observed by Mr. T. W. Backhouse, of Sunderland, to be taken by a spot in its revolution round another, which was visible on the northern zone on May 9th, 1870. The line joining them rotated through an angle of 80° or 90° in 5½ days. "It is interesting to observe," says a writer in *Nature*, "that the direction of this rotation (from south to east) is the same as that in which cyclones rotate in the earth's northern hemisphere; in the southern hemisphere they rotate in the opposite direction. This coincidence gives some support to the theory of solar spots being produced by cyclones." (September 1, 1870.)

But the retrograde movement of the spot on the 15th inst. (from east to south) has its counterpart in a large opening which I observed in July, 1870. The small companion to it moved from south-east to south-west, through an angle of 35°, in 23h. This also occurred in the sun's northern hemisphere.

The solar surface, especially in the equatorial regions, has of late been diversified by vast groups of spots, which, from day to day, have presented a most interesting and astonishing series of changes. Had it struck me earlier, I might have delineated some of the principal groups in detail, to exhibit, in a succession of drawings, their daily alterations in appearance as they passed across the disc. Yet, on several occasions, the complexity of many of these spot-aggregates was extraordinary, and might have severely taxed my artistic skill—whatever that may be!

I do not think that "P. S. T." (qy. 11548) would find a revision of double stars, and of other oft-inspected heavenly objects, an occupation of such transient interest as he seems to apprehend; on the contrary, if he once got over a few preliminary difficulties, I feel sure the pleasure of the labour would excite him to continue it. Guided at first by a work such as Darby's "Astronomical Observer," or Smyth's "Celestial Cycle," a telescope would soon cease to be a mere toy in his hands, and would afford him many a pleasant hour of unfailing and instructive employment in one of the most soul-stirring of the natural sciences. But, supposing for a moment that "P. S. T." found his interest in such studies to be on the decrease, he might endeavour, with a good 9¼in. or 10¼in. reflector, such as Mr. Browning supplies, to aid the Moon Committee in their Selenographical labours. Our little satellite, though so much examined, is still a wide field for research, and can never fail to yield a store of detail to a careful observer, provided with the requisite means. Reflecting telescopes (equatorially mounted) of the sizes mentioned would cost "P. S. T." from £100 to £150, a price about one-fourth of the value of an equatorially-mounted 6in. refractor. As such reflectors perform best in an observatory, constructed on the plan of that described by the Rev. E. L. Berthon in No. 342, Vol. XIV., of the ENGLISH MECHANIC, "P. S. T." would have at his disposal great power and efficiency, combined with small expense, by purchasing one of them. But I have no doubt Mr. Proctor will give a fitting reply to his inquiries, and he could not have applied for an answer to a more competent guide.

April 18. W. BROWN.

REVOLVING FURNACES—DRILLING MACHINE.

[4039.]—SEVERAL years ago I read in a newspaper a report that the Manager of the Dowlais Iron Works had constructed a revolving furnace, which was giving great satisfaction, and specimens of the puddled iron had been exhibited at a meeting of the trade in the Midland Counties. It was likewise stated to be the intention of the Company to erect more furnaces on the same plan. I hope it is not asking too much, if those capable of doing so would let us humble readers know, if such had been the case; or, if not, what was the reason? As it is reported here, Danke's patent has been declared invalid, and the agreement with the English iron masters broken through. A full statement of this, if true, might be a very proper subject for the pages of "ours." A universal angular drilling machine is figured on p. 57 of this volume. How is the ratchet motion used on such machine, as it is not shown in the engraving? A tool for the same purposes was figured in the *Penny Mechanic*, August 17, 1868, as invented by Messrs. Westroy and Forster, Barrow-in-Furness, Lancashire, which seems to me to have a stouter and better sliding bracket. Those who may have seen both tools would oblige by giving their opinion of both machines for actual hard service.

LINUM.

COMPRESSIBILITY OF THE ATMOSPHERE.

[4040.]—OWING to this property, it follows that at lower elevations, two or more, or many given volumes must be compacted together in a space, which at higher elevations one such volume suffices to occupy. Hence, as the density of air is to that of water, so, though in a far less degree, is the density of the air at any level to that of the air immediately beneath it.

It follows, therefore, that the bullet fired horizontally from a gun must be deflected upwards, though in a far less degree in its course through the air, even as it is by striking the surface of the denser fluid, water.

I wish to ask your learned correspondents whether they have ever considered that the well-known phenomenon—viz., the rise of the bullet from a gun above the line of aim, is thus accounted for. I beg also to express my conviction that the spinning top is supported, placed or even replaced, in its vertical position from the same cause. If I am right, a top should not be able to spin in a vacuum. I have no means of trying this experiment, but feel convinced that it will not.

Seer Green Vicarage. J. M. TAYLOR.

THE FAIRLIE LOCOMOTIVE.

[4041.]—THE letter Mr. Fairlie has sent (page 41), signed by G. Allan, though giving many particulars, is very far from complete.

1st. It makes no mention of the diameters of the cylinders of the three engines: and, unless I am mistaken, the Fairlie had slightly the largest.

2nd. No mention is made of the stroke of either the "Wonder," "Pony," or "Giant."

3rd. The pressure on the driving wheels is not mentioned, and though the total weight of the Fairlie is half a ton less, yet if in the "Pony" or "Giant" there was less pressure on the driving wheels than in the Fairlie, the tractive power would, of course, be less.

4th. It does not state whether sand was used by any of the engines after they first started.

5th. It is stated that the Fairlie engine is economical in fuel, but no mention is made of what average amount per mile, and as engines made from the same design and exactly alike, as far as can be ascertained in every respect, are some more economical than others, one cannot be surprised at some difference existing in this case.

6th. As regards steam pressure, if we compare it at the different points given on the journey, we shall find it as follows:—

	Giant.		Welsh Pony.		Little Wonder.
At starting ...	150	...	150	...	160
At far end of embankment	160	...	142	...	165
At Weigh-house	Not stated	...	140	...	167

Thus, in every instance given, the pressure in the Fairlie was in excess of the others. Here again is another omission—viz., the pressure in the Fairlie at the point where the other engines were pulled up.

7th. The diameter of the driving wheels is not mentioned, either of the Fairlie or the other engines.

8th. A point is made of the diminution of oscillation, consequent on the use of bogies; but were not these used on the ordinary engines some years before the first Fairlie was built? and as it is not a thing belonging exclusively to this particular class of double engine, we are not, therefore, obliged to adopt the Fairlie system because we want to diminish oscillation.

I must say I agree with what our correspondent "Osa" (let. 3864, p. 41) says in his last paragraph. Now, I suppose, Mr. Fairlie would say he intends his engines for drawing extra heavy loads on the ordinary gradients as well as on very steep banks. Now, as there are engines on one of our main lines, whose load is 40 full or 60 empty trucks, surely Mr. Fairlie would not advocate trains of 80 loaded or 120 empty trucks, making a train of about 650 yards long, causing a fearful strain on the couplings, and rather unmanageable if it was necessary to pull up quickly. But if the Fairlie is designed for overcoming steep gradients, why run so much unnecessary power when not required? If it was any advantage to have so much extra power, what is to hinder two ordinary locomotives being coupled to one train?

Our correspondent "G. R." (let. 3987, p. 96), though perhaps right as respects the 50 Fairlie, with 5 laid up being about the same as 100 ordinary engines with 10 laid up, yet seems to forget that engine boilers, &c., are not so easily interchangeable as the parts of a military rifle, and that an engine must needs be "laid up" in order to have its boiler or whatever is necessary changed. Then he says that another advantage is the regularity of water-level on inclines; but he forgets that the Fairlie has not an upright boiler, but a horizontal one.

Again he says "the contingency of one of the motions breaking down when three cylinders will remain effective," is an advantage overlooked. But, if this is so very desirable, why not do as I said before—viz., couple two engines to one train? This would have one decided advantage over the Fairlie, inasmuch as if an axle or tire of one of the two engines broke, or any part which totally disables an engine, you could at least use the other engine, but with the Fairlie if one end was thus disabled the whole would be useless.

Whilst writing on the subject of the Fairlie system, might I refer to a statement I saw in print a few months ago, with what truth I cannot say, to the effect that Mr. Fairlie had invented a new kind of buffer to facilitate the passage of trains round sharp curves? It consisted of a single central buffer instead of the ordinary double one. Now, in the "Engineers' and Mechanics' Encyclopedia," published in 1836, at page 571 (Vol. II), is an engraving of an apparently similar construction that was used on the Dublin and Kingstown Railways.

I am sorry I was unable to answer Mr. Fairlie's letter sooner, but was unavoidably prevented.

A. G. BOYD.

Cheshunt, Herts, April 17.

[4042.]—GRANT space but for a few words more, because, as I take it, the object of the Fairlie locomotive, or, rather, that which should lead the public to have an interest in it, is similar to that of the ENGLISH MECHANIC—namely, the opening up of new fields of operation and research. And the latter brings the same principles to bear—to wit, flexibility of (wheel) base, easily adapting itself to the various curves and inclines, often very great, of the different branches (of knowledge); steadiness; smallness of gauge (of type); and length (26 pages solid). Amos Appleyard says (page 96), that the companies could easily build far heavier engines than they at present use. He does not say how this is to be done, seeing that the limit of adhesion is already quite reached, and every inch of width is taken up. So much so, that in some recent goods engines on the Brighton line, the slide valves are put underneath the cylinders to gain room, also to admit of longer bearings on the crank axle. Moreover, it is not found advantageous to couple more than six wheels together.

However, our present trains are quite heavy enough, and it is not likely that Fairlie engines would be generally required for the 4ft. 8in. or wide gauge, the Mexican railway being an extreme case, as abounding with steep inclines and sharp curves. But the Fairlie principle supplies the possibility of building an engine for the 3ft. gauge of the same power as our present heaviest goods engines; and it is possible to make a line on the smaller gauge which will pay where the expense of the wider would be simply ruinous. So that whole districts in this and other countries hitherto debarred from the advantages of railway communication may be opened up and become valuable feeders to the existing trunks. Indeed, so satisfactory has been the working of the little Festiniog line, on which 35 miles per hour have been run, although its gauge, only 1ft. 11in., is admittedly less than it would have been had it been originally intended for steam, that the Indian and Russian Commissions both reported in favour of a narrower gauge with Fairlie engines. And a bill of the London and North-Western is now before Parliament to extend the Welsh line on the same gauge to Bettws-y-Coed. The difficulty with regard to the flexibility of the steam and exhaust pipes has been also so completely overcome that they are now said to give very little trouble. G. R.

WARMING AND VENTILATING.

[4043.]—WILL "E. L. G."—who considers that any one who proposes to ventilate a room in any other way than by withdrawing, or allowing the escape of, its air from its very top, supports a "misleading and mischievous fallacy," and that any plan which permits any of the air which has once been breathed to mingle with that which will be breathed, "a murderous arrangement"—kindly explain to us how it is that though all warm-blooded animals do, whenever they breathe, draw back into their lungs a large proportion of the air which has just left their lungs, they are not injured, but benefited thereby? Such being the universal arrangement for respiration, it is, of course, the right arrangement, even though it be in direct opposition to "E. L. G.'s" dictum, and that it is the universal arrangement cannot be disputed by any one who remembers that a large proportion of the air expelled from the lungs on expiration necessarily remains in the windpipe and other air channels, to mingle with and help to warm the air drawn into the lungs at the next inspiration. I do not know the proportion of the air inspired which does not enter the lungs; but it is, probably, not much less than half, and this accounts for the proportion of carbonic acid in expired air being much greater in that forced from the lungs by a very deep expiration than that of ordinary breathing, the air so forced being less mixed with air which never entered the lungs at all.

It is clear, therefore, that "E. L. G." is quite mistaken in attributing dire effects to the mere mixing with air of a small part which has been once breathed, for that we are doing constantly, yet it is quite essential to health and comfort that air that has been breathed should be quickly removed, and I allow also that it is desirable to let it escape from the top of the room; but deny that it is essential to [illegible] is very frequently not done in rooms wh[illegible] ventilated, as any one may prove b[illegible] a fire is burning air enters the ro[illegible] however high, unless, indeed, it [illegible] chimney. To make openings t[illegible] for every cubic yard of inclosed space to let in and out just as much air as is breathed, neither more or less, or anything like it, I will believe to be possible when I see it done.

Has "E. L. G." any evidence to prove that the air at the very top of a room is materially different except in temperature from that which has just descended from the top from being cooled by contact with the cold glass of the window, when it is not cold enough to condense the moisture by the removal of which the air would be somewhat purified? If not, how will be prove that it is essential to remove the air from the very top of the room? M. R. C. S.

DR. CARPENTER AND PERSPECTIVE.

[4044.]—How many more times will M. Paris need to be told that perspective is totally unconcerned with what the eye may notice or not notice (p. 119); being matter of pure mathematics, and dependent on *the plane of projection* chosen? On a vertical plane, all really vertical lines must be projected vertical, and no tower not tapering can have its picture tapering *at all*. Whether its height be 100ft or 100 miles, a hair's-breadth of convergency is wrong, nor will any *levelled* camera make its photograph converge one hairs'-breadth. Tilt the camera upward, and, of course, the lines will converge—"painfully" if viewed as a vertical picture, but be equally right, rightly viewed. M. Paris shows that he has the very first notions of perspective yet to begin. E. L. G.

DUODECIMAL SYSTEM.

[4045.]—Though the last paradox of the author of letter 3965 (p. 118) would be far better answered by the "F.R.A.S." than *I* can pretend to do; yet, as our learned and indefatigable astronomical instructor has, by going out of his way and rôle (let. 3960) incurred, as I contend, the paramount duty of going to the bottom of his geological statements, it becomes mine, however imperfectly, to help in the defence against "the multipliers of £19, &c., by £19."

Feet can no more be multiplied by feet or inches, than pounds can be multiplied by pounds or shillings. In finding an area of a rectangle you are told to multiply the units in length by the units in breadth, merely because we have chosen as the unit of area the square whose side is a unit of length (and this not always, for an acre and a rood are only units of area, not related to any particular linear unit). That an oblong of 3 inches by 5 contains 15 square inches is only a short way of saying its area is to that of one an inch long and an inch broad as 15 to 1. There is no natural reason for fixing on the *square* of a linear unit as the superficial unit, rather than the equilateral triangle on the same base, or the circle (which is, perhaps, the most natural). If we used *circular* inches, the length and breadth of an oblong multiplied would *not* give the units in its area. But the inches in the length and breadth of an ellipse would give its area exactly, by mere multiplication. So, if we used *trigonal* inches, a trigon whose base was 4 would have its area 16 exactly; but a square or oblong would *not* have their areas expressed by the product of length and breadth. Thus lineal and areal measures are as distinct in kind as shillings and degrees of heat, and the connection between the units we choose of each is purely conventional.

Feet, therefore, multiplied by feet, do *not* make square feet. Not at all. No more than feet multiplied by lb. make the mechanician's foot-pounds. To say that they "make square feet" is merely a compendious way of expressing the use of an arithmetical dodge; a way of saying shortly that the number of feet in one line multiplied by the number in another line will give a product equal to the ratio between certain areas. But regard it how you will, let feet × feet make square feet, then, as one has told you, £ × £ can only make square £. Till you show us a "square pound," or its worth, or explain to us what it is, and what it will buy, your computation has no meaning.

Hind's figures have plain meanings as units of area. The first denomination are square feet; the next, twelfths of square feet; the third, square inches. But the working by multiplication is never used but by schoolboys. The rule of "Practice" is the only rational and practical treatment of such "squaring and cubing." E. L. G.

TO "THE HARMONIOUS BLACKSMITH."

[4046.]—If our obliging friend "The Harmonious" visits the Exhibition early in the season, perhaps he will say which of the pianofortes are most worthy of attention, and thus oblige many who, like myself musically inclined, will only be able to spend one day in the building, and, consequently, will want to economise time as much as possible. A. B. L.

Fastening Loose Window Sashes.—The most convenient way to prevent loose window sashes from rattling unpleasantly when the wind blows is to make four one-sided buttons of wood, and screw them to the stops which are nailed to the face casings of the window, making each button of proper length to press the side of the sash outwards when the end of the button is turned down horizontally. The buttons operate like a cam. By having them of the correct length to crowd the stiles of the sash outwards against the outer stop of the window frame, the sash will not only be held so firmly that it cannot rattle, but the crack which admitted dust and a current of cold air will be closed so tightly that no window strips will be required.—*Industrial Monthly.*

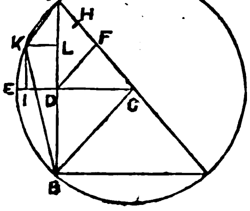
REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[9440.]—**Mathematical Question** (U.Q.).—The diameter of a circle being one, to inscribe in it a triangle, the rectangle of whose two sides shall be equal to the square of half the base of the triangle. Also to show what are the values of the three angles of the triangle, and of the sector in which the said triangle is found. Let angle of sector $= 2\,m$; and A C Q be the diameter. Let A C Q = unity; C, the centre; A B, the base, bisected in D by radius E C, equal to ½; then



A D into D B = ½ × ½ × sin.$^2\,m$ = altitude of triangle × diameter of circle (Euclid VI., C.). Draw D F perpendicular to A C in the point F; then A F = A D × sin. m; but A D = A C × sin. m = ½ × sin. m, ∴ A F = ½ × sin.^{2} m, therefore, if we bisect A F in H, we shall have A H = ½ × ½ × sin.^{2} m, as in the first deduction. Make D I = A H; draw K I parallel to A D, cutting the circle in K, and draw K L parallel to I D, and therefore equal to it or to A H; join K A and K B and (Euclid VI., C.) we have K A into K B = K L into A Q = A D into D B = square of half the base of the triangle, which was demanded. Also, let the arc K E be equal to (n), then the side K A will be equal in value to sin. $\left(\frac{m-n}{2}\right).1$; and K B = sin. $\left(\frac{m+n}{2}\right).1$; and A B will be equal to sin. $m.1$; or sine of half the number of degrees in the sector; and, lastly, the angle A K B = 180° − m, of which the last named is also the sine.—*Q. E. D.*—Thetamu, Horsham.

[10640.]—**A Reason Wanted.**—I am, and have been for many years, accustomed to use a means of lifting heavy weights, such as cabinets of minerals, chests of drawers, &c., with ease, namely by laying hold of the cabinet, &c., breathing out steadily, and lifting simultaneously with the breathing; and I learned the method at college, where we placed a man on the ground, and took hold, each of us, four in number, of an arm or a leg. He came up easily while we breathed out, and fell as easily when we ceased to do so! The breathing out brings all the bones of the chest into a compact form, and draws upwards the arms.—Gerard Smith.

[10664.]—**Angle of Reflection and Incidence.**—Dufton, in his work on "Practical Billiards" says the angle of incidence is the acute angle made by the incident line with a perpendicular line touching the cushion. "Billiardist" and "F. N." take opposite views of the difference between the forces of compression and restitution. I always understood that the momentum destroyed in restitution bears to that destroyed in compression a constant ratio; that is, a ratio independent of the intensity of the impact; but if this were the case it would follow that in a case of oblique impact, as when one ball is played at another, a half ball division, the balls should take the same directions whatever be the magnitude of the momentum, but it is well known to all billiard players that the harder you strike the wider the balls fly apart.—A. P. S.

[10664.]—**Angle of Reflection and Incidence.**—"Billiardist, on p. 100, thinks I am in error in stating that the co-efficient of elasticity is the force of restitution divided by the force of compression, and that the co-efficient of elasticity diminishes with increase of momentum. If I err it is in good company, as I made the statements, not on my own authority, or from my own observations, but on what, I think, will be admitted to be the very highest authority, although in strictness I ought to have employed the word velocity instead of force. But, in the first place, allow me to state that "Billiardist" is quite correct as to the generally accepted meaning of the words angle of incidence and reflection. Sometimes, however, the angles made with the plane struck are employed instead of those made with the perpendicular, and in my reply to the query I unfortunately did so by mistake. Now, as to the meaning of the phrase co-efficient of elasticity, most writers on Mechanics use it in the sense in which I employed it—viz., the ratio of velocity of recoil to velocity of approach. I thought of using the phrase co-efficient of restitution as being more correct, but did not like introducing any new term. I have since observed, however, that Sir Wm. Thomson has proposed that very expression as being more in accordance with facts. Again, as to the statement that this co-efficient diminishes with the momentum, I have several authorities; my chief, however, is M. Athanase Dupré, who, two years ago, published the results of his experiments, being the most elaborate and carefully executed series ever undertaken with the view of determining the laws of collision of elastic bodies; he experimented with ivory balls of seven different sizes, from 1¼in. to 2½in. diameter; falling on a marble slab from all intermediate heights, from eight-tenths of an inch to 8in.; also, with these same balls, suspended by threads over 10ft. long, and allowed to strike the same marble slab, and each other, horizontally in every possible way, from distances varying from 1in. to 40in., and, of course, velocities in the same ratios. The number of carefully recorded experiments is over 200, and in every instance was the co-efficient of restitution less with increased momentum. That this should be the case, I think it would not be difficult to give a good and sufficient reason, if my remarks had not already extended too long; but, nevertheless, I should be most happy to have "Billiardist's" proof to the contrary. I stated in my first communication that there was a very great variety of matters to be considered in calculating the angle of reflection of a billiard ball, most of which tend to make the angle of reflection greater than that of incidence; but there is one cause of a contrary effect—viz., the soft nature of the cushions, which by yielding cause the ball to rebound more towards the perpendicular, and, no doubt, is quite sufficient to produce the results which "Billiardist" describes. My remarks and all the experiments with which I am acquainted, have been with hard elastic bodies, such as glass, steel, ivory, marble, &c. I should like much to have "Billiardist's" proof that the harder the blow with which one billiard ball strikes another, the greater is the ratio of recoil to approach, as it is contrary to all experiments with which I am acquainted.—F. N.

[10731.]—**Fastening Escape Wheel in Lever Watch.**—I am surprised to find "West Cornwall" finding fault with my reply on page 100. If the job had been sent to me I should have done it without soft solder. I was influenced by two considerations in my reply—(1) the wording of "S. H. L.'s" query led me to believe that he had little practical knowledge, and not the skill to make the nicety of fit to get the wheel right height for the pallet stones, therefore I gave him a simple method by which he could make a tolerably good job of it; (2) I sent the information in the belief that it would suit his particular case. I spoke of the soldering iron because I had in my mind some men who when they have had a verge contrate wheel or lever escape come loose on the staff, have used the blow-pipe and softened both staff and pinion. Not a particle of soft solder in the original composition of the watch. "W. C." surely knows that the fusee and stop are soldered on to the arbor; that all verge colets (both English and French manufacture) are soft soldered on, and I have often met with balance staff colets done the same. For twenty years I have been seeking the best methods of doing all kinds of jobbing work, and I am a learner yet. If soft solder forms the great mainstay of all my operations, I can yet give watch querists a few practical wrinkles.—A Yorkshire Pivot.

[11024.]—**Stuffing Birds.**—"Frank M.," or any other of our readers, would, indeed, want to use their judgment if they depended on A. J. Shaw's information. I will try and help "Frank M." from my practical experience. Let the bird cool so that the blood will coagulate, then stuff a piece of cotton in the mouth to soak up any moisture; dislocate the wings by turning them over the back towards the head; by doing so the bird will be easier to skin. Make an incision from the centre of breastbone to vent, just large enough for the body to pass through; having come to one of the legs, cut the second joint across with a pair of scissors, skin to the bend of the knee, and strip the flesh off the bone; then take hold of the foot, and draw the bone back in its place, treat the other leg the same; next cut the tail within a quarter of an inch of the stumps of the feathers, and cut off all flesh and fat; then stick a hook in the rump-bone, and suspend the bird; turn down the skin carefully and skin to the wing-joints, disjoint, and serve same as legs. When you come to the head skin a little below the eyes, but be very careful not to cut the eyelids; then cut off the neck at the poll; keep the body as a guide, lay the skin on a table, and cut as small an aperture as possible at the base of the skull, and take out the brains. Remove the eyes and roots of tongue, cut off any fat that may be on the skin, and apply any preservative you wish. I use ground alum four parts, saltpetre and pepper one part, and find it a first-class preservative. Previous to skinning take a piece of wire of suitable thickness and measure from the centre of bill to tip of toes, have the wire twice that length and double it in two, and point the double end with a hammer; do not separate them; point the other ends with a file. Having put in the eyes and twisted some cotton on leg bones, and filled up the aperture in skull with a piece of cork, thrust the double end of the wire through the cork, and let it enter the base of the beak; then twist some cotton or tow round the wire same thickness and length as neck; then separate and form a shoulder on each wire, roll up some tow same size and shape as the bird's body, and twist some thread round it; then thrust the wires through it, one at each side; then carefully turn the skin over your artificial body, in doing so place the wing bones in their right place; then pass the wires through the back of the legs inside the skin, add a little tow if required, sew up the aperture, and fix on stand by the wires; then form a piece of wire same shape as a hair-pin, and pass under and through tail into the body to keep tail up; tie the bill with a piece of thread till it sets; then give the bird the natural set, fix the wings in the right position, and pass a thread with a long needle through the body and last joints of wings and tie, not too tight, and tie tips of same at tail. Pay particular attention to the eyes, replace stray feathers with a needle, and brush down with a camel's-hair brush.—FREDERICK R. ROHN.

[11045.]—**The Bug Bible** (U.Q.) was printed by John Day, 1551, with a prologue by Tindall. It derives its name from its rendering of Psalm xci., 5, which reads, "So that thou shalt not need be afraid of the bug by night." This edition is very scarce, and rarely finds its way into the book-market.—JOURNEYMAN PAINTER.

[11054.]—**Calculating Contents of Cylindrical Vessels.**—"Excelsior" will see that his formula is incorrect. I gave the more usual and simple one. Had he said, multiply half the circumference by half the diameter to give the area, he would have been right, and that sum multiplied by the height (if vertical) will give the cubical contents.—TUBAL-KAIN.

[11083.]—**Treacle Beer** (U.Q.).—I see this in the list of unanswered queries, and as it is a refreshing, harmless drink, it should not remain unanswered. It was, and I suppose still is, a popular drink in Forfarshire, and was made in perfection somewhat as follows:—Heat four gallons of water to the boiling point, and dissolve in it four pounds of treacle. Let it cool to 170° Fahr., and then add a quarter of a pint of fresh yeast, or two pints of new ale taken from the fermenting tun, and stir briskly till thoroughly mixed. Bottle, but don't cork, for from twelve to twenty-four hours, during which time the bottles should stand in a warmish, or rather, not in a cold place. The time to cork is when the yeast rises fungus-like half a finger's length from the mouths of the bottles, and the beer will be in excellent condition in two days thereafter. The bottles should be pretty strong, as the quantity of carbonic acid formed is considerable. I am not sure that the proportions here given are the best: I write from memory of thirty years ago. They will, however, make a good beer, but any one who will take the trouble to experiment a little with varying proportions may make it better. One thing, however, must be kept in mind, the yeast or new ale must on no account be added to the solution of treacle till the temperature has fallen to the 170°, or at the highest 175°.—AULD REEKIE.

[11120.]—**A Question of Sight.**—J. Barwick must surely have taught our lively satirist "A. J. V. G." by this time the inutility of anything "wrote sarcastic" with the querists wherewith "ours" has to do. It is useless to be "agape with speculative wonder," and expect the virtue of an "if," even in italics (as our satirist says he meant to "speak in italics," p. 674) to prevent J. Barwick regarding the sun "as a point," if it happened to land them in novelties they have the distinction of not finding "noticed by any one but myself." By the way, it was not I who asked "A. J. V. G." seriously "why he should regard the sun as a point." He will see (p. 20) I merely questioned his luminous point "illuminating half" his globe, which seems not to have been "wrote sarcastic." Being thus on the subject of Mr. Barwick's last questions, first, I may as well proceed to remind him he is making no distinction between the space whence all rays or the space whence part of the rays of a luminary are intercepted. In other words, he is regarding the sun "as a point"—something whereof you cannot hide any without hiding all. Shadow is not, as he tells us, "the absence of intercepted rays." It is the absence of all rays (or all direct rays) of the luminary that casts the shadow. The spaces whence a part of its rays, but not all, are intercepted, are not called shadow by any one, scientific or not. There is no call, in common matters, to mention such space; and, therefore, the unscientific have no name for it; but astronomers and opticians call it "penumbra." The peculiar distinctness of shadows cast by an electric or lime light arises from their smallness, and the consequent small amount of penumbra round the shadow. These lights may show J. Barwick the shadows of his single hairs, even at some feet distant from him; which the sun never can at one foot, or even 3in., because his diameter causes all shadows he casts to be bordered by penumbra, the darker portion of which, next the shadow, seems a shading off, destroying its sharpness; but really the edge of shadow is a distinct line that may always be traced with care (at least when received on a white surface), while the limit of penumbra cannot, and the outer portions of penumbra are quite invisible to any eye, even on snow. Hence the moon is not eclipsed by merely touching our penumbra, nor is anything reckoned as a lunar eclipse but her touching the earth's shadow, the only shade whose limit we can see as a distinct line. On the other hand, we reckon as a solar eclipse every time the moon's penumbra touches our globe, for every point in her penumbra has part of the sun hidden. Her shadow need not touch the earth at all, and does not in eclipses that are nowhere total—and a majority of solar ones are of this kind—and in the minority, where the shadow does reach the earth, it can never exceed two or 300 miles wide; so that very few places, in a given century, have been in the moon's shadow, those only that have seen a total solar eclipse, while every place has, more than once, even in a child's life, been in her penumbra. Now Mr. Barwick has only (as I suggested to "A. J. V. G.," p. 20) to hang up a globe or bead in the sunshine, and measure how far its shadow (as distinct from penumbra) extends, which he will find between 108 and 112 times its diameter, and about three diameters farther in July than in January, to have the proof he asks, that the earth's shadow does the same (and also the moon's). The shadow ends at the point where an eye will have the sun exactly hidden by his globe, but by nothing a hair's-breadth narrower than his globe. Now as he knows that the moon sometimes makes annular eclipses of the sun, and yet sometimes total ones, he knows that her shadow may or may not be long enough to reach the earth, according to its variation of length with time of year, but more according to her own monthly variation of distance from us, which is greater than ours or hers from the sun. If he admits then that the earth is less than 4 times the moon's diameter, he must admit that "our" shadow, though always extending to the moon's orbit and even much farther, can never extend above 4 times as far. The penumbra of even the smallest thing (which is what he falsely calls "shadow") extends, if he will, to infinity. We are in Mercury's penumbra whenever we see him transit the sun, which, in fact, is a small annular eclipse of the sun. Now, returning to his first subject, what can he mean by 1130 *feet* per second being the "one hundred and seventieth part" the velocity of light; namely, some 180,000 *miles* per second? It is the 170th of the 5280th part! But if air and ether are each composed of atoms (and one or other is, but we have no sure grounds for saying both are) we have nothing here to inform us which atoms are nearest. If, however, you take a 6in. cube of air, and let it expand into 8 such cubes, or a foot cube, Mr. Barwick will grant, probably, that we may be quite sure the atoms (if any) are now just twice as as far apart. Well, this can obviously be done in gas-pipes or sewers long enough to try experimentally at what rates sound may reach their end. This has been done under Paris by M. Regnault, with air varying in density as 5 to 1, the distance of atoms, therefore, as $\sqrt[3]{5}$: 1, or about 19 : 11, and the velocity of sound was just the same at a given temperature. At different degrees of heat, though with the very same number of atoms in the same pipe, the speed differs, as was well known. Long before this experiment (which was repeated in various pipes, Mem. de l'Acad: tom. 37, pp. 113, 171, 551), climbers on the Alps, as Stampfer and Myrbach, 1823, Bravais and Martens, 1844, had measured the speed of gun reports where the air is only about half as dense as at sea level, and the same equality had been found. Heat or cold alters the rate, though the atoms be at one unaltered distance; but distance of atoms alters it not at all, at a given temperature. Lastly, let Mr. Barwick observe that long before any of this had been tested by experiment, Sir Isaac Newton had predicted it all mathematically, from the mere mechanical properties of air, as settled in the well-known "Law of Mariotte." Therefore, what J. Barwick has succeeded in "impressing on" me (whether "anxious to impress on 'E. L. G.'" or not) is that however little any of us know of what air and other matter *is*, we may know it is *not* a number of things kicking one another, like J. Barwick's bits of needle; and that Newton knew rather more of it, even two centuries ago, than Mr. Barwick in 1872.—E. L. G.

[11120.]—**A Question of Sight.**—Tyndall says that, according to Wertheim, sound travels through iron at the rate of 16,822 feet a second, at a temperature of 20° C., quickening to 17,386 feet at 100° C. Mr. Barwick, p. 128, gives only 11,090 feet per second. I have very little doubt which is right, but Mr. B. will probably state his authority.—SAUL RYMEA.

[11120.]—**A Question of Sight.**—Mr. J. Barwick states that sound travels through air at a velocity of 1,130 feet per second, and as many readers of "ours" may not have seen the account of some late experiments on that subject made at the Cape of Good Hope, I subjoin the result. Further particulars, and the details of the experiment, will be found in the *Philosophical Magazine*, Vol. 43, No. 284, pp. 153-154, for February, 1872, on "An Experimental Determination of the Velocity of Sound," by J. E. Stone, F.R.S., Astronomer Royal at the Cape, on February 27, 1871. "There were 38 observations, and in the reduction of the equations, the co-efficient of elasticity of the air under a constant volume (that is to say, the ratio of the increment of pressure for an increment 1° F. of temperature to the pressure at 32°F.), was regarded as an unknown quantity, as well as V, the velocity of sound at 32° F. The reduction of the equations furnished by the observations gave—

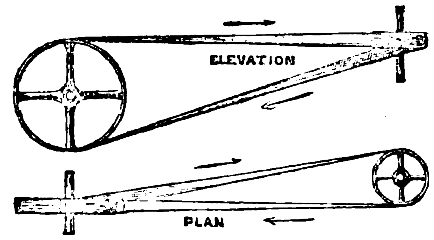
$$V = 1090{\cdot}6 \text{ feet per second.}$$
$$a = 0{\cdot}0019 \quad " \quad "$$

Regnault's value of a being 0·0020. There appeared to be but little difference between the residual errors as dependent on the motion of the air. The author grouped the residuals into two classes, according to the dampness of the air, but there appeared to be no appreciable difference in the velocity as dependent upon dampness."—LINEA.

[11129.]—**Greek "Upsilon."**—Nobody pretends that our transliteration is meant to convey the true sounds of either Greek or Latin. It is purely historical and matter of grammar, and after 2000 years, admits, I must again insist, of no innovation whatever, as long as Roman letters are used at all.—E. L. G.

[11166.]—**Area of Segment of Circular Ring.**—"J. K. P." has correctly but very needlessly figured, on p. 128, the most curved of the forms I remarked that "Thankful's" segment might have had. I should call it as much a "segment" as his own figure, p. 650. In the broadest sense, anything is a segment that is cut off, whether by one straight cut or two. It is not a sector unless the two cuts are directed to the centre, and there being no hint, either in the query or drawing, that this was intended, I could not see my way to any such conclusion. I therefore gave "Thankful" a rule equally applicable whether he meant "sector" or not.—E. L. G.

[11196.]—**Turning Perpendicular Shaft.**—Samuel Smither's sketches A and B would possibly mislead an unpractised hand. The wheels shown in sketch A are bevel and not spur-wheels, and in sketch B the positions of the pulleys will not carry the belt. I inclose sketch, plan, and elevation: were they put as he has shown them, they would not drive, unless they were a



very great distance apart in comparison with their diameters. My sketch shows the relative positions of the pulleys to lead the belt right. If the shafts are required to move in the opposite direction, they would have to be reversed in positions to lead the belt right.—TUBAL-KAIN.

[11208.]—**Incubators.**—My only wish was, if possible, to find an incubator that would hatch to a certainty, and I thought "Shylock's" plan would not, as there is no heat over the eggs. I have got several expensive patented ones, and none of them will do it to a certainty. Brindly's, of Derby, does it the nearest, and the heat there is conveyed in copper pipes over the top of the eggs. I have this night put eggs in an incubator of my own make, and if I succeed I will give you a drawing of it. I have eggs above and below the heat, and a very fine jet of steam conveyed across the top of the eggs, but not touching them. I have from 1,500 to 1,600 eggs per year, many of which I try in my incubators, and I must say spoil. I should be glad to hear if "Hatcher" got any chickens out of the one he made (Cantelo's).—M. O.

[11223.]—**Stereotyping.**—I am under the impression that the mode of stereotyping with the plaster process has been given in back volumes. "H. W. R." must oil his type well, and remove the superfluity with a brush, then put an edging round it, and having the plaster mixed rather thinly pour it on. When dry remove and bake in an oven, standing the cast on edge. He will now want a casting-box, which consists of a tray with a lid capable of being screwed down, and what is known as the floating-plate—a plate of cast-iron with notched edges fitting the bottom of the tray. The plaster-cast having been oiled or plumbagoed is placed face downwards on the floating-plate at the bottom of casting-box; the lid, which has pieces cut off two corners to allow the molten metal to flow in, is then put in position and secured by the screw so as to give the requisite thickness of metal for the plate. The whole is then plunged into a bath of the molten metal, which flows in through the holes at the corners, lifting the floating-plate slightly as well as the cast, but by means of the notches in the edge of the floating-plate the fluid metal gradually spreads over and into the crevices and lines in the plaster cast, and owing to the pressure of the metal in the bath a solid cast is obtained. The process is not an easy one for an amateur; the plaster casts require a high temperature to bake them, and need careful handling afterwards. But such is an outline; if "H. W. R." wishes for details I will help him, or possibly some of "our" friends, who may have succeeded in getting good casts with more simple apparatus, will come to the rescue.—SAUL RYMEA.

[11226.]—**Concertinas.**—I do not know what is the peculiarity of a "trio" concertina, but a "bass" is merely an instrument supplied with reeds yielding bass tones instead of the usual treble ones; a "piano" is one with soft-speaking notes, and a "chromatic" is one with semitones. They are, of course, similar in construction to the German concertina and are as easy to play. The only thoroughly chromatic concertina is the English.—E. M.

[11233.]—**Marine Engineer.**—Presuming that "E. W. B." wishes to determine the proper velocity of the piston I copy the rule given by Templeton: Multiply the log. of the *n*th part of the stroke at which the steam is cut off by 2·3, and to the product add ·7. Multiply the sum by the distance in feet the piston has travelled when steam is cut off, and 120 times the square root of product will equal the proper velocity of piston in feet per minute. In condensing engines the approximate velocity of piston with stroke of 22in. would be about 150ft. per minute.—E. M.

[11237.]—**Four-Wheeled Vehicle.**—Your carriage would be drawn easier up hill with large wheels than with small ones. The reasons for which you will see fully gone into in the number of the ENGLISH MECHANIC for January 12, 1872 (reply 10054).—101, PARK-STREET.

[11255.]—**Farm Estate Agent's Duties.**—The duties of an estate agent (read the "General Text-Book for Architects, Engineers, Surveyors, Land Agents, Solicitors, and Others," by E. Ryde; and "For Landowners," by J. Donaldson; also the "Book of the Landed Estate," by Robert E. Brown) being thus so multitudinous, it is evident that the person undertaking them must be a man of high and general qualifications, such, indeed, as the most liberal, practical, and scientific education can alone confer. In the first place, it must be his business to make himself thoroughly acquainted with the property, and with a things and persons connected with it. He must superintend and conduct the whole of the work that is done on the estate, give all orders himself to the subordinate officers (each foreman in every department), and see that each performs his duties. He ought to have a thorough knowledge of the principles and the best practice of good farming, to enable him to encourage the system of culture best calculated for the soil, the climate, and the peculiar circumstances of the estate. The best practical book on farming I have met with is "The Book of the Farm," by Henry Stephens. Also read Morton's "Cyclopædia of Agriculture," and "The Journal of the Royal Agricultural Society of England." For a general knowledge of agricultural chemistry and geology, read the books written by James F. W. Johnston. Of arboriculture, or the raising of forest trees, planting and forming new plantations, the general management of old woods and plantations, and of different descriptions of fences, read the book written by John Grigor, The Nurseries, Forres, N.B.; "The Forrester," by James Brown; "The Transactions of the Highland and Agricultural Society of Scotland;" and "Transactions of the Scottish Arboricultural Society of Scotland." Of surveying for making plans of roads, new plantations, drainage, and computing the contents of pieces of land in exchange between estates, farms, &c., for general improvements; on architecture, for the making of plans for farm buildings, cottages, &c., making specifications and estimates of all buildings and all other works on the estate, see the "Book of Farm Buildings: their Arrangement and Construction," by Henry Stephens and Robert Scott Burns. Also, in the above-named books will be found a lot of useful information on this matter, and the valuation of landed property, of the soil, houses, woods, minerals, manorial rights, royalties, fee farm rents, tenant-rights, &c. He has, moreover, to let the farms, cottages, &c., to the tenants under such conditions as shall induce them to cultivate the land to increase its productiveness—this should be his constant aim. Collecting rents: This is a very simple matter to do when the money is forthcoming—see the above-named books. A little knowledge of law between landlord and tenant is quite necessary. Read "Every Man His Own Lawyer," Dixon's "Law of the Farm," Rouse's "Practical Man," and Archbold's "Landlord and Tenant."—Thirteen Years' Agent.

[11294.]—**Dividing Metal Disc.**—So simple a problem does not require an elaborate answer. Take D = the exterior diameter of disc in inches, and n = the number of equal area smaller discs to be cut out of the same. It would be, $a = \frac{D^2}{n}$ = area of the several discs in circular inches; then for the smallest disc $\sqrt{a} = d$, the diameter in inches, the next size $\sqrt{2 \times a} = d$, then $\sqrt{3 \times a} = d$ and so on.—Tubal-Kain.

[11299.]—**Tarpaulings for Railway Carriages in the Tropics.**—I have seen a material invented by Spill and Co., Bow Common, which is as pliable as a glove, and always remains so, not being affected by either extreme of temperature. It is the result of twenty years' experiments, and the amicable co-operation of two substances hitherto as opposed as fire and water. It is in use on several English, American, and Indian railways.—Amateur.

[11318.]—**Setting Lathe.**—To F. Hume (additional).—I don't think the screws between the beds are intended to be moved; but if they are, could you not make a mark to indicate exactly how far you have to set them back after altering? My contrivance for tapering is merely a hardened cone-point screwed into a hole in the collar-plate, or into a separate plate of the same description, if there is not a convenient place in the collar-plate itself, of course taking care to keep the centre at the right height, and set the head up with a hammer. Screws cut taper with this plan would not be drunk if, as well as pulling the back centre over towards you, you also alter the mandril-head so as to be truly in line with the back centre itself. But taper screws (true ones) are rarely, if ever, wanted. I think if I had to use your lathe I should take out one set-screw or both and fit in a parallel piece of iron (or brass) on each side to regulate the position of the mandril-head, and the said pieces of metal need only be (say) 1in. square or less, and if they had a rivet or stud sticking out ¼in. on one side, which you could insert into the old screw-hole just when you are putting the head-stock back in its place, they would not drop out. Don't pinch your fingers in doing it. My mandril-head is held by a thin wedge on one side.—J. K. P.

[11339.]—**Astronomical.**—It is asked "why does the polar star always occupy the same place when the earth's axis, by reason of its orbit, changes position?" The polar star may occupy the same place as compared with other stars, but it does not occupy the same place as compared with the Pole, or rather the Pole does not occupy the same place as compared with the star. In the year 1790 the Pole and the star were about 1° 49′ apart; in 1839 the distance between them was about 1° 33′, and now it has decreased to about 1° 22′ only. Mr. Porter may consult with advantage upon this subject Sir J. Herschel's "Outlines of Astronomy" (a new edition of which, I see by the English Mechanic, has just been brought out), and the astronomical vol. of Orr's "Circle of the Sciences," and, doubtless, other works on astronomy, but I mention these because I happen to know of them. The star does now appear to describe a small circle in the heavens once in twenty-four hours, but this arises from the rotation of the earth on her axis, not on account of her revolution in her orbit.—C. W. M.

[11354.]—**Fire Balloons.**—If your correspondent, William McDonald, refers in his question to fire balloons, the proper material for a fire balloon of 20ft. in circumference will be 12lb. double crown paper, that is paper of double crown size, each sheet measuring 30in. by 20in., and weighing 12lb. per ream. To inflate it, a cotton pad soaked in spirits of wine is fastened to the junction of two cross wires arched upwards in the mouth of the balloon, and the balloon itself must be supported by a loop at the top fastened to a head line, so as to hang 5ft. clear of the ground, and fastened so that by pulling a string the attachment can be cast loose. The balloon should be held out above the mouth by two persons, the spirits of wine lighted, and when the balloon is thoroughly inflated the string is pulled and the balloon let go. It is generally the fault that they are let go much too soon, and before they have power to rise rapidly. A balloon of the size mentioned will require some small weight as a car to be attached to it to keep it steady, and the mouth should be about 12in. or 14 in. in diameter.—J. F. E.

[11387.]—**Sundials.**—"Philanthropist" must excuse my mentioning it, but it appears to me that his reply to this query may mislead some persons. That edge of the gnomon which casts the shadow which indicates the time on a sundial must be parallel to the earth's axis, and therefore, although in an erect south dial it should form an angle with the plane or face of the dial, equal to the co-latitude of the place, yet in a horizontal dial it should form an angle with the plane of the dial equal to the latitude of the place. For a place having 45° of latitude, the angle would be the same for either of the above-named dials. A dial may be drawn upon a plane in any position, but the above rule for fixing the gnomon must be adhered to.—C. W. M.

[11393.]—**Metallic Harmonicon.**—What does "Zoo Andra" mean (in his reply to query 11393, p. 108) by "similar to an inverted aquarium," and then further on, saying that this "inverted aquarium is to be partly filled with a solution of alum"? Does he mean an "inverted fern case," or what?—Tuba.

[11398.]—**Stinging of Bees, Hornets, and Wasps.**—Take a pinch of tobacco, damp the palm of your hand, work and rub the tobacco until you get the juice well out, then rub the spot where stung well with it for five or ten minutes. I have found this a perfect cure for bee stings, and used it with success only last Sunday. Let the sting be withdrawn as soon as possible.—S. W.

[11409.]—**Canine.**—The dosing with Dr. Rooke's Oriental Pills, recommended on p. 103, should be "for about three weeks," not "eight weeks" as printed.—Amateur.

[11415.]—**Scarlet Runners** are scarlet runners!—*i.e.*, there is only one *scarlet runner*, a variety of tall-growing or running bean. There are white runners, Painted Lady, and black-podded or Negro runners; there is also a so-called giant variety of the scarlet—not a bit better than the common scarlet as grown by hundreds of cottagers, but more than double the price. Sow as soon as you like, now; dig deep, at least 2ft.; put in rotten dung if you have it; make a tolerably firm trench or drill, lay the seeds 6in. apart at the bottom, and cover them about 2in. When up about 3in. draw the earth round them up to the seed leaves. If the soil is well dug, they will not require water in ordinary weather—*i.e.*, watering at the root—but they do require almost daily syringing. You may, however, give them all the soap-suds you can get—either overhead or at the root. Stop them at 5ft. high, or some little distance before they reach the top of your supports. Try a row as dwarfs by stopping them at a foot, and pinching the growing shoots afterwards. If you have no manure ready give liberally of guano or artificial, and they will pay you handsomely. Your blooms fell off through weakness or sourness of soil, shallow digging (or rather scratching), or want of the syringe.—Saul Rymea.

[11423.]—**Surgery.**—Having suffered from a thing very similar—viz., a curled shaving passed with the graver, when engraving a steel plate, into the fore part of the middle joint of the forefinger; and in cutting some German steel plate up that was hard, a piece either from the chisel or plate struck into the middle joint of the little finger, and in carelessly using a pump drill it slipped and entered the ball of my thumb and broke about three-sixteenths of an inch off and left in behind, all of which were sore troubles for four or five years. The former was the cause of the other mischief. The severe pain in handling things made me clumsy. It is only dangerous in boring it about trying to get it out. The two former do not trouble me, and although entering on the inside have worked along to the outside just under the first joint. They never festered or gathered, but a hard core, like a wart, kept growing out of the place where they entered for a long time, which, when touched, was exceedingly painful, which led me to cut and bore it about to no purpose. You might as well look for the article in a load of hay. If it appears inclined to gather, take a strip of lint or a small portion of cotton wool, and place upon it wet, and keep it constantly moist. Place over that a piece of oiled silk and a finger stall. This is the best form of poultice, and will greatly assist the opening and the ejection of the enemy. Do not apply every nostrum, drawing salve, or plaster in succession that is recommended, for thereby many lose their limbs and frequently their lives.—Jack of All Trades.

[11436.]—**Harmonium.**—I am "musician and mechanic enough to know" that the channels of a harmonium pan (there are no channels in the reservoir) should be graduated the whole way through; but "Practical Horologist" will excuse me if I tell him he is evidently not a practical harmonium maker. What I wish to know is whether in practice an inequality of (say) 1-64th of an inch in cutting the channel frame for divisions makes any material difference in the tone of the note the unequal-sized channel is intended to give?—K. T. L.

[11442.]—**Old Wives' Science.**—If "A., Liverpool," just glances at Dr. Brewer's "Guide to Science," he will at once perceive the following answer to the question, why does the sun shining on a fire make it dull and often put it out, is, because the air (being rarefied by the sunshine) flows more slowly to the fire, and secondly, the chemical action of the sun's rays is detrimental to combustion. The sun's rays are composed of three parts, lighting, heating, and actinic or chemical rays. These latter interfere with the process of combustion.—Wee Pet.

[11442.]—**Old Wives' Science.**—With respect to reply on page 105, I beg to say, not only for "A.'s" information, but also for that of S. Bottone's, that there is very good foundation for the statement that the sun shining on a fire puts it out, and the following are the only true and proper reasons:—1. Because the air (being rarefied by the sunshine) flows more slowly to the fire. 2. The chemical action of the sun's rays is detrimental to combustion. The sun's rays are composed of three parts: lighting, heating, and actinic or chemical rays. The two latter interfere with the process of combustion. 3. The air flows more slowly to the fire for being rarefied, because the greater the contrast between the air in the room and that which has been heated by the fire, the more rapid will be the current of air towards the fire. 4. Because rarefied air contains less oxygen than the same bulk of condensed air (or air that has not been rarefied by the heating influence of the sun's rays, in other words shaded, and therefore condensed). 5. In frosty weather the air being more condensed by the cold than at other times, as indicated by the high readings of the barometer during a frost, supplies more oxygen than a similar volume of warmer air, and consequently falls more rapidly into the place of the hot ascending air, and as we all know, makes a fire burn very brightly.—Science.

[11444.]—**Bursting of Compressed Air Receivers.**—The effects would be the same as those of steam, except the scaldings. Too large for any purpose. A series of egg-ended receivers, 2ft. diameter, 10ft. long, would be far better.—Jack of All Trades.

[11450.]—**Adjusting Equatorial.**—"Inquirer's" latitude is 53° 50′, and as ι Ursæ Minoris is 7° 45′ 42·4″ from the Pole, it is plain that his circle should read:—

$$\begin{array}{lr} & 61° 35' 43'' \\ + \text{ ref.} & 32'' \\ \hline & 61° 36' 15'' \end{array}$$

north declination at the instant of transit, or

$$\begin{array}{lr} & 90° \\ & -\ 61° 36' 15'' \\ \hline \text{N. P. D.} = & 28° 23' 45'' \\ \text{S. P. D.} = & 151° 36' 15'' \end{array}$$

—Thomas Buchanan.

[11451.]—**Weight for Safety Valves.**—If E. Naylor had the time and means to look up past vols., he would find sufficient information on the above. The following is an answer to his specific question:—Obtain a weight 9½lb., which at 16in. from fulcrum will give 39·96lb.; at 14in. from fulcrum, will give 34·66lb.; at 12½in. from fulcrum, will give 30·08lb.; at 10¼in. from fulcrum, will give 24·84lb. This is worked out according to Templeton. The effective weight of lever is correctly obtained by multiplying its length in inches by its weight in pounds, then dividing by twice the distance in inches from fulcrum to point of resistance. Thus a 60in. lever, 15½lb. weight, at 10in. from fulcrum, pulls 46½lb.; and at 20in. from fulcrum, pulls 23¼lb.—Mutual Improvement.

[11457.]—**Motive Power for Amateurs.**—The sketch shown is of no practical use, except to waste power by friction, and possibly to render the motion regular. Whatever the length of the pendulum (which is the way this would act) from the point of suspension to the centre of gravity of the suspended weight, so would be, in all ordinary cases, the number of vibrations per minute. Better apply your power, whatever it may be, in the simplest and most direct way.—Tubal-Kain.

[11459.]—**Printers' Ink.**—The recipe given by "H. B. E." (p. 130) is for common red ink, not printers' red ink.—A Barrister.

[11460.]—**The Beehive.**—In my reply to Mr. Godden I said that glass hives were dangerous things in a house, but I did not mean that they were likely to go raving mad and bite any one. The particular danger to be guarded against is the breaking of them, by which the bees might be let into the room, perhaps among nervous ladies or children. On that ground only I consider them dangerous, and recommend that they be always kept under cover, for accidents will happen. "Philo's" hive in the conservatory is a different affair certainly; but if his bees ever get loose he will find some difficulty in getting them back to the hive unless he be an expert. The reason the bees go into the conservatory is not because they see the hive there or their fellows, but because there is some attractive aroma, probably from the hive itself, which pervathe closed conservatory, and becomes palpable to the bees immediately on its being opened. Bees are "led by the nose" into all sorts of places, but glass houses bother them amazingly, as they do not perceive the difference between an open window and a closed one, and so they beat themselves against the glass until they exhaust themselves, or accidentally obtain egress. Many stocks are much injured through being in proximity to greenhouses from this cause, as they are induced to enter them by the aroma from blossoms therein, and perish there, and this in early spring causes great loss.—C. N. Abbott.

[11460.]—**The Beehive.**—I think no further proof is needed to show where the honey comes from than the diversity of its flavour, that from wild thyme, heather, and Narcissus being very strongly marked.—Inquiring Mind.

[11461.]—**Reviving Black Cloth Coats, &c.**—Black galls, bruised logwood, copperas, sumach, ½oz. of each, vinegar, 1 pint; macerate in a close vessel with heat for twenty-four hours; strain off the clear liquid and the copperas, and shake twice a week. Keep in a corked bottle, apply with a brush or sponge; this is improved with a little sugar or gum.—Inquisitive.

[11461.]—**Reviving Black Cloth Coats, &c.**—Those that look white I should think are cloth-dyed and mixtures; if you see Indices you will find revivers; if it is nap you require to use urine and ox gall, and a hard brush, a teasel brush, or a brush made of a piece of worn cotton cord. It strikes me that they have had too much brush, and nothing but turning will make them presentable.—Jack of All Trades.

[11465.]—**Problem.**—Mr. Tonkes appears to have misapprehended this query in his letter (4004, p. 126). "Puzzled" does not say that the trains move with equal but with uniform velocities. There is very little difficulty about the question. I see no answer to it, however, except Mr. Tonkes's rather weak criticism. The united velocity of the two trains is (92 × 84=) 176ft. in a second and a half, or 117⅓ft. per second. Now, the trains move with velocities such that one runs over 176ft. in six seconds of time less than the other, or, in other words, moves with a velocity $\left(\frac{176}{6}=\right)$ 29⅓ft., a second greater than the other. The united velocity of 117⅓ft. per second must, therefore, be divided into two parts, of which one must exceed the other by 29⅓. By a simple equation it is found that these parts are 73⅓ and 44, whence the velocities of the trains are 73⅓ft. and 44ft. per second, or 50 and 30 miles an hour.—V. B.

[11465.]—**Problem.**—The trains move at the rate of 30 and 50 miles respectively. Their united length is 176ft., which is passed in 1½ sec., = rate of 117·3ft. per second, and 29·3ft. per second = $\frac{176}{6}$.

$a + b$ = 117·3ft. per second.
$a - b$ = 29·3ft. „ „
b = 44ft. per sec. = 30 miles per hour.
a = 73·3ft. = 50 „ „ „

—Thomas Buchanan.

[11465.]—**Problem.**—Mr. Tonkes says (p. 126) that this problem (p. 80) is badly propounded. I consider it correctly worded and easy. First, take what is given last—viz., that the fast train passes the other 92 + 84 feet in six seconds, which gives us 29⅓ft. per second as the difference of their speeds. Next, when they meet, as in the beginning of the question, they will pass each other in the same time, as if one stood still and the other ran by with the joint velocities of both. Let the velocity of the slow one be v feet per second, then that of the fast one is v + 29⅓, and their joint velocity $2v$ + 29⅓, and at that speed 176ft. are by the question covered in 1½sec., or $\frac{176}{2v + 29\frac{1}{3}}$ = 1½sec., and v = 44, which is the velocity of the slow train, and 44 + 29⅓ = 73⅓ that of the fast train, or 30 and 50 miles an hour respectively. Mr. Tonkes has missed the signification of the word "uniform," which is that the velocities of the trains, though different, remain unaltered, while the "same" means that in the second half of the problem each train has the same velocity as in the first half.—J. K. P.

[11471.]—**Bows.**—Nothing can equal Spanish yew. Its return when loosed has that excessive velocity which gives the greatest vigour to the arrow's flight. Hickory, ash, and American elm are very tough, but very sluggish. They are excellent, therefore, for the backs, but useless otherwise in bow-making. Lancewood is very good when backed with any of the tough woods. I made some twenty years ago, and when shooting with them for Cheshire against Warwickshire, could have sold them for high prices. They were made of bright coloured lancewood, backed with hickory. After being shot with a day or two till they remained a little bent when unstrung, I cut out a piece of the lancewood from the centre of each bow, about 4in. long, right through. In place of these two rather longer pieces were glued in, throwing back the horns of the bow. They proved in this state excellent target bows, and very durable as well as handsome.—J. M. Taylor.

[11473.]—**Weak Voice.**—Practise singing daily, standing and leaning back. "Os homini sublime." The gamut in long sustained notes sung *crescendo* and *diminuendo* will be found useful. Over-exercise of the vocal organs is injurious. The rule "Ne quid nimis" is always good as a check to enthusiasm.——I thank Mr. Birt for pointing out my neglect of parallax. What I wrote of refraction causing the lunar orb to appear quite above the horizon when really below it, is true of the sun, the parallax of which is 8½ seconds. The parallax of the moon is a quantity far exceeding refraction, except at the horizon, when the two effects (parallax pushing down and refraction raising up—the bulls and bears of the superterrestrial exchange)—will nearly counterbalance each other. I have seen a case of unusual refraction at the horizon, when an invisible rifle butt was raised so as to look like the tower of a church, equal by estimation to four degrees.—Thomas Buchanan.

[11476.]—**Pattern Making.**—I know of no work on pattern making. To become a pattern maker you must have some idea of moulding, and it is only to be learned by practice. If there is any special patterns you require instructions to get out, there is not the least doubt but what you will find assistance in "our" columns.—Jack of All Trades.

[11479.]—**Tempering Cutting Tools.**—To prevent a lead bath from becoming oxidised when heated for such purposes is out of the question. Colza or Gallipoli oils and Ginseng oil are the best both for hardening and tempering. The raw oils are best for hardening, but they must be well boiled for tempering. Have a wrought-iron cistern set upon some bricks the size you require for your job, and a cover to fit, in case it should fire, which it will very readily at that heat, and your cistern not more than two-thirds full.—Jack of All Trades.

[11481.]—**Organ Building.**—It does not matter if the pipes touch at the back and sides, but they must be so firmly fixed that they will not rattle against each other. If "Aleph" is in any difficulty about what I have already written upon, I will be glad to answer any question, but if prospective difficulties, I must say "wait." I am sorry I shall not be able to continue my letters for a few weeks, being confined to bed with a broken leg, and 100 miles from home.—J. D.

[11483.]—**Dyeing Parchment.**—Have you tried Judson's dyes? To prevent them being affected with water or grease, use a weak varnish of shellac; one ounce of shellac put into a pint of spirit, and shaken up for a minute or two and poured off answers well for such purposes.—Jack of All Trades.

[11484.]—**Manures and their Values.**—Johnston's "Manual of Agricultural Chemistry," or Sibson's "Agricultural Chemistry" (published by Routledge), preferably the former, will afford the information Mr. Richardson requires. Johnston's lectures, particularly the appendix, would be useful, also the articles on "Agriculture and Manures" in the *Encyclopædia Britannica*, if these are available. As regards information to a beginner on the cultivation of a few acres of land this could not readily be given without some knowledge of the nature of the soil. Cannot the querist scrape acquaintance with some bucolic neighbour and obtain a wrinkle from him?—William Glazier.

[11485.]—**Florentine or Brown Bronze.**—No. These bronzes will not do for tinwork, but a red bronze can be given to tinwork with a very small portion of sulphate of copper dissolved in water and applied. It can be done over after with blacklead and polished with a soft brush, and lacquered with dark or light lacquer, as the case may be, and if the tin ware is wet all over with diluted muriatic acid before it will give it a frosted appearance, and it may be varied according to strength of solutions.—Jack of All Trades.

[11487.]—**Preventing Rust.**—Take an old stocking foot and daub it over with a mixture of four parts beeswax to one of olive oil, and one of turps, melted, and keep in a pot for use. When the above is well daubed over with it your wiper will last some time without a renewal of compost. After well polishing your work, well rub with the above rubber.—Jack of All Trades.

[11488.]—**Coating Wooden Concrete Moulds.**—Use a wash at first of alum water. When dry coat it with a strong solution of soap.—Jack of All Trades.

[11491.]—**Kid Dressing.**—If black, dress the face with a strong decoction of elder bark, afterwards with a decoction of nut gall and acetate of iron, finish with a coat of glair and rub down with a piece of old cloth with a few drops of olive oil upon it.—Jack of All Trades.

[11493.]—**Indiarubber Overcoat.**—Get some pure rubber and dissolve it in ether to a thick paste, and apply. The ether will soon evaporate and leave the seams sound.—Jack of All Trades.

[11497.]—**Removing Oil Stains from Billiard Cloth.**—Use finely-powdered Bath brick and a warm iron. Afterwards well brush.—Jack of All Trades.

[11500.]—**Welding Cast Iron.**—Should be welding cast steel. Two parts silver sand and one of sulphate of lime, or plaster of Paris, which is the same, will do for the job. Heat your article and dust it with the above, place in the fire again until you get a good heat, and it will weld.—Jack of All Trades.

[11505.]—**A Wooden Pump.**—Put in a metal working chamber or barrel in which the bucket shall work, it may be either of copper, brass, or cast iron.—Tubal-Kain.

[11510.]—**Defective Sewing Machine.**—The brush is there for retaining the loop until the point of hook has entered the next descending loop from the needle, and should then become free. I expect the edge of the recess in the hook is worn away, and the spool not having anything to support it, drops down between the hook and shield and jams the thread; if so, it can be made deeper in its place by taking a tennon saw file, and grinding the shape and using a block of wood for a rest, turn it out in its place. I have cured several by these means.—Jack of All Trades.

[11511.]—**Rubber Tires.**—I can assure "Constant Reader" that rubber tires do not "draw" harder than iron ones, but easier over rough roads. On smooth roads there would be no advantage. There is no suction between the tire and the road, which querist will find if he attempts to lift the wheel from the road. If there was, I do not think it would be an obstacle to a rolling motion. An indiarubber tire eases the draught by lessening the vertical motion. Whatever force goes in lifting the machine and rider over obstacles—that is, in vertical motion—is a dead loss to the desired horizontal motion. The analogy between indiarubber and soft roads does not hold good. The perfect elasticity of the rubber alters the case altogether. Force is consumed in compressing the rubber; but it is again given out to the wheel when it is restored to its original state; and it then urges the wheel forward as much as it offered an obstacle to the forward motion at first. Mud remains in a compressed state, consequently there is work done, and force consumed.—101, Park-street.

[11513.]—**Refining Animal Oil for Sewing Machines.**—This can be done with a weak mixture of sulphuric acid and water, after with potash or soda, and finally with lead shavings or zinc chips.—Jack of All Trades.

[11513.]—**Refining Animal Oil for Sewing Machines.**—The two chief impurities in oil for delicate machinery are margaric and stearic acid. For gun locks and, I believe, for watchmaking also, where the principal object is to prevent clogging, take, of course, to begin with, the purest neat's-foot or trotter oil, put any quantity in a wide-mouthed bottle, well corked, and scrape into it a quantity of bright, soft lead shavings, nearly half fill the bottle with the lead, which must be bright. Cork and expose to bright sunshine for a fortnight, shaking the bottle every time you go near it. If not perfectly clear and limpid at the end of that time, pour off oil, scrape in a fresh quantity of lead, and repeat process. Margarate and stearate of lead are formed, and the acids removed from the oil.—M. A. B.

[11514.]—**Brunswick Black.**—Boiled oil and asphalte, thinned down with turps.—Jack of All Trades.

[11514.]—**Brunswick Black.**—Fuse 2lb. of asphaltum in an iron pot, add of hot boiled linseed oil one pint; mix well, remove the pot from the fire, and when cooled a little add of oil of turpentine two quarts. Some makers add driers.—A Barrister.

[11516.]—**Veneering.**—Level the ground work, tooth, and size it, wet the veneer on the top side, glue the other side evenly (which is the great secret in veneering clean), work the glue out with a veneering hammer. If very large wet the veneer again and rub on a hot flat to melt the glue and work the hammer again, in this way you may lay a veneer any size. I have laid one 15ft. long without assistance. For French polishing see back numbers.—M. O.

[11516.]—**Veneering.**—Veneers are laid on by the trade by means of a veneering hammer or caul, but for an amateur a common light-headed hammer will do as well, if not better, as the use of the caul with advantage requires a certain amount of practice. In veneering by the hammer the ground should be warmed by the fire, and the outside of the veneer wetted with warm water or glue made very thin, applied by means of a sponge, and the side to be laid covered with a coating of thin glue, and warmed at the fire. The veneer should next be laid on the ground or on a table, and worked with the hammer backwards and forwards till neither air nor glue will come out. Even for experienced workmen veneering with the hammer is best when the veneers are straight and even, but as that is seldom the case, work is generally done with the caul. There are some favoured individuals who take to the caul as naturally as a duck to the water, but I have found the hammer to serve all requirements; but, of course, every one has his prejudices. A caul is an instrument made of solid wood shaped to the surface to be veneered, consequently the making of cauls will be rather expensive, especially for amateurs who have only one or two things of each kind to veneer. The caul should be well heated, then oiled and greased; it is screwed down upon the veneers, and the heat and pressure sends out the glue, causing the veneer to bed close to the ground. The veneers should be of an even thickness when worked by a caul, otherwise the glue will collect and the work is liable to blister; it should not dry too quickly. The great fault with amateur veneering is blistering, and the workman's skill is exercised in no small degree in getting rid of these unsightly blemishes. The way this is generally done is as follows:—First, wash the exterior of the blister with boiling water, and with a coarse cloth remove dirt and grease; then place it before the fire, or heat it with a caul; oil its surface with common linseed oil; place it again to the fire, and the heat will make the oil penetrate quite through the veneer and soften the glue underneath, then while hot raise the edge gently with a chisel, and it will separate completely from the ground; be careful not to use too great force or you will spoil your work again. If it should get cold during the operation, apply more oil and heat it again; repeat this process till you have entirely separated the veneer; then wash off the old glue, and proceed to lay it again as a new veneer.—P. W. H. J.

[11518.]—**Respirator.**—"Jersey Crapaud" will find a piece of ordinary calico, unglazed, with a string sewn on both ends answer his purpose; if one thickness is not close enough, use two.—Elektro.

[11518.]—**Respirator.** — An excellent respirator may be made of a thick sheet of carded cotton wool placed between two pieces of muslin. Professor Tyndall's experiments show that nothing stops dust more effectually.—A BARRISTER.

[11518.]—**Respirator.**—Take some cotton wool and place between two pieces of horsehair cloth. Makes a very good one for grinding, millstone dressing, or saw sharpening, bind it round the edge with kid leather.—JACK OF ALL TRADES.

[11522.]—**Goldfish.**—See that the fins and tail are unbroken, that no scales are rubbed off, and that there is no appearance of what I may call (for want of a better name) mouldiness about the fish. This latter indicates a disease very common and almost always fatal to fresh-water fish when kept in confinement, and strongly resembles the white mould which appears on stale bread, fruit, &c. It is very contagious; therefore, if apparent on one or more fish in an aquarium, all the others should be considered doubtful.—LOACH.

[11522.]—**Goldfish.**—These fish should be bright and lively, with perfect scales and fins. If any of the former are rubbed off, or the latter split, they never do well, and generally die soon. Goldfish require frequent feeding. The best food is vermicelli, or dried beef, powdered, given in small quantities. — A BARRISTER.

[11522.]—**Goldfish.**—When in good health the tails of these fish are perfectly flat. The opening and shutting of their gills occurs at regular intervals of about one second, and the eyes have a blue tint. If the tails are crumpled at all, or the eyes are at all red, the fish are not good, and I should advise "S. K." not to buy them.—ANON.

[11524.]—**Pitch of Roof.**—The proportion of the height of the roof above the eaves to half its breadth is the pitch. What is called the true pitch is 1 : 1, or 45°. Houses are seldom built now with roof so steep. See Bennycastle's "Practical Geometry."—PHILANTHROPIST.

[11525.]—**Fresh Water Aquarium.**—I have an aquarium 3ft. 6in. × 1ft. 8in. × 2ft., which contains altogether the following fishes and animals, which live in harmony together. I think "S. K." will find it a good example: 2 goldfishes, 1 silver carp, 1 small torpedo eel, 12 minnows, 2 efts, 2 tritons, 6 water beetles, 1 pollock, 2 long-noses, 8 fresh-water whelks, and 1 small cassavery. I feed them on watercresses and lob-worms; bread crumbs I put in for the silver carp and toast for the copper ditto.—ANON.

[11525.]—**Fresh Water Aquarium.**—Any kind of fish, but keep them as much as possible of the same size. Small fish, as a rule, will damage any larger ones in the same collection, unless the aquarium be very large. Plants: Fontanalis antipyrectica (if procurable): Anacharis alsinastrum (procurable everywhere). The former is best, as carp and other coarse fish will eat Anacharis but I never knew of any fish eating Fontanalis.—LOACH.

[11525.]—**Fresh Water Aquarium.**—Almost any fish may be kept, except sticklebacks. These little wretches, although very interesting when kept by themselves, destroy all other fish, large or small, by splitting their fins and tails, which soon brings them into a state of disease. I have kept gold fish, carp, tench, gudgeon, minnows—these will do well for years. Roach, dace, perch, bream, and mullets will live for a time, but are much more delicate. The best plants for an aquarium are Valisneria and Anacharis. — A BARRISTER.

[11527.]—**Barrister.**—A person wishing to become a barrister must enter at one of the Inns of Court, pay about £30 for fees, deposit £100, and find two sureties who undertake that he shall conform to the rules of the society, &c. The £100 is appropriated for the fees when he is called to the bar, or is returned should the student take his name off the books. The actual qualification consists in appearing in Hall a certain number of times, in each of twelve terms, at the dinner hour (commonly called eating terms), and the student must have been a member of the Inn at least three years. There is no doubt that very shortly a strict legal education will be required as a qualification; at present I believe the only examination is a voluntary one upon the subjects of the lectures lately instituted by the different societies.—A BARRISTER.

[11527.]—**Barrister.**—Qualifications required are too numerous almost to mention, but these are some of them.—A good classical, and yet more, a good mathematical education, a knowledge of the statute and common law, the power of speaking, confidence in one's own powers, and a good constitution.—JANNIFRED.

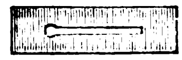
[11531.]—**Water Wheel.**—V = velocity of stream of water in feet per second; then, quantity = $2{\cdot}0 \times {\cdot}25 \times V = Qv$ (1). The power = $\cdot075 \times Qv \times 80$ = H.P. (2), allowing 65 per cent. of the effective power of the water available for useful purposes.—TUBAL-KAIN.

[11531.]—**Water Wheel.**—Before I can answer the first part of this query I must know with what velocity the stream of water runs, and the angle at which it strikes the buckets; also, I might as well ask whether, by centrifugal engine, "Columbo" means a rotary engine, because, if so, I would say don't. A rotary engine is the rock upon which the inexperienced split. No really practical man will now advocate a rotary engine. In spite of all inventors may say to the contrary, the rotary engine has not been made that will beat the reciprocating engine. One may be invented some time, but it seems far distant. If "Colombo" will answer the above questions, I will see whether I can satisfy his requirements.—P. W. H. J.

[11532.] — **Steam Fire-Engine.** — Shand and Mason's engines are very powerful for their weight. I extract the following from "Recent Improvements on the Steam Engine," by Bourne, 1869, p. 304:—"In an experiment made with one of these engines at Messrs. Pennison's factory in 1864, with an engine having two cylinders of $6\frac{9}{32}$ in. diameter, and 7in. stroke, the power generated with steam of 120lb. pressure in the boiler, and with 152 revolutions per minute, was about 15 horse-power." Another case is stated on page 306:—"The engine exerted 32½ actual horse-power, and as the total weight of the engine was only 32 cwt., the weight was about 1 cwt. per actual horse-power, a very remarkable result." Further information if desired.—PHILANTHROPIST.

[11533.]—**Area of Boat.**—A cubic foot of water weighs 62½lb., so the tonnage can be readily calculated from the solid content of the immersed portion, the area varies according to the model, being greater for a given tonnage in a long, narrow, or sharply built boat.—PHILANTHROPIST.

[11534.]—**Cleaning Metal Buttons, Jackets, &c.**—Cut out of a clean piece of thin deal, a protector like sketch, put the button through the large hole and run the slit up on shank. This is to protect the cloth. Clean



with very fine (not gritty) whiting and water, with soft nail brush and elbow grease. Rub white cloth with pipe-clay, and brush off well, repeat if necessary; this will not remove grease. Clean German silver with rotten stone and oil.—M. A. B.

[11534.]—**Cleaning Metal Buttons, Jackets, &c.**—Use finely washed whiting for jacket, take pollard or middlings and a fresh baked loaf, the above will do for keys for flute. Preparation of whiting:—Take a ball of whiting and pour boiling water upon it, and make it of the consistence of new milk, let stand for two or three minutes, pour the liquor quietly off into another vessel to settle for use.—JACK OF ALL TRADES.

[11535.]—**Small Wheel-Cutting Machine.**—See indices. There was one given to be fixed upon lathe bed.—JACK OF ALL TRADES.

[11536].—**Character of Curve.**—This curve will naturally vary according to the place where the water is poured upon it, and it would, I should think, assume the character of the different conic sections, but it is worth experiment.—P. W. H. J.

[11537.]—**Scott's Patent Moulding Machine** is nothing more nor less than a worm wheel dividing plate revolving round upon a pedestal, and furnished with a horizontal slide or radiating arm. It has a vertical slide, which is furnished with jaws for the insertion of the templates, which are made by the pattern maker of wood for the pitch. It is generally made with two or three teeth. There is a train of wheels, the same as an ordinary wheel-cutting machine.—JACK OF ALL TRADES.

[11537.]—**Scott's Patent Moulding Machine.**—Better write to the patentee and maker in Manchester. He, no doubt, will be glad to supply information. There is an older patent, by P. R. Jackson, which does not appear to be so generally used. Nevertheless, it is possible to make good wheels without either of them.—TUBAL-KAIN.

[11539.]—**Wooden Beehive.**—Many thanks to "H. A. D." for his good opinion of my suggestions for improvement in hives, but with all respect, and in perfectly good temper, I beg to refer him to Mr. Woodbury's own description of his improvements in hives for apiculture, and the bar frame in particular. Mr. Woodbury was the first adapter and promulgator of bar frames and bar frame hives in England; hence the hive bears his name. I am glad to give information at any time, but think it unfair to other inquirers and subscribers to occupy space on a subject which may be found so well treated of elsewhere at so trifling a cost. If "H. A. D." will advertise his address, I will send him a bar frame as a pattern if he will pay the postage.—C. N. ABBOTT.

[11543.]—**Amateur Observatories.**—See Wm. Brown's letter on "Solar Phenomena."

[11545.]—**Sulphur.**—This has been answered several times. Take a pitch kettle and fill it about one-third full of oil, and place upon a fire to boil. At first it will seethe and spit, afterwards becoming calm and the surface beginning to smoke. The temperature will be then between 500° and 600°. Then put sulphur in in proportion of 1oz. to every lb. of oil, and stir. It will become mixed, and when cold have the appearance and consistency of Stockholm tar.—JACK OF ALL TRADES.

[11548.]—**Bending Amber.**—Drop it into some hot beeswax; after it has remained there a few minutes take it out and before the fire bend it to any shape.—JACK OF ALL TRADES.

[11549.]—**Water Floats.**—Floats are scarcely ever used now for boilers using so high a pressure as "Young Fireman" mentions, because the stuffing-box is a fruitful cause of mischief, from corrosion. Wherever floats are used it will be necessary to raise the float up and let it fall at least twice a day to prevent corrosion. The water-gauge (glass) is so immensely superior that few modern boiler makers, having the interest of the buyer at heart, would supply a float, if offered his choice which he should supply. There is no doubt but that floats could be, and are, made to act perfectly, but at the cost of an immense amount of trouble. I would advise "Young Fireman" to get or ask his employers to get a glass water-gauge.—P. W. H. J.

[11549.]—**Water Floats.**—Don't use them, they are worthless and unreliable, give endless trouble, and never to be depended on. It is so difficult to get the packing around the wire the exact tightness —too loose, it "leaks;" and too tight, it "jams." Many a boiler has gone up like a balloon that was set with such a defective fitting, and the poor unlucky "stoker" has, in many cases, had all the blame cast on his head when he little deserved it.—TUBAL-KAIN.

[11549.]—**Water Floats.**—Yes, they are of use if made to act upon a valve in feed pipe, but are a nuisance through the boiler, by reason of the wire and gland.—JACK OF ALL TRADES.

[11550.] — **Preserving Eggs.** — "Young Nest Hunter" had better leave the poor birds alone, unless he has the definite object in view of benefiting some public museum or assisting the cause of natural history. Being "wishful to form a collection" seems to point too sadly to decreasing the number of specimens in this country of the more rare birds—such as kingfishers, green woodpeckers, &c.—as one can scarcely fancy even a youth collecting linnets' eggs. Pierce and blow the eggs; the "white skin" cannot and need not be removed. White hard spirit varnish, where there is reason to believe colours will fade, will have a retarding effect.—JANNIFRED.

[11551.]—**Cement.**—After the meerschaum is manufactured there is nothing will cement it to make a job of it.—JACK OF ALL TRADES.

[11551.]—**Cement.**—I have heard that a cement for meerschaum pipes can be made with quicklime and white of egg, but I think if it had proved satisfactory it would be more frequently used.—SAUL RYMEA.

[11552.]—**Meerschaum.**—The safest way to test a pipe is to try if it will float lightly in water, as I have never seen any composition which could be mistaken for meerschaum which would do so.—A., Liverpool.

[11553.]—**Agriculture.**—The best book for "Agricola" is undoubtedly "Evans on the Chemistry and Machinery of the Agriculture of the Present Day." In attending to its simple rules I have been very successful in hops, oats, &c.—CINCINNATUS.

[11557.] — **Treasury of Botany.** — The latest edition of this book was published in 1865. Cloth, 8vo. Its price is 7s. 6d.—ANON.

[11558.]—**Refuse Paint.**—Make it hot with a small portion of linseed oil, and rub through some gauze wire with turps. It is coarse, but good for outdoor work.—JACK OF ALL TRADES.

[11558.]—**Refuse Paint.**—See reply, p. 623, Vol. XIII., Sept. 8th, 1871, by "Os." If correspondents would search back vols. before sending queries, it would save much time and trouble. By-the-bye, what has become of "Os" and "Eos." I hope they will soon re-appear after this protracted silence.—H. B. E.

[11558.] — **Refuse Paint.** — Dissolve sal. soda, ½lb. in rain water, 1 gallon; cover the refuse paint with sal. soda water for two days, then heat it, adding oil to reduce it to a proper consistence for painting and straining.—INQUISITIVE.

[11560.]—**Gold Polishing on Stone, &c.**—This requires putting on in a peculiar manner, and I believe the ground is laid in with Armenian bole; it can then be polished with an agate burnisher.—JACK OF ALL TRADES.

[11563.]—**Moon.**—The moon influences our distance from the sun in two ways. 1. It causes us to be nearer to the sun at the time of full moon than at new moon, and *vice versâ*. This is because the common centre of gravity of the earth and moon describes an exact ellipse round the sun; if we leave out the small difference made by the perturbation caused by the other members of the solar system. This being the case, and the earth revolving round this common centre of gravity, M. Paris will see that the earth is alternately within and without the said orbit, being without it at time of new moon, and within at the full moon. 2. The presence of the moon causes our mean distance from the sun to be greater than it otherwise would be, for the distance is altered in inverse proportion to the joint square root of the mass of the sun and earth and moon; the moon being left out the joint mass would be diminished by the twenty-five millionth part, and we should revolve in an orbit further from the sun by nearly two miles, a difference which, of course, would be wholly imperceptible; the distances of the other planets too would be influenced in a like proportion.—G. F. H.

[11566.]—**Equisetum.**—I have seen the movement of the pollen myself, and would send M. Paris a specimen if I knew his address.—M. D.

[11567.]—**Rigging Model Yacht.**—Fasten mainsail to mast with fifteen brass rings, and foresail to mast with thirteen ditto; these should not be too large for the respective masts, but just large enough to travel easily at the mast near deck, they will then be quite slack at top, or bounds of masts, when sail is set up to place. The neatest and best way to secure shrouds to the hull of model is, use the brass screw eyes, small size, used or sold to hang up small pictures, these have a very good screw cut on them, and if screwed to margin of deck as proposed in my article on "Model

Yacht Rigging" in a former volume, will be out of harms way, then pass end of shroud through the eye and draw tight, and take two half hitches and cut off ends, allowing a little surplus end for convenience. A good way to prevent ends of shrouds fraying out, is to tip each end with a little hot pitch or sealing-wax.—W. F. W.

[11568.]—**Turbine.**—Better go to a maker and give him the fall you can obtain for your water, and the quantity in a given time.—TUBAL-KAIN.

[11570.]—**Furniture Polish.**—My answer to qy. 10585 was not a furniture polish, but a French polish reviver. The French polish sweats and the surface becomes rough, and the sharpness of the acid is to take it off, and if it will not remove it take some very fine brickdust on your cloth and rub well without scratching. The quantity of oil is about one tablespoonful to a pint, well shaken, which gives it a creamy appearance. Finish off with a clean cloth, and see that you leave no oil on the face.—M. O.

[11572.]—**Compressing Water.**—I consider this question to be one of great importance. Water has always, in my experience at least, been considered to be practically incompressible. Unless further particulars are given of this case, I should say that the extra gallon or so pumped in goes to waste by leakage.—C. S.

[11572.]—**Compressing Water.**—Water is certainly compressible. There is an instrument called the piezometer for measuring the compressibility of water, and by its use it has been found that at a pressure equal to that of the atmosphere water is compressed ·00005 of its original bulk. This, it will be observed, is a very small amount; but it shows an appreciable degree of compression, and probably the enormous pressure in an hydraulic press would compress water to the extent indicated by the gallon pumped in after the press is up.—SAUL RYMEA.

[11572.]—**Compressing Water.**—No doubt but that the water with the pressure exerted was slightly compressed. The remainder was that of the elasticity of the cylinder, the four side bars and nuts, and the two large blocks spoken of. Always remember "Smeaton's" rule; Nothing is elastic, and (so to say) nothing is non-elastic, but every substance has more or less of elasticity.—TUBAL-KAIN.

[11572.]—**Compressing Water.**—Water is incompressible in itself, but consisting of an infinite number of globules, the spaces between these are occupied by air, and it is this air which is compressed, and allows of some more water being forced in after the cylinder is apparently full. Is J. Westwood aware that if a ball of gold be made with a small hole in the centre, fill the ball with water, screw a plug and hard solder it, then place under a hydraulic press, that the water will be forced out like high pressure steam through the pores of the gold ?—A., Liverpool.

[11574.]—**Gas.**—Try one of Carnaby's patent regulators.—H. B. E.

[11574.]—**Gas.**—Let "H. J. W." turn down his main cock a little more, and use Bray's patent burners, and turn off the gas from the servants' rooms himself every night, and then report progress.—L.

[11575.]—**Well Sinking.**—You had better have the well sunk of the usual diameter about 4ft., and brick it up to any diameter, and fill in round it. It would be difficult to bore larger than about 4in., and even then you must go down to the rock, as it is called, by well borers. Water will not always rise to the top of the earth; it depends upon where it is supplied from.—M. O.

[11582.]—**Spiral Turning.**—See p. 557, Vol. XIV., February 16, 1872, with drawing.—M. O.

[11583.]—**Vacuum in Barometer Tube.**—"Never Rust" had better take the tube out of his barometer, then empty the quicksilver of the bottom short tube; place thumb of right hand over the open end tightly, and turn the tube bottom upwards; now lay baize or cloth doubled several times upon counter or table, and keeping end covered, commence jarring the tube upon this pad till he sees the air bubbles have all risen to the surface of quicksilver. Let the jarring be performed in quick succession. All that is required is a quick light hand; well warming the whole tube (especially the bulb) before a good fire facilitates the operation; patience and the above must succeed. Having got out all bubbles, refill as before by pouring silver in tube, and repeat the inverting and jarring process; or if he thinks the quicksilver is dirty, see Vol. VIII., p. 566, for recipe to clean quicksilver. Having cleaned it, refill tube in usual way. To adjust weights, let the one which rest upon silver be heaviest, the whole five in frame.—A HOROLOGICAL MECHANIC.

[11584.]—**Cleaning Cornopean.**—Mix a little vitriol with warm water, and run through the instrument; it will clear all dirt out.—J. P.

[11584.]—**Cleaning Cornopean.** — Let "Wee Pet" fill his slides with water and clean by means of a small bottle-brush. Then put in the slides and pour warm water into the bell, and gradually turn the instrument, so that the water may run through the tubes and out at the mouthpiece. The little water remaining may be blown out at the valves and water-key.—C. T. B.

[11584.]—**Cleaning Cornopean.**—I don't think it requires if the inside of the tubing of a cornopean is furred or dirty. I keep mine in a very good state by running through it every month a mixture of half vinegar, half water, working the valves well at the same time. You may put it by for months after this, and the valves will not stick.—J. G. S.

[11589.]—**Dry Steam.**—The higher the pressure of steam the less the quantity of water contained in any given quantity of it. Steam from a tea kettle, evaporating at 212°, will burn you severely, while you may place your hand in high pressure steam with impunity. You cannot see steam until it condenses on exposure to the cold air, consequently when at high pressure there is very little water to be condensed, although there may be great heat to fly away.—A., Liverpool.

[11592.]—**Medical.** — The ammonia citrate, or potassic tartrate of iron.—M. D.

[11593.]—**Lime Juice and Glycerine.**—The article sold under this title is simply a calcareous soap, which "Duffer" may imitate thus :—Take an ordinary wine bottle and fill it to the depth of three inches with good olive oil, or olive and castor oils mixed, add 2in. in depth of fresh lime water, half an inch of glycerine, and ten drops each of essence of bergamot and essence of lemon, or any other scent which he may prefer. Shake it well and keep it in a moderately warm place, or the ingredients will soon separate. This preparation was originally introduced from America under the name of "Lime Julep," which is what it really is. The ingeniously misleading name of "Lime Juice and Glycerine" was a happy thought of some sharp perfumer. It is very palatable (without the castor oil), and with the addition of one-fourth part of vinegar makes a capital salad dressing.—J. L.

[11593.]—**Lime Juice and Glycerine** (so called).—Take of almond oil 4lb., lime water 4½lb., oil of lemon 1oz. Weigh the almond oil into a dry bottle, add the lime water in quantities of about 5oz. or 6oz. at a time, with agitation, lastly, add the oil of lemons.—A. P. S.

[11598.]—**Long and Short Rifles.**—The data given are not sufficient, the bore of rifle, weight of powder and bullet, also the initial velocity must all be taken into account.—A BARRISTER.

[11598.]—**Long and Short Rifles.**—What reason has A. G. Miller for wishing to reduce the length of the barrel of his rifle? It would not shoot so well if cut down to 26in. As a rule, the shorter the barrel, the quicker should be the twist of the rifling, for example, the long Snider has one turn in 6ft. 6in., whereas the artillery carbine, carrying the same ammunition, has one turn in 4ft. If A. G. Miller will say what description of rifle he has, and the distance between the fore and hind sights, I will try to assist him with respect to the sighting.—ARTILLERY CAPTAIN.

[11604.]—**A Task for Chemists.**—EXTRACTING RESINOUS AND SILICIOUS MATTER FROM WOOD.—If Geo. E. Davis will cut his wood into chips about 1½in. or 2in. long, ¼in. thick, put them into a solution of caustic soda and water—about 1lb. soda to 25lb. water. A heat to indicate 380° Fahr. must be given and maintained for an hour and a half or more; then he will find his wood as soft almost as wool, with all the resinous and silicious matter quite dissolved out. 380° heat means about 181lb. pressure per square inch, which is the great objection to the present system of boiling wood for the purposes of paper making, and so far as I know there is no other system that answers. I have seen wood shavings boiled for 86 hours under a pressure of 50lb. per inch with the caustic liquor at 16° Tw.: the only change visible when taken out was their colour being redder, otherwise they were as tough as ever. A certain amount of heat is wanted to dissolve the resinous substances, and with the chemicals at present in use the requisite amount of heat can't be got without pressure of from 180° to 200° per inch.—DEVONSHIRE.

[11607.]—**Ebonising Wood.**—The wrinkle in this case is to use blue polish. Stain work as before, adding powdered nut gall to the logwood and copperas solution, dry, rub down well, oil, then use French polish made tolerably dark with indigo or finely powdered stone blue. N. B.—This is a trade secret worth a little fortune to the querist. As some acknowledgment, I would respectfully suggest that "W. C. W." forthwith obtains at least one dozen new subscribers to "ours."—WILLIAM GLAZIER.

[11608.]—**Boiling by Steam.** — In reply to "A. W. B.," have an outside casing on your boiler or vessel, with inlet and blow-off cock, this latter cock to be regulated to take away condensed water only. The steam will surround the vessel, and is used instead of a coiled pipe inside.—DEVONSHIRE.

[11610.]—**Defective Coil.**—The fault is in the coil, not the battery. In all probability the secondary wire is broken, and the two ends only slightly touch; it is also most likely that this occurs at one of the points of attachment to binding screws or connections, and that the vibration of the contact breaker jars the wire away. This is assuming that I understand "G. F. L." correctly, and that the contact breaker works properly, but the shock is unreliable and unsteady. The truth would easily be discovered by using a galvanometer in the circuit.—SIGMA.

[11612.]—**Injury to Vacuum Tubes.**—Paste a minute circle of tinfoil over the broken end of platinum, pressing well down to insure contact; place over this any small bell of metal that has a loop attached, a brass button with the top cut out, and the lips neatly turned back, for instance; fill the top of the bell with tinfoil, and fasten it to the glass tube with coaguline—viz., isinglass dissolved in acetic acid. At many of the opticians you may buy little bells, made on purpose, price 2d. each, but the toy bells children hang round a kitten's neck, or a good brass button, answer every purpose. I find it a good plan to put them on my tubes directly I get them, and before the platinum loop is broken.—PRIAM.

[11617.]—**Numismatical.**—1. Obverse, arms of Coventry,"Coventry Halfpenny." Reverse, Lady Godiva on horseback, "Pro Bono Publico, 1792." Edge, "Payable at the Warehouse of Robert Reynolds & Co." Some of this date are "Payable at Nuneaton, Bedworth, and Hinkley," towns in the locality. It is an ordinary halfpenny token issued by the above-named at the time (1792), and is one of the commonest of the immense issue of tokens at that period; of no value except it is a fine cabinet specimen. 2. Is a copper penny token issued by the Cornish Mines Company, and is described in my work on the British and Colonial copper currency; it is very common. The first is between blocks of lead and tin. 3. Is a weight for a gold coin value 10s. of the reign of Charles I., and is worth about 6d.—D. T. BATTY.

[11618.]—**Deadening Sound.**—If the partition is but a single board, the best way will be to make it double by affixing studs upon one side—*i. e.*, pieces of deal about 2in. × 3in. as long as from ceiling to floor, 15in. or 18in. apart, and board it upon the studs, have the boards tongued, and fill up all the spaces solid with sawdust.—HELPMATE.

[11619.]—**Electrical.**—I have no doubt the Leyden jar alluded to by "F. T. Z." is made of glass containing lead. The thin German phials make the best Leyden jars, and the whiter and clearer the glass, the better the insulation usually.—PRIAM.

[11621.]—**Killing Roots of Trees.**—I think if "A Gardener" bores a large hole and fills it with sulphate of iron (common green vitriol), he will soon kill the root, and at the same time stain the wood of a very nice gray colour.—A BARRISTER.

[11622.]—**Colouring Walls.**—The best liquid to be used with distemper colours is skim milk; this will give a surface almost equal to paint.—A BARRISTER.

[11624.]—**Photography.**—Rain-water will answer all photographic purposes if prepared thus: Collect in a clean tin vessel, and boil and filter it; if for a nitrate bath put a crystal of nitrate of silver in it, and expose to the sun for a day; shake it then and filter any chloride of silver which may have formed. What is sold as pure distilled water often spoils solutions; if your nitrate bath does not act well with this add excess of washed black oxide of silver and sun it, then filter and add dilute nitric acid till there is the faintest reaction to litmus.—M. A. B.

[11631.]—**Income Tax.**—A "Maiden Lady" should apply to the assessor of her parish, or the surveyor of takes for the district in which she resides, and obtain some claims of exemption (No. 40) and fill them up according to the printed directions contained in them and then send them to the tax surveyor, and in due course she will receive a letter from the Special Commissioners of Income Tax, authorising repayment of the tax deducted from her dividends, either at Somerset House, if in London, or at the nearest stamp office if in the country. "Helpless" can fill up the forms for her, but they must be signed by the claimant herself. Should it be inconvenient for her to make a personal application for the money she can authorise any one to receive it for her, by filling up and signing a form on the back of the repayment letter. Repayment is limited to three years preceding the 5th April in the year in which the claims are made. A separate form, No. 40, must be made for each year claimed for.—TAX SURVEYOR.

[11633.]—**Fever Tree.**—The scientific name of this tree is Eucalyptus Globulus, or blue gum tree, a native of Australia, but cultivated in Corsica and South Europe. A tincture of the leaf, in two drachm doses, is used in intermittent fever; it has also stimulant, tonic, expectorant, and antiseptic properties. I will refer "Quinquina" to Savory and Moore for all the preparations of the drug. Not adopted in the Pharmacopœa.—OPALINE.

[11638.]—**Silkworm Disease.**—The "credible cause" of the silkworm disease will be found on p. 9, Vol. XII. ENGLISH MECHANIC, forming a portion of Professor Huxley's address to the B. A.; see also a paper by Dr. Bastian in a recent number of the *British Medical Journal*.—SAUL RYMEA.

[11639.]—**The Rock Inscriptions.**—The neglect of which "H. E. H." speaks, is quite as great a mystery to me as to him. Ever since hearing of them, at the time of Forster's book and the Crimean war, I have thought them obviously the most important antiquities to be examined or preserved on earth. As far as I can make out, the sudden collapse of all interest in them ensued on Dean Stanley's very singular remarks in the volume I referred to. He had galloped through the country in a few days, happened to pass very few of the inscriptions (which are scattered over a country as large as Yorkshire), and set down that their number and importance "had been greatly exaggerated," and so the whole matter seems, for this age, to have ended, perhaps luckily or providentially; for after the miserable "Moabite stone" and similar catastrophes, we may well pray Heaven to keep any such things from nineteenth century discovery.—E. L. G.

[11646.]—**Electric Spark.**—The simplest way to get a spark would be to have a small induction coil giving such a spark as desired, and to use a bichromate cell with it, mounting the zinc on a spring, to be depressed, as required, by a revolving cam mounted on the shaft at disposal, the ordinary break of the being screwed down, as the depression of the zinc into the liquid would produce one spark. Another plan, not so reliable, would be to rig a glass plate with rubbers, &c., on the shaft, in fact, to make it work an ordinary electric machine, and connect to a small Leyden jar, arranged to discharge at ½in., the first would be the simplest plan, and a coil and cell for the purpose could be had for £3. Cost of working would be trifling, and it would be in order for years if taken care of.—SIGMA.

[11647.]—**Cabbage Plants.** — "Anon." cannot prevent cabbage plants from running to seed, when once started, save by "heroic" measures—viz., cutting off the tops and leaving the stumps to sprout, or pulling them up altogether. His soil is too poor; but if all the plants have not started for seed he might find a dusting of bone-dust and superphosphate assist in saving some of them. Cabbages require manure—mineral manure in "Anon's." case very likely.—SAUL RYMEA.

[11648.]—**Bee Management.**—If "Apis" will carry out the following directions, driving bees will give him no trouble, and one trial will suffice to show him this. Blow two or three puffs of smoke into the hive to be driven to send the bees up into the combs. Invert the hive on a bucket and place an empty hive (of the same size) on it, making the junction secure by winding some calico round it and fastening this cloth with string. Then drum the sides of the lower hive with the hands or two sticks. The bees will soon run up, and in five to ten minutes he will have a good swarm taken off, but he must be careful to leave enough bees to cover the combs. The hives must be separated and put in their places at once, or the bees would soon descend to their old home. Wearing a veil is quite optional, and stupefying material worse than useless. Large hives do not show signs of swarming so much as small ones.—E. D.

[11655.]—**Making Gold and Silver Leaf Adhere to Fabric.**—I was told by a manufacturer that glaire of egg is used with gold or silver leaf on smooth silk or satin fabrics, but that a mixture of powdered resin and dextrine is employed for velvets or any rough surface.—A BARRISTER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Thetamn" has answered 9440; "Journeyman Painter," 11045; "Auld Reekie," 11083.

11195 M'Carter's Improvements in Condensation, p. 676
11198 Drowning, 676
11199 Blowing Engines, 676
11203 Barometer, 676
11204 Turning Ivory Frames, 676
11205 Five Pound Telescope, 676
11207 Siphon Bottle Caps, 676
11209 Making Gold Malleable, 676
11211 Piano Keys, 676
11212 Tanning Nuts, 676
11214 Import Duties on Books, 676
11222 Aphengescope, 676
11228 Vulcanite, 676
11230 Dyeing Vulcanite Black, 676
11234 Pianoforte.—To the "Harmonious Blacksmith," 676
11238 Sugar Test for Impure Water, 676
11241 Hot-air Apparatus, 676
11253 New Mechanical Agent, p. 677
11254 Diaphanie, 677
11257 Watchmaking, 677
11264 Judging Distance, 677
11267 Waterproofing Cloth, 677
11268 Tempering Knives and Trowels, 677
11270 Friction, 677
11272 Diastase, 677

QUERIES.

[11663.]—**Steam Power.**—Will some correspondent kindly inform me if I shall obtain enough steam to drive two 1in. bore and 2in. stroke cylinders, from a vertical boiler 13in. high, 6in. in diameter with inclosed firebox, 4in. in diameter at top, and 5in. at bottom? Also what weight must the fly-wheel be, so as to make 200 revolutions per minute? The exhaust is conducted to the chimney, which is 1in. in diameter, and the fuel burnt is charcoal.—T. W. J. M.

[11664.]—**Polishing Bullock's Horns.**—How can I polish a pair of bullock's horns?—W. POWER.

[11665.]—**Ink.**—Will any of your numerous readers be so kind as to give me the recipe for making brown ink, used in perspective drawings?—R. F.

[11666.] — **Qualitative Analysis.** — Would Mr. Davis or any of our chemical friends kindly inform me of a simple method for detecting the impurities in water?—GRATUS.

[11667.]—**Carbon Points.**—I am desirous to know what these are. How are they produced, and where, and are they expensive? Will "Jack of All Trades," "Tubal-Kain," or any other kind correspondent give me this information?—H. S. C.

[11668.] — **Astronomical.** — The appendix to White's "Ephemeris," for 1835, contains a valuable table to abridge the computation of the longitude and latitude, the right ascension and declination being given, or the contrary. This table has been computed by J. C. Buckhardt to the obliquity 23° 27′ 50″. Will some one of our able astronomical correspondents, who may possess a copy, kindly show how to make the necessary correction for the present obliquity, so that in practice this table may continue to be used without sensible error? Also, I should be glad to know how to find the latitude when the "diff." is nil; *i.e.*, between Arg. + 0·30 and 0·51, or between + 2·00 and 10·00.—ASTRÆA.

[11669.]—**Trunk Engine.**—Will any of our readers kindly inform me if a trunk engine with 2 cylinders, 1½in. bore and 1in. stroke, would drive a 8ft. boat, with 6in. paddles? Also, would they give a drawing of a cheap pump for the same?—A. PEDD.

[11670.]—**Electrical.**—1. W. H. Coffin, in answer 10447, gives, on Mr. Highton's authority, the details of a battery. Can any reader speak from experience as to the merits of the arrangement? And particularly I wish to know the proportions of nitre and mercury used to amalgamate fused zinc. 2. Can any reader give me an opinion about M. Bouman's Leclanché, mentioned in No. 357, p. 479? Will Mr. Tonkes say whether felt can take the place of a porous pot? 3. What is the best work on electro-metallurgy, at a reasonable price? 4. Where can I get the "needled manganese" used by Leclanché?—M. D.

[11671.]—**Spectrum Analysis.**—Will some one kindly tell me whether it is possible to conduct any sort of spectrum analysis with a very small pocket spectroscope? And also what is the best work on the subject?—R. M. F.

[11672.]—**Birth and Death Rates.**—Might I ask some of "our" mathematical readers to help me to solve the following problem? Given the following:—What will be the yearly death rates per 1,000 living in A and B each year for 20 years? Also what will be the population of A, and what that of B at the end of 20 years? A is a town of 100,000 inhabitants; B is a town of 100,000 inhabitants. The numbers in each town of the same age are the same. The birth rate in A is 40 per 1,000 per annum; in B it is 30 per 1,000 per annum. The death rate to be taken is 183 in 1,000 in the first year of life; 18 in the fifth; 6 in the tenth; 5 in the sixteenth; 8 in the twenty-first; 13 in the forty-first; 33 in the sixty-first; 70 in the seventy-first; 153 in the eighty-first; and 307 in the ninety-first year of life.—P. Q. P. V.

[11673.]—**Hydraulic Rams.**—What modifications are made in the ram when intended to lift water to a great height? What is the practical limit to the height to which the water can be raised by a ram with a given fall? What is the modulus of the ram or the proportion of the power utilised by it?—PHILANTHROPIST.

[11674.] — **Stretched Indiarubber.** — How much power in units of work may be accumulated by stretching an indiarubber band or rope round a drum? And would this be any use as a motive power for amateurs, or for propelling ferry boats?—PHILANTHROPIST.

[11675.]—**Solder for Britannia Metal.**—Will any of "our" kind readers tell me what kind of solder is used for Britannia metal, and how to use it, and the proper flux to use in soft soldering copper?—LEARNER.

[11676.]—**Lemonade Syrup.**—Can any reader tell me how to make lemonade syrup for aërated drinks?—LEMONADE.

[11677.]—**Rendering Wood Incombustible.**—Is there any easy and cheap way of making deal boards wholly or partially incombustible? Is there any cheap material for roofing, incombustible? I wish to erect a summerhouse, or small cottage of two rooms, in a garden that I rent. Boards would be the most convenient material for my use, because they could be easily removed at the expiration of my tenancy. I am told that, if I paint all the boards that I use for walls, &c., with white lead, or some similar paint, on both sides, and use some sort (query, what sort) of felt for the roof, then my building would be as safe from fire as most houses are. Is the advice given me correct, or can I adopt any better plan?—CLERK.

[11678.]—**Photographic.** — As the photographic season for amateurs is coming on, it will be a great boon if you can give some more useful hints, more particularly about the new dry plan of coating the plate with a collodion prepared with silver. If any of your numerous scientific correspondents have tried the process, and been successful, a hint from such would be gladly received by a gormandiser of the ENGLISH MECHANIC.—A. CHALMERS.

[11679.]—**Fork and Wedge Valve Motion.**—Having just noticed in your last issue a reply (10883, p. 100) from one of your correspondents referring your readers to the fork and wedge valve motion fitted to one of Stephenson and Co.'s engines in 1844, I wish to ask your correspondent or any of your numerous readers if they could tell me to whom the honour of that invention is due. One would naturally suppose from reading "C. E. S.'s" letter that the invention is due to Stephenson, which, Mr. Editor, I very much doubt; in fact, I believe that Stephenson in this manner gets praise for a good many inventions that he is not at all entitled to.—ONE IN SEARCH OF THE TRUTH.

[11680.]—**Mildew in Boat Sails.**—Will any one give a recipe for curing the above? What do they use in bleaching factories for the purpose? Would carbolic acid have effect?—KIRKWAY.

[11681.]—**Water Glass.**—How would this do for the purpose of painting the bottoms of boots used in salt water?—KIRKWAY.

[11682.]—**Wheatstone's Bridge.**—I have a small Wheatstone's bridge for ascertaining the resistance in wire. The screw for tightening the gland on the main spindle is made of copper. Now, I am of opinion that this tends to lower the resisting medium below what it ought to be, and below what it would be if the screw were made of some neutral metal, such as iron or nickel, so I cannot depend on my results. I should like Mr. Tonkes to inform me whether I am right; and if so, what metal I had better use for the screw.—ANON.

[11683.] — **Height of Sea Waves.** — Would "F.R.A.S." or Mr. Proctor kindly solve, if possible, the following? Is there any recognised method of telling, in the case of sea waves, suppose a wave be 20ft. from trough to summit, how much of that height is above the level of the ocean when perfectly quiescent? and if there is no fixed rule bearing upon the subject, would they kindly offer their opinions?—A., Liverpool.

[11684.]—**Pressure on Cork of Bottle.**—Given, an ordinary bottle of soda-water, which is filled to within 2½in. of the cork: Is there more pressure on the cork when the bottle is standing cork downwards or upside down and the air space right above the liquor than when it is lying on its side?—SODA-WATER.

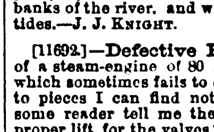
[11685.]—**Canary's Song.**—I have a mottled canary, which commenced its second moulting last August, which was over apparently about Christmas, but up to the present time it has not sung at all. It is very lively, and apparently in good health. I have repeatedly changed its food, and occasionally hung it out in the open air within hearing of another bird, a good songster, but it only chirrups a few times. It has not, to my knowledge, received any fright or injury. Can any fellow reader inform me of any means of getting it to sing again, as last year it sung very well?—EXON.

[11686.]—**Cement for Fixing Glass Letters.**—Does any reader know of any recipe for fixing glass letters on glass? Colour of the cement no object, only it must resist wet.—HOWE.

[11687.]—**Speeding Machinery.**—Will any of our numerous readers kindly inform me what is the most simple and certain mode of obtaining the correct diameters of pulleys, or wheels to increase or diminish the speed of a machine? I find the rules laid down in most scientific works are so complicated that I cannot use them. I will give a case in point. Suppose my driving shaft runs 60 revolutions per minute, and I want to drive a machine (say) 135 revolutions per minute, what size wheels and the number of teeth in ditto, or pulleys, would be required to obtain that speed?—A READER.

[11688.] — **Cleaning White Sheepskins.** — Can any of your subscribers inform me of the best way of cleaning a white sheepskin hearth-rug at home? Professional cleaners charge very high, about half as much as the rug cost at first.—A HOUSEKEEPER.

[11689.]—**Reel for Rotary Sewing Machine.**—Allow me to ask for instructions how to make a reel for a rotary shuttle sewing-machine (the shuttle of which I send you a sketch), also a winder for the same? I have a machine of this class, minus shuttle reels and winder. I can make them if I see a sketch, however rough. The machine is made by Drake, of Huddersfield.—Z. A.



[11690.] — **Anchovy and Bloater Paste.**—Will some kind subscriber inform me the way that those are made, not in very large quantities?—HENRY FRANKLIN.

[11691.]—**Tidal Mill.**—Would any reader oblige me by giving a description of the best form of tidal mill, for pumping water or driving machinery? I am on the banks of the river, and want to utilise the force of the tides.—J. J. KNIGHT.

[11692.]—**Defective Feed Pump.**—I have charge of a steam-engine of 80 horse-power, the feed pump of which sometimes fails to do its work, and when I take it to pieces I can find nothing under the valves. Will some reader tell me the cause of its failing, and the proper lift for the valves? The plunger of the pump is 5in. diameter, and the stroke 16in.—AN ENGINE DRIVER.

[11693.]—**Ice Chest and Refrigerator.**—Will any one who has constructed or purchased a good ice chest, to economise from 5lb. to 10lb. of ice per day, give a description of it? I want it to cool (say) 3 or 4 sodas, 1 or 2 quart bottles, and a plate of butter at the same time. Also that I may be able to chip off a lump of ice if required, and that the ice as it melts may trickle into a cistern, from which I can draw off a tumbler of cold water. And all this with as little loss as possible. I hate those which require the ice to be wrapped up in rotten blankets. Kindly state expense.—M. A. B.

[11694.] — **Green Fly.** — Can any of "our" correspondents inform me of the most effective way of killing the green fly which is beginning to cause great damage amongst my plants. My conservatory is too large and lofty to admit of their destruction by burning tobacco. I have tried syringing with soapsuds but without any effect. An army of spiders, large and small, of every shape and description, has made its appearance within the last few days. How can I destroy them? Any information will oblige.—H. T. C.

[11695.]—**Succession Duty.** — Would any correspondent favour me with information on the following, or refer me to a work on the subject? I have succeeded to some property left by will from my father. It consists of two leasehold houses, worth £1,100, producing £90 per annum. What I wish to know is how the duty is calculated, whether charged on the £1,100 or as an annuity, and how much it would come to. I am told I have to pay 1 per cent., but on what?—C. P.

[11696.]—**Decaying Ivory Carving.**—Some time ago I brought some ivory carving home from China. It is now turning black, and seems to be rotting away. Will some brother reader tell me if I can bleach it or stop the decay?—JOURNEYMAN PAINTER.

[11697.]—**American Lathe Chucks.**—I have seen a chuck to take in drills up to ⅜in. It has got three grabs, which close equally to the centre by turning a collar. The drills for it are from ⅜in. downwards, with a groove straight along each side of the drills. The heads of them are flat, like a tap, for screwing. There is also screw drills for chucks. All above are American inventions, I believe. Can any reader say if these are to well, and are durable? also, if either of the above-shaped drills is adapted to bore into solid metal?—JOE.

[11698.]—**Improving Memory.**—Would one of your correspondents kindly state if there is any means of improving a rather dull memory?—GEORGE J. B. HAYTER.

[11699.]—**Organ Cleaning.**—Will any of our practical organ builders kindly say how much an organ of about 24 stops would cost for thoroughly cleaning, tuning, and re-wiring? Also, the extra charge for tuning from unequal to equal temperament?—A. B. L.

[11700.]—**Ginger-Beer Making.**—Will any reader give me a good recipe for the syrup used in ginger-beer making—that put in the bottles before pumping the gas and water into them?—HYDRAULICAN.

[11701.]—**To Mr. Knott.**—Has Mr. Knott obtained any measurement of the close companion of ζ Cancri during this season? and if so, would he kindly give it? I have seen it two or three times lately, and it seems very close. By estimation, its position angle is between 200 and 180.—C. GAUDIBERT.

[11702.]—**Curry and Rice.**—Will any old Indian of "ours" give, in detail, the process of how rice is boiled so as to fall into grains, not into a pasty mass? I have tried several times the recipe quoted at p. 107, No. 368, from the *Food Journal*, unsuccessfully. Would he also give the ingredients, specifying quantities (procurable here), to make a really good curry powder?—M. A. B.

[11703.]—**Ink.**—Will any of "ours" who has the recipe for a reliable ink powder, which he has proved, kindly give it? I have used many ink powders, but most are bad, and, as sold, of course, about 300 per cent. above actual cost. I want a powder mixed which will not decompose abroad, and which, by the addition of water, will make a good black ink. What quantity of sugar candy or lump sugar added to the pint will make it good for copying?—M. A. B.

[11704.]—**Rats.**—Can any of "ours" tell me what essential oil ratcatchers use to entice these vermin? They shun my trap, but I have heard oil of rhodium sprinkled on the floor is attractive. It is, however, very expensive—my druggist asks 8s. per fluid ounce. Is there any other, and is rhodium good?—M. A. B.

[11705.]—**Small Yachts.**—Can any one give me information regarding the construction of small yachts (about five tons), especially of iron? How are the ribs held in position during construction, and how counterstern stiffened? what distance apart are ribs, and thickness of iron?—L.

[11706.]—**Optician's Lacquer.**—Will any of "our" readers inform me of a good lacquer (one similar to that used by opticians), and how to use it?—J. W. CARD.

[11707.]—**Para.**—Would any subscribers having any practical experience of Para give some information about it? 1. What would be the cost of passage out? 2. The port to start from. 3. What to take in way of outfit. 4. The possibility of obtaining shelter and food, while looking round to see what one could do. 5. The smallest sum in way of an annuity on which one could rub along. 6. And would it not be possible to form a co-operative society, to colonise some portion of the banks of the Amazon, where land is a drug and very little labour required to make it very productive? I believe many industrious men would be happy to join in such a movement, if it could be started under safe principles.—A DRONE AGAINST MY WILL.

[11708.]—**Gas Burners.**—Will any subscriber inform me what amount of gas different sizes of ordinary burners will burn per hour?—LOACH.

[11709.]—**Smoking Cap.**—I have a smoking cap made of blue velvet, and braided with amber. By the action of perspiration, the blue and yellow have become changed into a shade of green. The braid has suffered the dyeing most. Can any reader of "our" MECHANIC advise me of the means of taking out the dye, and regaining the proper colours?—HECTOR.

[11710.]—**Cleaning Oil Painting.**—I have an old oil painting. Will some one instruct me how to clean it, so as to bring out the colours without injuring them?—E. PARKER.

[11711.]—**Time at Our Antipodes.**—Will any reader kindly explain to me whether the time at our antipodes is 12 hours earlier or 12 hours later than our own? because, although we well know there is a difference of 12 hours, it appears to me that it can be demonstrated with equal plausibility to be both. For example, supposing it to be Tuesday, 12 o'clock (noon), in London, it will be 6 o'clock Tuesday evening at Calcutta, 90° east, and, therefore, 12 o'clock Tuesday night, at a point close off New Zealand, 180° east—our antipodes. But, also on the other hand, if it be Tuesday midday here, it must be Tuesday, 6 o'clock a.m., at New Orleans, 90° west, and, therefore, just commencing Tuesday morning at the aforesaid point off New Zealand, 180° west—our antipodes. The argument appears equally conclusive either way, but the result somewhat perplexing, because at the same point, at the same moment, it can be proved to be both the close of Tuesday night and the commencement of Tuesday morning.—T. S.

[11712.]—**Barlow Lens.**—Will "F. R. A. S." oblige by giving the focal length of a double concave lens, which will about double the power of the eyepieces of a 6in. object glass (focal length, say, 15 diameters), and its proper distance from the eyepieces, which are of the positive form?—S. W. BURNHAM.

[11713.]—**Composition for Moulding.**—Will any brother reader help me out of a difficulty? I am in want of a composition similar to that used by gilders, colour no object, to be used by pressure of fingers only. It is required to dry hard but must be pliable, to mould before drying, and not to make moulds dirty used for moulding, as they are used for another purpose. An early reply will greatly oblige.—J. S.

[11714.]—**Test for Sugar.**—Will any of our esteemed chemical correspondents be kind enough to give me a reliable test for adulteration of sugar, whiteness being the object? The sugar we use is the best that can be procured, and sent to the drug grinders to be ground, and, when returned, is sometimes very good, and at others not so. When mixed with water (not dissolved) it has the appearance of being mixed with starch, and when dissolved in the mouth has a pasty feel, instead of dissolving quickly, and sometimes has a chalky appearance.—J. S.

[11715.]—**Testing Acetic Acid.**—Would Geo. Davis, S. Bottone, or some other talented chemical correspondent, kindly describe a simple and easy method of testing common commercial acetic acid for the presence of mineral acids and other impurities likely to occur? A simple test might be of great use to many persons for testing vinegar, as it is often mixed with sulphuric acid.—ACETICUM.

[11716.]—**α Draconis.**—Will "F. R. A. S.," or any astronomical subscriber, inform me if I am right in supposing that the once pole star, now known as the star "α Draconis," takes 600 years in performing its cycle or revolution?—J. X. T.

[11717.]—**Removing Gold from Plated Articles.**—Will some practical subscriber inform me of a simple way to remove gold from old work thickly plated? I have tried nitric acid and salt, but it destroys the brass plates before the gold is half removed, with an ebullition and dreadful fumes; also the battery process, but have failed. Can "Jack of All Trades" assist me, as I have a quantity to strip, and want to use the gold again?—ELECTRO.

[11718.]—**Cheap Water Filter.**—In yours of April 12, p. 87, you describe this as being made of galvanised iron, with zinc and lead trays, &c. Will not the zinc and lead render the water dangerous for drinking purposes?—A SUBSCRIBER.

[11719.]—**Gut Lines.**—Can any one inform me how to make transparent gut out of sheep's guts?—EDWARD JACKSON.

[11720.]—**Extracting Zinc from Plumber's Solder.**—What is the best way of extracting zinc from plumber's solder? and the best way of bending brass pipe, from ½in. to 1in., without bulging?—INQUISITIVE.

[11721.]—**Assayers' Duties.**—Will "Un Irlandais" kindly give me the information that he promised to do in No. 351, p. 335 on this subject, particularly that relating to copper, as I am in immediate want of the knowledge, which, would no doubt, be valuable to many others?—G. T. H.

[11722.]—**Eyebrows Falling Off.**—I should be grateful if any kind reader could inform me of something that would prevent my eyebrows and eyelashes rapidly falling off.—A SUB. FROM THE FIRST.

[11723.]—**Contact Breaker.**—I have recently made an electric bell, but am puzzled about the contact breaker. 1. A weak spring with a flat head acted on the hammer, which was placed about half way thereon, the head of the spring being brass and acting on flat brass. Result: The strokes were very slow but continuous. 2. The spring head was placed quarter distance on hammer and flat tables as before. Result: Quick loud strokes, but the action would stop itself and require an alteration in the pressure of the spring (which was adjusted by a screw); then commence and stop again. I now bent the spring head and found the result the same. Will electrical readers inform me what form is best for break of contact, whether a point, curved wire on flat surface, or two flat tables? I may remark that the tables were perfectly clean, and a strong battery was used; the magnets also were strong.—T. H. SOMERVILLE.

[11724.]—**Discharge of Water Over Weirs.**—May I beg some readers to inform me what book or table is the best to use for ascertaining the discharge of water over weirs? An answer to the following question, with a formula for producing the same, would also greatly oblige. The water from a reservoir is conveyed by a valve into a large stone basin. In the middle of one side of this basin there is placed a gauge or weir (being a strong iron plate), 4ft. in length. What quantity of water will discharge itself over this fall in twenty-four hours, supposing the depth of water flowing over the gauge to be 2¼in.?—B.

[11725.]—**Reversing Gear for Double-Action Oscillation Cylinders.**—I will be much obliged to any brother reader who will explain the reversing gear for two double-action cylinders for a model screw steamer. A drawing would oblige.—ERIN.

[11726.]—**Toughening Cast Metal.**—Can any of your numerous obliging readers say whether it is possible to toughen cast metal? and if so, how it is done?—W. G. L.

[11727.]—**Cork-Cutting Machine.**—A subscriber would feel obliged if any of your readers would have the goodness to give some information regarding the best cork-cutting machine, and price of same.—BALMARINO.

[11728.]—**Adjusting Balances and Mainsprings.**—Will "West Cornwall," or any other horological subscriber, kindly inform me how to adjust compensation balances, and also ordinary balances? also, are the bobs of an adjusting rod to be placed on a certain part of rod when adjusting a mainspring?—APPRENTICE.

[11729.]—**Teeth of Spur Wheels.**—Will some reader inform me the correct method of setting out the teeth of spur wheels with the true epicycloid curves? What I wish to know is how to get the proper curves and shape of teeth of wheels and pinions for any number of teeth and any pitch. Wheels of equal number of teeth, of course, would be alike in shape; and as the shape of the teeth of a wheel and pinion to work together would be different in shape, I should like to know the correct form of both of them (say, a spur wheel, 150 teeth, 1½in. pitch, and a pinion to work into the above with 12 teeth). Any information respecting the correct method of setting out the teeth of wheels would oblige.—A PATTERN MAKER.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£334	0	4
G. H. Howell, Framlingham	0	1	0
	334	1	4

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, April 23, and unacknowledged elsewhere:—

Miller.—Brightonian.—Horos.—J. D. H.—Musa.—W. Nicholson.—Comet.—Ignoramus.—G. Marshall.—James Rogers.—H. and Sons.—The Ross Union.—J. O. Frazer.—Wm. Brown.—E. Pigott.—G. R. Hallam.—Wm. Waghorn.—J. B. Winspear.—F. G.—H. Hicks.—G. P. Compton.—W. Hunton and Co.—Jos. Washurst.—Hy. Mercier.—Gay and Co.—Robert A. Whitelocke.—F. F. D.—C. Colman.—G. J. B. Hayter.—R. L. G.—A New Subscriber.—R. A. Proctor.—Bobo.—J. Round.—F. C. C.—The Harmonious Blacksmith.—M. A. B.—Dentiste.—One in a Fix.—Apprentice.—W. L.—W.—Camera.—H. G. Nash.—A Subscriber.—Touchweight.—Fred. Gibson.—Ralph Lowdon.—A Subscriber.—Thetamu.—Hedera.—W. N. Oswad.—A. Brothers.—Starley and Company.—E. G. Capon.—Webb and Son.—J. W. Matteson.—A. M. Festing.—W. H. Coffin.—J. H. Brabazon.—Rev. E. L. Berthon.—Philanthropist.—Sigma.—G. and Co.—W. H. M.—Archer.—Zeta.—Amateur.—J. J. Allingham.—Undergraduate.—John Negus.—Edward Sutton.—Elizabeth Davis.—Robert Campbell.—A. Monckton.—F. J. Gedden.—W. M.—E. F. C.—J. F. Stanistreet.—Disc.—H. P. H.—J. H.—Professional Adviser.—Guano.—Wood Sawyer.—G. H. Howell.—H. G. W.—W. Fox.—H. D. W.—Senicio.—Afloat.—H. O'B.—Goux.—J. Guthrie.—A. C. and D.—J. T. E.—P. H.—W. H.—Edgar Davis.—W. D.—Bed of Stone.—Champagne Charlie.—W. C. B.—Dane.—Harmonic Chord.—John Rae.—Rat-Tat.—Der-Sunthal.—J. B. P.—J. Barwick.—C. A. S.—J. L.—W. H. Cash.—W. H. Hughes.—Apiarian.—H. R.—Joe.—Mountaineer.—Ethyl.—A Subscriber.—A Mechanic's Wife.—H. B. J.—E. L. C.—A. P. Bower.—M. Paris.—P. H. Holland.—E. Sutten.—Grapeshot.—Philo.—Duet.—Digby.—A Young Beginner.—James Wilson.—F. R. S. A.—W. R. Birt.—J. B. Youngman.—No. 10.—Carboy.—Humphrey Clinker.—Paul Gregor.—Alpha.—J. Bolton.—Saul Rymea.—W. Tonkes.—Mineralogist.—A Three Years' Subscriber.—J. L. Foster.—Bookworm.—A Sufferer.—W. French.—F. B. A.—An English Engineer.—B. A.—An Emigrant.—Carambolo.—F. A. Edwards.—Excelsior.—Capt. Maxse, R. N.—G. S.—Civil Engineer.—W. A. N.—B. R. Mills.—Howard.—Smith, Starley and Co.—Sundial.

THE DECIMAL SYSTEM.—We must bring this discussion to a close, not because it is uninteresting or unimportant, or because the subject has been exhausted, but because "E. L. G." has imported an unusual and an unnecessary amount of personal feeling into it. "No 10," in a letter full of eloquence and sarcasm, has answered "E. L. G.'s" letters on the subject at great length, but he adds no new argument to the discussion, and his letter, if inserted, would in all probability provoke a similar rejoinder from "E. L. G." Mr. Bottone has also answered "E. L. G.," in an unusually long and unusually able letter, which we cannot insert for pretty much the same reason as that given for not inserting "No. 10's" letter. We have also a letter from "E. L. G" in answer to "Sigma's" last letter. "E. L. G.," as usual, is courageous and provocative. As "Sigma" is not one who will quietly take a blow without returning it, and as we have no room for highly-spiced controversies, however eloquent, we must serve "E. L. G.'s" letter in the same way as we have those from "No. 10," and Mr. Bottone.

H. O'BRIEN sends us her "personal thanks" for our article on the alcohol question, and asks whether "a kindred subject—that of women's suffrage—would find admittance in our pages, as it is fairly a public question." With every desire to gratify correspondents, and fair ones in particular, we cannot well open our pages to the discussion of women's rights, as it is, to all intents and purposes, a *political* question. If she will refer to our article on alcohol, she will see that we treated the question on its scientific side, and if our correspondent or any one else can show us that the "women's suffrage question" has also essentially a scientific side, we will let them discuss it. The editor, however, believes with Mrs. O'Brien, that now we have a rating suffrage, if a woman occupies a house and pays her rates and taxes, she ought to be entitled to vote for parliamentary as well as for parochial representation.

HENRY NEWMAN.—Space will be given you.

CHARLES FRANK.—We cannot report on the merits of the lamp. As you want it, you had better get it and try it, and then give us your experience of it.

"42 INCHES."—In asking such a question, the least you could do was to put your own name to it, so that the correspondents referred to might know with whom they had to do.

W. B. E., writing from Burslem, asks what has become of the scheme for founding an English mechanic colony. We cannot say, and the scheme is not sufficiently interesting to a vast majority of our readers, to be rediscussed in our columns.

AUTODIDACT.—Pray read the motto under "Letters to the Editor," and try and know something about the subject on which you write.

J. T. SPRAGUE says: "I am preparing papers on electro-metallurgy, but pressing business matters on hand take up most of my time and attention."

P. T. D.—Mr. Denning has not sent any chess problem yet.

Communications which can only appear as advertisements to hand from Gymnast, A Novice, J. S. (first query), F. A. R. (second query), Morning, A Young Henkeeper.

Exon.—Yes; 2½d.

C. J. K.—We could not promise till we saw it.

Linea.—Please send. The advertiser you mention is to be depended upon.

Neville.—The first question is one you should put to a patent agent, and *pay him* to make a search at the Patent Office in order to answer it. Your second appears to answer itself. The use of the instrument is indicated by its name.

Fantail.—For hints on the extermination of mischievous stray cats, see pp. 166, 191, 215, 266, 415, and 287, Vol. XIII.

R. T.—The discussion on the subject is now closed. If you wish to communicate privately with "Jack of All Trades" on the subject, you had better advertise your address.

Musa.—For information on whitening ivory, see p. 241, Vol. XIII., and previous vols.

R. J. H.—Advertise it; but if you wish to sell it do not ask a guinea an ounce for it.

Sulphur.—The writer who gave the information has been appealed to by other correspondents to explain the process. He has not done so, however, and we believe he was misinformed.

An Old Subscriber.—For recipe for making ice cream, see p. 98, No. 316, Vol. XIII.

Manchester.—For information on means of cure of squinting, see replies 11334, p. 49, No. 366.

G. F. Glasgow.—So many directions appear in back vols. for making chain belts, that we think we can hardly be expected to engrave a new form which you have devised—and find will not act.

S. M.—Sketching in oils appeared in Nos. 822, 322, 324, 325, 326, 327.

A Would-be Tinker.—We should think you might acquire a knowledge of the art of soldering by carefully perusing our back volumes, each of which contains a number of practical directions on the subject. At all events we know of no book that contains plainer or more trustworthy directions. Read up the information in our back volumes, and if you meet with any difficulty, send a query. You will get an answer.

X. N.—A similar query to yours forms the subject of a discussion in recent numbers. See pp. 596, 621, 644, Vol. XIV., and pp. 18, 74, 127, present volume.

W. H. Neal and W. G.—Many thanks. What can we do when dishonest advertisers adopt such tactics.

F. W. Robinson.—See pp. 461, 296, and 99, of Vol. XII., for information on diamonds, and their discovery in South Africa.

Proven.—Your letter on personalities would only add fuel to the fire.

J. Barwick.—Please not seal your communications on which halfpenny stamps are affixed.

E. F. Mitchell.—Consult back numbers for information on bicycle construction.

W. Quy.—Your answer to 11188 was not inserted, because it was wrong.

"A Thinker on Aeronauts."—Fantastical and foolish.

Beacon Lough.—Your long letter was prepared for the printer, and like several others of a similar length that week was pressed out. The controversy may now be considered at an end.

H. Wilson, Scraper, Hy. Axon, B. M., W. J. W., see "Hints to Correspondents," No. 4.

A Subscriber.—Your pet question about the revolution of the earth being caused by a gas exuding from it was discussed almost *ad nauseam* some months ago. It has cropped up in various forms, and always, we think, directly or indirectly from the same hand. There was never a particle of proof adduced to prove your theory.

Philo sends an answer to the charge of "Khoda Bux." He says: "If 'Khoda Bux' will refer back to my letters he will find that I have been the attacked and not the attacking party. I never, as some of your correspondents do, call those from whom I differ ignorant, or accuse them of misrepresenting, and do not like to be classed with those who are foolish enough to do so."

A. M. Festino.—See our note on the Decimal System. The discussion for the present, at all events, must be closed. We should, however, be glad to hear from you on other matters.

Ralph Lowdon.—If commenced at all, the discussion would assuredly take a theological turn, which we must try to avoid.

John Jones.—A respectable firm, we believe. Your query was an advertisement.

C. S.—We never heard of a barber's hair *cutting* machine, and if we did your query could not have been inserted, as it was to know the seller of such machine and the price.

Stopping Pinholes in Lead Pipe.—A correspondent in an American journal writes:—"The supply water-pipe which extends from the street, along the top of our cellar to the sink in the kitchen, had a very small hole in one side, so that a stream of water spun out, not so large as a cambric needle. If I had known that the difficulty could have been remedied by placing the square end of a tenpenny nail on the hole and hitting it two or three light blows with a hammer, the knowledge would have saved me much trouble and expense. But I did not know that a small hole in a lead pipe can be stopped by battering the metal just enough to close the orifice, therefore I went and called a plumber. Of course he was employed by the day, and cost me a dollar and a half, when any one who can handle a hammer could have closed the issue in half a minute if he had thought of how to do it."

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING APRIL 16, 1872.

1045 W. Williamson, High Holborn, for improvements in washing and wringing machines.

1046 H. A. Bonneville, Piccadilly, for a new and improved process for treating metals or metallic ores. A communication.

1047 W. E. Gedge, Wellington-street, Strand, for improvements in feeding bottles. A communication.

1048 T. S. Derham, Leeds, for improvements in machinery for manufacturing bricks.

1049 W. R. Lake, Southampton-buildings, for improvements in ditching or trenching machines. A communication.

1050 S. Bennett, Manchester, for improvements in construction and fixing cocks or valves for high or low pressure.

1051 J. H. Johnson, Lincoln's Inn-fields, for improvements in the treatment of animal and vegetable substances. A communication.

1052 A. Browne, Gracechurch street, City, for an improved glove-sewing machine. A communication.

1053 S. Danks, Southampton-buildings, for an improved method of lining rotary puddling furnaces.

1054 E. Sonstadt, Ramsey, Isle of Man, for improvements in the manufacture of iodide of potassium and of bromide of potassium.

1055 E. G. Brewer, Chancery-lane, for improvements in tuyeres or tuyere pipes. A communication.

1056 J. Greene, Pall Mall, for improvements in the manufacture of types, logotypes, and phrasotypes.

1057 A. S. Guttman, Park-road, Holloway, for a shade or covering for the protection of outside passengers of omnibuses, tramway cars, and such like public vehicles.

1058 A. V. Newton, Chancery-lane, for an improved spring motive power. A communication.

1059 W. Thornton, Nottingham, for improvements in machinery for the manufacture of looped or knitted fabrics.

1060 A. Fraser, Edinburgh, for improvements in apparatus for distributing types.

1061 A. M. Clark, Chancery-lane, for an improved postal or correspondence card. A communication.

1062 H. Larkin, Theydon Gernon, Essex, A. Leighton, Liverpool, and W. White, Hampstead, for improvements in the production of iron and steel.

1063 K. W. Zenger, Charing-cross, for improvements in the purification of iron, copper, and zinc.

1064 W. R. Lake, Southampton-buildings, for improvements in the manufacture of sieves. A communication.

1065 L. A. Badin, New Ormond-street, Middlesex, for a new or improved method of deodorising human excrementitious matters, and of its manufacture into farm manure suitable for all descriptions of agricultural purposes and to all localities.

1066 S. C. Reed, Fulham, for improvements in the construction of portable stretchers and bedsteads for military and other purposes.

1067 F. Render, Manchester, for improvements in reins for driving and riding.

1068 G. Winram, Manchester, for improvements in spring mattresses and seatings.

1069 J. Worrall, Manchester, and J. Kershaw, Wadsworth, Yorkshire, for an improved apparatus for scouring pile fabrics.

1070 J. Worrall, Manchester, and J. Kershaw, Wadsworth, Yorkshire, for an improved mode of and apparatus for finishing cotton cords.

1071 J. Heberlein, Southampton-buildings, for improvements in apparatus for working brakes in railway trains.

1072 W. Cullen, Belfast, Ireland, for improvements in apparatus for grinding grain.

1073 J. Bell, jun., and T. Bell, Wishaw, N.B., for improvements in apparatus for discharging horizontal retorts.

1074 H. Ashworth, Walsden, Lancashire, for improvements in apparatus for spinning and doubling cotton and other fibrous substances.

1075 G. Luttringhaus, Prussia, for an improvement in machinery or apparatus for cutting out metal plates to pattern.

1076 J. H. Johnson, Lincoln's Inn-fields, for improvements in preparing linen thread for dyeing. A communication.

1077 J. H. Johnson, Lincoln's Inn-fields, for improvements in rotatory steam engines. A communication.

1078 H. A. Bonneville, Piccadilly, for improvements in machines for spinning wool, cotton, silk, and other fibrous materials. A communication.

1079 H. A. Bonneville, Piccadilly, for painting the surfaces of woven jute, alone or combined with flax, hemp, and cotton, in imitation of paintings well known as tapestry of the Gobelins or of Beauvais. A communication.

1080 J. J. Bodmer, Hammersmith, for improvements in the manufacture of iron and steel.

1081 J. R. Croskey, Portsdown-road, Maida-hill, and G. Remington, Mansfield-road, Haverstock-hill, for improvements in rails for railways.

1082 H. Jones, Birkenhead, and W. Green, Tranmere, Cheshire, for improvements in apparatus for putting out, lowering, and detaching ships, life, and other boats.

1083 D. Foxwell, Manchester, for improvements in cards used in carding engines and other similar machinery.

1084 N. Lloyd and R. E. Green, Manchester, for improvements in preparing cloth or yarn for dyeing or printing.

1085 T. Hicken, Bedford, for an improved corn sheafing and binding machine.

1086 W. H. Maw, Bedford-street, Strand, for the construction of floating stations or docks for floating fire engines.

1087 R. F. Fairlie, Westminster, for an improved means of increasing the adhesion of railway trains on steep gradients.

1088 W. R. Lake, for an improved process of converting cast iron and articles made thereof into steel.

1089 J. Anderson, Newbuildings, Ireland, for improvements in refining iron, in obtaining malleable iron and steel, and in apparatus therefor.

1090 E. Manico, Bedford-street, Strand, for an improved means of raising sand or shingle covered by the tide to the level of high water, and therewith forming embankments for the construction of sea works.

1091 F. Lamy, France, for improvements in the production of a puce garnet colour of colours from naphtylamine and its derivatives.

1092 E. W. Pugin, Victoria-street, Westminster, for improvements in printing, which said improvements are chiefly applicable to the printing and publishing of advertisements.

1093 W. Wilson, jun., Manchester, for improvements in kitchen boilers for more effectually heating water for domestic purposes and preventing choking of the flues by cinders.

1094 J. Liddington, Liverpool, for improvements applicable to tramway cars, omnibuses, and other passenger carriages, parts of which may be used to record the number of persons entering or leaving public buildings and other places.

1095 D. D. Kyle, Victoria-street, Westminster, for improvements in traps for preventing the escape of foul air and gases.

1096 J. Betteley, Liverpool, for improvements in the construction of ships or vessels, and in appliances connected therewith.

1097 H. G. Keyworth, Cirencester, Gloucestershire, for improvements in cases or receptacles for receiving and retaining letters, papers, or documents in alphabetical or other order.

1098 A. M. Clark, Chancery-lane, for improvements in machinery for blocking or pressing hats, part of said improvement being applicable for regulating the pressure of fluids and liquids generally. A communication.

1099 E. R. C. Morgan, Swansea, for an improved means or apparatus for instantaneously communicating between the passengers and guard or engine-driver of a railway train.

1100 R. Clarke, Lincolnshire, for improvements in the manufacture of cranked shafts or axles, and machinery for the same.

1101 A. Lilly, Stockton-on-Tees, for improvements in lubricators or steam greasers.

1102 G. Luttringhaus, Prussia, for an improved lock for travelling bags, applicable also to other purposes.

1103 R. Tiernan, Liverpool, for an improved manner of treating tobacco.

1104 T. White, Birmingham, for improvements in nutcrackers and lobster crackers.

1105 W. Walton, Denton, Manchester, for improvements in the manufacture of wire cards.

1106 M. F. Jenkins, Exeter, for a new sheath or protector for crochet-needles.

1107 W. J. Porritt, Lancashire, for the manufacturing of woollen cloth applied to the spindle rails of throstles, upon which cloth the ends of the bobbins rest, whereby sufficient drag is applied to them, and also lubrication of the spindles is secured in a superior manner.

1108 W. Spence, Quality-court, Chancery-lane, for improvements in metallic coverings for roofs and walls of buildings. A communication.

1109 W. E. Newton, Chancery-lane, for improvements in compositors' type cases. A communication.

1110 A. Browne, Gracechurch-street, City, for improvements in lamps. A communication.

1111 S. Danks, Southampton-buildings, for improvements in rotary puddling and heating furnaces employed in the manufacture of iron and steel, and in apparatus to be used in connection therewith.

1112 W. R. Lake, Southampton-buildings, for improvements in the feed mechanism of sewing machines. A communication.

1113 R. McKenzie, Achnasheen, N.B., for improvements in railway, steamboat, and other similar tickets, and in the means employed for producing the same.

1114 W. Tongue, Kennington, for improvements in machinery for combing fibrous materials.

1115 R. Stone, Liverpool, for an improved system of casting or moulding, applicable to ceilings, internal and external walls, roads, navigable vessels, and other large surface structures.

1116 J. Ingham, Blackburn, Lancashire, for improvements in looms for plain weaving.

1117 G. Stavers, Morpeth, Northumberland, for improvements in apparatus for steering and manœuvring vessels.

1118 J. Long, Little Tower-street, City, for improvements in apparatus for bottling wines and other liquids, and in the means for facilitating the removal and cleansing of the parts thereof.

1119 W. E. Gedge, Wellington-street, Strand, for improvements applied to boots and shoes. A communication.

1120 W. E. Gedge, Wellington-street, Strand, for an improved method of raising and floating sunken or stranded vessels. A communication.

1121 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of files, rasps, rubbers, taps for screwing, and other tools requiring hardness and durability. A communication.

1122 P. Jensen, Chancery-lane, for improvements in the construction of coke ovens, in the utilisation of the waste heat therefrom for the manufacture of refined salt, and in the apparatus therefor. A communication.

PATENTS SEALED.

2719 E. Butterworth and J. Heap, for improvements in boilers and furnaces.

2720 S. L. Redpath, for improvements in knitting socks, stockings, and other similar articles, and in the machinery or apparatus employed therefor.

2735 A. C. Duncan and A. Duncan, for improvements in madder dyeing.

2744 J. MacLaren, for an improvement in the manufacture of boots and shoes.

2760 J. B. Pow, for improved arrangements for filtering and purifying, also for collecting for utilisation, the solid matter in suspension in sewage, especially applicable for obtaining pure potable waters.

2763 W. Crookes, for an improved disinfectant and deodoriser.

2788 Sir A. Brady, H. E. Dresser, and M. M. Harris, for improvements in couplings.

2855 W. J. Hay, for improvements in preparing cork for use as a protecting medium, and for filling in spaces in ships, vessels, rafts, pontoons, and other structures.

2902 J. Shand, for improvements in fire-escapes.

2937 C. Moseley, for improvements in the manufacture of bowls for calenders and other purposes.

2961 T. B. Gibson, for improvements in the manufacture of certain figured fabrics, and in the modes and means employed therefor.

3106 C. Burrell and G. J. Fowell, for improvements in elastic wheel tyres.

3480 W. R. Lake, for improvements in apparatus for supporting and adjusting the seats, and parts connected therewith, in sulkies and other vehicles.

3590 C. Binks, for improvements in treating a certain residual matter left in manufacturing aniline dye, for the manufacture therefrom of valuable products.

445 H. Walker, for improvements in breech-loading small arms

2752 G. Rydill, for improvements in the process for extracting, dyeing, or staining and changing the colour of woollen piece goods, woollen rags, and animal substances.

2753 G. Rydill, for improvements in apparatus and machinery and method or methods for extracting vegetable substances from and preserving the colour and staple of wool, woollen rags, and animal substances, and re-using certain agents employed in the process, also removing dark shade.

2754 G. Rydill, for improvements in the means of and apparatus and machinery for extracting vegetable substances, and preserving the colour and staple of wool, woollen and silk rags, and animal substances, and removing dyed colours.

2765 E. Davis, for improvements in the construction of axle-boxes.

2766 J. Gurrin, for an improved apparatus for fastening immediately and securely any broken bar, carriage pole, shaft, oar, scull, mast, or scaffolding.

2767 J. Holdsworth, for an improved feed or supply pipe for supplying illuminating gas to gas burners.

2769 C. A. McCalla, for a new metallic clip or fastening for securing the strings of ladies' hats or bonnets and other articles of dress.

2782 J. J. Cousins, for an improved apparatus for raising and lowering window sashes.

2785 J. Swan, for an improvement in augers and bits.

2790 F. A. Marshall, for improvements in the manufacture of metal.

2799 E. Edwards, for improvements in photo-mechanical printing and in apparatus to be used in such printing, parts of which apparatus are also applicable to other purposes.

2800 W. T. Henley and H. Horstman, for a new or improved self-acting method of signalling by magneto-electric apparatus.

2807 G. Rydill, for improvements in machinery for drying and cleaning animal and vegetable substances, known as the shaking willies.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

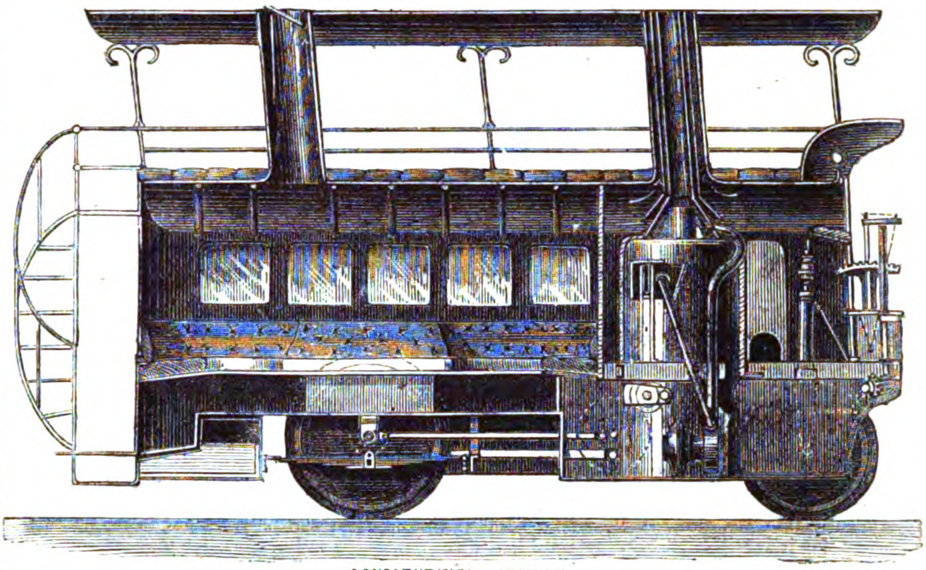
FRIDAY, MAY 3, 1872.

ARTICLES.

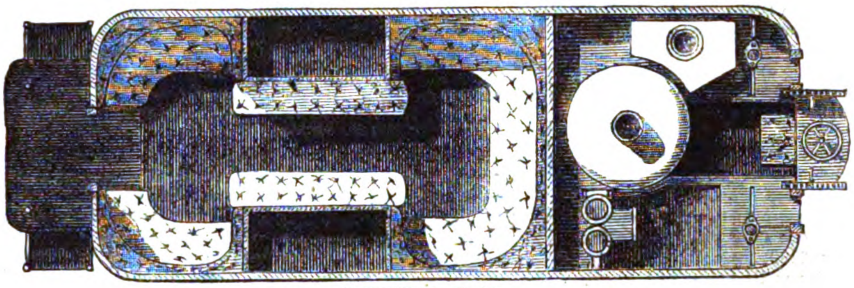
A NEW STEAM 'BUS.

AN idea of the general arrangement and principal features of the design of the steam 'bus patented by Mr. Leonard J. Todd, engineer, Leith, will be easily gathered from the accompanying engravings. It will be seen that it is not unlike an ordinary horse 'bus of rather large dimensions, being painted and finished outside so as closely to resemble one, for it has been found that by doing this the horses think it a familiar object, and provided that it can be made to run in perfect silence they in a very great measure cease to be afraid of it. This desirable end is also promoted by the apparent absence of any machinery or working parts—as boiler, engines, funnel, &c., and also by the fact that there never is the slightest appearance of either smoke or steam; in fact, the more ignorant among the general public fail to comprehend how or by what means the machine is propelled. It will, however, at once be remarked that it is a very simple matter to make such statements on paper as that the 'bus will be silent, smokeless, &c., but that it will not prove so easy or feasible to carry all this, not only into practice, but into a really successful and durable practice. This remark is no doubt fully justified by the many crude schemes for different mechanical arrangements which are continually brought forward by enthusiastic individuals who have little acquaintance with actual practice, and but the slightest knowledge of what is wanted to attain a desired end. It may be as well, therefore, in the first place to consider what is wanted in a self-contained steam 'bus, and then refer to the means employed to attain the desired results, taking note at the same time of what has actually been done in this line and of what is new. We shall also slightly examine into the commercial part of the matter, as to fares, working expenses, profits, &c., so that the entire scheme in all its bearings may be clear to our readers. We need not add that the subject is one of much interest to many classes of society. In the first place we may state that the only self-contained steam 'bus which has yet been made is the "Pioneer," proposed and designed by Mr. Todd, which ran between Edinburgh and Portobello last summer. Of course, many attempts were made in this direction some twenty or thirty years ago by Scott Russell, Hancock, and others, but there is no necessity here to do more than mention the fact. The term "self-contained," as applied to a steam 'bus, refers to the plan of combining the boiler, engines, and carriage in one machine, as opposed to that of drawing a 'bus by means of a separate engine. The "Pioneer" was made as closely to resemble an ordinary horse 'bus as possible—indeed, on several occasions, persons got into it and rode to the end of their journey without knowing that they were in a steam 'bus. It was 22ft. 6in. long over all, by 6ft. 6in. wide, and the same height as an ordinary bus; the boiler was in front, with a horizontal funnel under the seats of the outside passengers. It ran on only three wheels, one leading and two drivers 40in. diameter, to which were coupled direct three cylinders $7\frac{1}{2}$in. diameter by $10\frac{1}{2}$in. stroke. The working pressure was 180lb. The total weight with fifty passengers on board was eleven tons. A great many defects in this arrangement speedily developed themselves in practice: with the horizontal funnel above, and the cylinders below, the floor, it was most uncomfortably warm inside; while the three wheels rendered it liable to upset, especially when turning. The horizontal funnel to enable the boiler to keep steam required a much heavier blast than is usual in any kind of locomotive, the three cylinders exhausted through a hole $\frac{15}{16}$in. diameter, and we are afraid to tell our readers how much the back pressure was greater than 30lb. per square inch, in case they should not take it seriously. Enlarging the nozzle was found to be worse than useless, for the boiler then simply would not keep steam, unless the 'bus ran at a rate of about sixteen miles an hour. It also proved an exceedingly dangerous arrangement to throw the greater part of the weight on to a cranked driving axle. In a six-wheeled rail locomotive, if the inside cranks should break, the engine cannot come down; while as it runs on a perfectly smooth road the crank axle will last a number of years; whereas, when running on a rough road — perhaps over new-laid metal—its duration can only be reckoned at a very few months, especially if rigid wheel-tires are used. There were also many other minor objections to the "Pioneer," which need not be further specified, such as the noise of the blast, &c.

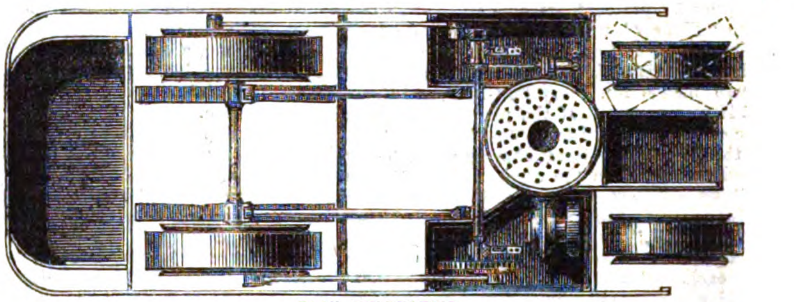
As far as can be discerned at present, it would seem that the best method of applying steam motive power to omnibuses for traffic in streets,



LONGITUDINAL SECTION



SECTIONAL PLAN



PLAN OF GEARING

or in the neighbourhood of towns, is some form of self-contained 'bus in preference to separate engines drawing 'busses. They occupy much less space, and cause less alarm to horses than the use of separate engines; at least, as at present made. These remarks, it must be observed, are not intended to apply to the use of steam on tramway lines, a branch of the subject requiring separate consideration.

We may now more particularly refer to our engravings of the steam 'bus "Edinburgh." A space at the fore end is partitioned off, in which the boiler and engines are placed, the funnel going straight up and emerging at the top of the awning, so that it has thus a good natural draught. The cylinders, 7in. by 10in. stroke, drive a counter shaft by a gear of 4 to 1, and side coupling-rods transmit the power to the driving wheels. By this arrangement the much sought after, but hitherto unattained, desideratum is found—viz., that the main axle can be hung on very sensitive bearing springs, yet gearing can be used, and the whole combined arrangement will work smoothly and silently even at the very highest speeds. The main axle also is straight, and so will not be so liable to break. The next principal feature is the "blast suppressor," by means of which the 'bus can at all times, even on the steepest hills, run in perfect silence, and yet keep abundance of steam. There have been only two plans hitherto proposed to avoid the puffing noise from the exhaust steam in road locomotives: one is the use of an ordinary blowing fan, and the other is to fit the engine with a condenser into which the exhaust can be turned when passing horses. The ordinary blowing fan has practically proved a failure, not only because the noise by it cannot be avoided, but because by its use the steam cannot be kept up at a regular pressure. If the engine is going slowly up hill and steam is wanted, the fan also goes slowly, and the pressure falls. On the contrary, if running fast down hill, requiring little steam, the fan then runs at a great speed and raises far too much steam, which must be blown off at the safety-valve. The condenser, again, is a more inferior contrivance than the common fan, and a great want of judgment is shown in employing it. An engine fitted with it has entirely to rely upon the usual blast-pipe for its power of making steam, and the condenser only furnishes the means of doing away with the noise of the exhaust for a very short time together—say, a si[illegible] minute on a hill. A moment's reflection however, show that precisely the same object can be much better attained by using an adjustable nozzle fitted with a hand lever, so that it can be quickly opened and shut. But all these contrivances are not what is wanted, as is shown by the fact, that although they have all been before the public for many years, yet there is no sign of them coming into general use; indeed, they have only been fitted to a very few engines.

What, however, is wanted, and what any engine intended to work regular passenger traffic in crowded streets *must* have, is some contrivance by means of which it shall at all times run in perfect silence, and yet always keep a uniform steam pressure, as is the case with the common blast-pipe, so that it may go quietly up hill and yet have plenty of steam, or again go down hill without making too much steam to blow off at the safety-valve and startle all horses within hearing.

This second great desideratum is obtained in the "Edinburgh;" by placing a jet turbine-wheel fan in communication with a close ash-pan the ordinary adjustable blast-nozzle is caused to discharge the exhaust steam against the turbine wheel so as to rotate the fan. From this arrangement it will be seen that the speed of the fan, and consequently the draught, will be as perfectly regulated as if the blast were in the funnel in the usual manner, for a moment's reflection will show that the two actions depend for their success on precisely the same principle—viz., that in any steam-engine the back pressure of the exhaust varies directly according to the power that the cylinder is giving out. With the fan, whenever the engine starts the fan starts; if it stops the fan stops; when going up hill the back pressure increases and the fan runs fast, when going down hill it falls away, and the speed of the fan becomes in the most perfect measure reduced. It will thus be seen that so far as relates to their capabilities of regulating the intensity of the fire, the blast-pipe and the steam-fan stand just on the same footing; with the blast-pipe, however, the exhaust is projected violently into the atmosphere, while with the steam-fan it is still kept, being retained in a pipe, and may be condensed or otherwise disposed of, the best plan being to superheat it and then allow it to escape into the funnel through an opening so large that not the slightest noise will be heard. The superheating, of course, makes it invisible. The absence of all smoke is avoided by the use of nothing but Brancepeth coke. It may finally be added that the four road wheels are each fitted with patent rubber tires.

Having thus described the leading features of this steam 'bus, we may shortly refer to the financial part of the scheme. In the first place the "Pioneer" ran fourteen consecutive weeks last summer between Edinburgh and Portobello, a distance of three miles. The total sum earned was £280, thus giving £20 a week, or 5s. 10d. for each run that the 'bus made. The working expenses were £12 a week, thus leaving £8 a week clear profit, which is at the rate of £400 a year, thus paying 50 per cent. on an outlay of £800. But the "Pioneer" was not run to nearly the greatest advantage; it only made one run each way every hour, or sixty-eight runs a week, whereas the horse 'busses ran every half-hour, and thus made 144 runs a week. If the pioneer had done this the earnings would have been about doubled, while the wages and interest charges would have remained constant. In the case of the "Edinburgh," by allowing it to make 144 runs a week and only to draw 5s. each run, instead of 5s. 10d., as did the "Pioneer," which it should easily do on a good route, as its carrying capacity is greater, the receipts each week will then be £36. From this take £14 for working expenses and interest charges, and the clear profit remaining is £22 a week, or £1,100 a year, thus paying 110 per cent. on an outlay of £1,000. These figures are founded on actual fact, for as far as the "Pioneer" is concerned they are simply what has actually been done, and can no doubt be repeated to as great advantage as has been stated.

The advantages to the general public by the use of this patent steam 'bus may be summed up as follows:—

1. It will be much softer to ride in than even tramway cars.
2. The fares will only be one half of what is usual.
3. The outside seats are covered from the weather.
4. The inside can be warmed in winter.
5. It will run much faster than tramway cars.
6. It will set down passengers near the footpath, and not in the middle of the street, as do tramways.
7. No kind of weather or state of roads can interfere with its running.
8. It will at all times run in silence as regards noise from steam, &c.
9. The public cannot see any boiler, machinery, or means of propelling it.

MICROSCOPICAL NOTES.

CERTAIN readers of the ENGLISH MECHANIC have frequently complained of the uncertain results they obtain from the use of semi-fluid media in mounting microscopic objects, and it occurs to me that a few stray hints may be of general service to them and others beyond the circle of my own immediate acquaintance. I therefore take this opportunity of replying to the several queries on the matter that have been addressed to me privately through the post.

GLYCERINE JELLY.—This is a cause of constant vexation to some of my friends, especially to those who use it for mounting fish-scales. The complaint is that although the object may be perfectly clear and transparent when mounted, yet sooner or later "air-bubbles appear all over the slide, and completely spoil the object." It so happens that these are not air-bubbles (usually, at all events), but vacuoles, and are caused by one of two things. The object perhaps is very elastic, or has too much "spring" in it, and hence gradually raises the cover away from the object, straining the medium, and producing vacuoles, which have to the inexperienced observer all the appearance of air-bubbles. In one slide which has been sent me this is evidently the case, for a beam of plane polarised light at once shows lines of unequal tension lying most heterogeneously throughout the thin film of jelly. Or the object may not have been sufficiently soaked before being mounted (if soaked in too fluid a medium, as water or spirits, the same effect will be produced), the object, consequently, absorbs fluid from the jelly, leading to the production of spaces. Lastly, the slide may be covered with paper without the precaution of securely luting in the jelly with varnish having been taken. In this case, the paper absorbs moisture from the jelly, and either air spaces or vacuoles at once appear. Slides should never be papered if any of these fluid or semi-fluid media be made use of. Having thus pointed out the causes which lead to our friends' disappointment, it is easy to point them to the means of prevention, which they will, I think, admit is better than cure.

First. Objects to be mounted in glycerine jelly should be carefully prepared by prolonged soaking in glycerine. Very delicate objects may be brought (and should be) to this stage gradually by adding at intervals a few drops of glycerine to the water in which they are first immersed. When removed to the slide all surplus glycerine should be absorbed by blotting-paper, and the slide gently heated to the melting point of the medium, which should then be placed upon or near the object, and all air-bubbles removed with needles. The thin cover, slightly warmed by being held in the steam from boiling water, may now be carefully placed on the object and secured by a very little pressure. Only just sufficient pressure should be applied to secure the flatness of the object, and prevent the cover from slipping. The whole should be set aside to cool, the jelly cleaned off from the edges, and a neat luting of dammar in benzole applied to make all safe. When fish-scales are mounted in this medium it is always safest to use a thin cell, unless a very tough and secure cement be applied immediately the jelly is set. It is hardly necessary to add that care must be taken not to overheat the jelly in rendering it fluid. A hot-water bath should always be used, and it is advisable to warm only a small quantity more than is actually required, keeping the stock bottle cool and dry.

The great value of Mr. Rimmington's jelly in preparing vegetable structures has caused me to have a tolerably extensive acquaintance with both its good and bad qualities, and I can unhesitatingly say that if proper care be used in the preliminary soaking of the object and subsequent luting, that few, if any, disappointments will arise, and that the objects will for all practical purposes be perfectly preserved.

There are some few substances, however, that require a somewhat less dense medium than jelly prepared according to Mr. Rimmington's plan. One of these is starch. After prolonged trials of every likely medium in which to put up specimens of starch for purposes of measurement and comparison, I have hit upon the following:—Two parts of Rimmington's jelly to one part of glycerine, in which a piece of camphor has been immersed for some days. This medium *must* be luted down, but sets sufficiently to enable the luting to be done easily. To mount starches without the inclusion of air-bubbles is a matter of difficulty, as heat must only be applied in bare sufficiency to melt the medium, and the objects cannot be put through the course of preliminary soaking. Those who *will* not have bubbles, from a constitutional abhorrence of them, had better lay in a Baker's microscopical air-pump, and try their luck with it. *Pour moi*, the bubbles rest in peace.

GLYCERINE AND GUM WATER.—For delicate sections of young tissues, sexual organs of flowers, and some starches for exact observation, I prefer a medium prepared as follows:—Take of picked gum arabic 1oz., and having washed it in cold water to remove dust, add as much cold water as is just sufficient to dissolve it to a very viscid fluid; add an equal quantity of strong glycerine, and mix. Place a small lump of camphor in the bottle, or add two grains of arsenious acid (white arsenic), and allow the whole to stand a few days; after which, if clear, it will be ready for use. If not clear, it must be filtered. For excessively delicate tissues, where it is desired to retain the form and position of the protoplasmic masses as much as possible, the above medium, plus one part of camphor water, is well adapted. The above medium is always fluid and must be treated accordingly. Dammar in benzole is the best cement for it.

A medium that I have lately used in the examination of pollen, and also in the study of materia medica "vegetables" with good results, is one I should be thankful to learn how to "keep in." I allude to an essential oil, such as thyme, anise, cassia, bergamot, &c. Dammar answers pretty well for a few weeks, but, of course, a gradual escape goes on, and sooner or later the slide becomes nearly dry. If any microscopist, given to experimenting, will light upon a cement which will resist these oils and yet be usable cold, let him publish its formula and earn my hearty thanks.

H. P. H.

EFFECTS OF FAULTS IN VISION ON PAINTING.

ON Thursday evening last week Dr. R. Liebreich delivered a lecture on this subject at the London Institution. The following is an outline of it:—

On one occasion, when visiting the National Gallery, Dr. Liebreich was struck with the difference between Turner's earlier and later paintings. The cause of this did not clearly appear from Turner's life, though during the last five years of it the painter's vision and intellect were known to have suffered, for the changes had first appeared 15 years before that, Dr. Liebreich was therefore led to seek for the cause in a scientific study of his paintings. The prominent feature in this change consists of a vertical *streakiness*; each luminous point is changed into a vertical line. In his earlier works the sun, *e.g.*, has a clearly defined disc, the light radiating equally to all parts; in his later, a vertical yellow streak divides it into two distinct halves. So with less luminous objects—houses standing near water, or figures in a boat, are made to blend with their reflection, and all becomes a conglomeration of vertical lines, while all tracing of detail vanishes under such lines.

The first appearance of change is in 1831, consisting of an increased intensity of diffused light from illuminated parts. From 1833 this diffusion begins to get vertical, and the tendency increases in the following years.

Now, it is commonly supposed that Turner adopted a peculiar manner, and exaggerated it more and more. The fact appears to be that his change of manner arose from a change in his eyes, and that he reproduced scenes as he saw them.

As age advances, the crystalline lens of the eye (at no time perfectly transparent) gets dimmer, and disperses the light more strongly, throwing a haze over illuminated objects. In Turner's case, a clearly-defined opacity was formed in the dimness of the lens, and had the effect of dispersing the light vertically. This increased till not only the aspect of Nature was altered, but he could not see his own pictures correctly.

While these later paintings have many merits, it is yet a mistaken notion which leads people to admire the defects referred to, and call them Turner's style, from which they would form a new school.

Dr. Liebreich illustrated some of the above effects by experiment. Projecting a picture of Venice, distinct in its outlines, on a screen, he then interposed a lens, which gave the picture the streaked appearance of Turner's later paintings. A picture of a tree was also thus altered into one of "Turner's trees," which, the lecturer said, were entirely unlike anything in Nature, and unknown to botanists.

Turning to another class of cases, we find irregularities of refraction in the eye affect an artist's work. To see an object distinctly, its image must fall on the retina. But to effect this, the eye must accommodate itself to the different distances of the objects seen. It does so by changing the form of the crystalline lens. For the nearest point, the lens is at its greatest tension; for the farthest, in complete repose. This latter state of the eye constitutes its refraction. There are three different kinds of refraction. 1. That of the normal eye, in which rays parallel, or from an infinite distance, unite on the retina. 2. That of the short-sighted eye, in which they unite in front of the retina. 3. That of the oversighted eye, in which they unite behind the retina. In the second case, when looking at distant objects, concave glasses are used to make the rays *diverge* on approaching the eye; in the third case, convex glasses are used to make the rays *converge*.

Now, it may occur that an eye is normal in one direction and short-sighted in another. Conceive the eye as a globe with one pole in front, and two meridians on the surface at right angles to each other. If these meridians have different curvatures, we have a difference of refractive power in the two directions. This constitutes astigmatism. The effects of this, in artists, vary with the particular kind of it, and with the subject painted. Thus Dr. Liebreich knew a landscape painter and a portrait painter who had the same kind of astigmatism, their sight being normal for vertical lines while they were slightly short-sighted for horizontal lines. In the landscapes there was no disturbing influence in the distant parts, where sharp outlines were not requisite, but rather undefined and blending tones of colour. The foreground represented water with gently moving waves, and Dr. Liebreich noticed some short horizontal strokes of different colours that did not seem to belong to the water. Using a glass which gave him the same kind of astigmatic vision as the painter's, he saw the strokes indistinctly and mixed together, and the effect became quite natural and good.

The portrait painter had at one time a high reputation, though some thought his portraits showed too great indistinctness in details. This was due really to astigmatism. Latterly, his portraits had become very much worse, the neck and oval of the face being elongated out of all proportion, and all the details distorted. The effects of astigmatism were doubled in this way: the painter having become far-sighted for vertical lines (for which he had normal vision before), sees a distant person at whom he looks elongated vertically. The picture being near, is seen enlarged horizontally, and thus he paints the person even more elongated than as the latter is seen. Some illustrations of these results were given. Square figures were projected on the screen, and a cylindrical lens being interposed, these were elongated vertically or horizontally, according to the position of the lens. This effect was also shown on a portrait.

We come next to colour-blindness and its effects. The primary sensations of colour are red, green, and violet. What we call colour-blindness occurs when one of these is absent, and an artist who has this defect should confine himself to drawing otherwise his work will be marred. There are, however, slighter degrees of colour-blindness, thus the perception of red may not be quite wanting—only diminished. To a person thus affected, strong bright red will appear red, while less intense red will look green. Some artists show this in their works, painting, *e.g.*, the roofs of houses red on the sunny side, green on the shady.

The crystalline lens often becomes yellow with advancing age. What effect has this in the perception of colours? We may test it by looking through yellow glass of the corresponding shade. At first every thing looks yellow, but the eye gets dulled by degrees, and things begin by-and-by to appear again in their true light and colour. It is found, however, that a pale blue, or a very small quantity of blue, fails to be perceptible after prolonged experiment. The yellow glass excludes it. Now, the colours of natural objects reflecting light are very much more intense than those in a painting. In looking through yellow glass at the former the small quantity of blue excluded makes no sensible difference in a painting—on the contrary, there is, in some parts, just as much blue as is completely absorbed by the glass, and even in the parts of intensest blue, the quantity of blue excluded by the glass makes itself felt, for it bears a larger proportion to the entire quantity of blue than the blue excluded in the other case did.

Now, a painter whose lens has become yellow will see natural objects almost correctly, but in his picture everything will appear yellowish, and so he will paint it too blue. He does not perceive this, and he will not believe it when told of it, as his own impressions have a stronger force of conviction.

Incorrect perception of form may be demonstrated. A square that appears oblong, *e.g.*, may be measured with a compass. But faults in perception of colour can only be recognised as such from the testimony of a number of persons of normal vision.

An artist in the state referred to, and beginning to paint blue, is said to have changed his style. He thinks he paints in his old style, and has improved the tone of his colours. His early works appear to him too brown. Were his lens suddenly removed everything would appear too blue.

Mulready may be taken as an example. The peculiarity in his later works is produced by an addition of blue. Looked at through a yellow glass these paintings become natural—the violet colour of the face shows a natural red; blue shades become gray, the unnatural glaring blue of the drapery is softened. We may thus see these pictures as he saw them with the naked eye. One subject he has fortunately painted twice; first when 50 years old, and when his lens was in its normal state; again, when he was 71, and the yellowness had advanced considerably. The pictures are both in Kensington Museum; the first one called "Brother and Sister, or Pinching the Ear;" the second, "The Young Brother." The difference in the colouring is very striking, and it almost entirely disappears when the second picture is looked at through the yellow glass. If we look at the first picture through the glass the tone appears too weak; the shadows brown; the green dark and colourless. We thus understand how he became dissatisfied with his earlier works and changed his colouring.

METALLURGY OF IRON AND STEEL.*

(*Concluded from p. 135.*)

IN his sixth and concluding lecture Dr. Percy commenced by recapitulating the former account of the puddling apparatus and furnace, referring, in passing, to the late application of mechanical means to this operation. In speaking of the estimation of the strength of iron, he pointed out the great difference between concussive action and the action of a slow force, and in the materials used for guns, &c., we must calculate from the former grounds. Sir Joseph Whitworth and others had lately experimented on this subject, using gunpowder as the agent to cause the concussive force, and it was thought that gunpowder was, as a rule, the most fitting for that purpose. The more immediate subject of the lecture, however, was

Steel.

What is steel? Steel is *essentially* nothing but iron, containing a certain proportion of carbon. There are a great variety of steels, these varieties depending more or less upon the presence of certain foreign bodies in certain proportions. Taking into consideration the quantity of carbon contained, we may ask, when does wrought iron cease to be wrought iron and become steel? and when does steel cease to be steel and become cast iron? It is a difficult thing to fix the precise lines. We may say that iron containing ·2 per cent. of carbon would be more or less steely, it might be regarded as mild steel, approximating to wrought iron, but capable of being hardened, which wrought iron is not. When we get to 1 per cent. of carbon we find a variety of steels; and at 1·4 per cent. we pass rapidly to cast iron. Steel is a valuable, marvellous metal. It differs as much from wrought and cast iron as many metals differ from each other. It is capable of a hardening process; if steel be heated and then quenched in water, the metal is rendered much harder. The small amount of carbon in the iron does the whole thing, the hardening depending on the way in which the carbon is combined with the iron. The quality of the steel depends especially upon the mode in which the carbon occurs in the iron, and not entirely upon the quantity of carbon. If, after the steel is heated, it be allowed to cool slowly, on acting on the product with an acid and dissolving the iron, a carbonaceous mass remains, but if the metal be cooled rapidly (*e.g.*, by plunging it into water) none of this residue occurs, but the whole of the steel is dissolved by the acid.

Steel is more fusible than wrought, but far less so than cast, iron. It is capable of being welded, is malleable, and can be hammered, rolled, and drawn out into wire and so forth.

Modes of Making Steel.

In the puddling of iron the problem is the separation of carbon. The question arises—Cannot you make steel by that process? Why can't you stop short when you have separated all the carbon except the proportion necessary for forming steel? because in passing from cast into wrought iron and *vice versa* the mass has to pass through the state of steel. In the old method of making pig into malleable iron this ought to occur, and it does.

There are about twenty different methods of making steel on the theory above stated. The most common method of making steel is by

Cementation.

If we take an iron bar and imbed it in charcoal, and then keep it at the temperature of melting copper for ten days or a fortnight, although the iron is never melted, the carbon, by simple contact, will find its way right into the interior of the mass of the bar, and we get "blistered steel." All good steel used in England has been for a long time made by this process. Some suppose the carbon enters the mass in the state of carbonic oxide, for there is always a quantity of air mixed with the fuel. The furnaces are built so as to exclude atmospheric air beyond that which originally exists in the mass of the charcoal. The furnace itself is like a long firegrate with two stoke holes at each end. About it are built two rectangular chests of brickwork, and these are surrounded on all sides by flues, so as to make the temperature as uniform as possible. Around the whole is built a large cone, like a glass-house cone. When a fire is made the products of combustion pass through the openings and surround the converting chests, and by this means a great uniformity of temperature is maintained. The gases then escape into arched chimneys built above of firebrick; a hole being left at each end (which, however, is stopped during the working), through which a man can enter when necessary, the smoke, &c., passing through the flues and by three openings into the outer cone.

At the bottom of the chests is placed a layer of charcoal, then bars of iron on that layer, taking care that the bars are sufficiently short to allow of expansion; then another layer of charcoal, then iron, and so on till the chests are filled. Over the top of the whole is placed a layer of some material which will exclude the air; frequently a substance called "wheelswarf" is employed, being the dust formed by the wear of the grindstones used for grinding steel instruments at Sheffield, and consequently containing fine particles of steel.

The chests are kept heated for about a fortnight, the exact time depending on the kind of steel required; the longer the iron is kept heated the more carbon it will take up. When the proper time has been given the fire is allowed to go down, the chests are uncovered, and the bars are brought out. On these bars will now be noticed strange large blisters, and hence the term "blistered steel." There are diversities of opinion as to the cause of the blisters, but I think they are produced from the action of the carbon as it finds its way into the heated mass, upon the interposed slag, for all iron contains slag, and it is certain that if the carbon comes in contact with slag, some of the oxide of iron must be formed into gas, and this gas produces bubbles or blisters. The steel in this state is heated, worked and drawn out into bars.

* An abstract report of a course of lectures by Dr. PERCY at the London Theatre of the Geological Museum.

The Bessemer Process.

A great feature in this process is Siemens's gas furnace, by which we can obtain a very high temperature. By means of it we can obtain the metal in the form of cast steel—*i.e.*, steel which has been perfectly fused, and, therefore, much freer from the impurities which exist in steel made by the ordinary process. In this process you may see about four tons of steel as fluid as water at one time. A somewhat similar method, as employed by Bessemer, was known in 1722, but in the present process the application is new, and the means of obtaining heat are altogether new, and therefore it possesses a high interest for us.

Bessemer took out his first patent in October, 1855, and at first he had no idea of what he was subsequently going to achieve by it, but he seemed to look upon it as a preparatory process to the operation of puddling. It has, however, turned out to be one of the most remarkable inventions of modern times.

The problem is to eliminate a portion of the carbon from the iron and to convert it into steel, and it is solved by melting the iron and then blowing through it atmospheric air. It appears to be a very simple thing, but it is a very difficult one to accomplish.

The *converter* is ellipsoidal in shape, and made of wrought iron, in several pieces, screwed together. It has a false bottom; underneath it is an empty space into which air is blown. The interior is lined with a mixture of crushed slag and fire-clay, and the lining is dried very gradually. In the bottom is fixed a number of conical pipes, each containing numerous holes, and arranged so as to come flush with the bottom. The converter is suspended on trunnions, and there is a very ingenious contrivance for tilting it up—*i.e.*, lowering the mouth, and erecting it again, the work being performed by hydraulic machinery, or other such power. The trunnion on one side is hollow, and a pipe leads from it into the empty space at the bottom of the converter, from which clay tubes pass into the converter, and through these are forced numerous jets of air. Two converters are usually placed near each other on opposite sides of a circular pit. In the centre of this pit is an arm which can be moved up and down by hydraulic power, and at one end is a lever which can be turned about in several directions very gradually. By means of these converters either wrought iron or steel can be produced at will from the cast iron put into them.

A charge of iron being already molten in a reverberatory furnace (say three tons, but frequently five, and even ten tons, are operated on at one time) at the proper time the converter is tilted, and this metal run into it by a spout of iron lined with clay. The quantity run in is regulated so that it shall not rise up to the lowest twyer opening. While the converter is in this position the blast is powerfully put on—say about 15lb. to the square inch—a contrivance being adopted to allow of this, otherwise the molten metal would run down the above pipes.

The converter is then tilted back again, and now we have streams of atmospheric air rising vigorously through the metal in the converter. The operation goes on pleasantly at first, but at the end of 10 or 12 minutes there is a miniature volcano eruption, and a great roaring flame comes out of the mouth of the converter. In the first furnaces a shower of sparks and pieces of red hot slag and metal accompanied this eruption, but alterations in the form of the furnace have prevented this since. At this period the metal undergoes a remarkable change, and if required the whole of the carbon can be taken out and wrought iron made. The usual process now is to burn out the whole of the carbon in this way, and then at a given time to pour into the remaining mass a quantity of molten pig-iron containing just the proper quantity of carbon to convert the whole into steel. Besides carbon, there is also a certain proportion of manganese, and this has a wonderful effect.

The charge of pig-iron being ready, it is poured in in a molten state, and the resulting mixed mass—steel—is then transferred from the converter to large pans on the lever, which is then carried round, and the molten metal dropped into moulds underneath.

Only certain kinds of iron can be employed in this process—viz., those which are free from phosphorus and sulphur, and unfortunately these kinds are very limited in this country, only that obtained from hæmatite being applicable. The supply obtained from this source is insufficient to meet modern requirements, and we are consequently obliged to import a great deal from Spain. There are no less than 30 or 40 vessels exclusively engaged in this trade.

A small amount of silicon in the iron is thought to be advantageous, inasmuch as by its combination with oxygen it developes a very high temperature, becoming converted into silicon as slag. Sometimes the metal obtained by this process is not so homogeneous as it might be.

The lecturer concluded the course with a few remarks, regretting the short space of time he had been able to devote to a subject of such magnitude, which, to be properly dealt with would require something like sixty, instead of six, lectures.

WRITING MACHINE FOR THE BLIND.

AT a recent meeting of the Royal Scottish Society of Arts a communication was read from Mr. Robert Meldrum, teacher of the blind, Alloa, describing an improved method of corresponding between blind persons. The invention consists of two parts—the upper having the types, with keys and levers for moving them, and the lower containing the paper-moving apparatus. The base of the upper part is a metal disc, with a circular hole in the centre. Around the central opening are arranged twenty-six little hammers, having on their striking surface copper types for embossing the paper. The types are so arranged that they all strike at the same place—viz., on the opening in the disc, and each hammer, after striking, is pulled back to its original position by an indiarubber band. Each of the keys represents a letter, and when any particular key is pressed down the corresponding hammer strikes, and the type makes a mark on the paper, which is stretched on a revolving drum in a drawer below the disc. When one letter is impressed the drum is moved round by a handle in front of the machine, and a plain surface is presented for the next stroke. When a line is finished the drawer in which the paper moves is pulled out one line. The machine is constructed to print Moon's type, but its principle is equally applicable to most others, and especially to Braile's. After the paper had been read the machine was exhibited in operation, and worked very satisfactorily.

CONTACT OF LIQUIDS.

IN a recent note to the Paris Academy of Sciences, M. Van der Mensbrugghe enunciates the following principle: When a liquid of strong surface-tension, and holding gas in solution, is brought into contact with a liquid of feeble tension, there is a disengagement, more or less pronounced, of the gas in the former. This may be shown from a large number of experiments—as, *e.g.*, the following:—1. If a drop of alcohol or ether be introduced into distilled water, contained in a small vessel three or four centimetres in diameter, and about half filling it, and if the liquid be then shaken, a lively effervescence takes place. This effervescence cannot be attributed to air introduced by agitation, for alcohol or ether alone, and water alone, do not give any marked results in this respect. The same experiment may be made with benzine, sulphuret of carbon, creosote, spirit of turpentine, olive oil, linseed oil, colza oil, &c. Similar effects will be produced if a glass rod with a greasy surface be plunged into distilled water, and the water then agitated. A disengagement of small bubbles of gas takes place. If the vessel containing the water be not quite free of greasy matter, small gaseous bubbles form at those parts of the internal surface to which this matter attaches. 2. A drop of oil spreading itself on the surface of distilled water produces a disengagement of small gaseous bubbles, which may easily be observed with a microscope. This seems to be the true cause of the cohesion figures observed by Mr. Tomlinson; which consist in the separation of the film, that has spread out on the liquid surface into a number of parts, which form at first a sort of network, and this gradually breaks up into small discs, which continue to decrease in size, till the disengagement of gas ceases, when they remain unaltered for an indefinite time. The phases of this phenomenon may be watched with a microscope, and it seems to be explained by the liberation of innumerable small gaseous bubbles under the films.

When an oil is kept for a time in contact with water, the surface of separation of the two liquids loses its transparency. This is accounted for by the liberation of small bubbles of gas causing the oil to resinify more or less, and thus become incapable of transmitting light rays. 3. It has been long known that water boils less rapidly the more free it is of gas held in solution. It will be seen from the above that when distilled water is mixed with alcohol, for example, a large quantity of the dissolved gas may be expelled. We have in this, confirmation of an experiment made by M. Kremen. Having added one part of spirits of wine to three parts of water, and applied strong heat, he found the boiling point raised to 109 degrees C., and even beyond it, in proportion as the volatile liquid evaporated.

NATURAL PHENOMENA AND PRODUCTIONS OF THE POLAR REGIONS.*

THE polar year consists only of summer and winter, their limits being determined by the breaking up and re-formation of the sea-ice. The breaking up of the winter ice is sometimes accelerated a month or two, or delayed an equal length of time by circumstances the causes of which are unknown. In August, 1838, Dease and Simpson found the sea about Coronation Gulf a mass of fixed ice, and could only progress on foot along the shore, whilst the following year a month earlier they ran past the same coast with a fresh breeze, a flowing sail, and an open sea. The great mass of the sea-ice does not remain stationary through the winter and melt away in summer, but is in constant though slow motion, mostly in the direction of the lower latitudes, where it is finally broken up and dispersed. Captain Back, in the *Terror*, was helplessly borne along amidst the most frightful commotion of the surrounding ice, from Repulse Bay through Hudson Strait, until liberated after many months in Davis Strait. The wonderful drift of the *Fox* down Baffin's Bay from August, 1857, to April, 1858, by which McClintock was delayed a whole year in his search for the Franklin expedition, was another illustration of the above fact.

The immense floating masses called icebergs consist of fresh water ice formed on the coasts and broken off by the action of the waves. The rocks of ice from which they have been severed are huge glaciers advancing far into the sea. When the buoyant power of the ice overcomes the attraction of cohesion masses break off at the bottom of the sea and rise to the surface in the form of bergs. As they float with only a tenth of their bulk above the water, the rate of movement of the glacier, the distance of its front from the sea, and the depth of the water near the shore, have been made the elements to determine the date at which the first berg will be floated off. If this be the true theory of icebergs, their extraordinary abundance in the Antarctic Seas will suggest large tracts of land in the south frigid zone.

The Aurora stands pre-eminent amongst the atmospheric phenomena of the polar regions. Captain Hall alludes to some peculiarities respecting it not generally known. It was attended by the kind of clouds named cirrocumuli, and the auroral beam illuminated the face of the cloud, proving that it was at play between the cloud and the observer. This writer mentions as the most remarkable feature he ever witnessed the peculiar movement of the clouds overhead, which was by hitches, passing with the wind slowly and then stopping for a few seconds. It seemed as if the clouds were battling with an unseen enemy, but that the former had the greater power and forced their way by steps along the vault above. The observer felt sure the aurora had something to do with it. Dr. Walker, naturalist to McClintock's expedition, also expresses his conviction that on several occasions the aurora was only a few feet above the vapour rising from the sea.

McClintock, Simpson, and Kane, all refer to the connection between the aurora and clouds, and think the former is never seen in a perfectly clear atmosphere. Most observers have negatived the idea of the accompaniment of sound, but Mr. Simpson was convinced of the fact upon what he considered good evidence.

The discovery of the position of the magnetic pole by Sir James Clark Ross claims some notice. Previous calculation had nearly determined its place, and it was most interesting to find as the actual place was neared that the horizontal needle ceased to move and the dipping needle became more and more nearly perpendicular until it showed a dip of 89° 59′, only one minute from the vertical. This was in latitude 70° 5′ 17″ N. and longitude 96° 46′ 45″ W. Fifteen years later the same discoverer made the nearest approach ever effected to the place of the south magnetic pole, determining it to be in about 155° E. long. and 75° S. lat.

The phenomena of cold and darkness during the Arctic winter claim attention. The effect of a fall in temperature to − 50° or − 60° Fahrenheit is shown by the tendency to sleep, and in its worst form exhibits itself in loss of reasoning power, memory and every mental faculty. Dr. Kane narrates several instances of this species of insanity among his men, and was himself to some extent the subject of it. The influence of the long intense darkness is described by the same writer as most depressing.

* Abstract of a paper read by Mr. C. F. Ravis, before the Bristol Naturalists' Society.

Even the dogs were strangely affected by it, and many died, as he thinks, from the absence of light as much as from the extreme cold.

The effects of refraction are particularly noticed by Arctic voyagers. The immense amount of evaporation constantly going on during the summer from the melting of the ice, produces an unusually humid condition of the atmosphere on and near the surface, a state of things eminently favourable to the phenomenon of mirage, of which many very interesting instances are on record. Akin to this phenomenon are those of mock suns and moons, both very common in these regions. These, in combination with halos, are sometimes seen for many hours together, and are attributed to the presence in the atmosphere of innumerable spicula of ice, forming so many minute points of reflection and refraction. They are most common in the winter months, alternating with dense fogs, which for days together conceal every distant object upon the surface of the earth and sea, and quite shut out the glories of the heavens.

The question of an open polar sea has been much discussed during the last few years, and many circumstances have contributed to foster the opinion that such an open basin exists in the vicinity of the north pole. Drs. Kane and Hayes succeeded, the former by one of his sledge parties and the latter in his own person, in reaching an open sea perfectly free from ice in latitude 80° and 82½° respectively, whilst their ships were frozen up 300 miles to the south. Subsequent exploration by a German expedition fully confirms this discovery.

Animal life in the Arctic regions is by no means so scarce as might be expected, except during the depth of winter. In the summer the seas and lakes, the rivers and plains, teem with life. The birds are innummerable, swarming on the sea-cliffs and on the borders of the streams where they arrive in the early summer to hatch and bring up their young, and whence they migrate on the approach of winter to more congenial climes. The marine Mammalia crowd the bays and inlets of the Arctic coasts, and the land quadrupeds wander in immense numbers over the plains, now covered with verdure and bright with summer flowers. The most important members of this order were noticed and their habits briefly described. Of the Whale kind the *Balæna mysticetus* of the Greenland seas, the *Physer microps* or Sperm Whale of the Southern Ocean, the White Whale (*Delphinapterus Beluga*) and the Razorback (*Balæna physalis*) were particularly mentioned.

Of all the Cetaceæ, none is more curious than the Narwhal (*Monodon monoceros*), with its enormous tusk or horn projecting from the snout in a straight line with the body, which has given to the animal its common name of Sea Unicorn. There are, in fact, two tusks, but that on the right side is usually rudimentary. This appendage belongs to the male animal only. It is from 5ft. to 10ft. long, tapering to a point, and with a spiral twist through its whole length.

The Seal is the most valuable of all Arctic animals to the natives, as it supplies them throughout the winter with food, clothing, light, and fuel. The sagacity of the seal-hunter is taxed to the utmost in its capture, as its senses of hearing and smell are remarkably acute. The animal is caught either by watching a seal-hole at which it comes up through the ice to breathe, and by striking it through the head with a spear, or by following the chase upon the open water in the native "kayak" or skin-canoe. The former process entails great privations upon the hunter, who is frequently out for several days and nights at a time in a temperature of — 50° Fahr. The principal species of seal inhabiting the Arctic regions are the Common Seal (*Phoca vitulina*), the Rough Seal (*P. fœtida*) and the Great or Bearded Seal (*P. barbata.*) The seal is carnivorous, feeding on fish, crustaceæ, and water-fowl.

The Walrus or Morse far exceeds in size the largest seal, being sometimes 20ft. in length. It is gregarious in its habits, large numbers being frequently seen lying in heaps upon floating ice. It uses its tusks to aid its movements in climbing or dragging its unwieldy body from crag to crag. It lives on fish and marine vegetation. The hide of the walrus supplies the Esquimaux with the best material for their sledge-lines, the flesh forms a large portion of their winter and spring food, and the blubber is used for their lamps. Both the seal and walrus are known to swallow large quantities of gravel and stones, for what purpose is unknown.

Of quadrupeds the Polar Bear (*Ursus maritimus*) for his great strength, activity, cunning, and ferocity, is pre-eminent. This animal is the terror of all smaller and less powerful tribes, whether terrestrial or aquatic, as he is equally at home on the land, in the water, and on the ice. Exploring parties suffer much from his attacks upon their caches of provisions, which, though constructed with great care and labour, generally fall an easy prey to these tigers of the ice. Captain Hall states, on the authority of the natives, that the bear in his conflicts with the walrus ascends the cliffs and hurls enormous stones upon the head of his prey, fracturing the skull. Most writers agree that he does not attack man except when provoked or wounded, and McClintock says no instance is known to the contrary.

The Glutton or Wolverine (*Gulo luscus*) is allied to the bears, badgers, otters, and mustelidæ. Old authors have told wonderful tales of its climbing trees and pouncing upon the backs of reindeer and elks as they passed beneath. It is no doubt extremely voracious, but modern travellers assert that its attacks upon the larger animals are chiefly made upon them during their sleep, or upon weak and dying deer or young fawns. It is extremely mischievous, and a great pest to the hunters and trappers of the fur countries by destroying their traps for the sake of the bait. Its strength is prodigious. It has been known to disarrange piles of wood among which were trees that had required two men to lift them.

The Esquimaux Dog (*Canis familiaris*, var. *borealis*) is well known. His sagacity in the chase, his patience and perseverance in the sledge-team, and his great speed, render him an invaluable possession to the native inhabitant or the more civilised explorer of the northern regions. Though generally treated with harshness by their masters, and often half-starved, they seldom rebel against human authority. They will attack the bear and every other animal except the wolf, to which they have a great antipathy.

The Wolf is one of the tyrants of the northern parts of the world, and is found in both hemispheres. Its great strength, rapidity of movement and savage disposition, render it the terror of all animals inferior to itself in these qualities. Its strength and courage even after being wounded are the subject of many interesting anecdotes by writers on northern research and adventure.

The resemblance between the wolf and the dog has been noticed by many writers. Cases are on record in which dogs have themselves mistaken wolves for animals of their own species, and have fallen victims to the delusion. Dr. Kane says:— "There is so much of identical character between our Arctic dogs and wolves, that I am inclined to agree with Mr. Broderip, who, in the 'Zoological Recreations,' assigns to them a family origin. Both animals howl in unison alike. Their footprint is the same, at least in Smith's Sound. Dr. Richardson's remark to the contrary made me observe the fact that our northern dogs leave the same 'spread track' of the toes when running, though not perhaps as well-marked as the wolf's."

The Arctic Fox (*Vulpes lagopus*) is found in both hemispheres. It has a fine fur, bluish gray in summer, and pure white in winter. Its habits are gregarious, twenty or thirty burrowing together. It is easily taken in traps and tamed without difficulty. It is said that this little animal hunts with the bear, and "It is certain," says Dr. Kane, "that they are often found together, the bear striding on ahead with his prey, the fox behind gathering in the crumbs as they fall."

Of the few strictly herbivorous animals that inhabit or frequent the Polar regions, the Reindeer (*Cervus tarandus*) takes the foremost place, from its size, its numbers, and its utility to man. The animal itself as well as its habits are too well known to need description. In their migrations they go in large herds. Franklin states that in a short morning walk near Fort Enterprise in the month of October, he saw upwards of two thousand.

The Moose Deer or American Elk (*Alces Americanus*) is the largest animal of the genus. It is higher in the shoulders than the horse, the neck is short and strong, adapted to bear the large horns, which weigh sometimes nearly fifty pounds.

The gait of the animal is a kind of shuffle, and the joints crack at each step with a loud noise. It is said to trip occasionally and throw itself down, by treading with its hind feet upon its fore hoofs.

The Musk Ox (*Bos moschatus*) which ranges over the barren lands of America north of the parallel of 60° is about the size of one of our Highland cattle. Its horns are of a peculiar form, and cover the brow and the whole crown of the head. These animals live on grass and lichens, the country being destitute of wood, except some spruce trees on the banks of the larger rivers. They are not found in the eastern hemisphere, nor in Greenland, Spitzbergen, or Lapland. They assemble in herds of twenty or thirty, and will sometimes attack a man and endanger his life.

Notwithstanding what has been stated as to the annual migration of the deer and other Arctic animals, it is nevertheless doubted by many Arctic explorers whether they do migrate at all. It is certain that several expeditions found even in the depth of winter large numbers of deer in various parts of the frigid zone, and it was the opinion of Parry that only the darkness prevents their being seen all through the winter. What they live on is a mystery, and indeed the animals found at that season are very lean. It seems probable that where migration is easy, as on the Continent of North America, it may be the habit of these animals to seek a more genial climate, from the rigours of an Arctic winter, whilst in more isolated situations they may from the force of circumstances remain permanently on the spot.

FLUORESCENCE.

SOME curious and interesting experiments in this branch of the science of light were recently exhibited at the American Institute by the President, Henry Morton. The subject of the paper was—"Fluorescence," or that action by which rays of the higher purple, or even invisible light, such as produce most strongly photographic action, excite in certain bodies lower rates of vibration, resulting in the emission of light, generally of a red, green, or clear blue colour. The paper was illustrated by a number of striking experiments. Thus, a flash of solution of chlorophyl (a green colouring matter obtained from leaves), which is of an olive green colour, being held in a beam of blue light, appeared to be full of a blood-red liquid. Various solutions colourless in ordinary light were then shown to exhibit the brightest hues when illuminated by the violet rays of the lantern, or those obtained from the electrical discharge of a large coil in rarefied gases. Professor Morton then announced that, in the course of the examination which he had been making of such substances, he had encountered one which he believed to be as yet unknown, and which possessed the property of developing light by fluorescence in a pre-eminent degree. This body was obtained from petroleum, and he proposed to take for it the name "Viridine." The word viridin had been already applied as a synonym for chlorophyl, but was now practically obsolete, and too appropriate to the present substance to be thrown away. The material from which this new body was extracted was given to him by Professor Horsford, of Cambridge, Mass. A large drawing of a flower, with leaves painted seemingly in light umber tints, was then shown and illuminated by electric discharges, when it appeared of the most vivid green. The peculiar fluorescent spectrum of this body, and its relations to the spectra of other substances, was explained, and many other illustrations were exhibited.

THE NERVE OF A TOOTH.

MOST of our readers are no doubt familiar with the phrase, the "nerve" of a tooth, but we imagine that very many of them have only a vague idea as to what is meant by the expression, or rather what is understood by it amongst those versed in Odontology. There is, we think, no more interesting field for the inquiring microscopist—certainly none more replete with "entertaining" objects—than the animal frame. Whether his attention is confined to the construction of the tissues of what are commonly termed domestic animals, or is devoted to acquiring a thorough knowledge of the masterpiece of Creation, the ardent pursuer of this fascinating branch of science is unfailingly rewarded for all his trouble. Take, for instance, the subject of this article and consider how necessary a portion of the human economy are those little instruments by which our food is masticated and prepared for digestion and assimilation by those organs whose especial business it is. And yet how few there are who, if they think about it all, imagine their teeth are worth more than the usual daily brush; how many there are who forget that they have teeth, until, frenzied by a severe attack of toothache, they rush to the dentist's to have the neglected servant discharged or its "nerve" destroyed.

A paper by Mr. T. Charters White, the hon. sec. of the Quekett Microscopical Club, affords an opportunity, and points out the way, of becoming better acquainted with our teeth, and we therefore reproduce a portion of it:—

If a tooth be divided longitudinally the main body of such a section would reveal three different substances surrounding a cavity, which, to a certain extent, partakes of the external shape of the tooth; immediately surrounding the cavity, and constituting the principal bulk of the tooth, we notice a fibrous silky substance, called the *dentine;* capping that part of the dentine which appears above the gum, we see the crystalline, almost insensible *enamel*, designed to protect the highly organised and exceedingly sensitive dentine beneath it; we shall also observe that the dentine inserted in the jaw, and forming the root of the tooth, is clothed with a material of a different appearance to the other two substances—that is called the *cementum*. Of the enamel and cementum, it is not necessary on this occasion to speak, but the important relation existing between the "nerve" and the dentine demands that I should enter more into detail in explaining its microscopical appearance. In looking at a section of dentine under the microscope in a well-developed human tooth, one is reminded of those views of the comparative sizes of the rivers of the world given in some atlases, only here our rivers are all the same diameter and about the same length, and run together in parallel waves. If, for the sake of illustration, we speak of them as rivers, we should say that they arise beneath the enamel by exceedingly fine tributaries, by the confluence of which the main stream is gradually enlarged till, flowing on towards the centre of the tooth, its "debouchure" helps to make up the walls of the central cavity, which is occupied in living state by the so-called "nerve." A closer examination of our metaphorical rivers with higher magnifying powers will show us that they are tapering and undulating tubes, and existing so abundantly in the dentine as to impart to it that fibrous silky aspect which cannot fail to strike the most casual observer. These tubes, which, on the walls of the cavity, measure about the ten-thousandth of an inch in diameter, are occupied in a recent tooth by transparent structureless fibres known as the dentinal fibrillæ, the exact office of which is but obscurely defined, but they may minister to the nutrition and vitality of the tooth, since, when from age or disease these tubes become consolidated, the fibrous structure is replaced by one resembling horn, and, as a consequence, the tooth dies, becomes loose and a source of painful irritation. If a section of the dentine be made in a direction that shall cut across the course of these tubes, each tube will present an irregular aperture, and will be seen separated from its fellows by an almost equal proportion of intertubular tissue. We need not now consider any further the character of the dentine, as I shall have to recur to it when speaking of its relation to the nerve; but what I have laid before you will enable you to understand the meaning of much of the structure it is our especial object to examine in the central or *pulp cavity* of a tooth.

If we take a recently extracted healthy tooth and split it we shall notice that the pulp cavity is occupied by a pinkish fleshy mass about ⅜in. long and one-tenth of an inch wide at its upper and thickest part; it partakes somewhat of the external shape of the tooth, being wide in the upper part, and tapering towards the tooth: this, then, is what is popularly called the "nerve." In physiological parlance it is termed the pulp. The basis of this pulp is composed of areolar tissue, whose interstices are filled with a homogeneous plasma.

A microscopical examination of its exterior will reveal an infinite number of small points, giving to it an appearance not much unlike the cross section of the tubes of the dentine, both as regards size and distribution. Having noticed this much, recourse must be had to compression before we can readily make out the arrangements of its internal structure. Before proceeding to flatten it by pressure it may be withdrawn from its cavity, and allowed to soak in the ammoniacal solution of carmine; let it remain in it twenty-four hours, wash away the carmine fluid, and transfer it to glycerine for a few hours; then put it under gentle, gradual pressure for some few hours more, when it will be rendered sufficiently thin to be easily examined by a ¼in. objective or higher powers.

Commencing our examination at that part of the pulp nearest the apex of the root, we shall notice it entering the foramen of the fang as a fine thread, which though so fine nevertheless conveys the nerve and the artery into the pulp, and gives exit to the returning vein; tracing this thread into the pulp we shall readily distinguish the nerve as a bundle of parallel fibres which, running in together a short distance, divide into two, three, or four fasciculi, and dividing again still give off fibres to every part of the pulp; it is highly probable that these fibres end in loops, but the pressure necessary to reduce the pulp sufficiently thin for observation ruptures the loops, and consequently they very frequently appear to terminate in free extremities; but one fact may be easily demonstrated, namely, their course is always at right angles with the dentinal tubuli. Besides the ramifications of the dental nerve the pulp also contains the branches of the artery and its vein; these are not so easily followed, but in an examination of the pulp of a tooth extracted for severe inflammation in it, the congested vessels were naturally injected, and could be seen as a complicated network without any definite arrangement excepting a loop-like distribution towards the circumference; in some cases the vessels of the pulp, becoming stained by the carmine, will be readily seen with their peculiar transverse nuclei and distinguishable from the areolar tissue, whose nuclei are spindle-shaped. There is one feature in the microscopical examination of this prepared pulp which will not escape observation—it is the curious arrangement of its cortical portion. In referring to the microscopical appearance of the exterior of the pulp, as it appears on first splitting a tooth, I alluded to the comparative likeness presented by it to that of the dentine cut across the tubes, and if that comparison is borne in mind in the examination of this external portion of the pulp, under its present circumstances, we may easily interpret the meaning of this arrangement. The cortical substance of the pulp in its healthy condition consists of a number of oval bodies placed side by side with their long axes perpendicular to the surface of the pulp on which they stand; they are deeply stained by the carmine, which proves that they are endowed with active and growing powers. These oval bodies are termed "Odontoblasts." An examination of an odontoblast, which has been isolated by pressure from the others, will show that it has an attachment by a transparent structureless appendage to something within the body of the pulp, while a similar appendage, proceeding from its distal extremity, penetrates a tubule in the dentine, and becomes the dentinal fibril of Tomes.

The odontoblastic layer of the pulp is so important an element in the life and histology of a tooth that its history deserves a closer examination than the limits of a paper like this can afford; but it may be interesting to show the part it plays in the formation of the dentine.

About the sixth or seventh week of embryonic life a groove is formed in either jaw, at the bottom of which, after the lapse of a few weeks, papillæ begin to rise, and shortly after transverse partitions in this groove shut off and separate each papilla, which then becomes the representative of the future temporary tooth. About the seventh month of fœtal life the ossification of the tooth commences, and the dentine is represented by a cup-shaped scale capping the crown, and ultimately extending down the sides and embracing the whole of the upper surface of the pulp. It is at this period of their growth that the odontoblasts are most active, for they have the development of the dentine before them, and deriving a plentiful supply of nutrition from the plexus of bloodvessels beneath them, dentine is formed through their agency from without inwards, till the pulp being reduced to the size at which we generally see it by the gradual formation of the dentine, the odontoblasts become dormant, but capable of awaking to activity under the influence of certain circumstances of irritation; thus if caries attacks a tooth at a particular spot the tubuli in the dentine, through the fibrillæ in them, become consolidated at an equal distance from the point of attack all round it, and a barrier seems to be thus thrown up against the inroads of the advancing enemy; but unless such a remedial measure as the careful excavation of the carious portion of the tooth and subsequent plugging of the cavity be adopted, barrier after barrier may be thrown up but to be overcome. Even then the odontoblasts of the pulp resist by forming new dentine in its very substance, and it is only when inflammation and suppuration destroy the odontoblasts that this reparative process is annihilated. In some cases of general irritation of the pulp, as where the crown of a tooth is worn through by the grinding down and wear of mastication, the whole of the pulp may be converted into an irregular dentine. Sometimes nodules of ossific matter are found in the meshes of the areolar tissue of the pulp, but these do not partake of the character of the dentine, but are semi-transparent and structureless, testifying to the amount of bone-producing matter in the homogeneous plasma saturating the body of the pulp, but which it is the legitimate office of the odontoblasts to build up as dentine.

There are great and, I fear, almost insuperable difficulties in the way of clearly seeing the termination of the nerve-fibres in the pulp; one can only conjecture at the method in which they end. In some specimens two fibres may be seen running side by side for some distance, and when you expect to see a loop the ends are found separated; this may probably arise by the pressure used to render the pulp thin enough for observation. Some specimens, again, show a very apparent looping of the fibres, but the loops extend round the circumference towards the end of the pulp, they are so large; but in no case have I met with fibres that would lead us to suppose that were they small enough to enter the tubuli that they do so. How, then, are we to account for the painful sensation experienced in cutting into live dentine, unless we suppose that a connection of some kind exists between the tubuli and the fibres of the nerve? The only theory that can be suggested is that the dentinal fibre contained in a tube of the dentine passes out through its odontoblast, and then, becoming fused with the nerve, conveys the sensation to the brain, and we are conscious of the irritation.

I have not found it possible to see this connection between the odontoblast and the nerve fibres, because the re-agents usually employed to render nerves visible, dissolve away the odontoblasts; neither have I, by means of thin sections, been more fortunate, as the proximal caudal appendage of the odontoblast is too transparent and too minute to admit of demonstration, except, perhaps, by the employment of new re-agents; in specimens of the pulp, that after staining with carmine have been teased out with needles, the isolated fibres have had, besides their own coloured nuclei, coloured odontoblasts, with this internal caudal appendage fused into their outer parts. Such may be the general mode of their connection, but I am not clear on that point. Such, then, are a few of the principal elements met with in a microscopical examination of what is popularly termed the "nerve" of a tooth, but in case any one may feel inclined to work out these details for himself, it may be as well to append a few remarks relative to the plans of investigation attended by the best results. The teeth employed have been temporary teeth, removed in a healthy condition, to make room for the advancing permanent set, any others being unsuitable from disease. It is necessary to exercise great care in extracting the pulp from them, as the bone dust from the tooth and impurities of various kinds cling most tenaciously to the odontoblasts, and not only obscure the view of the delicate details, but look unpleasant and slovenly. The plan found to answer best is to file a longitudinal groove round the tooth; then, having washed away all the débris very thoroughly, split the tooth with a pair of wire nippers, when it will come in two and expose the pulp for its whole length, which may be withdrawn by seizing it at its smallest part and tearing it out of the cavity. This will draw out not only the odontoblasts but some of the dentinal fibres attached to them. Another very good plan for observing the relation of the pulp to the dentine is to soak the tooth for a few weeks in the carmine staining fluid, which is sucked up through the foramen of the fang, and being absorbed by the pulp, colours it completely. The tooth may then be decalcified by immersion in ordinary hydrochloric acid, which removes the lime but does not hurt the soft tissues. At the end of a fortnight the tooth may be cut in thin slices, when the pulp will be cut with the decalcified osseous tissue, and the relation will be well shown. I have thus, in these few brief remarks, which fail to do justice to my subject, endeavoured to show you that that which is generally called the nerve of a tooth is in reality a mass of areolar or connective tissue, through which ramify the nerve, vein, and artery destined for the life of a tooth, that its function originally was the formation and building up of the dentine, that its powers in adult life remain dormant, but capable of being aroused under the action of a stimulating influence to develop dentine again, and that it performs an important part in ministering to the vitality of a tooth, as well as constituting a tooth a very delicate sensory organ.

THE STAR DEPTHS.

MR. RICHARD A. PROCTOR, Honorary Secretary of the Royal Astronomical Society, delivered his third lecture on the "Star Depths," at three o'clock on Saturday last. This lecture was specially devoted to the consideration of the laws according to which the stars are distributed. The arrangement of the stars visible to the unaided eye was first considered. Then the lecturer discussed the star-gauges of the Herschels, in which 610,000 stars were counted, the researches of Wm. Struve relating to 31,000 stars, and the peculiarities of stellar distribution exhibited in the lecturer's chart of 324,000 stars. Next the motions of the stars were inquired into as bearing on the same question, and the evidences of star-drift—that is, of a motion of whole sets of stars in one direction—were considered and analysed. Mädler's theory of a central sun in the Pleiades, around which the whole galaxy revolves, was shown to be based on insufficient evidence, as Sir John Herschel had already suspected. As bearing on the subject of stellar distribution the fact was mentioned that in certain regions of the heavens nearly all the stars are of one colour—as greenish white in Orion, yellowish in Cetus and Eridanus, and so on. The aggregation of variable stars in certain regions was also discussed, and the remarkable fact mentioned that with the single exception of the "Blaze Star," which shone out in 1866 in the constellation of the Northern Crown, all the temporary stars have appeared within the Milky Way. The lecturer put forward a theory in explanation of this circumstance. He remarked, in conclusion, on the amazing vitality recognisable within the sidereal system. The lecture was illustrated by nearly 30 photographs illuminated by the electric light belonging to the institution.

DEATH OF AN INVENTOR.

MR. AUGUSTUS SIEBE, Sen., the mechanician and inventor, died at his residence in South London on the 15th ult., at the age of 84. He was born in Saxony, but was taken by his parents at a very early age to Berlin, where he was educated. He was apprenticed to a fine caster, and early evinced great taste both in modelling and chasing. In 1812 he had to join the army, and fought as lieutenant in the Artillery at the battle of Leipsic, where he was wounded. On peace being signed he went to Kiel, where he worked at watchmaking. In 1814, he came to England, and obtained employment as a watchmaker, afterwards as a chaser, and then as a gun-maker. In 1820, having become acquainted with Mr. C. A. Deane, who had invented an apparatus for entering into fires, he suggested to him the practicability of working under water with a similar apparatus, and eventually constructed an air-pump and diving dress, now known as the open dress. Seeing the dangers to which the divers were exposed in using the open dress he afterwards invented what is now known as the close diving helmet dress, by which all danger was removed, and to this he continually added improvements—head piece, the outlet valve, the inlet valve, and the regulating valve. In 1848 Sir Charles Pasley, C.B., who was employed in removing the wreck of the Royal George, requested Mr. Siebe to make a trial of his apparatus, which was done with the greatest success, and eventually it was adopted by the Admiralty for the use of the navy. In addition to this contrivance, Mr. Siebe was the inventor of a great number of mechanical appliances which have found their way into general use.

THE PROGRESS OF GEOLOGY.—COAL-MEASURES AND COAL-SUPPLY.*

(*Continued from p. 142.*)

WHILE the presence of water has determined the early settlement of population, the existence of coal has given rise to exceptional local growths of that population, quite irrespective of the original cause of settlement. The existence of coal has created new wants, developed vast energies, enormous resources, and has established great industries dependent upon it for their maintenance and prosperity. Natural causes, unceasing and ever renewing in their action, maintain our supplies of water in a condition of constant and unfailing operation. They are physical and geological agents, equally in force in the past as in the future of the earth's history. Not so with coal, which is a store of the past, and of which we can look for no renewal. Our coal-measures, great as they are, have defined limits, whereas our wants seem to have no bounds. With the increasing magnitude of the latter our fears of the extent of the former have increased, and have given rise to much speculation and much discussion. At first the estimates of the duration of our coal-fields were little more than guesses; but the subject has of late years been treated in a systematic manner, and in all its various bearings, in the able works of Hull, Jevons, and Warington Smyth.

The area of the exposed coal-measures of England may be estimated at about 2,840 square miles. To these Mr. Hull had added 932 square miles of coal-measures overspread by newer formations; but the investigations of Prof. Ramsay lead him now to conclude that this latter total of unproved coal-measures may be increased to 2,988, to which may be added 153 miles of the Bristol coal field, making a total of 3,141 square miles of coal-measures under the Permain, New Red, and Triassic strata of central and northern England, or of 301 square miles more than the area of all our exposed coal-fields. This branch of the inquiry embraces curious questions of variations in the mass of the coal-measures, in the thickness of the strata, and in the number and persistence of the coal-seams. The extent and magnitude of the faults bounding so many of our coal-fields is also a point of great difficulty, especially when it is complicated by denudations of pre-Permian and of pre-Triassic age; and in this intricate inquiry it must be borne in mind that it is not only a question of superposition and faulting, but one also of removal and replacement, involving a number of important geological problems. Especially is it necessary to distinguish steep old-surface and submarine valley denudations from faults.

The other branch of the inquiry relating to the possible range of the coal-measures under the Jurassic, Cretaceous, and Tertiary strata of the south-east of England, involves questions of a much more hypothetical character, and can, in the absence of positive information, only be treated on purely abstract geological reasoning. Still, it is one essentially within the range of inquiry, and the collateral geological data we possess are sufficient to guide and direct those inquiries. There are two primary points to be determined:—First, how much of the area under investigation remained dry land during the Carboniferous period, and was, therefore, never covered by coal-strata. Secondly, supposing the coal-strata to have spread over a portion of that area, how much of them escaped subsequent denudation? With regard to the first question it is comparatively easy, where the Palæozoic rocks now form the surface, to determine the antiquity of that surface, but where the old rocks are covered by great masses of other strata it becomes very difficult to determine the original conditions.

The great lines of disturbance traversing Central and north-eastern England are subsequent to the Carboniferous period, and the many detached coal-basins separated by the Penine chain and the Derbyshire Hills, together with the Mountain Limestone forming those ranges, are held to be portions of one great Carboniferous formation, which, in its entirety, spread from the south of Scotland to central England, and, probably still farther south. This great Carboniferous deposit was originally bounded on the north either by the uplands of the Scottish-border counties, or, possibly, by the Grampians; on the west by the high lands of Cumberland and Wales; while on the south we find no old exposed land-surfaces of older Palæozoic age until we reach Brittany and Central France. With respect to the deposits going on during the Carboniferous period in this area, Professor Phillips was the first to show that the lower Carboniferous series puts on, as it trends north from Derbyshire, more sedimentary conditions—that the Mountain Limestone there begins to show traces of the proximity to land, which increase rapidly in proceeding northwards—beds of shale and sandstone and subordinate beds of coal gradually setting in in the limestone series, and increasing in importance as they approach the older border land. In the same way the approach to an old barrier-land on the south and west is supposed by Professor Ramsay to be indicated in the overlying coal-measures by the increase in number and thickness of the beds of sandstone in the south of the Staffordshire and Shropshire coal-field, and Mr. Hull connects that old land with the Cambrian and Silurian rocks of Leicestershire.

If such were the case, the question arises, did this form a barrier which cut off the Carboniferous deposits from extending over the South of England, or was it only a partial barrier which in no way prevented the extension southward of the Carboniferous rocks? It has been supposed that during the Carboniferous period a spur from the Silurian district of Wales extended eastward from Herefordshire into central England, dividing the coal-fields of Shropshire and Staffordshire from those of Gloucestershire; and that against this old Silurian tract the coal-measures of South Staffordshire die out. If carried farther eastward it would limit the southern prolongation of the coal-measures of Leicestershire, and then pass under the Oolites of Northamptonshire and the Cretaceous series of Norfolk; and so great an expansion has been given it southward, that it would equally exclude the coal-measures from the area of the south-east of England. We have, however, no sufficient evidence of the continuous extension of these old rocks eastward of Staffordshire. Palæozoic rocks show, it is true, in Leicestershire; but there the coal-measures wrap round them, and the older rocks seem merely to be an island in their midst. At those spots in the southern counties where they have been proved underground, I imagine they were raised by disturbances of a later date than the coal-measures, and did not form part of the land surface of the Carboniferous period. As just mentioned, the older Carboniferous rocks show deeper sea conditions as they trend from north to south, and the same deep sea conditions existing in Derbyshire are found to prevail in the Mountain Limestone of Belgium, while, at the same time, similar slight indications of distant land, in the presence of intercalated shales and imperfect coal, reappear and increase westward in their range into the district of the Boulonnais, in France. There is nothing to show but that the spur of old land stretching eastward from Herefordshire was merely a promontory ending in Warwickshire, round which the Carboniferous sea passed and extended southward uninterruptedly to Belgium and the north of France, and westward to Somersetshire and South of Wales, spreading over all this wide area first the Mountain Limestone and then, in due order, the coal-measures. Of the existence of these formations over the south-western and south-eastern portions of this area we have proof in Wales, Somersetshire, and Belgium. The intermediate area is covered by Jurassic, Cretaceous, and Tertiary formations, which hide from us the older rocks whose position it is our object to determine.

Just as with the disturbance which at a later period caused the Mountain Limestone of the Penine chain to break through the great expanse of coal-measures originally spread over the central and northern counties of England, and brought up to the surface the disturbed and disjointed coal-strata, of which, after subsequent denudation we have the isolated portions remaining in the existing coal-fields, so was the area of Southern England traversed by the earlier axis of Palæozoic rocks of the Ardennes and Mendips, bringing up the coal-measures in like manner along their northern flanks in separate basins and troughs, some of which are uncovered by newer strata, while other basins not exposed on the surface may still possibly exist beneath the newer strata of the south-east of England. They have, in fact, been proved to exist under considerable portions of those newer strata of north-western France and of Belgium, and under some of the older Secondary strata in the south-west of England.

All geologists are agreed upon the age of this great east-and-west axis of disturbance. It took place after the deposition of the coal-measures, and before the deposition of the Permian strata. Its effects, all through its range, are singularly alike. It was not so much a great mountain-elevation, as a crumbling up and contortion of the strata for a breadth of many miles, and along a length of above eight hundred miles. The Silurian and Devonian rocks are thrown up by it into a number of narrow anticlinals, and the flanking coal-strata are tilted, turned back on themselves, squeezed and contorted in the most remarkable manner—the same type of disturbance being apparent whether in Westphalia, Belgium, France, Somerset, or Pembroke. These great flexures have also resulted in throwing the coal-measures into deep narrow troughs, having a length of many miles and a width of but very few.

In France, these disturbed old strata are covered by Jurassic, Cretaceous, and Tertiary strata, and in Somerset by Permian, Liassic, and Jurassic strata; they sink beneath the Oolites at Frome, and reappear in Belgium from beneath the Cretaceous strata. What becomes of them in the intermediate area? It is not to be supposed that a line of disturbance of such great magnitude could have been intermittent. The coal-trough has, in fact, been followed from near Charleroi, where it passes under the Cretaceous and Tertiary strata, to Mons, Valenciennes, and Bethune, a distance of eighty-six miles. Along the whole of this line, the Chalk and overlying beds extend, with a thickness varying from 500ft. to 900ft. around Mons, decreasing to from 250ft. to 300ft. near Valenciennes, and increasing again towards Bethune. At Guines the Chalk was found to be 670ft. thick, and at Calais 762ft. On the other side, the coal-trough of Somerset passes eastward under the older Secondary rocks, which in their turn pass under the Cretaceous and Tertiary strata of Wiltshire; but no attempt has been made to follow coal-measures beyond a distance of six miles from their outcrop, where the overlying strata have been found to attain a thickness of about 450 feet.

The original supposition that the Secondary strata maintained, in the main, their regular sequence, and, to a certant extent, their thickness over larger areas, has long been proved to be erroneous; but we were hardly prepared until lately to learn how rapid the variation in their thickness is. Mr. Hull has now shown that the Great and Inferior Oolites thin out from a thickness of 792ft. in Gloucestershire to 205ft. in Oxfordshire, and the Lias and Trias from 1,090ft. to 400ft. (?); while in like manner the Trias decreases from 5,600ft. in Lancashire and Cheshire, to 2,000ft. in Staffordshire, and 600ft. in Warwickshire. We also know that on the northern flank of the Mendips, the Trias, Lias, and Oolites tail off, although their dimensions in Gloucestershire are so considerable. It would appear that all the Secondary rocks, except those of the Cretaceous series, show a distinct thinning-out in their range southward, which is doubtless due to the existence of an old pre-Triassic land on the south—such as would have been formed by the prolongation of the Palæozoic rocks of the Ardennes and Mendips through the south of England. It has been urged, on the other hand, that this thinning-out is a proof of the existence of a still older land in that area; but as the argument is based on the evidence of rocks of post-Carboniferous age, it is clear that, whether the land were of Cambrian and Silurian, or of Devonian and Carboniferous age, the result, as affecting the Secondary rocks, would be the same.

This thinning out of the Secondary strata has now been proved not to be merely hypothetical. At three points, on or near the presumed line of the old underground range, the Tertiary and Cretaceous strata have been traversed in well-sections, and Palæozoic rocks found to underlie them at once, without the intervention of any Triassic, Liassic, or Oolitic strata. Thus at London the presence of red and gray Sandstones, apparently of Palæozoic age, has been proved under the Chalk at a depth of 1,114ft. Again, at Harwich, and at Calais, strata of early carboniferous age have been found also immediately under the Chalk, at depths respectively of 1,026ft. and 1,032ft. There is therefore reason to believe that the underground ridge of the Mendips and the Ardennes passes in a line from Frome through North Wiltshire, Berkshire, Middlesex, North-east Kent, and between Calais and Boulogne, at a depth beneath the Secondary strata of not more than from 1,000ft. to 1,500ft., while the coal-troughs, which may flank this range on the north would, judging from the analogy of the structure and relations of the same rocks at Mons and Valenciennes, be met with at depths very little, if at all, greater.

To the north of this area it is probable that the thickness of the overlying rocks is greater; but we have no means of knowing exactly. In Northamptonshire the Great and Inferior Oolites and the Lias have been found not to exceed together 880 feet, at which depth the New Red Sandstone was reached; but its thickness was not proved beyond 87 feet; while at Rugby the Lias was found to be about 905 feet thick, below which 136 feet of beds of New Red Sandstone were passed through. Looking at the proved thinning out from north to south of the New Red and Permian strata, there is no reason to suppose that they would be found of any very great thickness in the southern counties. Even immediately to the south of the known coal-fields of the midland counties, the trials for coal have not yet proved any very great thickness of these rocks. It would seem, in fact, that the extensive tracts of Chalk, Oolites, and Trias, forming the substrata of our midland and southern counties, constitute but a comparatively shallow crust filling up the plains and valleys of Palæozoic rocks, the great framework of which stretches apparently at but a moderate depth under our feet, and of which the highest ridges only, such as those of the Ardennes and Mendips, now rise above ground.

It is clear, therefore, that in any search for coal, the relation of the Secondary and the Palæozoic groups of rock to one another being perfectly independent, the latter must be considered entirely on their own internal evidence, and apart from the bearing of the newer rocks covering them and forming the present surface, except possibly in a few cases where old lines of disturbance have proved points of least resistance, and yielded again, as suggested by Mr. Godwin-Austen, to later movements, which have equally affected the overlying formations.

* An abstract of the annual address of the President of the Geological Society.

It was in the north that the conditions fitted for the formation of coal first set in. The common *Stigmaria ficoides* and various coal-measure plants appear at the base of the Carboniferous series of Northumberland, which there overlies conformably the Upper Old Red Sandstone; and productive beds of coal exist low down in the Mountain Limestone series. These disappear in proceeding southward, and the great productive coal-series becomes confined to beds overlying the Millstone Grit.

Of the prolongation of the axis of the Ardennes under the south of England there can be little doubt; nor can there be much doubt that the same great contortions of the strata (which in Belgium placed the crown of the anticlinal arch at a height of four or five miles above the level of the base of the accompanying synclinal trough, to the bottom of which the coal-measures descend, and was the cause of similar folds in the coal-measures of Somerset and Wales) were continued along the whole line of disturbance, and that the preservation of detached portions of the same great supplementary trough is to be looked for underground in the immediate area, just as it exists above ground in the proved area; for the minor subordinate barriers dividing the coal-basins can, I conceive, in no way permanently affect the great master disturbance, by which the presence of the coal-measures is ruled. Whether, however, admitting that the coal-measures were originally present, they have been removed by subsequent denudation, is another question.

(*To be concluded next week.*)

HINTS ON PAINTING.*—V.

(*Continued from p. 88.*)

Gilding.

THIS beautiful art requires our special attention, for it appears to many to be a very troublesome operation to execute well. But it is easily done, as my remarks will show, and a little experience prove. It is best when gilding on carriage or waggon work, where the gold will be protected with varnish, to procure "gold size" ready prepared —English gold size being the best. If not to be had, you can make a substitute by using English varnish and Japan in equal parts. If the gilding is for striping, you should mix a little chrome yellow with it, to be able to see the lines better; but in lettering no colouring is required. Having your job rubbed down smoothly, take a piece of muslin and tie up in it a little whiting to form a "pounce bag;" with this you pounce or dust over every part of the work where the gold leaf is to be put, to prevent the leaf from sticking to the surface not covered by the size. Another method is to wash the job over with starch water: while still another plan is—where dust or starch is not applicable on account of newly varnished work near by—to cut a potato in half, and with the raw surface rub the place desired, leaving the juice of the potato on; this soon dries and forms a thin film, to which the gold will not adhere. Any one of the above methods will be found to answer the purpose, and the coating will wash off clean when the gilding is dry. The surface prepared, take the size and put on the stripes, ornaments, or what not, and allow it to dry just enough to enable you to pass your finger over it without sticking; but if when the finger is placed directly upon it, it is "tacky," it is ready to receive the gold.

For signs, or work which is not to be covered with varnish, we should use oil size, which is made with old boiled oil. The best is that taken from a paint cup in which the paint has settled and left the oil on top. Pour this off carefully and grind into it a little chrome yellow.

To Lay Gold Leaf.

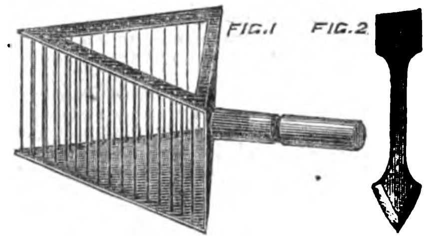
If for scrolls, letters, or large work, take the book of gold leaf in the left hand, and with the forefinger of the right hand lift the first paper leaf, leaving the gold on the opposite leaf smooth; then holding the book close to the work, with the front pointed downwards towards the bottom of the letters or scroll and lightly touch it, rolling the book up and leaving the gold on the letters. Repeat this operation until all the size is covered. Touch any missed spot with the finger tipped with the superfluous gold, and wipe all off nicely with a bunch of cotton. For striping it is better to use a "tip." Place the book on a piece of board covered with cloth, and raising the paper, cut the leaf the desired size with a table knife, the edge of which is perfectly straight and smooth. Then draw the tip across your face or head, to slightly grease it, and lay it on the cut gold; you can then lift and carry it to the size. Thus you can proceed until the striping is completed. Some painters cut the book of gold leaf in strips, and lay the leaf directly from the stripes: practice with either method, and you will find it easy enough. Gold may be shaded with transparent colours, such as asphaltum, ultramarine, lake, carmine, verdigris, Paris green, &c., to suit the taste of the painter.

Bronzing.

Gold bronze is used on carriage parts for striping; and many fine fancy jobs can be done with this powder. The size used for bronze is the same as that described for gold leaf. To put on the bronze, take a piece of plush or velvet, and make a small "pounce" bag, by tying up a ball of cotton. This will take up the bronze, which is gently rubbed over the size. The best quality of bronze is but little inferior to gold leaf, and for striping is better, as it does not consume so much time, and at the same time it is cheaper than gold leaf. To make fancy work with bronze, cut out any desired pattern in paper, and laying it over a nearly dry varnished surface, rub the bronze on through the holes of the pattern. The fronts of the spokes and the ribs of express waggons may be nicely ornamented in this manner. Copper and silver bronze can also be used in this way, and when the three are mixed up in ornaments they look well.

To Remove Old Paint.

There are various methods employed for removing old paint, and I will endeavour to describe them. First there is the hot-iron process. This is done by taking a heavy piece of iron and heating it in a stove or forge, and then holding it close to the work. The paint will blister or soften, and can be scraped off with a putty knife or chisel. A better plan is the furnace process. The furnace is made of sheet-iron and heavy wire; its general form is shown in Fig. 1.



The triangular shape allows it to be held closely to the work on either side. Being filled with ignited charcoal, and a good fire kept up by holding it in a draft frequently, one can with this "burn off" a body very quickly and well.

There is also a patent lamp used for the purpose (p. 124). I have used it, and found it an excellent tool. It is designed to burn alcohol, and makes at the same time alcoholic gas, which is directed upon the flame by a pipe, while the flame is blown out in a long tongue of fire. This lamp is self-acting, and the workman merely holds the lamp in his left hand, directing the tongue of flame upon the desired spot, scraping the paint off as he goes along with the right hand.

Still another process is the potash plan. Dissolve one pound of potash in three pints of water over the fire, then add yellow ochre or some common dry paint until it is as thick as rough stuff. Smear this over the panel with an old brush, and in a little while you can scrape off the paint like old cheese.

After the paint is taken off by the potash process, wash the wood well with soap and water to remove any residual potash, dry off and sandpaper, and then give a coat of clean raw oil. With the furnace or hot iron process, sandpaper smoothly and apply a coat of the usual priming, and proceed as if on new work.

Carriage parts must be scraped, and for this purpose I use a tool, of the shape shown in Fig. 2. It is made of steel (an old file, for instance), the square centre part being ground, and the four square edges are excellent to scrape the spokes, while the ends will be found useful on the carriage part. It is only where an extra job is wanted that it will be necessary to scrape off the carriage part, for we can generally fill them up with lead and get a good substantial surface.

Re-Varnishing.

Old jobs should be rubbed well with pumice-stone and water, the bare wood being covered with lead colour. All spots not bare can be touched up with dead colour; then put on a coat of rubbing varnish. It there be spots yet not coloured properly, they can be fixed for the next or finishing coat. It is generally the cheapest plan to colour the carriage part over and stripe anew, as it is a long, tedious job to touch it up, and never looks well.

To Bind a Brush.

Brushes, when new, should be bound at least one-third the length of the hair, to preserve them and render them better for use. Some painters bind a strong cord round and round to the proper distance, and secure each end to the handle.

But a better way is, to take a piece of strong muslin and wrap one thickness around the hair, then tie a cord firmly around the same as low as you desire the binding to come: then fold the muslin back toward the handle, and fasten it by tacking the margin around the border of the original binding.

This method makes a very neat binding, especially for varnish brushes.

Bleaching Oil.

Pour about as much linseed oil into a shallow earthen vessel as will stand one inch in depth; then pour in six nches of water, cover with a fine cloth, and let the whole stand in the sun for a few weeks until the liquid becomes thick, when it should be poured in a phial and submitted to a gentle heat, after which the clear is to be poured off and strained through a flannel cloth.

The longer oil is kept, it is always the better both in regard to its drying and transparent qualities. To make good nut oil, the skins of ripe walnuts should be peeled off, as it contains an acid which turns it brown. Poppy oil is made from the ripe seed of poppies. It is the best drying oil. The oil of spike, or lavender, is obtained by distilling spike with water; it is very volatile and fine for working with the pencil, or for enamelling. To make a fine drying oil for extra fine painting, take of poppy oil or nut oil one pint, of gum sandarac two ounces, of white vitriol and sugar of lead each one ounce. Boil the whole till the solid ingredients are dissolved, and the mixture is the colour of linseed oil. This oil will dry fast, and a portion of pure turpentine added makes a fine oil for use where the purest white tint is required. It may be mixed with other oils as a dryer, where common drying oil would be injurious to the colour.

Raw linseed oil for carriage work is best, as being more volatile than boiled oil, it strikes into the wood, and forms a hard, resinous filling.

To Transfer a Picture.

Pictures are frequently transferred to painted surfaces or wood, and may be seen on stages, fancy boxes, &c. To transfer a picture, prepare a white ground well rubbed down with pumice-stone and water. Then apply a thin coat of very light-coloured varnish. (English hard drying is good). When this is not quite dry—"tacky," like gold size—damp the picture on the back with clean water, and lay it between some newspapers to remove any water that might be on the face of the picture: then lay it carefully on the varnished surface, pressing it down with a damp cloth, or the finger, until there are no bubbles of air underneath. If there should be bubbles not easily pressed out, prick them with a pin to let the air escape. Then stand the work aside to dry, and when hard, damp the paper, and it can be rolled off by the finger in small rolls, until the picture is left quite perfect on the paint. After this has dried well, a coat of clear light varnish will finish the operation. The same process is used to transfer pictures to glass, and when coloured on the back they look beautifully. Almost any one can do this kind of ornamentation nicely. Try it on a small scale.

Another method is to use Grecian varnish—Canada balsam and turpentine,—but Copal varnish is better where you desire durability; and, besides, every carriage painter has the material always at hand.

* From the "Carriage Painter's Manual." By F. B. Gardner. New York: S. R. Wells.

SOME RECENT IMPROVEMENTS IN ENGLISH AND AMERICAN BOILERS.*

By W. Forsyth Black.

(*Concluded from page 139.*)

THE size of the boiler is regulated within certain limits by the number of units employed in its construction. The units are always of one size, and more can be added at any time without disturbing those previously fixed. The usual, and, indeed, the most advantageous size of the boiler consists of six arched front units and twelve rear units—equal to about 36 horse-power. The effective heating surface of one rear unit, from the top of the base-piece to the centre of the upper chamber, is 23 square feet, which is considered equivalent to about 2 horse-power; and the effective surface of each arched unit above the firegrate level, taking only the inner half of the surface, is 7 square feet, which, from its position, is also considered equivalent to 2 horse-power.

Though larger boilers than this size have been made, they have not been found so easily manageable on account of the firegrate being rather too deep for efficient and ready firing. Consequently, when more power is wanted, it has been found better to employ two smaller instead of one larger boiler.

The boilers were practically introduced in this country by the Isca Foundry Company, at Newport, Monmouthshire, where the first was erected. It was employed to drive machinery which had been previously driven by a Lancashire boiler of 26ft. in length and 6ft. in diameter, with two outer flues of 2ft. diameter, the firegrate being 27 square feet, and the total heating surface 390 square feet. The cast-iron boiler used in its place has eight arched units and fourteen rear units, giving a heating surface of 378 square feet, and the firegrate area is 17 square feet.

The result of a careful trial, extending over ten days, to test the relative consumption of the two boilers, including in each case the fuel requisite to get up steam, was, that the average total consumption of fuel per day was 16cwt. with the cast-iron boiler, and 27cwt. with the Lancashire boiler, the day's work being practically the same for each boiler. The coal used was Monmouthshire small

* Read before the Civil and Mechanical Engineers Society.

steam coal, costing 6s. per ton at the boilers, and the difference of cost in working was consequently very considerable.

Trials made to ascertain the evaporative power and economy of the cast-iron boiler have proved very satisfactory; and, in one instance, an evaporative duty was obtained of 11¼lb. of water per pound of coal. In this case 625¼ gallons of water at 53° Fahr. were evaporated in 3 hours 54 minutes by 560lb. of Ebbw Vale Elled coal, amounting to 11·17lb. of water per lb. of coal, and equivalent to 11·67lb. of water, evaporated from 100° standard temperature of feed; the steam pressure was from 55lb. to 60lb. per inch.

I have been able to obtain minute details of this trial, also of others. The first table gives the particulars of the experiments upon the evaporative duty of the cast-iron boiler to which I have just referred. The general results were that the evaporative duty ranged from 10·15lb. to 11·67lb. of water per pound of coal, calculated at the standard temperature of feed of 100° Fahr., the mean evaporative duty being 10·93lb., and the rate of evaporation per square foot of grate surface per hour ranged from 79lb. to 119lb. of water, the maximum temperature in the chimney flue did not exceed 425°, and the firebars had ¼in. spaces between them.

In a subsequent series of experiments made upon the same boiler by Mr. Joseph Tomlinson, with other kinds of South Wales coals, for the special purpose of testing the speed of evaporation and the evaporative power of the boiler, the evaporative duty ranged from 9·37lb. to 10·15lb. of water per pound of coal, the mean being 9·82lb.; the maximum temperature in the chimney flue was 575° Fahr., and the firebars had ¼in. spaces. The rate of evaporation per square foot of grate per hour ranged from 136lb. to 159lb. of water.

One of these boilers has been working at the City Saw Mills, Worcester, continuously for about ten months, and about five or six months ago it was opened, the interior was carefully examined, and the whole deposit raked out. There was found a small quantity of loose scale and mud in the bottom horizontal tubes 10lb. in weight, and consisting of thin scale of less than one-sixteenth of an inch in thickness; and the interior surface of the cast-iron units was found to be quite clean. Their outer surface, where exposed to the fire, was also found to be quite sound, and the metal uninjured. This boiler, which is of the size shown in the engraving (p. 138), had been supplied with water from the water-works, and had been regularly blown off completely under steam pressure every week, and refilled again at the main; in addition to being partially blown off twice a week to the extent of 2in. of water.

The fracture at the centre of the length of one of the vertical tubes of a rear unit, to which I have referred, did no damage whatever, and in two other cases where fracture took place it was where the last front arched unit is connected with the first rear unit; the result was simply the escape of water from the boiler through the fracture, without any other damage whatever ensuing. This second fracture occurred from a method of construction which was altered after the early boilers for this country had been made. The bottom flanges of the last front unit were at first bolted to the bottom tube of the first rear unit, on each side of the fire, so that the legs were prevented expanding freely sideways; consequently, when the arched tubes expanded under the heat a strain was thrown on the two bottom connections, which caused one of them to give way. On this account the connection of the arched units to the first rear unit is made on one side only of the fire, the legs being thus left free at the other side to yield laterally to the expansion of the arch. Although, therefore, this boiler is not exempt from being injured through ignorance or carelessness, it has been proved with ordinary care in working to be safe, and to be free from any risk of a destructive explosion.

It has also the advantage of an easy and ready replacement of any portion of it being effected without disturbing any other portions, by simply disconnecting the joints at the bottom, and the steam-pipe at the top, of the unit to be removed. Access is obtained for this purpose by removing a portion of the brickwork at one side, opposite to the unit to be taken out, which is then disconnected and drawn out sideways, and the whole process of removal and making good again may be completed in 24 hours. The brickwork setting of the boiler is of very simple description, consisting only of side walls with low cross walls for the support of the separate units.

As the total quantity of water contained in this boiler is small to the extent of heating surface—a range of 9in. in the gauge-glass giving only a capacity of 100 gallons, it is requisite in ordinary working that the water-level and the feed should be attended to regularly at intervals of not more than 20 minutes.

The fronts of the boilers are formed of cast iron. The lining of the door is perforated for the admission above the fire of air supplied through a register in the outer shell of the door. The advantage of such an arrangement for securing thorough combustion of the gases, and for preventing the escape of fuel in the shape of smoke, has long been known.

TABLE I.—EXPERIMENT UPON EVAPORATIVE DUTY OF MILLER'S CAST-IRON BOILER, AT THE ISCA FOUNDRY, NEWPORT. With Monmouthshire Steam Coals.

Date of Experiment.	Description of Coal.	Coal burnt per sq. ft. of grate per hour.	Pyrometer in flue beyond boiler, highest reading.	Actual temperature of feed.	Water Evaporated. Calculated from actual temperature of feed. Per lb. of coal.	Per hour.	Per sq. ft. of grate per hour	Calculated from 100° Fahr. standard temperature. Per lb. of coal.	Per hour.	Per sq. ft. of grate per hour
		lb.	Fahr.	Fahr.	lb.	lb.	lb.	lb.	lb.	lb.
1869.—September 9	Tredegar large coal	7·65	—	70°	10·12	1316	77·41	10·40	1352	79·53
" 16	Ebbw Vale elled............	8·45	—	63°	10·52	1512	88·94	10·83	1557	91·63
November 15	Ditto	8·44	360°	53°	11·17	1604	94·35	11·67	1676	98·60
" 24	Abercarn top	10·32	400°	56°	9·74	1710	100·59	10·15	1781	104·82
" 25	Abercarn bottom	8·60	350°	56°	10·81	1580	92·94	11·26	1646	96·85
1870.—February 5	Ebbw Vale elled............	10·67	425°	45°	10·58	1921	113·00	11·14	2023	119·01
" 22	Tredegar small coal......	9·83	375°	48°	10·52	1763	104·00	11·05	1856	109·21

In these experiments the space between the grate bars was ¼in.; area of fire-grate, 17 sq. ft.

NOTE.—The equivalent evaporation from 100° Fahr. standard temperature of feed is calculated by the Admiralty formula which was employed for the purpose in the Wigan coal trials, in 1866-67, the latent heat of steam at atmospheric pressure being taken at 988° Fahr. Pounds of water actually evaporated $\times \frac{988° + 100° \text{ standard}}{988° + \text{temperature of feed}}$ = pounds of water evaporated from 100° standard temperature.

TABLE II.—EXPERIMENTS UPON SPEED OF EVAPORATION AND TOTAL EVAPORATIVE POWER OF MILLER'S CAST-IRON BOILER, AT THE ISCA FOUNDRY, NEWPORT. With Cardiff Steam Coals.

Date of Experiment.	Description of Coal.	Coal burnt per sq. ft. of grate per hour.	Ash and clinker.	Pyrometer in flue beyond boiler, highest reading.	Actual temperature of feed.	Water Evaporated. Calculated from actual temperature of feed. Per lb. of coal.	Per hour.	Per sq. ft. of grate per hour	Calculated from 100° Fahr. standard temperature. Per lb. of coal.	Per hour.	Per sq. ft. of grate per hour
		lb.	Pr cent.	Fahr.	Fahr.	lb.	lb.	lb.	lb.	lb.	lb.
1870.—May 24	4ft. vein......................	15·47	4·0	500°	56°	9·27	2441	143·59	9·67	2544	149·63
" 25	9ft. vein......................	16·47	4·0	500°	56°	9·26	2594	152·58	9·66	2703	159·00
June 17	4ft. vein......................	16·77	4·5	550°	67°	9·09	2592	152·47	9·37	2673	157·24
" 22	Locomotive coal..........	15·82	6·6	525°	69°	9·35	2514	147·88	9·62	2587	152·29
July 7	Steam vein (light firing)	14·00	4·8	525°	67°	9·85	2346	138·00	10·15	2419	142·32
" 13	Ditto (hard firing)	15·18	4·7	550°	70°	9·64	2539	149·35	9·90	2611	153·59
" 14	4ft. vein......................	15·19	4·7	550°	70°	9·85	2543	149·59	10·12	2615	153·83
December 13	Two veins mixed	13·53	4·4	575°	44°	9·56	2200	129·41	10·08	2320	136·44

In these experiments the space between the fire-bars was ¼in., and the fire was not disturbed with the pricker, the shovel only being used for firing; area of firegrate, 17 sq. ft.

As, however, such admission of air is only requisite for a certain time after the application of fresh fuel to the fire, a difficulty has been experienced in the burning out of the lining of the furnace doors. This has been provided for by making the lower hinge hollow, and thus establishing through it an air passage between the ash-pit and the interior of the door. A register or valve is placed in centre of door and by opening and closing this air is admitted as requisite. These doors have been proved to have no tendency to sag, or crack, or warp. By use of such an appliance combustion is improved, the radiation of heat is prevented, and the engine room is kept cooler. A door for the ash-pit is also provided.

That there are many advantages consequent on using these boilers is, I think undeniable; and most important of all of these is the immunity from destructive explosions. There follow economy of fuel and consequently steam at low cost; facility of repair, both as regards the ready obtaining of any part, of rapidity of fixing the same; and, not least, the special and obvious advantages of a number of small and comparatively light parts for easy and cheap transit, by sea or land.

Such are the leading characteristics and details of this novel species of boiler—novel alike from the material of which it is composed, and the manner in which this material is adapted to what at first sight would seem an improper object. As the old Latin saying holds true in things scientific, that "the end is the crown of the work," and when we see that end to a great extent attained, no preconceived notions of unfitness as to the means employed should deter us from examining it in all its details, and determining for ourselves how far success has been achieved.

SUBMARINE TELEGRAPH CABLES.

THE construction and submersion of submarine telegraph cables formed the subject of a paper read before the Edinburgh and Leith Engineers' Society, by Professor Fleeming Jenkin, F.R.S., from which we abstract the following information in connection with a growing industry and an important commercial enterprise:—All submarine cables hitherto laid have consisted of three parts:—1. The conducting wire, generally, if not universally, copper. 2. The insulator surrounding the conductor, generally guttapercha, or some preparation of indiarubber. 3. An outer covering intended to afford protection, and give longitudinal strength. The simplest form of outer covering consists of iron wires laid helically over a jute or hemp serving.

Conductor.

Copper, being the metal which offers less resistance to the passage of the current than any other commercially available, is employed in all but a few exceptional cases. The earliest cables had conductors formed of a solid wire, which has the advantage of occupying less bulk than any strand, and so requiring less insulating material to give the same thickness of coating. This advantage was more than counterbalanced by the brittleness of the solid core, which breaks after being bent a few times, and frequently caused total interruption of telegraphic communication. A strand of three or seven wires is, therefore, now universally used. Messrs. Clark and Bright introduced a strand made of wires of such section as to fit into one another, building a truly circular rope, and thus endeavoured to combine the advantage of the strand and solid wire. Many have been unable to carry this plan to any commercial advantage. The strength of copper wire is given in some books as equal to 60,000lb. per square inch, but the one used in submarine cables is chosen rather for electrical than mechanical properties, and will bear only from 35,000lb. to 39,000lb. per square inch. It elongates from 10 to 15 per cent., or even more, before breaking, so that its full strength cannot be made use of; but this extensibility is a very valuable property, since it insures that the conductor shall not break before the full strength of the protecting cover has been made use of and overcome. A copper strand will bear 1½lb. per pound weight per knot before breaking. It will stretch 1 per cent. with 1lb., and will not stretch sensibly with a weight of 0·75lb. per pound per knot.

Thus a strand weighing 300lb. per knot, such as was used for the Anglo-American cables, will barely carry 450lb., will stretch 1 per cent. with 300lb., and will not stretch sensibly with 250lb.

Great care is necessary in making the joint between two portions of the conductor. A scarf joint is first made by soldering together two tapered and fitted ends. Fine copper wire is wrapped round this joint, which is somewhat inflexible, and solder run round the wire. A second wrapping of fine wire is then given, and left without solder. The solder must be applied with rosin, and not with spirits of salt.

The joint is necessarily less extensible and more brittle than the rest of the conductor, but if from any cause the soldered joint is broken and stretched so as to open, the fine wire maintains perfect electrical connection, being simply pulled out like a helical spring.

Insulator.

Even the best insulators, such as glass and guttapercha, do conduct to some extent. Indiarubber has a somewhat higher resistance than guttapercha, and different preparations differ considerably in their resistances. Indiarubber has been applied in many ways to the conductor. Most commonly tapes of masticated or bottle rubber are wrapped round and round the conductor until the required thickness is obtained. These tapes used to be gummed together by solvents, but this plan was found to cause decay, and has been abandoned. Simple heat has also been applied unsuccessfully; the indiarubber so heated becomes tacky. Mr. Siemens applied the tubes longitudinally, and simply pressed the freshly cut edges together. This did not make a safe joint. Some manufacturers vulcanised the indiarubber, but the material thus formed, although quite homogeneous, absorbed water, was subject to decay, and allowed free sulphur to reach the copper wire. Mr. Hooper's method of applying indiarubber has been the most successful; he covers the conductor with tapes of pure indiarubber next the copper, followed by a coating of oxide of zinc and indiarubber, which he calls a separator. The separator is inclosed in a jacket of vulcanised indiarubber. In the process of baking the core to vulcanise the jacket, a little sulphur passes the separator and slightly vulcanises the pure rubber, which is welded into a perfectly homogeneous mass; the core during this process is heated to 250° Fahr. and baked for four hours; it does not become tacky and is remarkably compact and durable. The joints between two lengths of the insulated core are made with the same materials, and are baked for two hours in a steam-jacket. This is the only application of indiarubber which has been thoroughly successful for submarine cables.

Guttapercha is more easily applied, and its use has been attended with almost invariable success; it is pressed out while warm and plastic through a die round the conductor; several successive coatings or tubes are thus applied till the desired thickness is attained. The first coating is attached to the strand by what is termed Chatterton's compound, being a sort of mastic composed of 1 part by weight of Stockholm tar, 1 part of resin, and 3 parts of guttapercha. Guttapercha will bear about 3,500lb. per square inch of section, but owing to its great extensibility it does not add more than about one-third of its strength to the copper strand. It will stretch 50 or 60 per cent. before breaking, and will bear an astonishing amount of ill usage—such as knotting, squeezing, or stretching, but is easily pierced by a nail or similar sharp tool, or cut by a knife. It becomes soft at the temperature of about 100° Fahr., and after manufacture should never be subjected to a higher temperature than 90° Fahr. The joints are made by heating the two ends of the covered conductor after the copper has been joined, and applying by hand successive coatings of warmed and plastic guttapercha, the separate layers of which are cemented by Chatterton's compound. Much skill and extreme cleanliness are required in making these joints, which were a frequent cause of failure in early cables. If the guttapercha be either overheated or under heated the junction effected is not permanent, the guttapercha at the joints becomes hard and brittle, and shrinks back from the guttapercha of the core, leaving a very visible gap which destroys the insulation. The process is now thoroughly understood, but each joint is made under inspection, and subjected to strict electrical tests after completion. When dry and exposed to light guttapercha very rapidly decays, becoming brittle and porous, but under water it appears to undergo no change whatever. The electric and mechanical properties of the cores of cables laid down twenty years ago are as good as ever. The experience with indiarubber is totally opposed to this. All forms except Mr. Hooper's rapidly change under water. Mr. Hooper's appears hardly so absolutely permanent as guttapercha, but the change observed does not appear to be material. Hooper's indiarubber will bear much greater exposure to heat than guttapercha, and is much more permanent in dry places. Both guttapercha and Hooper's indiarubber absorb some water, but not to such an extent as to be mischievous. Some forms of indiarubber are rendered unfit for use by this absorption, which in pure indiarubber is such that the material absorbs 25 per cent. of its own weight of fresh water.

The completed core has considerable strength. The Anglo-American cables have a core with 300lb. of copper and 400lb. of guttapercha, and this bears without injury ¼ ton quite unassisted by the outer covering; it will stretch 10 per cent. under this weight, and may afterwards be knotted and squeezed without any electrical injury being done. Before the application of Chatterton's compound the copper wire used, after a strain had come on the core, to allow the guttapercha to slip back over it without itself returning to its original length. This forced the copper to buckle, and in some cases brought it through the guttapercha. This can no longer occur. The dimensions of the core are determined by the number of words per minute required to be transmitted, and by the total length of the cable. With guttapercha cores the ratio of copper to guttapercha in pounds weight per knot varies from equality to two-thirds. The smallest core practically used has 73lb. of copper and 119lb. of guttapercha per knot, a more common size is 107lb. copper and 105lb. guttapercha. The largest size yet adopted is 400lb. copper and 400lb. guttapercha for the French Atlantic.

The number of words which a core will transmit is inversely proportional to the square of the length, and when a constant ratio is maintained between the weights of the insulator and conductor, it is simply proportional to the weight of the core per knot. Thus a core of 100lb. copper and 120lb. guttapercha will transmit 20¼ words with the mirror and rather less than 1¼ word per minute with a Morse instrument; if Hooper's material or Willoughby Smith's improved core are used, the speeds would be 24 words and 1·7 respectively.

The Morse is restricted to short lengths of cable, thus 250 miles of the above core would transmit by Morse 27 words per minute, or as much as a clerk can conveniently send by hand; the mirror cannot be read at much more than 30 words per minute; but Sir William Morrison's new recording instrument will receive as fast as the mirror, and leaves a permanent writing which can be read at leisure; with this instrument as much as 120 words per minute may be read if the core will allow it.

Outer Covering.

The core is served with hemp or jute applied wet, and either tanned or saturated with brine; originally the hemp was tarred, but the tar tended to prevent the discovery of faults, sealing up any small aperture temporarily. Sometimes for cables of moderate length several cores, 3, 4, or even 7, were laid up together so as to form with strands of hemp, called worming, a circular rope, which was served like the single core with hemp or jute. These multiple cables of course transmitted independent messages through each core. The served core is commonly protected in cables intended for moderate depths by a sheathing of iron wires laid round in a long helix, so as to give the cable the appearance of an ordinary iron-wire rope. The tube which the wires so laid on forms cannot diminish in diameter, and hence stretches very little more under a given strain than an iron rod of the same weight per knot would do. The diminution of diameter is prevented by the abutment of each wire against its neighbour, so that the soft heart of the cable undergoes no compression. If the wires are laid on with equal tension the strength of the completed cable is equal to the sum of the strengths of the wires which compose it. In the spinning or closing machines, as they are called, the wire is wound on bobbins, which as they revolve round the axis through which the core passes remain parallel to themselves, so as not to put a twist in the wire.

A cable so formed is not spongy, and has little liability to kink, that is, to throw itself into a loop when leaving the hold of the ship in which it is coiled. The elongation of an ordinary iron covered cable with half the breaking weight varies from about 0·5 to 1 per cent., an amount which can never injure the core. While being laid the cable generally untwists slightly, but the elongation from this cause also is insignificant. The iron wire is protected from rust by being galvanised, and still further by being covered with hemp or jute, and a compound of asphalte and silica. A cable covered with good iron should bear 2 tons per pound of iron wire per fathom.

A large size of wire is used for shore ends, to protect the cable against anchors, attrition, and rust; for this purpose cables of from 10 to 20 tons per knot are used. The largest size is generally covered with 10 or 12 strands, each spun of three galvanised iron wires. A cable so made is much more flexible and easily handled than one covered with solid wires. Cables covered with ordinary iron are hardly strong enough to resist the strains to which they are exposed while being laid in depths above 1,500 fathoms; above this, homogeneous iron wires (really a variety of steel) are employed. This material will bear from 50 to 60 tons per square inch. The Malta and Alexandria cable is an example, which differs in nothing from the shallow water cable except in the substitution of homogeneous iron for ordinary iron.

Outer Protection.

For still greater depths recourse is had to a more complex type of cable. Each steel wire is inclosed in a serving of hemp or manilla, the strength of which may be added to that of the steel in calculating the strength of the cable, while the serving adds nothing to the weight of the cable in water. The elasticity of a straight hempen fibre is less than that of most steel, but by choosing the lay of the hemp strands properly, the hemp or steel may be made to stretch so evenly as to give way together, and then the strength of the served wire or cable is found to be actually greater than the sum of the strengths of the compound parts; each part breaks at its weakest point, but these weak points never all occur at the same point in the compound cable, so that we obtain for the strength of the cable the sum of the average strengths of the parts, which is, of course, greater than the sum of the weakest parts. The Atlantic and most other deep sea cables are of this type.

The completed cable is coiled in the works, and on board ship in large circular tanks, with eyes of from 6ft. to 8ft. diameter. On board the Great Eastern the largest tank was 75ft. in diameter, and 16ft. 6in. deep, holding 1,100 knots of cable. The diameter of the tank depends on the beam of the ship. One twist per turn is necessarily put into the cable as it is coiled away. This twist as necessarily comes out when the cable runs up out of the tank. In fact, the one operation is exactly the reverse of the other, and leaves the cable as it came from the spinning machine. The cable as it runs up from the tank is led to the centre, and confined to the centre by large wrought-iron horizontal rings, which prevent the line from lashing out under the influence of centrifugal force.

From the tank it runs in troughs to the brake drum, round which it takes four or five turns. This drum is prevented from turning freely by a brake-strap, which thus puts the necessary retarding strain on the cable.

It is essential that the restraining friction should be constant, a result obtained by the Appold brake. In this arrangement both ends of the brake-straps are attached to one lever in such a manner that when the brake begins to turn it tends to lift the lever and weight hanging from it, and as the lever is lifted it slackens the brake-strap, until the difference of tension on the two ends of the strap is equal to the weight hanging on the lever. When this is the case, the lever is no longer lifted, but remains stationary with the strap, allowing the drum to turn, restrained by a constant friction equal to the weight on the lever (reduced to the point where the strap is attached). If the co-efficient of friction increases the lever will be lifted a little more, and the strap slackened; if the co-efficient of friction diminishes, the lever and weight will fall, tightening the strap; but in any case the retarding force will be simply equal to the weight. After passing the brake-drum the cable dips under a weighted pulley, which rides suspended on a V of taut cable. If the strain increases the rope straightens, and raises the pulley; if the strain diminishes the weight and pulley fall. Thus the height of the pulley indicates the strain. This instrument is called the dynamometer. Lastly, the cable passes over a pulley into the sea.

A cable paid out in air hangs in a catenary curve, but a cable paid out in water lies in an inclined shaped line; the strains in the two cases are completely different. In air the rope meets with no sensible obstacle to its motion, either longitudinally or in a direction perpendicular to its own length; in water on the contrary each foot of the cable meets with an opposition to its motion perpendicular to its length. The rough Atlantic cable, when the ship was going at the speed of six knots per hour, was at an angle of 6¾°, so that the inclined plane was 17 miles long, and each foot of the cable took nearly 3 hours to reach the bottom. Cables of light specific gravity have a small settling velocity, and lie at great length in the water; and if they are also rough, the brake is relieved from most of the strain which would be necessary to lay a cable of equal weight, but small bulk, and smoother surface with the same amount of slack. If no slack were laid there would be little difference between the tension required for cables of different construction, but of equal weights in water. When much slack is laid all cables will be considerably less strained than if laid without slack; and, finally, the faster the ship goes the less slack is required to produce any given amount of relief.

The correctness of this has been amply proved in practice. If in seas 2 miles deep the cable hung in a catenary 12¾ miles long, the weight to be carried would be 8¼ tons, and the strain on the cable 29 tons; while if the cable hung in a catenary the inclination of which to the horizon at the stern was 9° 30′, the length would be 24 miles, the weight 17 tons, and the strain 102 tons, instead of about 14cwt., the strain actually observed for the Atlantic cable when being paid out at the rate of 7 knots per hour, while the ship was going at 6 knots. The motion of the ship even in heavy weather alters the strain very little.

New Form of Galvanic Cell.—K. Kohlfurst has devised an arrangement of a copper and zinc battery, which, he states, will, if used for ringing electric bells, give a sufficient current for a year, at the cost of 1½lb. of crystals of sulphate of copper. A truncated hollow cone is thoroughly varnished inside, filled with crystals of sulphate of copper, and placed mouth downwards in a glass cylinder deeper than itself. This cone has notches round the rim, and has a small hole in the centre of the top. The positive pole is a thick cake of zinc suspended over the face of the cone, cast with a hole in the centre, through which passes a guttapercha covered wire, making the connection with the copper side of the battery. The glass cylinder is then filled with water, when it is evident that the rate of solution of the sulphate depends on the facility with which it is dissolved by the access of water through the notches in the cone, and this taking place at a uniform rate, the electric current arising from the mutual action of the copper and zinc in a solution of a given strength will be uniform also. The strength of the current is said to be increased if instead of water a dilute solution of sulphate of magnesia, or of common salt is used.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

MR. LOWDON "AT SEA"—SOLAR LONGITUDE, &c.—PHOTOGRAPHING THE SUN—SIDEREAL CLOCK—NEW ZEALAND TIME AGAIN!—AND α DRACONIS AS THE POLE STAR.

[4047.]—JUDGING from internal evidence, I should say that Mr. Ralph Lowdon (letter 3966, p. 119) can certainly never have been "at sea"—save, of course, in a very obvious, if figurative, sense—in his life. I have twice read his letter through, to be quite sure that the whole affair was not an elaborate joke on his part; but, having ultimately arrived at the conclusion that he is serious in what he advances, can only express my belief that we have not had a funnier communication in "our" columns for many a long day. In effect, it would appear to be an attempt on Mr. Lowdon's part to supersede the old nautical method of obtaining longitude by "lunar distances," by the terrestrial one of Moon culminators. It is, however, in the details of his suggested method of observation that he shows such a curious want of knowledge of the possibilities of observing on board ship. I have no doubt that the ENGLISH MECHANIC must circulate as largely in the navy as we know it does in the army (and to such an enormous extent in civil life), and I really should be very glad if any Navigating Lieutenant who may read these lines would give us an opinion of an arrangement that involves the examination of the direction of plummets with a microscope (!); the keeping the pedestal "exactly even with these plummets, and thereby upright or perpendicular by an assistant with an even hand" (I fancy that I hear Jack's remarks, made *sotto voce*, while he is being shouted at by the observer to "keep that pedestal perpendicular!"); the use of the "[illegible]," the meridian "lines in the telescope," *et id genus omne!* As for Mr. Lowdon, I would [illegible] of Professor Piazzi Smyth's [illegible], by the aid of the "Free-revolver" stand (an arrangement on the principle of the gyroscope)? and ask him how it is that he does not endeavour to apply that mechanism to his astonishing arrangement? Pending his success in doing so, I fancy that the sextant will serve sailors for a little while longer.

In answer to the string of questions put by "W. H." (in query 11597, p. 131) I may tell him that (1) the Sun's mean longitude signifies his angular distance measured on the ecliptic from the mean equinox. Question 2, as your correspondent will see on reflection, [illegible] form. 3. The longitude of perihelion [illegible] "W. H.") was [illegible] 1, 1872; this increases some 1° 43′ in a century. 4. The mean obliquity of the ecliptic on January 1, 1872, was 23° 27′ 21·36″; its mean annual diminution is 0·476″. Question 5 involves another on my part—"those" what of the Moon?

"X." (query 11640, p. 132) might get a small instantaneous photograph of the Sun; but nothing else with his appliances—or absence of them.

With regard to his next query (11641, same page), the only way which occurs to me as being a feasible one for him to adopt, seems to be to mark a second set of figures on his clock face above the existing ones—*i.e.*, 13 over the 1; 14 over the 2, &c., and so on; and then to shorten the pendulum until the clock beats sidereal seconds.

It is altogether extraordinary to me that people like "J. S." (query 11711, p. 159) will persist in raising—and re-raising—questions which have been discussed over and over again in these columns. He will find the identical one which he puts most fully gone into in letters and communications running through the first half of your thirteenth volume; and the entire subject of longitude and time thoroughly argued in earlier ones.

If, by the "cycle of revolution" of α Draconis, "J. X. T." (query 11716, p. 159) means its return to the position of our pole star, I may tell him that, instead of 400 years, 25,800 years must elapse from the period at which it occupied that place before the northern end of the earth's axis will again point towards it.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

"E. L. G." AND CATACLYSMO-MYTHOLOGY.

[4048.]—UPON finding myself accused by "E. L. G." (letter 4011, page 146) of copying exactly "the most sensational line or two from the first preface of (I omit the graceful and thoroughly argumentative adjectives) Bishop Colenso," I at once obtained his book on "The Pentateuch" in order to see whether really there was anything in it to justify your correspondent in making such a charge. Having read the preface carefully through, the only passage which I can find which in the smallest degree would warrant "E. L. G.'s" suspicion is this: "Volcanic hills of immense extent exist in Auvergne and Languedoc, which must have been formed ages before the Noachian deluge, and which are covered with light and loose substances, pumice-stone, &c., that must have been swept away by a flood, but do not exhibit the slightest sign of having ever been so disturbed." Are these the words which I am accused of "having exactly copied with every blunder, as the Chinese copy a worn picture?" Reading on, though, through this same preface of the Bishop of Natal, I have found some words in a footnote which I certainly should have copied, had I had the preface before me. They were uttered by the greatest palæontologist living (if not the greatest who has ever lived), Professor Owen, in 1864, before "The Young Men's Christian Association," at Exeter Hall, when, after speaking of the geographical distribution of plants and animals, he went on to say: "*And such knowledge is incompatible with the notion of the divergence of all existing, air-breathing, or drownable animal species from one Asiatic centre within a period of 4,000 years.*"

I hope that the Geological Society will get over the epithet with which "E. L. G." has essayed to describe them—"a little English coterie and mutual admiration society"—but, doubtless, coming as it does from one so perfectly entitled to speak *ex cathedrâ*, it must be a tremendous discouragement to them; even should it not finally extinguish them altogether.

I am sorry to say that I was never in Auvergne in my life, and am indebted to Scrope, Lyell, Murchison, Mantell, and people of that sort, for my knowledge of it. Those who have been on the spot would be likelier than I, I should think, to satisfy "E. L. G." as to the exact whereabouts of the particular cones which exhibit proof of having remained quiescent since the Pliocene period. He complains that "Lyell and the whole Geological Society" have ignored him for eight years past; but I can scarcely conceive that any English gentleman would be discourteous enough not to answer a letter asking civilly for information, even if the Society (*quâ* Society) declined to give your correspondent a field-night to himself, to show that they were all utterly wrong, and that his was the only original and infallible system.

What the "widely-circulated paper" was in which eight years ago "E. L. G." offered to bet £10 that nobody would find any Pliocene pumice-stone *in situ* I don't know. I should have guessed *Bell's Life* (as its columns generally teem with cognate announcements from people who wish "to back their opinions") but for the fact that I am in some doubt as to whether that lively serial "chiefly circulates among the clergy." At all events, I am content to leave such a mode of [illegible] scientific question to my *bettors*, and shall forbear to instruct my solicitors to sue "E. L. G." whether I find out the exact locality of the cones under discussion or not.

I wait for more light. As far as we have gone we have had plenty of declamation and assertion, but nothing else whatever. We must have encountered comets at various periods, *therefore* deluges must have ensued. There are marks of deluges, therefore we *must* have encountered comets. There seems to me to be a faint resemblance in this to what we used to call the "circulus in probando;" but this may arise from the fact that in the matter of "E. L. G.'s" dicta I walk by sight and not by faith.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE THEORY OF VISION, AND SPECTRUM ANALYSIS.

[4049.]—I REALLY think that the difficulty of "E. J. D." (letter 3974, p. 160) will disappear if he will consider that his hypothetical "statue of black polished marble" would be illuminated by rays of light coming from every conceivable direction, and that they would certainly, as he says (quoting apparently from some book), "be detached from every physical point of it"—*i.e.*, reflected, I suppose—"in all directions." That "only those rays which enter our eyes can render them (the points?) visible to us," seems too elementary a principle to need discussion here. It would be demanding a trifle too much of any theory to require it to explain how an object could be seen by the aid of rays which did *not* enter the observer's eye. Of course, in the case of black marble a good deal of the light would be absorbed, some irregularly and some specularly reflected; the kind and amount of reflection depending upon the contour of the different parts. That objects do thus send off light in all directions "E. J. D." may satisfy himself by darkening any room by the aid of a shutter, and inserting lenses in three or four apertures cut in it. He will find that each lens will form its own image of a church, tree, or other object in the landscape upon a screen held behind it. A little practical study of the phenomena of stereoscopic vision, too, would, I think, tend to clear up your correspondent's ideas as to the radiation of light from every part of an object. Of course, he does not need reminding that a man viewing his imaginary statue from the north would have a totally different image on his retina from one who regarded from the south: while those among the "vast multitude of persons" who were situated to the east or west of it would see it in an entirely different phase from either. Evidently the rays sent up perpendicularly (or nearly so) from the top of the statue's head, could never enter the eyes of the men down on the plain at all; albeit they would be those by which a man in a balloon would discern it.

It is certainly possible for "R. M. F." (query 11671, p. 158) to conduct some "sort of spectrum analysis with a very small pocket spectroscope." With such a one the spectra of many of the metals and metalloids may be very beautifully seen; and (if the instrument be furnished with a reflecting prism covering half the slit) compared immediately with the dark lines in sunlight. Schellen's "Spectrum Analysis," reviewed in these columns some little time ago, is the standard work on the subject.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

HEIGHT OF SEA WAVES.

[4050.]—THE only method of measuring the height of sea waves (for which "A., Liverpool," asks in query 1168?, p. 158) is by eye estimation. From the nature of wave motion, the height above the mean sea level would be one-half of that from trough to crest—*i.e.*, in his own supposed case of a wave 20ft. high in all, its summit would be 10ft. above the sea level.

I have myself, though, seen waves very considerably higher than this. I shall never forget one awful night out in the Atlantic, when I made an effort to estimate such height, and when standing—or rather hanging on—on the poop of one of her Majesty's ships, with my eye 22ft. 6in. above the water-line, I saw huge mountain after huge mountain of water come rushing towards me at least 8ft. above what was visible of the horizon. I have no doubt whatever that every one of these waves was at least 31ft. from trough to crest; and but for the sublimity of the sight, I would express a hope that "A., Liverpool," may never be compelled to endure a similar experience.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4051.]—"PHILANTHROPIST" (let. 3992, p. 129) will be glad to learn that his manslaughtering invention is not likely to prove a blot in his career of philanthropy. The attempt to communicate a rotary motion to projectiles fired from smooth bores has been made in various ways, but (to quote from a letter written to me by the War Department, in 1864) it has been found impossible to obtain "efficient rotation" by such means. My plan was to fire a long bolt, having a hollow screw through its centre, the breech end being, on firing, closed by a shoe or by a suitable projection in the breech. Mr. Cottam, the engineer, told me my bolt would fail, because the projectile must be rifled at the instant of leaving the gun. He invented a bolt with the screw outside, which laboured under the same defect.

If "Philanthropist" could succeed he would gain many advantages. 1. The use of smooth bores. 2. The use of smooth or rifled projectiles *pro re natâ*. 3. Cheapness, &c. Some time after 1864 the *Débats* gave an account of a conical cannon ball invented by the King of Portugal, which appears to have been grooved on the outside. I believe it turned out also a mouse. "Philanthropist's" firework would hopelessly fail, because he could not arrange the direction of his fuses on leaving the gun, so that the rotation might be at any angle to the line of flight, it being quite possible for him with such a ball to shoot round a corner; not to mention the nice state his gun would be in from deposit after a few rounds, as I doubt whether sponging would be sufficient.

M. PARIS.

THE ALCOHOL QUESTION.

[4052.]—ACCELERATED heart-beats may be from rapid oxidation, demanded by too suddenly carbonised and hydrogenised blood, rather than by (as Dr. Richardson suggests) removal of resistance. Our oxygen retention requires all foul topers' expulsion to the woods, so that the production of CO_2 and H_2O, the quick formation of which is essential to their safety, may more rapidly proceed, and contribute more directly to the increase of timber.

Alcohol requirers need ozone, and should work in the garden, or contemplate duty at Southport, where the Fernley Observatory shows ozone in abundance beyond rivalry.

Excess of C and H, from imbibing C_2H_6O, rapidly absorbed and dispersed, paralyses infirmity by overwork, and may it not accumulate molecules obstructive to atomic recombination in capillary network, and to the blood's capillary circulation?

Chloroform's effects are widely different; its chief element Cl (in weight 106·5 to C_{12} and H_1) being inorganic, whilst all alcohol's three elements are organic. Death from chloroform, I suppose, is mainly from over reduced circulation, by alcohol mainly from over rapid; oxygen in both cases too out proportioned by the other elements; the lungs are overtasked, whilst nitrogenic process is retarded or becomes *nil*, alcohol and fat being without it.

Alcohol drinking may suit out-door work, but tea or lemonade better suit for study, for council, for el[illegible] duty, and for work at the desk. Alcohol may be [illegible] spur, but needs caution in its use.

J. BARW[illegible]

P.S.—How do the heart-beats count under i[illegible] of chloroform? Are they fewest during inse[illegible] to pain?

TERRESTRIAL GRAVITATION.

[4053.]—"T. A.'s" last letter (4008, p. 144) illustrates the difficulty of reasoning with one who has taken up the discussion of a subject in advance of his present knowledge. The letter is crowded with mistakes and misapprehensions. Thus the integral calculus is by no means "useless," as "T. A." conceives, but particularly useful in dealing with problems on nearly neutralised attractions. It deals excellently with the case of a particle placed at the middle of one of the circular surfaces of a flat disc, though in this case the attractions are by no means neutralised, as "T. A." supposes, but larger than they would be if the particle were raised above the surface. "T. A." does not seem aware of the fact that a flat disc *is* a cylinder, though every cylinder is not a flat disc. Moreover in the case of a cylinder whose axis is considerable compared with the radius of its base (which seems to be "T. A.'s" idea of a typical cylinder) all the attractive force of the molecules cannot "act in one direction," as "T. A." supposes, "on a particle at either end," nor in anything like one direction. They act, in fact, one half of all the directions possible with respect to such a particle.

But the closing sentence of "T. A.'s" letter causes me to doubt whether, apart from the difficulty abovementioned, I have not done unwisely in discussing this matter at all with him. He refers your readers to the able reasoning in Ganot's "Physics," on "Capillarity" (a subject, by the way, having absolutely nothing whatever to do with "T. A.'s" troubles), and then he adds "those who are desirous of discovering the truth concerning this question are recommended to study Chapter 2 of this excellent work." The idea he wishes to suggest is obviously (I fear) that Ganot is on his side. Now, the *fact* that Ganot is not on "T. A.'s" side is a circumstance which "T. A." *might* have overlooked; but it chances that "T. A." opened this very discussion by pointing to the accepted (or rather known) facts about the attraction of oblate spheroids as involving "a glaring error" repeated in Ganot's book; while in the same letter he described Ganot's work as fairly describing "the present state of physical science as based upon the atomic theory, the material forces of attraction and repulsion being consequently entertained, and as *consequently leading to error*."

Before "T. A." undertakes to exhibit the glaring errors of modern science, and his own superior insight into all truth, he should increase his store of knowledge, but above all he should show a love of truth in his own person, and avoid the *suggestio falsi*, as verging very closely on deliberate untruthfulness.

RICHARD A. PROCTOR.

SELENOGRAPHICAL.

[4054.]—LOHRMANN, describing his crater A, Sec. 1 (Halley), says that on the south side are two clefts, and between them is a great mountain chain coming from Albategnius, with a small cavity in its highest summit. I remark the opposite of this phenomenon where a lumpish protuberance rises from the bottom of the deepest part of the principal cleft as it enters Halley. It has all the appearance of having fallen from the mountain, and is a feature, one would think, that might easily attract the attention of Lohrmann, who, however, does not refer to it. The cleft, which is noticed by Beer and Mädler, extends to Albategnius, the west wall of which it appears to divide longitudinally, and it progressively deepens and widens from that crater to Halley.

A small rill, which I do not find in Schmidt's list, connects two craters W. and SW. of Arzachel.

Schmidt's No. 352, described as having been discovered by Lohrmann in 1824, and not found afterwards, agrees well in position, but not in direction, with this rill, which shows a remarkable parallelism with the above-mentioned cleft, and also with another, No. 358, that runs into Parrot.

Schmidt says of his No. 98, that it was originally discovered in 1824 by Lohrmann, and not seen again until 1865, when Schmidt observed it at Athens. It is situated in four or five degrees of latitude north of the great rill valley of the Alps. I saw it on the 15th of April, and believed I could distinguish another parallel, and close to it, but they were objects of extreme difficulty, as they ran nearly along the line of illumination.

J. BIRMINGHAM.

METHOD OF MAKING A LEFT SCREW WITH A RIGHT SCREW PLATE.

[4055.]—I DO not know whether any of the readers of "ours" can perform the above feat without the aid of a lathe or not; at any rate, as the *modus operandi* was shown me some time ago by a very intelligent journeyman watchmaker, I give it *pro bono publico*. It is as follows:—(1). With an ordinary plate tap a right screw on a piece of good steel wire; (2) file down the two opposite sides of the part that has been tapped until it assumes the form of a flat bar having the thread on its edges, and until it is about one-third the original thickness; (3) heat the tapped end, and, with the aid of a vice, a pair of strong pliers, and great care, give it a twist or two to the left, bringing the right edge over to the left, and *vice versâ*, then temper as usual; (4) with this transformed tap a thread is cut in a plate which will produce a left screw of exactly the same size, pitch, &c., as the original right screw plate would turn out. In small work, when it is necessary to make a right and left screw with identical thread, &c., on the same rod, the above method, with a little ordinary care and not much trouble, will effect the purpose. Of course, in giving the twist alluded to, the wire must not be bent.

A. M. FESTING, F.M.S.

THE SINGER NEW FAMILY MACHINE.

[4056.]—FIG. A represents the under side of the bed and the mechanism for working the shuttle and feed. The bed (80) is ribbed near its edge for strength, and other ribs, with grooves cut, contain the working parts. The bed is fitted with a pair of hinges (shown on the lower edge of engraving) for screwing to the stand. The original Singer machines are made with an upper and a lower horizontal shaft, with large gearing wheels to connect them. The needle-bar and cam act the same in all the machines, the shuttle slides in its race somewhat like the Howe, but driven by a crank instead of a cam. The shuttle is short and thick, but does not make so good a stitch; it is faster than the Howe, and is chiefly used, for its speed, in the slop-clothing trade. It has a wheel-feed resembling the Howe, but like the Howe has recently had a "step-feed" introduced for tailors' work. This machine is driven direct from the treadle by a connecting-rod, or "pitman" of wood, to the crank on the large-toothed wheel of the machine. The Singer machine, unlike the Howe and Thomas, which pull up a firm stitch by positive action, has a spring which governs the stitch, being depressed to form the needle-loop, and on being released suddenly pulls up the thread and stitch. These springs are very unsightly in the original machines, but the action is retained in a neater form in the new family machine herein described.

wears the shuttles much faster, and certainly makes an inferior stitch.

THE SINGER FEED.—A bracket, or feed-guide (72, Fig. A), is screwed to the bed; between these, in a groove, the feed-dog (74) is worked in one direction by the spring 75, for returning after the stitch is made, the same spring also depressing the end of the feed containing the teeth; the raising of the teeth up against the fabric is effected by the longitudinal travel of the feed-lever (61), which has an incline or wedge-shaped end, in contact with a corresponding incline in the plate, or raising-cam (62), adjusted on the bed by its screw. The same feed-lever (61) has also a cross motion, which acts against the end of the feed-dog nearest the shuttle, and at the extreme end of the lever (61). The other end of this feed-lever has an oblong hole, and in this the upright shaft is passed through, and above the crane disc (59) a cam is made to work in the slot, so as to give it the longitudinal and cross motion, not constant, but with a pause to give the time required for the feed-action. This motion is conveyed from the shaft to the feeder by means of a universal joint (69). It is formed by a piece having a groove cut the size to fit the flat lever (61), and to allow a sliding motion longitudinally, by means of a stud passing through a hole in the plate on the end of the bar (65). This piece and stud in one has a nut on the stud to retain it in place (as shown on the end of bar 65); this bar is the stitch regulator, the bed is

FIG. C

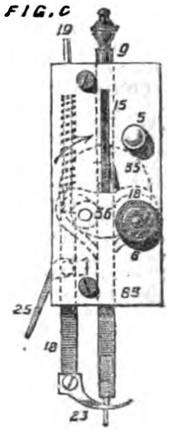


FIG. A

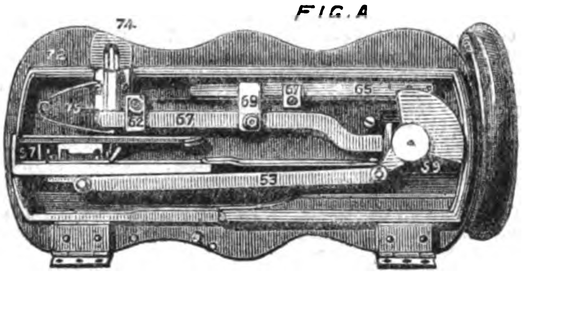
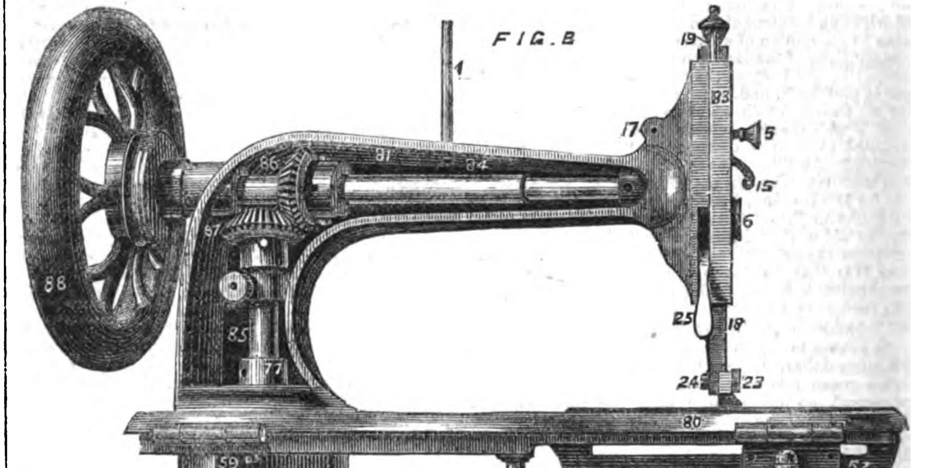


FIG. B



The arm of the machine (81) has a side to it, covering the upper mechanism; it contains the main shaft (84), which has a fly or balance-wheel (88) on its right hand end, a strap descends from a groove on a pulley to the driving-wheel on the stand below. Motion is communicated to the works below the bed by means of a bevel-gear, or toothed wheel (86), fixed on the main or horizontal shaft, and gearing into a corresponding cog-wheel (87) fixed on the top of an upright shaft (85), which works the crank (50, Fig. A and B) to drive the shuttle. A steel crank-stud inserted in the crank fits into the connecting-rod (53, Fig. B), which is kept in place by a washer over the stud, and a pin through the stud to retain it. A similar connection is made on the shuttle-driver. Instead of the Howe mode of sliding the shuttle, it is carried by its round back resting on two prongs, and its face against the shuttle-race on the bed. At 57 (Fig. A) the carrier is shown in the shuttle-race, the shuttle-race slides being partly open to admit the light. The shuttle-race is faced on its (apparent) upper side, and contains the needle-groove. The opposite side is faced also, and a slot cut through it and its back faced. The shuttle-carrier is connected by its back through this slot by two screws, and can thus only travel horizontally when moved by the connecting-rod 53. While the Howe shuttle only travels the actual distance needed to form the stitch, the Singer, and all shuttles worked by a crank, travel a greater distance. This has no advantage; but, on the contrary, the higher velocity and extended friction

grooved to receive it. A plate (67) with its screws, holds it in place, free only to travel longitudinally. A long stitch is made by placing the universal joint (69) near the cam or shaft, and the reverse, of course, for a short stitch. The stitch-regulator bar (65) is moved from above the bed by a thumb-screw, fixed in its right-hand end; when moved to obtain the stitch required the thumb-screw is used to fix it. These parts must be fixed firmly; in addition to set-screws, taper pins are driven hard in the crank, collars on shafts, and cog-gear wheels. If it gets dirty the worker should not attempt to take it to pieces. The parts are so complicated, and all requiring so much fitting and workmanship to accomplish what in other machines is very simple, that its invention would be a credit to a trades' unionist bent on the one idea of increasing the demand for labour. The closest inspection cannot discover a new or better motion than in the Howe class of machine, but it is easy to perceive that the motion obtained by all this complication is limited in range, no pause whatever is given to the shuttle, and carrying, instead of sliding it, is an idea borrowed from some other machine.

NEEDLE MOTION.—Fig. C shows the face-plate (83); the dotted lines, the heart-shaped cam (10), cam-roller and stud (36), and crank disc (35). The arrow indicates the direction of motion, which is towards the operator when sitting at the stand. On turning the cam-roller (or crank), the observer may notice that the action of the heart-cam causes the needle-bar to descend from the top steadily to the bottom; it is then raised about one-eighth of an inch, and remains nearly at rest while the shuttle enters the loop of needle-thread, but descends a little while the shuttle passes through the needle-loop thrown off the needle-eye in the act of rising of the needle-bar. When the shuttle has passed nearly through, the cam lifts the needle-bar quickly. The time of this action, compared with the Howe machine, is inferior for making a good stitch, but far superior for strength, speed, and wear. The defect of having a strong spring to pull up the thread-loop from off the shuttle, instead of the needle-bar direct and positive, makes it requisite to stop often to regulate the tension from thick to thin, or hard to soft, fabrics. The check-lever (15), which pulls up the slack or loop of thread, can be regulated by the check-spring, coiled around a screw placed in the hole for the screw (17), which acts as a pivot for the check-lever, as well as to keep the spring in place. The end of the spring is placed in one of the holes under the screw (17), so as to be weak or strong, according to the work in hand; it looks neat, but is troublesome to adjust, and leaves the machine far behind others in simplicity of adjustment. Testing it, by pulling up a firm stitch in thick cloth, and then in thin paper, shows the thread cutting the paper, and adjusting it to paper shows a slack or loopy stitch on the cloth. This experiment proves that the machine is made to depend too much on the fabric in forming the stitch, an arrangement which is sure to produce an uneven stitch, when the speed is sometimes necessarily too fast or too slow. There is a stop in the needle-bar to force up the spring at the end of the stroke; sometimes it acts properly, at others the spring acts in advance, according to speed and materials. This ever-varying quality is very troublesome, to new workers especially, and its want of simplicity is a drawback to all such machines as work the shuttle by a crank instead of a cam motion. This part will be better understood by comparing it with a cam-shuttle-action machine, to be illustrated shortly, and chosen as the easiest to explain the formation of the stitch, and all the actions of a sewing-machine.

TO THREAD-UP THE SINGER MACHINE FOR WORK.—Place the cotton reel on the wire pin (1), pass the thread through an eyelet-wire in top edge of face-plate, then down under and between the tension-plates or discs (6), then up to the eye of the check-lever (15), pass it through from the front backwards, then down to and through the hole in needle-clamp, and passing into the needle-eye from the front backwards, leaving the thread about three inches through, so as to hold it between the fingers while pulling up the shuttle-thread. The shuttle being properly threaded, and put upon its carrier (57), and the shuttle-race slide closed over, then one turn of the wheel passes the shuttle through the needle-thread loop; as the needle rises, pull up the end of the needle-thread, and draw up the shuttle-thread along with it. The lock-stitch is thus made, by a little practice, as easy as the chain-stitch, provided the operation is fully understood.

DEFECTS OF THE SINGER NEW FAMILY MACHINE.—When the machine has been laid aside, and thus made stiff by dirt, the worker finds the great disadvantage of a complicated machine. It will take a mechanic three-quarters of an hour to take it to pieces, clean, and replace the parts; and to do this more tools are required than are supplied with the machine. The teeth or cogs are liable to be broken off the wheels (86 and 87) inside the arm, and in many ways this machine requires the help of a mechanic, where some machines for similar purposes do not. Many other machines are nearly as complicated and troublesome, and for some it has been found needful to caution the user not to take the machine to pieces. Doing so involves sending it to the mechanic, thus incurring expense and delay. Users will know better in a few years.

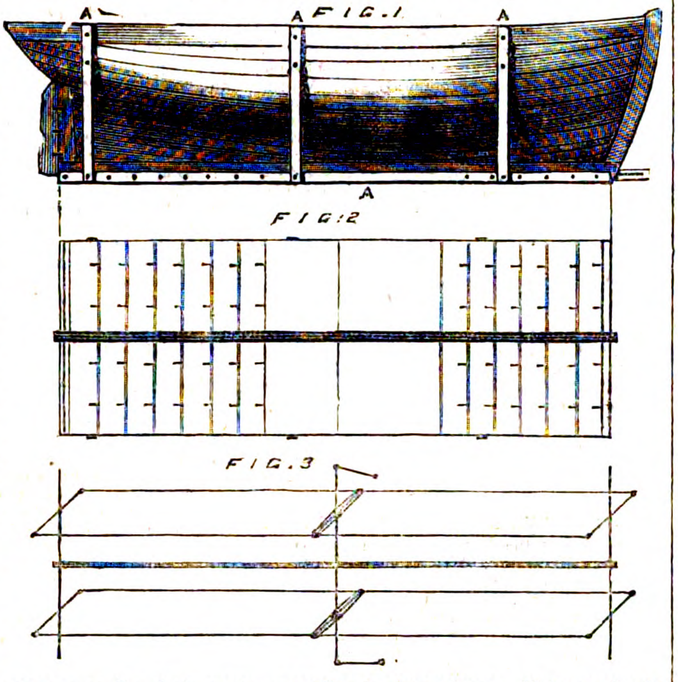
A PRACTICAL MAN.

IMPROVED DIRECTING POSTS.

[4057.]—I HAVE a fellow feeling with "Canis Minor" (let. 3991, p. 123). The fingers of most posts about here having been long amputated, and the letters as undecipherable as Sinaitic Pilgrim inscriptions, would it not be better for the plates to be perforated? There are few nights when a post is not darker than the clouds and to fumble about the raised letters like a blind man, does not impress me with a desire to pursue knowledge under such difficulties. As to the clerk "kept" by the Postmaster-General to hunt newspapers to any one acquainted with the Civil Service such a notion is ridiculous. It is more likely that some favourite of official fortune is paid £800 a year for seeing that a messenger or boy "chosen at once" at £50 stows them away carefully in a "depository" forgotten even by the ubiquitous spider. M. PARIS.

ALLINGHAM'S PROPELLER.

[4058.]—I FORWARD by same mail the *Liverpool Albion* newspaper containing an account of my latest experiment, as exhibited to a large number of professional men, and although all, including the reporter, who was personally unknown to me, came prepared to witness a failure, they were astonished, and the only objection which was put forward was that the invention was in a crude state, which, being translated, means that my means being limited and the experiments having extended over a period of nearly twelve months, I am forced to construct my models principally of tinned sheets for economy's sake, and they are very easily disarranged in rough weather. This apparatus would be invaluable as applied to lifeboats, as it would only require one man to steer, another to start, stop, or reverse the boat, instead of the large crew required at present to row against the storm. It is also applicable to the navy, as being below the surface it is beyond the reach of shot, and leaves the whole hull available where room is so valuable. I inclose drawings of latest designs for attaching to any vessel. Fig. 1, A A A A, represents steel bars as thin as possible, consistent with the size of the vessel, the vertical bars riveted to the vessel's side; the horizontal one on each side of keel carries the blades, and does not project below the keel, so that if aground the vessel would sit up as if supported by legs. The blades as shown in Fig. 2, which represents the boat turned keel up, are ten in number forward and fourteen aft, each blade securely attached by clasps to steel rods which go through the keel from side to side, each blade being just able to pass to upper or under side of frame. Fig. 3 represents the guards separately from Fig. 2 to avoid confusion. These guards regulate the height to which the blades rise or fall, and are capable of being closed or opened at will on port or starboard side, amidships, by means of a lever, worm-wheel, or



screw, according to circumstances. If the weather be fine, open slightly, which gives the highest speed; if stormy head sea and wind, open more, which increases the power as it reduces the speed; if to stop her, close similar to a parallel rule, which shuts all the blades; if required to back her, open to full extent, let the vessel acquire a little sternway, and all the blades would instantly reverse; then up with the guards until required to go ahead again, when on turning her head from the wind the blades would all go back into the original position for propelling ahead. By stopping or reversing one side the vessel may assist the helm to turn more quickly, and, if necessary, she could be steered altogether if any accident occurred to helm. I am perfectly convinced that no steamer could outsail a vessel of this construction in a heavy sea, although she would probably do so in light weather.

JOHN JAMES ALLINGHAM.

KING NUMBERS.

[4059.]—IF "E. L. G." (letter 3990) will refer back to my letter he will see that I did not say that it was king numbers that everybody knew before, but something quite different. I never said a word about king numbers, good, bad, or indifferent, and willingly allow that he has said much about them that I, at least, did not know. What I fail to perceive is the connection of the curious properties of numbers he has been explaining with the question whether the convenience of having what is called the metric system in use would or would not overbalance the cost and trouble of introducing it. It seems to me that the best judges of that are those who have tried both the English and French systems sufficiently long to become familiar with both, and I believe that those who have are nearly unanimous in favour of the change. Is this belief correct? PHILO.

PRACTICAL INSTRUCTIONS FOR MAKING THE PIANO ACTIONS IN No. 368.

[4060.]—HAVING contributed full-sized working drawings of these actions, and a pretty full description of their advantages, perhaps it may be as well also to contribute some instructions which will, I trust, facilitate the operation of making them.

It may, at first sight, seem rather presumptuous for so unpractical a person as the "Blacksmith" must be, to pretend to give practical instructions to small work makers, whose general experience must so greatly exceed his, how they can most easily form the parts of these actions, but it may be some excuse for his presumption that in the construction of them he has been enlightened by experience which they cannot yet possess. So he subjoins a few hints which, in his opinion, even those eminently practical men would do well to bear in mind.

That it might resist the rebound of the hammer from the strings as little as possible I had the sticker O, Fig. 1. made as light as I considered consistent with necessary rigidity. Its section is $\frac{3}{8}$in. from back to front, by $\frac{1}{4}$in. wide. It was made deeper than its width to afford sufficient depth for the oblique hole which receives the projecting piece. To make it wide enough for that hole to be bored in it, the upper 2in. of its length was reinforced by cheeks formed of two slips of good beech wood, one-tenth of an inch thick, one being glued on each side. For this purpose I know no better wood than beech, well-selected; no doubt good Spanish or Cuba mahogany would answer, but beech is stronger, cheaper, and, I think, holds the glue better, and for the latter reason I prefer it to hornbeam, which I first employed, and I don't think any much cheaper method than this of forming the sticker will readily be devised. Should it be desired to make the sticker capable of being disconnected from the butt on the French system—which I greatly prefer—probably the most facile and cheapest plan will be to glue one cheek in its place, then glue on the rectangular projecting piece required in lieu of the cylinder P, and when quite dry to plane the sticker in a suitable matrix to its required thickness, after which, the right-hand slip or check being glued in its place, the projecting piece will be well secured between the two cheeks, but it would greatly strengthen the connection of the parts if two (about No. 24) soft copper wire rivets were inserted below and one through the rectangular projecting piece, employed in lieu of P, whose section may be $\frac{1}{4}$in. × $\frac{3}{8}$in.

There is no necessity to make the lower end of the sticker into a cylinder. If tapered for a trifle more than half its length until its end is but $\frac{1}{4}$in. square, it may then have its edges planed off and thereby its end rendered octagonal, which answers quite as well, always assuming it to be glued in the centre of the cloth or felt disc at its bottom, and that it does not touch the hole in the rail in any of the positions into which the hammer carries it during performance.

Should it be determined to attach the damper to the butt in this sticker action, Fig. 1, which, as it saves fully $\frac{1}{2}$oz. in the weight of the touch, is a thing I should certainly do myself were I able to conceive it possible I could ever become foolish enough to be tempted—(qy., by the evil one)—to have a piano with a sticker action finished for me. I much prefer, however light the sticker be made, for the escapement, if any escapement be allowed, to be at the hammer butt. It is obvious that the forked portion of the butt must not extend far below the hammer centre, at least the last half inch of its length—it should be made about $\frac{3}{8}$in. longer below the centre—must be filled in solid, and have a hole bored in it into which the damper wire can be screwed. Of course it would be possible to mortice the butt cheaply by suitable machinery, and leave its lower part solid for the insertion of the damper wire; but, considering small work makers do not usually possess mortising machines whose scale is suitable for such small work as making the butts of pianoforte hammers (sooth to say, I greatly doubt if one such machine exists); also considering that they seem to think it is their mission to do everything they well can do (and sometimes something more) with the circular saw, I presume they will prefer making these forked butts with a circular saw (say) $\frac{1}{4}$in. thick, which is the space between their prongs, and to fill up the lower half-inch of their length by glueing a piece of hard wood (say) hornbeam, beech, or Cuba mahogany, between them. It might be preferable for the grain of this piece to be at an angle of about 30° with that of the butt, because the glued joint would be quite as strong, and it would hold the screwed portion of the damper wire better than any wood can whose grain is parallel to the hole which receives it. It would be a further improvement to leave that portion of the butt which is more than five-sixteenth's of an inch below its centre wire, the same depth from back to front as its upper portion, which receives the hammer shank, because this will not only afford larger surfaces to be glued together, but also room for a couple of soft No. 24 copper wire rivets, one in front of and the other behind the damper wire, thereby greatly increasing the strength of the butt at an inconsiderable cost.

It will be observed I have designed the butts in both actions, Figs. 1 and 3, so that the holes which receive the hammer shanks are bored parallel to the backs of the butts. This, which is by no means essential, was intended to facilitate correct guidance while boring those holes. As merely glueing the joint between the arms C C, which carry the counter weights D D, and the butts could not be relied on for endurance, [illegible] shown, by dotted lines, glued wooden dowels, [illegible] through the butts from their backs into th[illegible] for connecting the parts securely. The same [illegible] apply with equal force to the joint between th[illegible] and vertical portions of the hopper H in Fi[illegible] securing this joint I have also thus shown two wooden dowels, about five thirty-second's of an inch in diameter. These must, of course, be inserted sufficiently to the right and left of the centre of the hopper to allow room for the check wire descending between without touching them.

As the only means provided in Fig. 8 of regulating the distance of the hammer from the strings—and the parallelism of the damper to the strings—is by bending the damper wire, it will be found needful to facilitate those regulations by employing a somewhat thinner, or at least a softer, material than hard brass or iron for the damper wire. I found moderately hard drawn copper—a well stretched piece of copper bell wire, for instance—and soft brass wire preferable for this purpose, because its form was very easily altered by a tool with two nicks, one of them being at its end and the other at its side. The regulation did not require much time to effect with this tool, which is easily made.

As it is quite notorious that all pianoforte makers are so far advanced in civilisation as to have all (intellectual) things (if not their worldly wealth) in common, and no trade secrets from each other, and that they also are willing to co-operate intellectually for their mutual benefit, also, as the practical reader must long ere this have become quite convinced the writer is totally ignorant of all practical details, he "wery 'umbly" suggests that Mr. Schucht, and others of your practical correspondents who must necessarily know so much more about small work making than he possibly can, would oblige by suggesting better methods of constructing the different parts of these actions than his very limited experience has enabled him to carry out.

THE HARMONIOUS BLACKSMITH.

HOW WE SEE A DISTANT OBJECT.

[4061.]—"E. J. D." (letter 3974) infers that, because only the rays which enter our eyes render objects visible, "two distinct sets of rays must proceed to each of the spectators, that is, one for each eye." "E. J. D." should know that the eyes only catch proportionately to their size the rays in contact with their surface, which impinge on them neither more nor less than on every other object in space at an equal distance and equally unintercepted. The illuming ether is evidently that elastic as to need no atomic prisms for secondary reflection, it rebounds on all sides as balls inflated with hydrogen so thrown might aid towards exemplifying, each rebounding from contact with the other, rays extending till increased crossing rays finally divert them all. Astronomers may know at what distance combustion, or an unintercepted star, becomes invisible by distance; the law, or fact, may be learned. The great wonder is the enormous myriads of ultimate ether atoms that by variety of impingence force delineate with such nicety every distance, shape, tint, and magnitude that we behold.

We easily see the rate of reduction of light rays on secondary reflection, when we behold our face at the glass, with the light first falling on our face, and then compare it with the reflected face when we turn, so that the direct rays first impinge on the mercury, and then rebound to the face before they return, and rebound again from the mercury in the variedly modified impingements that present to us the picture of one's-self.

J. BARWICK.

[4062.]—"E. J. D." (let. 3974, p. 120) supposes a large statue of black, polished marble to be set up upon a plain, and seen by a vast multitude of people. How, then, he asks, is it that each individual of that multitude receives a distinct image of that statue? "E. J. D." seems to think that he would not be able to see it unless rays of reflected light were proceeding from every part of the statue in a direct line to his eye, but I do not think that to be at all a necessary condition. In the first place, how do we discern that the statue is black? Is it not because a great portion does not reflect any rays of light to the spectator's eye? No number of rays of light, be they few or many, can convey to the eye the idea of blackness—pure blackness is the absence of reflected light. Having perceived that the object is black, how do we perceive that it is a statue. I submit that it is because we see the black non-reflecting contour of the object standing between us and certain objects in the background which do reflect light, such as distant hills, clouds, &c., and we see that this black contour is that of a statue. But if no part of that statue reflected any light to the eye of the spectator it would appear against the background as a flat, black silhouette, without the appearance of roundness or modelled form. How, then, do we perceive this roundness and form? We discern this from the high lights—those points on the statue whence the rays of light are reflected in accordance with the well-known law of the equality of the angles of incidence and reflection,—and it is to be noted that this reflected light is white light. The mind combines these two facts; the non-reflecting condition of a great portion of the statue, and the position, form, and size of these high lights, and a correct perception is obtained of a black statue. If "E. J. D." will take a black bead, and place it on a sheet of white paper, he will perceive that the greater portion of the bead appears of an intense black, reflecting no rays of light whatever to his eye. He will also perceive the high light, a small speck of light which is reflected to his eye in accordance with the usual law mentioned above, and that it is so reflected he can easily test by moving to one or the other side of the head, when he will perceive that this speck of high light will appear to follow in the same direction as that in which he moves. If he were to photograph this bead lying on the paper he would find that the sensitised plate was not acted upon by that portion of the bead which appears black, clearly proving that from thence proceed no rays of reflected light; but it would be acted on by the light from the paper and by the high light of the bead, and if from this negative a positive were printed it would give a correct representation of the bead on the paper.

BOBO.

[4063.]—IN reply to Mr. Barwick's letter (3973, p. 120), I beg to state that he has not touched on the main point which I have put forward, particularly in my last letter (3974, p. 120), so I shall not at present allude to any of the statements in his letter. I would beg to refer his attention to my last (3974), and will now try and explain the point on which I want information. I presume he agrees in the theory of light, which I have quoted, as to our seeing distant objects by pencils of rays emanating from every part of the object to the eyes of the observers, no matter how numerous the observers may be, or where placed, so long as the object is in view. Sir Isaac Newton perceived the difficulty, and he ascribes the reflecting power to the principle of repulsion, remarking that what appears to our senses smooth and polished are found, when viewed through a microscope, to abound with inequalities. If, therefore, the power which produces reflection did not act at some distance from the reflecting surface, these inequalities would prevent the rays from being reflected with so much regularity as we find they are. This theory seems to me to reduce all rays to a sort of general specular reflection, and cannot (as far as I can perceive) explain the distinct pencils of rays on the present theory of light.

Again, I am at a loss to know how any object can provide all those rays to meet the requirements of a great multitude observing any object at the same time, for it is calculated that the best of mirrors reflect little more than half the light they receive. Thus we have the theory of repulsion upset, for by that the mirror ought to reflect the whole of the light it receives. Now to the point. From what cause do those innumerable pencils of rays proceed from every physical part of an object to the eyes of the numerous spectators (and as the theory states) in right lines, and converging to points before they enter the eyes? If Mr. Barwick adopts the theory of repulsion, how does he get over the specular reflection it would be likely to cause? Why do those pencils of rays converge to points before they enter the eye, and what is the inherent power in any object causing them to do so? Suppose an observer sees an object at three feet distance, he does so by this pencil of rays. The object is stationary, but the man retires from it, and we are to believe that for the most trifling change of position a fresh pencil of rays must flash from the object before he can see it; and in the case of a multitude constantly moving, the number of pencils of rays required to be thrown off the object would be innumerable. But to make the matter more difficult, these rays must all converge to a point before they enter the eyes of the spectators. Mr. Barwick will now, I hope, understand the nature of the information I require, and I shall now expect that he will answer the above questions in detail. I must have full proof in every case.

E. J. D.

REVOLVING PUDDLING FURNACES.

[4064.]—IN the last impression but one of the ENGLISH MECHANIC, it is stated that "Mr. Danks's patent for the revolving puddling furnace is contested." While giving Mr. Danks all credit for the energy he has shown in this matter, beyond this he has no earthly claim whatever to the invention. In 1853 Mr. Walker took out a patent for the "revolving puddling furnace," and most certainly Mr. Walker's furnace requires more consideration than it has yet received from the English ironmasters.

Next to Mr. Walker we have the revolving puddling furnaces of Mr. Tooth. This energetic gentleman's patents were taken out in 1859, 1860, 1861 and 1864. On the other hand, the first patents taken out by Mr. Danks are of very recent date—viz., 1869 and 1870. He has since taken out two other patents, dated 21st December, 1871, and 9th April, 1872. His specifications, however, are not yet filed in the patent office.

On comparing the inventions of Messrs. Walker and Tooth with those of Mr. Danks, it is difficult in the extreme to discover what the latter claims as new in his patents. In my humble opinion Mr. Danks is a mere copier of the inventions of the above-named gentlemen. Let us hope that Mr. Danks's claims on England for this invention will not be classed among the other items in the "Alabama claims."

During the late great Exhibition in Paris considerable agitation prevailed in England in reference to the great progress made in the manufacture of iron at Mr. Schneider's works in France. When this subject was investigated, all these so-called French "improvements in the manufacture of iron" were to be found recorded in our patent office, as the labours, of hard-working, but sadly neglected scientific men in England, which foreign ironmasters had adopted. In the present state of our intelligence it would appear that the scientific discoveries of the sons of England must first be adopted abroad and re-patented here before such discoveries can be appreciated in this country. This is a sad state of things, but so it is. We have numerous scientific institutions in England, but these, so far from rendering any aid to the development of scientific discoveries, or in any way assisting the inventive genius of the nation, are utterly worthless, in fact, little better than *egotistic shams.*

G. S. (Civil Engineer.)

EXTINCT VOLCANOES.—VII.

[4065.]—BESIDES the volcano of Jorullo (letter 3883, p. 66), so recent in its origin, Mexico contains other five, Orizaba, Toluca, Tuxtla, Popocatepeil, and Colima. What is rather remarkable is that these five, together with Jorullo, all lie nearly in a straight line, running east and west. The tracts of country which these volcanoes have desolated with their lava are called by the Mexicans the Malpays. The most remarkable of the mountains is Popocatepetl. Although it has long remained in comparative quietness, it was very active at the time of the Spanish invasion under Cortes. Of the first approach of the Spaniards to this volcano, and of the attempts made by some of them to climb to the top, Mr. Prescott, in his "History of the Conquest of Mexico," gives the following graphic account:—

"We are now passing between two of the highest mountains on the North American continent, Popocatepetl, 'the hill that smokes,' and Iztaccihuatl, or, white woman; a name suggested, I think, by the bright robe of snow spread over its broad and broken surface. A puerile superstition of the Indians regarded these celebrated mountains as gods, and Iztaccihuatl as the wife of her more formidable neighbour. A tradition of a higher character described the northern volcano as the abode of the departed spirits of wicked rulers, whose fiery agonies in their prison-house caused the fearful bellowings and convulsions in times of eruptions. It was the classic fable of antiquity. These superstitious legends had invested the mountain with a mysterious horror that made the natives shrink from attempting its ascent, which, indeed, was from natural causes a work of incredible difficulty. The great volcano, as Popocatepetl, was called, rose to the enormous height of 17,852ft. above the level of the ocean, more than 2,000ft. above the monarch of mountains, the highest elevation in Europe. During the present century it has rarely given evidence of its volcanic origin, and 'the hill that smokes' has almost forfeited its claim to the appellation, but at the time of the conquest it was frequently in a state of activity, and raged with uncommon fury while the Spaniards were at Tlascala; an evil omen, it was thought, for the natives of Anahuac. Its head, gathered into a regular cone by the deposits of successive eruptions, wore the usual form of volcanic mountains, when not disturbed by the falling in of the crater. Soaring towards the skies, with its silver sheet of everlasting snow, it was seen far and wide over the broad plains of Mexico and Puebla. This scene is enough to stir the young student up to diligence and duty, and to consider the omnipotent hand that formed such stupendous objects—the first object the morning sun greeted in his rising; the last on which his evening rays were seen to linger, shedding a glorious effulgence over its head that contrasted strikingly with the ruined waste of land and lava immediately below, and the deep fringe of funereal pines that shrouded its base. The mysterious terrors which hung over the spot and the wild love of adventure made some of the Spanish cavaliers desirous to attempt the ascent, which the natives declared no man could accomplish and live. Cortes encouraged them in the enterprise, willing to show the Indians that no achievement was above the dauntless daring of his followers. One of the captains, accordingly, Diego Ordaz, with nine Spaniards and several Tlascalans, encouraged by their example, undertook the ascent. It was attended with more difficulty than had been anticipated. The lower region was clothed with a dense forest, so thickly matted that in some places it was scarcely possible to penetrate it; it grew thinner, however, as they advanced, dwindling by degrees into a straggling stunted vegetation, till, at the height of somewhat more than 13,000ft., it faded away altogether. The Indians, who had held on thus far, intimidated by the strange subterraneous sounds of the volcano, even then in a state of combustion, now left them. The track opened on a black surface of glazed volcanic sand and of lava, the broken fragments of which, arrested in its boiling progress in a thousand fantastic forms, opposed continual impediments to their advance. Amidst these, one huge rock, the Pico del Fraile, a conspicuous object from below, rose to the perpendicular height of 150ft., compelling them to take a wide circuit. They soon came to the limits of perpetual snow, where new difficulties presented themselves, as the treacherous ice gave an imperfect footing, and a false step might precipitate them into the frozen chasms that yawned around. To increase their distress, respiration in these aërial regions became so difficult that every breath was attended with sharp pains in the head and limbs; still they pressed on, till, drawing nearer the crater, such volumes of smoke, sparks, and cinders were belched forth from its burning entrails, and driven down the sides of the mountain, as nearly suffocated and blinded them. It was too much even for their hardy frames to endure, and, however reluctantly, they were compelled to abandon the attempt on the eve of its completion. They brought back some large icicles—a curious sight in those tropical regions—as a trophy of their achievement, which however imperfect, was sufficient to strike the minds of the natives with wonder, by showing that with the Spaniards the most appalling and mysterious perils were only as pastimes. The undertaking was eminently characteristic of the bold spirit of the cavalier of that day, who, not content with the dangers that lay in his path, seemed to court them from the mere Quixotic love of adventure. A report of the affair was (I believe) transmitted to the Emperor Charles V., and the family of Ordaz were allowed to commemorate the exploit by assuming a burning mountain on their escutcheon. The general, not being satisfied with the result, two years afterwards sent up another party, under Francisco Montaño, a cavalier of determined resolution. The object was to obtain sulphur to assist in making gunpowder for the army. The mountain was quiet at the time, and the expedition was attended with better success. The Spaniards, five in number, climbed to the very edge of the crater, which presented an irregular ellipse at its mouth, more than a league in circumference. Its depth might be from 800ft. to 1,000ft. A lurid flame burned gloomily at the bottom, sending up a sulphurous steam, which, cooling as it rose, was precipitated on the sides of the crater. The party cast lots, and it fell on Montaño (I believe) to descend in a basket into this hideous abyss, into which he was lowered by his companions to the depth of 400ft. This was repeated several times till the adventurous cavalier had collected a sufficient quantity of sulphur for the want of the army."

The more tranquil state of the volcano in modern times having rendered the summit no longer so difficult of access as it was in those days, the ascent has been several times achieved, twice in 1827, and again in 1833 and 1834. The crater is now a large oval basin, with precipitous walls composed of beds of lava, of which some are black, others of a pale rose tint. At the bottom of the crater, which is nearly flat, are several conical vents, whence are continually issuing vapours of variable colours, red, yellow, or white. The beds of sulphur deposited in this crater are worked for economical purposes. Two snowy peaks tower above its walls. Not less magnificent in its proportions is the volcano of Orizaba, which is nearly of the same height as Popocatepetl. It was very active about the middle of the sixteenth century, having had several great eruptions between 1545 and 1560, but since then it has sunk into comparative repose. This mountain was ascended by Baron Müller in 1856. A first attempt proved unsuccessful, but by passing a night in the grotto, near the limit of perpetual snow, he was able, on the following day, after a toilsome ascent, to reach the edge of the crater. A yellow crust of sulphur coats in several places the internal walls, and from the bottom rise several volcanic cones. The soil of the crater, as far as I could see, was covered with snow, consequently was not at all warm. The Indians affirmed that, at several points, hot air issues from crevices in the rocks. Although I could not verify their statement, it seemed to me probable, for I have often observed similar phenomena in Popocatepetl. There are several of the West Indian islands of volcanic origin, and three of them, St. Vincent, Martinique, and Guadaloupe, contain active volcanoes. The most remarkable is the volcano of Morne Garou, in St. Vincent, the eruptions from which have been particularly violent. In 1812, the ashes which it threw out were so great in quantity, and projected to so vast a height, that they were carried to a distance of two hundred miles in the teeth of the trade wind. From Mount Pelée, in Martinique, there was an eruption in August 1851. La Laufriere, the volcano in Guadaloupe, is said to have been cleft in twain during an earthquake. Its activity has long been in a subdued state, but it is remarkable for its deposits of sulphur.

RALPH LOWDON.

PSYCHIC MANIFESTATIONS.

[4066.]—PERMIT me to point out the suspicious resemblance between the performances of the "painting medium" (noticed at p. 58) and the "sleeping preacher" of James I.'s reign. In his sleep, so-called, Dr. Haydock preached good sermons with a good voice, and quoted Hebrew; while, when he was awake, as there was good (?) evidence to show, he knew no Hebrew, and stuttered badly. He used to preach before numerous fellows of the Oxford colleges, whom he completely deceived. He was next taken up to Court, and preached there before the King; but James forced him to "ingenuously confess and acknowledge that this use of my nocturnal discourse, seeming to be in a deep and sound sleep when indeed I was waking, was from the beginning a voluntary thing," &c. This confession was made April 27, 1605. What a pity we have not another James I. to make Mr. D—— make a little confession in 1872!

HEDERA.

P.S.—There is an account of this man at p. 338 of Disraeli's "Miscellanies of Literature," and a fuller one in *Chambers's Journal* for Feb. 17, 1872, p. 99.

DR. CARPENTER AND PERSPECTIVE.

[4067.]—OF course no one conversant with perspective would think of disputing "E. L. G.'s" axiom, that on a vertical plane all really vertical lines must be projected vertical, and no tower not tapering can have its picture tapering at all, whether its height be 100ft. or 100 miles. This is indisputable. But a curious question arises, and if it will not be considered trifling with the subject, let us suppose that there should be a tower built, say, ten miles high. How could M. Paris possibly represent it as it would be noticed by his eye? In the first place, in order to see the base of the tower he would have to look straight before him, level with the plain on which the tower stood; but in order to see the top he would have to look right up over his head, nearly into the actual zenith, and as his eye roved over the tower from summit to base, and from base to summit, it would appear to bend over him in a curve. I think it would be rather difficult, not to say painful, to make a sketch of the tower as it really appeared. Of course I am supposing that the tower is not very distant from the spectators, say, a quarter of a mile.

BOBO.

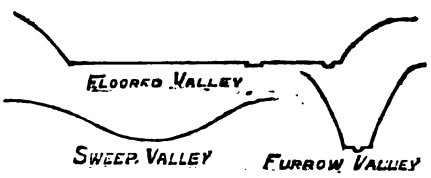
ONE PROOF OF THE DELUGE.

[4068.]—"P. SANTALINUS" (let. 3968, p. 119)—if we pass over the mis-statements of the former parts of that letter (which should be compared with his last query 9389, p. 489, and my reply, p. 514)—asks in the last sentence for some phenomenon unaccounted for, and unaccountable, by causes now in action, or without a cometfall. Now, in total ignorance what spot or country on earth "P. Santalinus" may inhabit, I can only lay, perhaps, nine to one that he is within a walk of such evidence. It is most probable that he cannot stir a mile, and very probably not step out of his door, without standing on ground whose form defies all Lyellian theory to account for, being such as the "causes now in action," never could form either in 60 million or 60 billion years (to say nothing of the 60 *thousand* of "F.R.A.S.," let. 3960). Probably, 99 hundredths of our *habitable* earth surface belongs to this category, but as the remaining hundredth includes the most fertile and therefore populous lands, and in some cases whole degrees in width of them, I must bear in mind the possibility that P. Santalinus *may* dwell where he might have to take whole days' journeys to reach the following evidence. This would be so if he dwells, for instance, in Alexandria, Calcutta, Venice, Amsterdam, or New Orleans. From any of those cities, to reach the traces of cometfall, or facts inexplicable without it, he must either go down a shaft or boring to some considerable depths (which, strange to say, are recorded by Lyell, but no other author I know of), or else he must go, perhaps, some hundred miles away; in fact, leave the alluvium. Alluvial land is the work of "causes now in action," and so are fore-shores and glacier moraines, and moreover, all precipices or cliffs, and banks that are as steep (or nearly so) as their material would stand durably in an embankment. All these kinds of surface the present actions, volcanic and atmospheric, are adequate, between them, to produce. But these alone are they *tending* to produce anywhere, and had they continued, or were they to continue a very long time uninterrupted, perhaps even the "sixty thousand years" of "F.R.A.S.," they would reduce the whole of existing land to these forms. There would be no other dry land than—

1. Lava streams.
2. Cinder cones.
3. Alluvial flats.
4. Embankment—steep hill-sides.
5. Cliffs and peaks, or aiguilles.
6. Blown sand-hills.
7. Moraines.

Of *undulating* and gently sweeping hill and vale, which P. Santalinus must well know to constitute *a majority* of all present land surface, there would, in a certain amount of time, remain not an acre. For the causes "now in action," instead of, as the Lyellists dream, anywhere *making* this kind of surface, are everywhere *unmaking* it, and through all historic time have been *diminishing* its amount! A few experiments with clay or dry mud, or a little observation either on a sandy tidal shore, or on fresh heaps of nearly any soil, exposed to all kinds of weather, suffice to prove this.

But coming to the globe's surface, regarded as a whole, P. Santalinus will allow that all the land is divided into a certain number of valleys. On whatever spot a drop of rain may fall and run, it will reach the sea by one ordained path, so that every square foot belongs to some particular valley, and the division between valley and valley is but a mathematical line. Now valleys, in this broadest sense, constituting our whole world, are divisible first into the *floored* and *unfloored* ones. The valleys of main streams, of nearly all that have names, or that are marked on common atlas maps, are, for most of their length, floored with alluvium or flat ground, rising *lengthwise*; indeed, parallel with the river's course, but level *across* at any point, like the stage of a theatre from side to side. The width of floor may be not half a mile, or many miles, and in approaching the sea such floors widen, or else several run together, and form whole alluvial countries, as Bengal, Lombardy, Holland, or the English fens. But the minor vales, all whose streams have no names (or none on ordinary maps), and in some strata (as chalk) ramify for miles and miles without a vestige of stream, and which make up the majority of every country's area that is not *fen*. These have, for most of their length, no alluvium; they may be called *unfloored*, as the Fleet or Holborn Valley, through the heart of London, and that of Marylebone (properly Mary-bourn) crossing its West end. Now, these are to be distinguished—as, indeed, the major sort are; but I speak here of the unfloored vales, because it is only in them that the distinction becomes glaring and impossible to ignore—into those whose cross section is a wavelike curve, finely rounded off, convex beyond or above the place of steepest fall on either side, and concave between these points, and those whose section is a mere V, a furrow or ravine, with banks of equal gradient from bottom to top. These last I will call *furrow*-vales, and the former *sweep*-vales, using the word "sweep" as short for "curve of contrary flexure," for which there hardly seems any other single English term (equivalent to the French *accolade*) for the word "ogee," used in building, is so gross a perversion of *og ve* itself, already totally perverted in France (for in old French its sole meaning was "groin rib," and in modern its sole meaning is "pointed arch"), that it should be abandoned, as now, in both languages, a mere source of confusion. Observe that the uniform slope of the furrow valley nowise renders it less picturesque or varied in curvature than the sweep valley, for as the stream or bottom is never straight, the banks have no plane portions or any resemblance to a railway cutting. Each necessarily forms in *plan* a succession of sweeps or contraflexures, every protruding part being convexly conical, and every recess part of a hollow cone. The straightness, as opposed to the swelling curves of the sweep valley, belongs only to the engineer's cross section of each.



Now, it is simply impossible to form sweep valleys by any length of exposure to "causes now in action." A heap of fine clay, loam, mortar, exposed to a single shower, will be furrowed with miniature gutters, gorges, and even, in the lower parts, model floored valleys, with their alluvial flats; and if they extend to the shore of a pond, you may even see the process of *delta* forming. In one hour of thunder-showers you may see, by means of an upset waggon load of soil, the entire history of a continent acted in miniature; and study it as if the mound were the Abyssinian table-land, the chief rill the Nile, and minutes were centuries. All effects of "*atmospheric* denudation" and *alluvial* deposit will be accurately reproduced; but nothing like a *sweep* valleylet, not even of the above dimension, an inch wide; nor can any length of rain exposure begin the least tendency to such sweeps and undulating forms. On the contrary, the perpetual action is to *deepen* and *lengthen* each furrow once begun, to lengthen them backward or upward into the heart of the mound, and multiply their upper branchlets; *deepening* and *steepening* every furrowlet wherein there is no deposit of alluvium going on, but *widening* none, so that all the decaying (or non-alluvial) surface is growing ever more rugged and more furrowed, and *less* like ordinary habitable hill and vale. It may lose, indeed, bits of sheer precipice, by their wearing down, as Shakespeare's Cliff has done; but loses also, and without recovery, all gentle gradients, which are progressively steepened, by erosion from their feet, and reduced to the steepest angle the material can assume (in rainy air). The only *widening* that the weather can effect in any ravine is that which may be seen in descending the gorge below any ancient waterfall. Just below the fall the sides are vertical (if not overhanging), not having had time to be weathered back by landslips into their permanent form of banks. Thus, of the six miles of gorge made by Niagara, the upper mile, next the fall, is a walled rectangular groove; but each furlong further down, being older, has less and less cliff, more and more slope (of slipped brow above and *débris* below), till, at Queenstown, the cataract's *original* place, where it began its work (not Lyell's "30,000 years," which plenty of *his own* observed facts contradict, but, as any real inquirer will find, only *five* thousand ago), there remains no cliff, but banks as regularly gradiented as the cleverest railway work; and such they must remain (except for cutting back of more tributary furrows) if "causes now in action" go on uninterrupted for ever—no undulation, no sweep-vale, for there are no causes in action to smooth off into any such form.

All this Niagara process we may see rehearsed in one hour, any fine day, on a shore of fine sand that a rill of fresh water crosses to reach the low tide. In sand but slightly damp, it will cut itself a channel, with one or more inch or two-inch Niagaras, quickly eating their way back, from the sea or wet sand, across the damp or drying, to the dry or to high-water mark. Your two-inch Niagara leaves, at any moment, its last-cut yard or two of channel between a pair of two-inch precipices, as vertical or overhanging (for in two inches damp salt sand can even stand overhanging) as those whereby Canada and New York State frown at each other across the last mile of roaring passage that their continents' outpour has hewn itself. But a few yards nearer the sea these curious sand-steps, especially if a shower has fallen, will have become slopes, and the rill's channel (if it has swollen and shrunk again) be a model of (say) Upper Egypt, a floored valley between regular level-topped steeps, bounding the deserts on either hand; the shrunken rill winding across its wide flat floor, alternately close to the foot of one steep, and anon across to the foot of the other, as if they played shuttlecock with it, but often having minor branches, canals of Yussuf, close to both. Now, when the tide has risen and washed over all this, but not till then, it will make something like a gentle sweep-vale, like those of the Fleet, Mary-bourn, &c., that the northern half of London covers.

No causes now in action, neither Plutonic nor of Jupiter Pluvius (the only two acting on land), have any tendency to make sweep-vales, but are unmaking them. Hence Lyell has to bring in Neptune, but also in vain, as a far superior geologist, Colonel Greenwood, has repeatedly shown in editions of his work on "Rain and Rivers," only he has *not* shown that these can account for the majority of the surface. He has well explained what they *can* do, and exposed the inconsistency and muddle wherewith Lyell drags in continually both Pluto and Neptune unwarrantably and uselessly to account for things purely of Jupiter Pluvius his sole work. Moreover, Mr. Scrope has, by Lyell's own admission, excluded from central France (a most typical and immensely evidential *diluvial* region) any visit of Neptune proper, any sea overflow, sweep, or *horizontally* acting deluge, since, at least, Eocene times. The French geologists, at least, have long begun to see that chief of the enormous denudation which has moulded the present lands can *neither* have been *subaërial nor submarine;* the two between which Lyell (with his shadows) and Greenwood, his stout and seemingly now sole opponent, may fight for ever, both being equally unable to account by continuous actions for what is the work and monument of an *astronomical catastrophe.*

Observe that the more any district has had of "subaërial denudation," the less has it of undulating ground, or the most common character of surface. This common character of sweep vales is *most* developed, and most exquisitely carried out, upon deserts, or the districts having either least rain or no streams; if we may trust published surveys, in the waterless deserts bordering Egypt, or here in England on Salisbury Plain, on which it remains doubtful whether the autumn review can be held, because it is by far our most waterless district. Professor Smyth notes as unaccountable this most elaborately valleyed moulding of the African *rainless* hills; but the rule applies universally, the fewer springs the more beautifully and distinctly water-moulded the surface. On the other hand, no land historically of known age, alluvial or volcanic, or upheaved in historic time from a sea, has anything but *ravines* or *gulleys*, no vale or approach to anything like undulating ground. And the districts *most* like such new lands, or like weathered heaps of our own making, are those exposed to the greatest yearly rainfall. I will only name, as a striking case, the eastern end of Jamaica, probably also the last of any mountainous tropical island which meets the brunt of the constant trade winds and condenses their vapours, in this case of Jamaica, into two or three fathoms of rain-fall per season. Its name signified "Land of Springs." You will nowhere find, I believe, less undulating ground. For the space of a moderate English county, scarce an acre inclined at between 2° and 30°, or, in short, between alluvial flat and the steepest bank that will stand, for these two kinds of ground constitute all to the exclusion of original (*i.e., deluge-moulded*) surface. A view will have undulating *lines* or *horizons*, of course; these being the ridges or water-partings between valley and valley. But all these are as sharp as a house-ridge; too narrow even to make a foot-path, for the slopes, universally of one angle, about 35°, simply ascend from every stream or alluvial floor edge to that height in the air where they will intersect the like slope from the next other stream or flat, so that if you had a model of merely the alluvial flats and lines of stream, you could proceed to build up in clay a perfect model of all the country, and find the exact height of every square yard without seeing it!

That is simply a bit of *totally weathered* country, or the state to which weather is tending to bring all the earth, and to which the present course of things left long enough would infallibly bring every square mile—as, indeed, Colonel Greenwood has well shown. But how much of existing land is thus fully weathered? Probably not a hundredth. Now, on the remaining ninety-nine of all habitable land (except alluvium), there is literally *not one acre* whose form the Lyellian geology or "causes now in action" can account for. Every acre in our five zones, that is *not modern*, that cannot be historically traced to an origin within these fifty centuries, has been plainly *under a cataract*, which is not a cause now in action. E. L. G.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4069.]—I feel I am much in Mr. Vivian's, "Orion's," and Mr. Oldfield's debt, but should like to inform them how matters are with the object-glass. I took my own made eyepiece (power 130) down to a friend's 5in. equatorial, where it defined about equal to his own. But with my own glass it does the following:—On looking at a small white paper disc on a black board, a faint bluish ray is seen on two sides of the disc, perhaps more correctly it resembles a bluish white double secondary image. With a shorter focus colour is seen at quarters of the circle. It defines the moon well with the above power—only a slight doubleness on edge. But it is with Jupiter that I have most to complain of, he darts out two elongated rays top and bottom; this destroys all belts, but his satellites are all seen unless they come too near this formidable ray. This interesting phenomena turns round with the object-glass, not with the eyepiece. I should like to ask Mr. Oldfield are any object-glasses made with one lens fast in its cell, the other slightly movable by screws across the path of its optical centre? I am doing this with mine. I am also aware of an error of about a 200th part of an inch on the edge of the flint lens. We are told by Barlow, in his "Manufactures," that this optical centre is the all-important matter; also some reflection of candle flames, seen in and through that, are impossible conditions. My own definition of a lens is a piece of glass or a disc of glass cut absolutely true off a cylinder of small material; its edge would then be equal thickness, also its centres opposite. Would Mr. Oldfield be so kind as to give us the complete recipe and method of using a cement polisher, as in his reply (11090, No. 364) it might be useful to many? He will see from this I am still lost in the blue rays.

W. H. Cash.

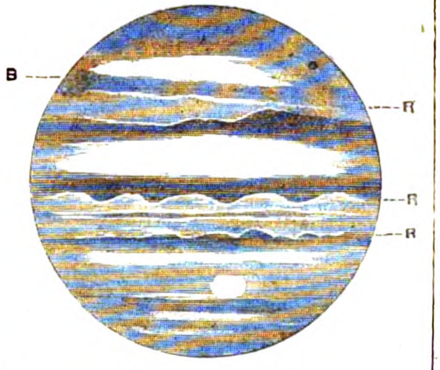
UNANSWERED QUERIES.

[4070.]—In the English Mechanic of 11th February, 1870, I asked for some information as to the working of Mr. Taylor's apparatus for screw-cutting—one of which I had just procured—and the method of cutting medallions in the lathe. Our sheet anchor, the author of "The Lathe and its Uses," has been deaf to the call, and Mr. Taylor offers but small inducement for parties at the antipodes to purchase the apparatus, as he persistently declines to explain its method of working. With reference to the medallions, I find in your issue of 16th September, 1870, that "J. L." has come to my assistance by publishing a sketch of a machine for this purpose. He has also politely sent me, by last mail, a photograph of some exquisite bits of eccentric turning, including medallions, but, unfortunately, his description is too meagre to be of any practical use. Bergeron, in the "Manuel du Tourneur," gives drawings of a machine for turning medallions—so arranged as to make the copies of the same size smaller or larger than the originals, with a description so full and minute that he who runs may read. I should feel much obliged to "J. L." if he would favour us with drawings and descriptions of his apparatus as minutely as Bergeron, or as fully and distinctly as Mr. Plant, described the geometric chuck in your pages, on 4th November, 1870. He should remember that a lathe with two mandrils is a *rara avis* with amateurs, and requires some explanation. I am inclined to think that a simpler method of turning medallions might be adopted, but I shall reserve my views on the subject till "J. L." favours us with a fuller description of his *modus operandi*. I thank him much for what he has done, but will thank him more for what he has still to accomplish. There are no secrets in art since the English Mechanic has become the medium of intercommunication with amateurs in all quarters of the globe.

John Rae.

ECLIPSES OF THE SUN AS SEEN FROM JUPITER.

[4071.]—As the eclipses of satellite 4 are of rare occurrence, I append a true sketch of the planet, and the shadow of satellite 4 at the beginning of transit, on March 14, 1872, as seen with a good 5¼in. refractor. The shadow of the satellite is given to the most prominent marking observed on the said evening, for the sake of making future observations with the same instrument. The general hues of the planet were brilliantly brought out, so as to render the observation somewhat interesting. Two large belts of ochreish colour, with a dark belt between them, were seen south of the equator, represented at R R; likewise at R, north of the equator. As the shadow was traversing the planet's disc, a some-



what remarkable occurrence took place: the large polar belt seemed to unite with the dark belt south of the bright belt at B, happening somewhat about 9.45 minutes after transit. At the end of transit of shadow of satellite 4, the bright belt (B) covered several degrees of the planet's disc, which, at the beginning of transit of shadow, was scarcely visible. Ralph Lowdon.

THE LINK-MOTION.

[4072.]—The dispute as to the originator of the link-motion is, I should think, finally laid at rest by the recent presentation of a testimonial to Mr. Howe, subscribed by 200 persons who should be intimately acquainted with the facts. The testimonial, which consisted of a gold watch and chain (the former of which was engraved with Mr. Howe's name and a representation of the link), a purse containing 200 sovereigns, and last, but not least, an illuminated address on vellum, was presented to Mr. Howe at the Angel Inn, Chesterfield. After the dinner the chairman, Mr. Smith, of the Sheepbridge Ironworks, said:—That all inventions might be considered to be divided into two parts, the idea and the method of carrying it into execution, and he did not believe that in any one patent that existed, that the idea and the working it out were not traceable to two brains. It was the case with the steam-engine; all knew very well the pretty picture of Watt as a child watching the tea-kettle, while at the very time steam-engines were already at work—rude and clumsy, no doubt, but the steam-engine was a fact before Watt was born. Still, Watt took up the idea and made it a practical success. The real practical use of the link-motion was to make use of the eccentrics of the engine to reverse the engine. No doubt that idea first struck Mr. Williams, but the way in which he attempted to carry it out would never have done, and if he had been left to it, it never would have been carried out. Here the man of genius and execution steps into the field. He says, "The idea is there, but it is of no use; the idea is a good one; can I make it of use?" He takes up the idea, but goes to the other end of it and works it out. Mr. Howe in reply, said that the matter had passed over so long that he did not expect to get any further recognition than he did when he received 20 guineas from Robert Stephenson and Co. Mr. Stephenson had come to his bench where he was working, and seemed to have some doubt whether the link-motion would turn out well or no; but he said a present would be made him, and some time afterwards he received a cheque for 20 guineas, which he put in the bank, and which formed part of the money which brought him from Newcastle to Claycross. Mr. Howe then referred to the plans which had been previously tried to meet the object of the link-motion, and remarked that the original draught he had made of his plan was on the table, as also the wooden model he had made the day after drawing the draught. He also read some letters written in 1843 upon the subject, and stated that the first accurate description of the link-motion appeared in the *Practical Mechanic* in 1846. In that year he made a design for applying the link-motion to winding engines, which he believed was the first time that was attempted, and in the latter end of that year he came to Claycross, and Mr. Binns set him to design some small winding engines for iron-stone pits. He applied the link-motion to them, and found it so successful that they had used nothing else, and he believed that there was no other gear that would meet the requirements. He then referred to the attempt of Mr. John Gray to claim the link-motion, and the trial which resulted in his defeat, and passed on to say that he thanked them heartily for the testimonial.

I think it may be said that the dispute is now satisfactorily settled: it is not claimed that Mr. Howe originated the idea, but he was the man who turned it to account, and if the honours are to be divided he certainly deserves the lion's share. Crude ideas are formed in many minds, but the master mind is that which utilises them. G. J. H.

ERRORS IN POPULAR WORKS PROFESSING TO DESCRIBE MUSICAL INSTRUMENTS.

[4073.]—I lately purchased Hiles' "Dictionary of 12,500 Musical Terms," which, certainly, is a very big shilling's-worth indeed, and would be very cheap, even at a higher price, if more nearly complete and accurate. Probably, so far as regards musical terms, accuracy is the rule of the work, and, after all, this is far more important to the musical student than any errors of commission or omission concerning instruments of "mvsick." Nevertheless, considering the writer is far from being the only person who feels an interest in the said instruments, both ancient and modern—as the present collection at South Kensington Museum, and that which is now being formed for exhibition in the forthcoming international display, testifies—he feels justified in commenting on Mr. Hiles' clever, if not quite accurate, catalogue.

About forty years ago I had the pleasure of seeing and hearing what was then alleged to be a new instrument of the double reed class, termed alto fagotto. This "faggot" of hollow sticks was shown to me by the late Mr. Bainbridge, the inventor of that pleasing instrument then so popular with the fair sex, the double flageolet. The tones of the alto fagotto, or tenor bassoon, whose compass extended, if I am not mistaken, down to tenor C, were remarkably firm and full, in my opinion quite equal to any sounds of the same pitches which it has been my good fortune to hear from its big brother even when the latter was blown by a Denman or a Baumann, and this is saying a good deal for their quality. It was, indeed, a very effective solo instrument, and put the chalumeau of the clarionet quite to shame; but I find Mr. Hiles has omitted the alto fagotto from his list, unless, indeed, it appears under the titles of Courtal, alias Dolcino, alias Tenoroon, for after all, the alto fagotto may be only the instrument formerly known by those appellations with a new name, which, *for commercial purposes*, at once converts it into a new instrument of "mvsick," just as the old harmonicon—one of the earliest of the free reed species blown by the mouth—has, by the addition of a pipe to enter our mouths, and finger keys like those of the flute, become the modern "angelophone," which musical angel, by the way, is also omitted from Mr. Hiles' catalogue.

That one of the very first words in Mr. H.'s catalogue "The Harmonious Blacksmith" would look at should be harpsichord need not "very much surprise" those of his friends who remember he formerly possessed no less than three examples of that old-fashioned instrument, for which be yet has an old man's old-fashioned fancy. Mr. Hiles' description of this ancient predecessor of the pianoforte is singularly inaccurate. He says, "it had sometimes two rows of keys, the sound (qy., its sounds) were produced by a plectrum (qy., by plectra), a statement about as accurate as saying the sounds of the pianoforte are produced by hammers instead of by its strings and soundboard when its hammers cause them to vibrate. He adds, "the keys were sensitive to the slightest touch, which is true enough if *waste* touch is meant, and, what is not true, that however lightly the key was put down, it—query the key—produced a sound whose intensity could be varied only by moving—query the sound on the performer's hands—from one set of keys to the other, or by moving certain "stops," whatever the word stop may mean as applied to a harpsichord. Mr. Hiles adds, "the single harpsichord had two unisons—I presume he means two unisonous strings—and the double harpsichord two unisons and an octave (string).

From what I have quoted, it may be inferred the touch of the harpsichord was remarkably light, but the very contrary is the fact. The only workman I ever knew who was what would now be termed a harpsichord finisher, assured me he was accustomed to regulate quill plectra until, for a drawing-room instrument with light touch, an old-fashioned copper penny piece weighing an ounce would just cause each plectrum to pass the string. More powerful instruments were regulated to what he called three "'arfpence and tuppence," the "tuppenny" touch being the limit of weight in harpsichords for domestic use, but his beau-ideal of a concert harpsichord was the one that perished in the fire which consumed old Covent-Garden Theatre, all the plectra of which he regulated to three original George the Third penny pieces. Now, when it is considered that an ordinary harpsichord, with two unisons and an octave string, has three plectra which have to be raised simultaneously, I think it probable Monsieur the conductor at old Covent Garden found three times three ounces—in other words, a nine ounces' touch—tolerably, or rather intolerably, heavy, and it must have convinced him that his occupation was no sinecure. The heaviest touches in modern pianos very rarely exceed three ounces (one third of this); and the touches of many modern German grands, are only from two to two and a quarter ounces. The latter exceeds the weight of most pianos made during the last century, so it is not much to be wondered at that the writer—when a good little boy, which, alas, is some few years ago—was told by a rather old-fashioned teacher he ought not to play on the piano because its keys descended so easily that it would certainly spoil his touch for the harpsichord and organ. *Cæteris paribus*, the loudness of a harpsichord or piano will be in proportion to its weight of touch; so we need not be very much surprised that Fanny Burney agreed with old Kirkman in thinking the pianoforte of their time was but a very poor affair, and not to be compared with the harpsichord for a concert instrument, although its weak sounds were rather pleasing for the performance of mere chamber music. "I rayther guess" things have changed" pretty considerable" since lively Fanny's time, both in music and literature. "Evelina" would be voted very slow indeed compared with Miss Braddon, not to mention "Ouida."

Mr. Hiles' statement that a single harpsichord had but two unisonous strings is simply a mistake. No doubt some of the very earliest examples had but two, and perhaps not much, if any, greater compass than four octaves. They were, indeed, little else than double virginals or spinets; but the compass was extended to nearly five octaves about two centuries ago. Not to mention the productions of the Rucker family, a fine example of which is in the possession of Mr. Hullah, and was used by him in his illustrations to the Cantor lectures, reported in the ENGLISH MECHANIC about three years ago, I may remark the only single harpsichord ever in my possession, dated 1774—viz., the one formerly the property of Madam Catalini—had the super-octave string and four rows of jacks, including the lute "stop." Nay, John Harris, in A.D. 1730, patented "a newly-invented harpsichord which might be performed on either one or two unisons, or two unisons and one octave together; or the 'forte' and pianos, or loud and soft; and the contrary may be executed quick as thought, and also double basses by touching single keys." My celestina harpsichord has two ranks of keys; it is dated 1778, and has, of course, the super-octave string; but, like the single harpsichord, it has but sixty keys. Probably our ancestors, in their remarkable wisdom, considered it impossible to distinguish a semitone whose pitch was between FF and GG. My modern harpsichord, dated 1790, the most modern I ever saw, excepting that in the possession of Mr. Chas. Salaman, has the F sharp between those notes, and a beautifully made Venetian swell. The weight of its touch was at one time 10oz.; but had it possessed another string sounding the sub-octave, I suppose its tone would not have satisfied me until its touch had been increased to from 12oz. to 15oz., when all four strings were plucked simultaneously. Capital practice for strengthening the fingers.

I have read that Handel possessed a large harpsichord with not only two unisonous, but also with super and sub-octave strings, thereby extending its compass to seven octaves. Probably the "large" one he devised to his friend. The "Rucker" in South Kensington Museum, contributed by Messrs. Broadwood, has but three strings, consequently, if it ever was Handel's property, which seems very doubtful, it can hardly be the "large" harpsichord be devised to his friend. Probably this, like most of its contemporaries, has perished, and many remaining examples of ancient musical instruments will perish also unless *conservative* principles (in relation to them) become more prevalent.

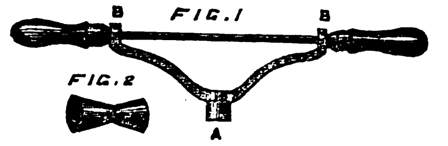
THE HARMONIOUS BLACKSMITH.

THE PIANO-QUATOR OR TETRACHORD.

[4074.]—HAS "The Harmonious Blacksmith" seen the piano-quator, and heard it properly played? if not there is a treat in store for him. This instrument, under a new, but to my mind an ugly name, tetrachord, can be seen at Stead's, in Piccadilly; I forget the number. Referring to the harmonicon, the finest instrument or instruments of this kind I ever heard, were performed upon by the brothers (3) Richardson, who were giving concerts here and in the provinces some years since, and termed by them the "Rock and Steel Band." I well remember the effect it had upon me the first time I attended their concerts. From memory, I consider the frame of this instrument was about 25ft. feet long, on which were laid roughly cut pieces of rock, similar in appearance to the stone used by mowers to sharpen their scythes with. These brothers performed at the same time (each occupying his proper portion in the scale of compass of the instrument), by means of small wooden mallets, one in each hand; in fact, the middle occupant had a double-headed one. With astonishing facility, expression, and point they rattled out the overture to "Zampa," Schuloff's "Carnival of Venice," Jullien's "British Army Quadrille," &c.; even the drum was well imitated. The steel portion of this instrument was on the same principle as the harmonicons now made, but much longer, and wider in scale. I should think the CC note was quite 4ft. long. DISC.

SIMPLE WAY OF FITTING BICYCLE HANDLE.

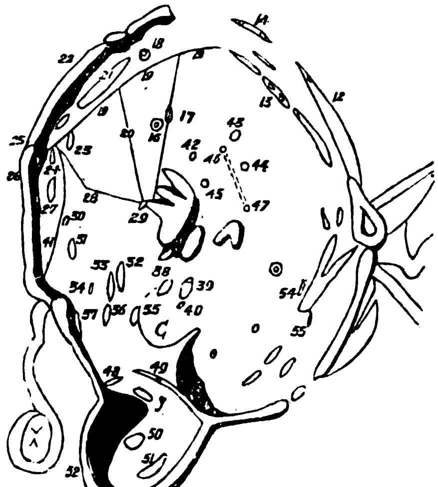
[4075.]—As the time for bicycle-riding is again coming on, I wish to place before the readers of the ENGLISH MECHANIC a simple, easy, and efficient method of fitting their bicycle handles, which will keep them tight, and prevent them making a noise. Make, or get made, the iron handle A, leaving two round bosses at BB, through which drill two ⅜in. holes. Procure a piece of good ⅜in. round iron, and draw out a tang on each end on which to fix your timber handles, which you can best do by boring a hole right through handle, and letting iron tang through it, and secure at



end with a thin brass or iron nut, which can be filed to shape of handle when finishing. Screw about an inch near each end of ⅜in. iron rod, where it runs through the two bosses BB, with the gas thread for ⅜in. iron pipe, and get a ⅜in. iron pipe socket. Fix in lathe, and turn two cones as in Fig. 2, cut them off, and having first coned or rimed out the holes BB, place in your ⅜in. rod, and screw up the two cones on the outside so as to compress or spring in the handle slightly, and let the cones fit rather tight on the spindle. Fix on your handles and finish off. You will find you will have a tight, well-fitting handle, and one which will not annoy you with that shaking, rickety noise so common in bicycle handles. FRANCIS J. B.

GASSENDI.

[4076.]—IN the ENGLISH MECHANIC for January 26, p. 487, you kindly inserted one of my sketches of Gassendi, with a description of markings situated chiefly on the eastern portion of the floor, while the west was covered with shadow. I now send you another sketch of the same crater, with a description of details contained chiefly on the western portion of the floor, so that these two sketches will complete each other as far as they go. To prevent crowding, and also to lighten, as far as possible, the work of your engraver, I have not lettered or numbered those markings which have received a designation in my sketch of January 26. I beg, therefore, the reader to refer to the description there given for objects not described now.



I observed Gassendi on April 19, 1872, from 8h. to 12h. p.m. The air was rather good, especially about midnight. At times—far too short, indeed—the whole of the floor seemed as if covered with gravel, so numerous were the markings. Had this lasted, it would have been impossible to give a sketch or a description of them, on account of the superabundance of markings. It reminded me of that fine region situated S.W. of the wedge-shaped valley, only the markings were the miniature of these. 16 is Schröter's N. crater. 17 is a cleft emerging from behind digit *a* (see sketch of January 26). It directs its course due S., passing at a short distance E. of crater 16. Just S. of this crater, where No. 17 stands, the cleft seems to be enlarged. This is the marking I spoke of in my letter of Jan. 26. The cleft 17 meets cleft 19 where it ends. 18 is the S. crater of Schröter. 19 is a cleft emerging from the shadow of the west rampart just now. Its general direction is S.S.E., forming a very obtuse angle near crater 18. It runs along the N.E. foot of mountain 22 and ridge 21. From the point where cleft 17 meets cleft 19 to the end I have seen other branches on March 2, 1871, but none of them were visible on this occasion. 20 is a cleft emerging from mound 29 just west of digit *a*, and, with a direction S.S.W., meets cleft 19 where it ends. 21 is a ridge between cleft 19 and the S.W. rampart. 22, a mound N.W. of 21. 23, a mound near the junction of clefts 19 and 28. 24, a mound near the emerging point of cleft 19. 25, a peak just shining out of the shadow of the W. rampart. So is also 26. 27, a mound situated on a high ground, round the foot of which runs cleft 41. 28 is a cleft branching (I think) from cleft 19 between the two mounds 23 and 24. It turns slightly towards the east, then towards the north-east, until it reaches a point west of 28. Then it runs in a straight direction towards peak 29. 41 is another cleft emerging from nearly the same point as 28 (I think). Its general direction is N., with a gentle curve, and ends in the shadow of the W. rampart. Among other clefts, Schmidt gives 17, 19, 20, and 28; but 41 does not seem to be the same as his 7, which I did not see on this occasion, though, I believe, I saw it on Sept. 20, 1870, and shown in that bad sketch of mine. 30 is a very small hillock east of cleft 41. 31, a mound also east of cleft 41. 32 to 39 are mounds of various forms and sizes. Among these, 35, 38, and 39 seem to form the west and south rim of ring G. Mound 39 has a minute hillock on its south end. 40 is a minute peak within ring G. 42, 43, 44, and 45 seem to be Phillip's four mounds. If so, there are two others in this neighbourhood (46 and 47), connected between them by a very low ridge, more visible as a streak of light than for its height. 48, within the opening of the "Spoon," a mound. 49, on the south border of the "Spoon," is a bright peak. 50, the central peak, and 51 a short ridge in the "Spoon." 52 and 53 show a double ridge on the N.W. border of the "Spoon." Towards the end of the S.E. border of Gassendi 12 there is a bright peak; two others are found at 14, and three on the interior ridge near 13. 54 and 55, two mounds.

Has it been observed that digit *b*, or the middle one of the central mountain, is much brighter than the two others? On one occasion, not very long ago, I found it as bright as crater 16 and mountain γ of Beer and Mädler, though smaller.

BROWNING'S MOUNTAIN, between Aristarchus and Herodotus.—This object is shewn as a crater in my sketch in the ENGLISH MECHANIC of May 12, 1871, p. 180. I have again and again looked at this object, when opportunities have offered, with the view of correcting my sketch in case I found it to be wrong; but I have never yet felt really convinced this object is not a crater.

During my present observation, after I had finished with Gassendi, I turned my telescope on Aristarchus. The streak of light west of Herodotus was, at that moment, the terminator here. Its shape was well defined. It forms a portion of the S.W. border of Herodotus, is thick on the top, and the west slope is nearly perpendicular. Is it not possible that the angle this surface presents to the rays of the rising sun might account in part for its early brightness? The T-shaped valley shown in my sketch was seen almost in perfection. The right-hand side horizontal branch was running right through the rampart into Herodotus, while the opposite side extended as far as the foot of the exterior eastern slope of Aristarchus. These objects, however, arrested my attention only for an instant, and I carefully examined Browning's Mountain. At once I said: If this is a mountain it is double. In fact, I saw two bright peaks close one to the other, with a black space between them. While considering this, it came to my mind that this object was looking very much as a craterlet in very early illumination; the west point of light answering to the western outside slope, while the east point of light represented the eastern interior slope, with the dark shadow of the western ridge between them. I ended my observation with the impression that my sketch is true. I do not write this, however, to defend my sketch, but rather to ask observers to examine this object, because, when I think of the far superior experience of Mr. Browning, and also of the larger aperture he observes with, notwithstanding all I have seen, I feel rather doubtful of the truthfulness of my sketch of May 12, 1871.

Jumet-Hainaut, Belgium, C. GAUDIBERT.
April 24, 1872.

COLLIERY EXPLOSIONS AND THEIR PREVENTION.

[4077.]—I HAVE just noticed that "King Coal" (let. 3994, p. 124, No. 369 of the ENGLISH MECHANIC) makes this remark: "If 'Arley Mine' is acquainted with any method whereby the large 'goaf' of a colliery can have the gas always removed and made safe, he will be conferring a benefit to humanity by explaining it, because (as I said before) this has been the great problem hitherto unsolved by mining engineers."

I beg to inform "King Coal," "Arley Mine," or whomsoever it may concern, that I have recommended the following plan for rendering "goaves" less dangerous, in a prize-essay sent into Lancashire two or three months back.

"Goaves," and all disused places which cannot be conveniently ventilated, should be firmly built up with bricks and mortar; but there should be an opening at the top (or roof), connected by a wooden or metal tube or conductor, open at each end, with the main or some other sufficient air-course, with the open outlet pointing in the direction of the "up-cast" shaft, and entering such air-course near the roof. In a favourable state of the atmosphere, it is probable no gas would issue from this tube; it would be condensed and driven back by the atmospheric pressure; but when the barometric pressure is low, the gas would expand and deliver itself quietly in the very place where it should be—viz., near the roof, and in the rapid air-course, whence it would be swept out of the workings. If this air had to pass over a furnace (I advocate the fan in preference), it would be advisable to make a cavity in the roof where the gas is delivered, and at dangerous times set a powerful jet of water (this has reference to a plan I proposed more than thirty years ago, to bring down the carburetted hydrogen in solution, by means of jets of pure water) from a tripod to play continually upon it. This would absorb the greater part of the gas, and take it to the "sump" to be lifted harmlessly to the surface. WILLIAM PEARSON.

Brampton, West Melton, Rotherham.

[4078.]—THE prevention of explosions is, I fear, impossible; a great diminution both in their frequency and in their fatality is quite within our reach if we render it much more costly for mine-owners to enforce than to neglect the precautions necessary for comparative safety. The proposed Mines Inspection Amendment Act will, if passed, do this in part by rendering all coal-owners and managers of mines liable to penalty when it is proved that certain precautions directed by the Act to be observed have been neglected, unless such owners or managers prove that they have adopted all reasonable means for enforcing their observance. I think the law should go a step further, and render the owners who have neglected, or allowed to be neglected, any precautions directed by law to be observed, liable to pay limited compensation to those who may be injured, who could not have been injured if such precautions had not been neglected; and I contend that such liability would be beneficial not only, though chiefly, to pitmen so injured and to their families, but also to all mine-owners who carefully observe the precautions upon which their pitmen's safety depends.

"King Coal" (letter 3994, p. 124) very fairly asks me if I know of cases in which injuries done to the paid servants of a company have been compensated. I do not, and it is, I think, a grievous hardship that paid servants are not entitled to compensation; but that is not the precise present question, though closely connected with it. There are stronger reasons why servants injured by the neglect of a specific precaution their employer is by special law directed to observe, and which is well known to be essential to safety (such as the sufficient ventilation of a fiery mine), should be sheltered from destitution than for securing compensation to all servants for injury arising from all causes, some wholly unexpected and unforeseen. I contend that whosoever by his act or neglect injures another, or allows him to be injured, should, unless he can show he has taken all reasonable precaution to prevent such injury, be liable to pay compensation to the person injured, whether he be his paid servant or not; but that *à fortiori* should he be so liable if the cause of injury be that which the employer alone can control (*e.g.*, the ventilation of a mine), and one which it is his express duty to control.

If the coal proprietor mentioned by "King Coal" at p. 124 had been liable to compensate men injured in consequence of his mine being badly ventilated, he dare not have let them run the risk he did.

PHILO.

EARWIG IN EAR.

[4079.]—Two queries which I have answered relating to stings and needles in the body bring to my recollection another annoyance which possibly may have occurred to some one of your numerous readers, but it is likely will be considered by many of them as mythic. I allude to an earwig entering the ear. I know of one instance, besides, which drove the sufferer into a half-frantic state; but having myself experienced a similar visit, may say that it is a most unpleasant situation, the sensation being that of iron claws scratching your inmost nerves. Now, as it is likely none of your readers would wish to await a reply on the subject while such a tenant was in residence, I will answer the query what to do in anticipation (*i.e.*, if you will permit me to bring tobacco-smoking again into your pages). Charge a pipe with strong tobacco (never mind the nicotine), get up a good light, then apply the mouthpiece to the ear, and blow through the bowl. There will, of course, be a good smoker wanting to assist in this performance, who may be considered active, but the passive will be transferred from yourself to the earwig. It may be asked what became of the earwig. I can only say that he was dead in a moment, and dropped out of the ear unexpectedly some months after, enveloped in a shroud of wax. I felt nothing of him after his decease.

SUFFOLK AMATEUR.

CO-OPERATIVE SOCIETIES.

[4080.]—HAVING given "F. C. S." a perfectly straightforward, definite, and practical solution for the problem that he says has baffled him, and a solution which, tried or not, differs from him and his "society," let me remind him, in having *never failed*, I should not be led away into the paths (tried or untried) of contemptuous, knowledge-scorning, social nescience, and pride of ignorance, nor think another line called for, save to correct "Loach" (let. 4030, p. 149), who fears that, whether any society pay a steward or secretary in the way I defined (p. 666), or keep the elaborate ledger of "Philo," the result will, "in a pecuniary point of view, be equally unsatisfactory." Now, he might surely discard such fear if he had merely read *how* my secretary" was to be paid—namely, not at all *until unless* their pecuniary results (or those of any member paying him) *are* satisfactory. His pay is together contingent on such results—to follow (not precede) them—and be exactly proportional to them, and this in each man's case individually, so that, for the very same year's or quarter's work, some members may owe him much and others nothing. A secretary paid anything before the store has "succeeded"—*i.e.*, before any members have made ascertainable saving, would not be "E. L. G.'s" "secretary" (steward is the term I prefer); so that "Loach's" fear involves a contradiction in terms.

Being thus obliged to add this, I may add that of course the storekeeper must (as "Loach" says) make good the "unknown quantity" or "leakage" of "F. C. S." (p. 148). It is simply ridiculous to talk of a keeper not undertaking the whole responsibility of this, and considering it in his bargain whether paid by salary or fees. Who else can possibly share it?

As for "E. L. G.'s" "check-system," I never professed to suggest any new one, having heard no complaints of the ordinary tin checks, but merely alluded to them as well known. The absurd payment of shopmen by mere time salaries *must* give way to uniform fees per parcel; but I never proposed it should do so at once. The best practical plan might probably be to bargain with every shopman on this understanding: that his full salary lasts but the first half year. At the end thereof, competitive tenders to be invited from him and others that have similarly served, to find the lowest fee per parcel that one will contract to take with three-fourths of this salary. Then, after a year, another tendering to determine what fee will suffice with half the original salary. Six months later, a similar tendering for the increased fee to go with only one-fourth of the first salary; and at length you would stop this, and begin to pay by fees alone, which is the ultimate goal.

The eleemosynary element, any help unpaid for, is the fatal leprosy that will poison with its touch, we must fear, every English working-class effort. The particular store that has occasioned this discussion is truly most unlucky, and its members to be pitied. I can only hope some or one of them may read the ENGLISH MECHANIC for himself, and if any such will refer to "Philo's" letter (No. 3166, Vol. XIV.), and (comparing it with whatever it attacks, as let. 3044) just bear in mind that one is, in their secretary's view, chimerical and "pernicious" (p. 149), and the other "an admirable letter," their main obstacle to satisfactory results will not be difficult to recognise.

E. L. G.

HONEYDEW.

[4081.]—HAVING in a previous number written upon this subject, I may, perhaps, be permitted to add a few remarks. In the first place I think it a great mistake to mix up what we call in this country honeydew with productions like the gums, sugar grains, and, above all, manna. In the course of the summer many of us will doubtless look out for honeydew, and I venture to predict that whether on limes, beans, hops, or roses, they will never find any on the upper surface of the leaves which are not overhung by others, and further, that if they pay attention they will see the aphides discharging little globules of viscid and transparent fluid for which the ants patiently wait, patting the backs of the aphides with their antennæ one after the other, as if to feel the state of the aphides. When there are no ants this sweetstuff falls on the leaves or ground below. Officinal manna is supposed to be an exudation, not an animal excretion, and the result of a puncture. I do not say it is impossible for it to exude naturally, for on my vine-buds I have noticed large crystals of sugar. The aphides do not feed on honeydew, if only for the reason that they protrude a sucking tube into the parenchyma.

M. PARIS.

PRESERVING AUSTRALIAN MEAT.

[4082.]—I HAVE intended for some time past to send you an account of the whole process, but cannot at present find it. In the first place what is called a 4lb. tin weighs gross 5lb. and more, the overweight depending more upon the weight of the tin than anything else, so that a 4lb. tin contains 4lb. and a 6lb. tin contains 6lb., and all sizes generally a few ounces more, of cooked meat (in most cases without bone), and some fat and a little jelly. That is my experience, and I have turned out some scores of tins. As regards preparation: Each tin has put into it a certain quantity of meat, then the lid is soldered on, a hole being first made in the centre. The tins are then placed in a bath of strong solution of chloride of calcium up to about two-thirds of their height. This bath is then heated to its boiling point, which is many degrees higher than that of boiling water. When all the steam and air have been expelled from the tin through the hole in the lid, a drop of melted solder is dropped over the hole, which is thus hermetically sealed, and the tin rendered perfectly airtight, the small strip of tin soldered under the lid catching any drop of solder which falls through the hole, and preventing it from mixing with the meat. The only fault I find with the meat is, its being somewhat overcooked, owing, I myself believe, to the heat inside the tins, during the progress of cooking, being too great. Improved processes are, however, being adopted. Each case, on being landed at the quay, is opened, and any tin found with convex ends is put on one side as unfit for sale, and the contents used for manure. The convexity or bulging out of the ends of the tin shows that the meat, owing to some fault in the process, has decomposed, and formed a quantity of gaseous matter in the tin. J. L.

P.S.—The cost of "tinning" the meat has been 3d. per pound on the 2lb. tins, and of course less on the larger sizes.

VERDE ANTICO.

[4083.]—I HAVE wondered whether my apparently simple queries as to verde antico and working in gold and silver would ever be answered. At length "Proven" (let. 3978) has noticed my communication, although not affording any direct information as to the oxydizing of the bronze.

I can only repeat that I have seen frescoes on the walls of Pompeii representing female figures with brooches and bracelets of a *green* colour, and I recollect in one of the recently excavated dining-halls in the palace of the Cæsars at Rome a fresco of a male athlete, wearing a snake bracelet, the colour of which is most decided, and as fresh as when first painted. It evidently represents bronze, and, had the original not been coloured with verde antico, would certainly not have been painted green. Besides this, many of the most exquisite bronzes in the Museo Borbonico at Naples were found, not in the earth, but in urns, hermetically sealed by the Vesuvian ashes and mud, so that the only air that could have acted upon them was that contained in the urn during 2000 years.

Would there be no way of so oxydising the mass of bronze before casting as to produce a green homogeneous metal which would take a fine polish?

"Proven" wishes to know how I work. I generally make my first models of the antique objects in lead—wire and plate, riveting when necessary—so as to be pretty sure, by a comparison of the specific gravity of the article, how much silver or gold I shall require to work up. My silver I have hitherto got from the Mint in ingots ready alloyed, 13 fine, but I would much rather make it myself from the fine metal. The gold I buy fine, of course, and indeed all the gold articles I have made were copied from fine originals. Some were so large and costly that I reduced them in copying—but it is impossible to produce any very elaborate work in soft fine gold, and the antique are more remarkable for their wild and original design than for the beauty of their execution.

The twisted snake bracelet is an easy and satisfactory ornament, the fine gold wire—about No 8 or 7—being drawn from the middle through decreasing holes in the plate so as to taper it away to nothing at each end. Three of these are then twisted into a cable, and a rough snake's head and tail beaten out of their ends on the anvil. The bracelet should be about ten inches long at least, to go once and a half times round a lady's wrist. It is perfectly pliable, and can never break, and if nicely made looks exceedingly savage and handsome.

I should very much like "Proven" to recommend me a tolerably exhaustive treatise on working the noble metals, as I really know very little about the art, but just try and imitate as well as I can what I see—much, I suppose, in the rough-and-ready way adopted by the ancients.

I would repeat the queries as to alloys and the composition of bronzes which I asked in my last (p. 560, Vol. XIV.).

If "Proven" will try and work in a pair of old long white gloves, already used for balls and parties, previously, however, tightening the first button on the wrist to make them fit close, she will not have to complain of her hands. When working at a furnace, or forging a large piece of metal, she will, of course, wear a thick pair of gauntlets.

Has "Proven" had any experience in the use of the spirit blowpipe recommended by "H. B. E." in 3999? I learnt soldering at Rome, from one of the principal goldsmiths who excel in that branch, but it is most difficult to use the blowflame like a pencil, as is done by those artists in fixing minute pieces to large ones.

The solder used by the Roman jewellers for their best work is as follows: 2 parts silver, 1 part copper; 1 part of this to 2 parts fine gold. Flux: borax and water. This solder suits 18 carat gold. To solder fine gold, use 18 carat gold and the same flux, but the heat required is much greater. Clean from borax by boiling a few minutes in sulphuric acid and water, equal parts.

"I do hope "Proven" will help me, as a sister interested in the same delightful work.

Stockholm, April 23. ETHEL.

INFLUENCE OF COLD ON VEGETABLE GRAINS.

[4084.]—THE explanations of "A. B. M.," for which I thank him, do not make this matter much clearer, and I can only reiterate the opinion that the conclusions of M. Duclaux are erroneous. The facts are merely these: Seeds of certain plants are exposed to cold, and because these germinated when seeds of the same kind preserved from the influence of cold did not, M. Duclaux thinks that exposure to a low temperature has an influence on the germinating powers of the seeds. On the contrary, I contend that there is something radically wrong in the experiments. Ripened and selected seeds certainly do not require seventy-six days to germinate when submitted to the requisite temperature (as those under discussion were); this fact is patent to all who have had any experience in the matter, and the wonder really is that any of M. Duclaux's seeds germinated at all. I presume the method of sowing was exactly similar in all respects, so that all I can conclude is that they were allowed to dry after swelling, the surface mould became caked, or some of the seeds were sown too deep, and so failed to germinate. What would be thought of a gardener who only raised eight out of eighteen thoroughly good seeds in one case, and only two out of thirty-six in another? Certainly further experiments must be made before anything reliable will be obtained.

I hope "L. C. E." will speedily make the amende honorable for his unfortunate letter, for he must now see that scientific experiments and researches, even those from which erroneous conclusions are drawn, are, by their very nature, of value; for the facts remain, while the errors of one explorer are but lighthouses to direct the steps of future discoverers. No one has said much for the microscope; but how "L. C. E." can say that that instrument has done little or nothing for science and humanity passes my comprehension.

SAUL RYMEA.

CASTINGS.

[4065.]—IN casting by the *forma perduta* method the mould is made of "due mattone, uno gesso," *i.e.*, two brickdust, one plaster of Paris, made into a thick cream, which is allowed to dry, and the wax is then melted out. This composition will not, of course, bake into a brick, and when heated enough to melt the wax out it becomes exceedingly friable, and must be handled with the utmost tenderness. My other occupations have prevented me testing this mixture personally, but, as I mentioned before, it is used in Italy, though the "Tripoli" is doubtless preferable. But if "Faber" is addicted to this kind of thing, he can make mixtures for himself, bearing in mind that crucibles are made of either fire-clay and sand, or plumbago and clay, and a little practice will soon obtain him a perfect non-porous mould. As to the wax, the red wax sold in Long-acre by artists' colourmen as "modelling wax" is, of course, the right kind to model with, but, unluckily, it is mixed with things which will not run out clean when the mould is heated, and though blowing through it and pouring quicksilver in and out are practised, I find nothing but wax comes thoroughly away. But it requires skill to model in beeswax alone, as it is too sticky, and it must, indeed, be remembered that skill in modelling is specially called for in this mode of casting. If you don't finish very fine and get a sharp cast, you must put it into the hands of a chaser, in which case it is better to have your work cast in sand. But then your metal casting will be finished by some one else than the original artist, which is, in fact, the objection.

PROVEN.

USEFUL AND SCIENTIFIC NOTES.

The Metrical System in Austria.—The law rendering the metrical system compulsory in Austria and Hungary has just been promulgated. The standard metre is a glass rod, which has a length of 999·99761 millims, at the temperature of melting ice. The standard kilogramme is a crystal glass cube, the weight of which in vacuo is equal to 999·9978 milligrms. (both standards having been made according to the great platinum standards at Paris). The new system is to be in full compulsory force from Jan. 1, 1876, but in all official works the new system will be required to be adhered to on and after Jan. 1 next.

Prehistoric Races.—The United States exploring party in Colorado have discovered many ruins of the communal houses once occupied by the prehistoric people of that country. Several of these houses stood upon the cliffs overhanging the canons, and many others were found in valleys amongst the mountains to the west. Stone implements, pottery, basket-ware, and other articles were found buried in some of the ruins. A tribe of Utes were found on the Kaibab plateau who still make stone implements, and Major Powell, the leader of the expedition, had an opportunity of witnessing the manufacture.

Dyes for Leather.—According to Herr Springmuhl picric acid gives a good yellow without any mordant; but it must be used in very dilute solution, and not warmer than 70° Fahr., so as not to penetrate the leather. Aniline blue changes this colour to a fine green. In dyeing the leather, the temperature of 85° Fahr. must never be exceeded. Aniline green is well adapted for dyeing leather, and its application is quite simple, a concentrated aqueous solution being employed. The leather is brushed off with a solution of sulphate of ammonia in water, and the dye solution applied at 95° Fahr. Care must be taken, however, by rapid manipulation, to prevent the dye from penetrating through the leather. By the addition of picric acid, the bluish shade of this dye stuff is modified to leaf green, and it becomes faster; but the picric acid must not be added to the colour solution; it must be applied to the leather before or after the dying with aniline green.

The Velocity of Wheels and Shafts.—Professor A. E. Dolbear suggests a simple and effective method of determining the velocity of rotation of wheels and shafts. Upon the face or upon the periphery of the rotating objects he fastens smoked paper, and this he touches with the point of rubber which is attached to one branch of a vibrating tuning fork, having a known rate of vibration; the fork is to be so held that the direction of its vibrations will be at right angles to the line of motion of the shaft. By counting the number of undulations made on a given extent of the smoked paper the speed of rotation is at once indicated. Thus if the fork makes 100 vibrations in a second, and one vibration is recorded on the smoked paper in a space covering one half the circumference of the wheel or shaft, or two vibrations within the entire circumference, it is evident that the rate of rotation is fifty revolutions per second. By this simple and easy method the velocity of rotation of gyroscope discs and of all kinds of shafts and wheels may be readily ascertained.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

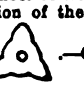
1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10414.]—**Retrievers.**—I am sorry to differ from "Hedera" in his advice upon training retrievers, but, as an old sportsman, and a very successful breaker of dogs, I should say by no means let a young dog, that is intended for retrieving game, play with or carry a stick. Teach him to fetch a soft ball or glove, and if he shows any disposition to be hard mouthed, cover the ball with a hedgehog's skin, and again with the skin of a rabbit or bird. A tender mouth is most essential for a retriever. I had one that would carry hens' eggs.—MOUNTAINEER.

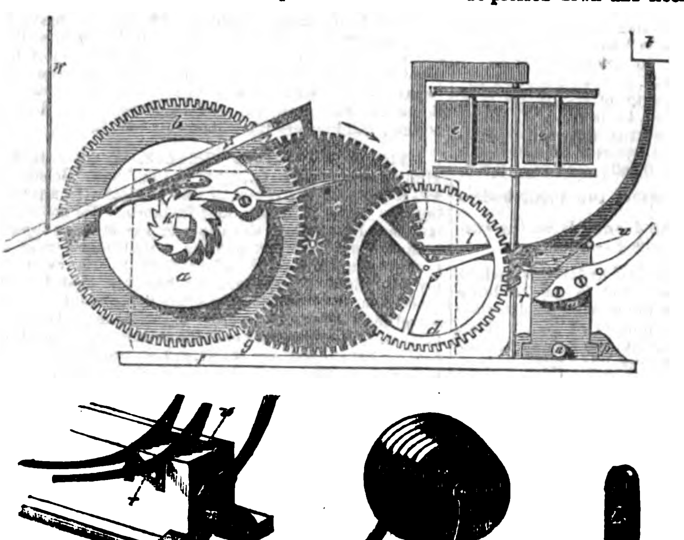
[10617.]—**Watchmaking and Isochronism** (U.Q.).—The reply of "Anglo-America" on this subject is meaningless nonsense. Isochronism as applied to horology, means unequal vibrations in equal times.—WEST CORNWALL.

[10954.]—**Circulation of the Blood.**—I do not doubt that "F. R. C. S." is a very good teacher of anatomy and physiology, for many high authorities in those sciences hold the same opinion that what is called the suction power in the chest favours the return of blood to the heart; but some are of the contrary opinion, and it is a question rather of hydraulics than of physiology. No doubt if an opening were made into the chest, air would be forced in by the excess of atmospheric pressure, and so also would blood, by the same excess of pressure, be forced from the rest of the body into the chest, were it conveyed in rigid tubes; but the veins are very flexible, and become quite flat when not distended with blood, just as the hose-pipe of a fire-engine does when the m-n stop pumping. No pressure on a flexible hose-pipe can possibly increase, and if it be in excess of the pressure of the pump it must diminish, the flow in the hose-pipe; if there is to be any suction whatever the pipe must be rigid enough to resist the excess of external pressure, or the pipe will be flattened just as veins are when the flow of blood into them is checked from behind, an experiment which any one may try by tying a bandage round his arm, when the superficial veins below the bandage will become full, and those above it empty, just as a soft hose pipe when trod upon will become fuller between the pump and the foot, and empty beyond it.—PHILO.

[11008.]—**Tilt Hammer** (U.Q.).—Mr. Fennell has entirely misunderstood the action of the tilt hammer used in the manufacture of steel, &c. In the machine engraved, the hammer would be lowered as gently as it rose, and the effect would be little beyond that due to its dead weight. The fulcrum or fixed axle of a tilt hammer is generally near the tail end, which is raised by the action of a wheel having two or more large teeth, which depress the tail as they revolve, and permit the hammer to escape suddenly and fall by its own weight as many times during each revolution as there are teeth on the wheel.—A BARRISTER.

[11008.]—**Tilt Hammer** (U. Q.).—If Mr. Fennell will look his sketch over on p. 128, I think he will agree with me that the hammer would not work with the eccentric motion as shown—first, because the hammer would not reach the anvil, because the eccentric has too great a diameter; and second, the hammer would not drop sudden enough, it would follow the circumference of the eccentric all through the revolution, and consequently fall as gently as it rose. There are several kinds of motion that might be used, but I should say use the cam with two, three, or four tappits on, to suit the number of blows you require of the hammer for one revolution of the shaft; shape of tappets more this style .—GOUX.

[11031.]—**Model of Church.**—Herewith drawings of mechanism to play wedding chimes and two tunes on eight bells every time a penny is dropped into the model. The bed of the machine is a brass plate *f*, having another plate *g* fixed perpendicularly to one edge of it. This latter supports the arbors of the wheels and barrel at one end, their other ends being supported by separate standards *h*, screwed on plate *f*. Plate *g* is drawn with dotted outline to shew *a*, the barrel containing spring, on which driving wheel *b* is fixed. The ratchet and pawl, *k* and *i*, and end of driving-wheel arbor, squared for winding, are outside of plate *g*. The wheel *b* drives the barrel, a long brass cylinder, to one end of which is affixed the wheel *c*, driving-wheel and pinion *d*, and fly-wheel *e*, by means of an elongated screw on the shaft. The wings, *e e*, of the fly are made to turn stiffly on their axes, so that the rate of speed may be adjusted. The hammers and bells are fixed to a movable brass block *m* (shown separately below) which slides by means of the rod *n* (which must be carried outside the model), so as to bring the hammer-tails against different rows of pins, and change the tunes. The hammer-rods *l*, bearing hammers *t*, are hinged in slits in the block *m*, at distances of one-third of an inch, having springs *r* to make the strokes, and a stop, *u*, to make them rebound after striking. The hammer-tails must be so adjusted as to be pressed down and liberated by the pins on the revolving barrel. The bells must be placed close together without touching each other on a rod fixed to the bars, *o o*, fixed at each end of the block *m*. If clock bells are not used it would be well to drill the bell handles, and carry out this arrangement as far as possible. The diagram of surface of barrel shows the arrangement of pins, which should not exceed one-sixteenth of an inch in length) for three different tunes — viz., "Wedding Bells," "Minstrel Boy," and Prayer from "Der Freischutz." These may be altered at will by shifting the lock *m* one-ninth of an inch. In fixing pins in barrel attach the diagram to the surface thereof, and drill through the dots. The whole is started and stopped by the rod, *v*, the inner end of which, bent inwards so as not to touch wheels *b* or *c*, is bent perpendicularly downwards, slides along the edge of barrel until the tune is finished, when it drops into a hole made in its track, and stops the motion. On the outer end of this rod (which is kept up by the spring *x*) is a small tray, on which the penny dropped in, guided by a tin shoot, strikes a blow which starts the machine, and then drops to the bottom of the tower. By means of the wire, *w*, which "Modeller" had better keep under his own control, the bells may be started without the denarial contributions. Finally—by means of those seductive, not to say, silvery, arts, which "Modeller" probably knows how to use, he may get much of this gear second-hand from a clock-maker. — HENRY NEWMAN.

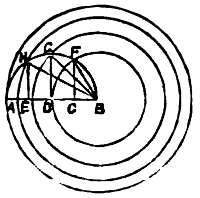


[11196.]—**Drowning** (U. Q.).—The reason why a human being, when drowning, alternately rises to the surface and sinks towards the bottom of the water is as follows:—When he falls into the water, if it is not of great depth, he goes to the bottom; but on account of the air in the lungs rendering the specific gravity of the body lighter than the water, he immediately rises again to the surface. The efforts made by him to maintain himself at the surface diminish the quantity of air in the lungs, and he again sinks, but soon rises again; and this alternate rising and sinking may occur several times. With every expiration the specific gravity of the body is increased; the powers of sensation and voluntary motion rapidly diminish, and the body settles at the bottom.—F. A. EDWARDS.

[11286.]—**Blacking Gun Barrels.**—There is no book on this subject as a specialty that I am aware of. Several recipes have appeared in back numbers; if "B. & J." cannot find them I will see whether I can.—E. M.

[11293.]—**Colour Blindness.**—There is, I believe no remedy for achromatopsy or Daltonism. The colour blind are taught to distinguish the colours just the same as we teach a child that the colour he sees reflected by grass is green, and so on. There are, of course, colour sensations they cannot receive, and to that extent the accuracy of their perception of colour is defective, for they soon learn to distinguish between the colour sensations peculiar to their abnormal vision. —SAUL RYMEA.

[11294.]—**Dividing Metal Disc.**—I send a demonstration as requested by Mr. Tonkes, on page 126, of diagram given on page 78:—Let A B = $\frac{12}{12}$ = unity of the quantity (to be divided). Put A C = a, and C B = b. Then by the equation to the circle and (Euclid I., 47) F B = $\sqrt{ab + b^2} = \sqrt{b(a + b)} = \sqrt{b(1)} = \sqrt{(b)}$. Similarly G B = $\sqrt{\text{D B}}$, H B = $\sqrt{\text{E B}}$, A B = $\frac{12}{12}$. Now, as circles are as the squares of their radii, therefore the circles to the radii F B, G B, H B, A B, described from the common centre B, are as their squares C B, G B, H B, A B, respectively, that is as the fractions $\frac{3}{12}, \frac{6}{12}, \frac{9}{12}, \frac{12}{12}$, and by successive subtractions the remainder 3 in every case is found. N.B.—In the geometry of fractions, the squares of fractions appear less than the fractions themselves.—THETAMU, Horsham.



[11305.]—**Bakers' Ovens.**—There are several patented ovens which, I believe, are better than the ordinary form; perhaps some one who has had experience will give the information. There is a "pyrometer" specially constructed for taking the temperature, being inserted through a plate by the side of the door. It has a dial on the outside face, so that the heat is read at any time.—E. M.

[11312.]—**Boiler.**—The best boiler is undoubtedly one of those recently patented, like Miller's in the last number. But "One in Trouble" says that his boiler is to be 30ft. long by 7ft. in diameter. If so, it should have two flues, 2ft. 3in. in diameter, and the rule for calculating the strength of the plates is T (thickness) = P (pressure per sq. in. in lb.) × D (diam. in inches), divided by 2 k, k varying with the description of iron: thus for best Yorkshire double riveted it is 7,800, best Stafford ditto, 6,200; ordinary, 3,700. The formula is $T = \frac{PD}{2k}$. Whether two small boilers would be preferable will depend entirely on the surrounding circumstances of working.—E. M.

[11313.]—**Setting Lathe.**—If I understand aright F. Humes's query—viz., an easy way to set the lathe mandril exactly in a line with the moving headstock—the readiest method is to drive a piece of wood, which is as long as the bed of lathe, into the hole in nose of mandril, or into a chuck. On revolving this, see that the centre at its end agrees with your moving centre; if so, the mandril must be truly in line with the moving centre.—A., Liverpool.

[11324.]—**Salt Damp in Walls.**—"Barbaros" kindly suggested to test the crystalline fur that exudes itself upon the wall-surface for saltpetre rather than salt. I have done so, but have not succeeded in detecting it. Nor can I discover any cause, such as the presence of liquid manure about or near the wall affected. The house is situated about a mile from the sea-shore, whence I know that sand is sometimes got for building with. It is used because of its cheapness as compared with the cost of carting pit-sand seven miles. I, therefore, think it not unlikely that this part of the brickwork was set with mortar made from that source. Perhaps "Barbaros" or some other of your talented correspondents would suggest some application that would chemically combine and form a barrier in the substance of the plaster.—W. M.

[11324.]—**Salt Damp in Walls.**—Let "W. M." try a strong solution of alum in water put on hot as a wash for his salted walls.—SUFFOLK AMATEUR.

[11329.]—**Electro Deposition of Iron.**—I do not clearly understand what "Puck in a Hollow" wants to know. His query is headed as above, but he talks about solid articles in copper.—E. M.

[11359.]—**Casting Brass Solid.**—Don't use the sand so wet.—GOUX.

[11378.]—**How to Kill Beetles.**—Get a suitable vessel—a large-mouthed pickle bottle—and put into it a few bruised laurel-leaves and warm it before the fire or in the sun to bring out the strength. Keep it corked when not in use. Any animal living in that for five minutes must have a constitution like a steamboat.—W. FRENCH.

[11380.]—**Sand for Casting** is a misnomer. The substance used is a species of loam called sandy or founder's loam. It possesses a certain amount of adhesiveness, and is of very fine grain. It is used without any preparation.—SUFFOLK AMATEUR.

[11386.]—**Crystals in Gas Tar.**—As Mr. Bottone says, these were probably naphthaline; he is, however, wrong in stating that this substance is used in the preparation of artificial alizarine, which is prepared from anthracene ($C_{14}H_{10}$). From naphthaline a body termed chloroxynaphthalic acid is prepared, which is somewhat analogous to alizarine, and is used in dyeing, giving fine shades of scarlet and orange.—ETHYL.

[11390.]—**Brown Hat.**—Take about three ounces each of fustic and madder, tie in a muslin bag and put in an earthen vessel (pipkin) containing two quarts of cold soft water. Having cleaned the hat with soda and water and well rinsed it, while wet put it in the vessel and let all simmer for about two hours. Drain the hat dry and gloss to taste with hot gum arabic; after pressing, another coating of gum may be given it. If the colour when dry is not sufficiently dark, add more madder and reboil.—REDIVIVUS.

[11398.]—**Sting of Bees** and all venomous bites are best treated with ammonia, or in its absence soda. Hartshorn and oil is a good form of application.—SUFFOLK AMATEUR.

[11423.]—**Surgery.**—Without pretending to any particular surgical knowledge, it seems unlikely that the presence of a fragment of a needle in the finger should be of much greater consequence than the fact of its causing some annoyance, unless severe inflammation were present. When a boy I had a needle broken and about half of it left in me; it entered about the bottom of the breastbone and caused some annoyance for about a fortnight, after which I felt nothing of it for some two or three years, when a hard lump gathered inside the knee, from which by pressure the piece of needle was extracted. As in the present instance, the effect of the presence of the piece of needle seems to show itself on the opposite side of the finger to that at which it entered; it will probably make its exit by that road, and Nature assist by a small gatheri g. The hard point of the needle may possibly be then felt under the skin, when a pointed pair of tweezers would do all that is wanted. —SUFFOLK AMATEUR.

[11428.]—**The Violin** alluded to is probably genuine. Thomas Smith was a maker (pupil of Peter Wamsley) of stringed instruments (his violins are supposed to be rare) from 1756 to 1766. He used a brownish red spirit varnish; occasionally labelled his violins as Steiners. They are of no particular value.—SUFFOLK AMATEUR.

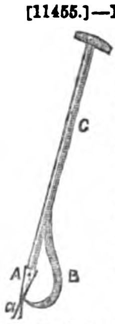
[11438.]—**Lemon Marmalade** can be made in the manner described for orange in No. 368, p. 107. For vegetable marrow preserve cut off the peel of the vegetable marrows, and scoop out the seeds. Boil the fleshy part left with sugar as in ordinary jam making. Some candied peel, cut in thin slices, added during boiling, will improve it considerably.—J. L.

[11442.]—**Old Wives' Science.**—I am sure my kind friends, "E. L. G.," "Wee Pet," and "Science," will forgive me if I revert to this subject. In answering the question in the first instance, I did not mention that I had made any experiments on the subject, because I always prefer quoting a well-known man to requiring my readers to place faith in the results of my own trials. It so happens, however, that I have made a series of rather exhaustive experiments, under a broiling Italian sun, in order to satisfy myself on this subject. My mode of experimenting was doubtless rough; but the average result was so unmistakable as to lead me to the conclusion that the direct rays of the sun have no perceptible influence on combustion. My method was this. Into an open brazier (basket) I introduced a given weight of coke, with a given quantity of wood, &c., to insure ignition. Fire was then applied, and a small copper, containing three litres of water, was suspended over the brazier at a distance of about 15 centimetres. The time at which the fire was lighted, and the water put on, &c., was carefully noted. The time required to raise the temperature of the water to 100° Cent. was also noted. After repeating this experiment, first in the full glare of the sun, and then in the shade of a high house, on more than twenty different occasions, with wind, and without wind, I found that no appreciable difference was noticeable in the time requisite to cause the water to boil. With regard to "E. L. G.'s" experiment of causing paper, &c. to inflame in the focus of a lens, I can only say that I have never failed in causing the paper to burst out into flame, provided it did not rest on anything. As to the effect of the actinic and heating rays (*id est*, the extreme violet and red), I have always succeeded in igniting phosphorus with these, though I failed with the pure yellow. Indeed, if these have any effect, so far from exercising a retarding influence, it is only consistent with reason to expect that the contrary should obtain. If "Wee Pet" and "Science" will consider for a moment, they will easily perceive that while the sun's rays are shining on the fire, the temperature of the fire is also raised in exactly the same proportion as that of the air on which the sun is likewise shining; hence the current of air is relatively the same in both cases. As to Dr. Brewer's statement that the heating and actinic rays are "detrimental to combustion," I need only say that it is contrary to fact. Many cases of chemical combustion are known, which only take place under the influence of actinic rays. I may mention as an example the detonation of a mixture of hydrogen and chlorine, when exposed to the highly actinic rays of the magnesium light.—S. BOTTONE.

[11442.]—**Old Wives' Science.**—One fact is worth a bushel of argument. I have fairly tried the effect of the sun shining on a fire, and it does not put it out or cause it to burn low. The room in which I tried it has two fireplaces at the same end of the room, and the draught equal in both. The two fires were lighted at the same time, and by adjusting the blinds the sun was allowed to shine full on the one fire, and the other fire was in a deep shade. The two fires were watched, and, contrary to the expectations of several persons present, both the fires burnt up equally well, and were left untouched till they were both nearly out from want of fuel.—SHU FLY.

[11450.]—**Adjusting Equatorial.**—ERRATUM.—Kindly permit me to correct an error in my reply (p. 154). Instead of "north declination at the instant of transit," read "altitude above the north point of horizon." The other two lines may be cancelled as inferential nonsense. The N. P. D. should have been the co-declination of star + refraction. The S. P. D. = 90° + declination − ref.—THOMAS BUCHANAN.

[11455.]—**Daisy Extractor.**—I think this will do for "F. T. S. S. D." (sketch enclosed). A is a socket having a forked end; a B, a piece of stout hoop iron at the back for a leverage; C, any kind of handle to which the hoop-iron and socket are fixed. Use it as you would a spade. The hoop-iron prevents marks on the turf.—W. H. M.



[11461.]—**Reviving Black Cloth.**—The following will be found very good for reviving black cloth, and may be useful to A. Despoire:—Strong ammonia, 1oz.; water, 4oz.; turpentine, 2oz.; good black ink, 4oz.—TIP.

[11472.]—**Plaster of Paris.**—There are few amateurs who know how to gauge (mix) plaster of Paris properly, although it is so simple. If "C. B. B.'s" plaster had been good, and he had used it properly, the result would have been satisfactory. This is the way to gauge it. Put into a basin the quantity of clean water you require, and shake the plaster into it with your hand, scattering it over the whole surface as fast, but no faster than it will sink, and when the water will soak no more plaster, stir it up quickly with a brush whose size should be in proportion to the quantity of plaster. If you require to fill in a mould, or to make a mould of a medallion, dab it in with the brush. This is as clear as I can make it on paper.—W. FRENCH.

[11475.]—**Artificial Butter.**—The fat or oil is heated in a shallow vessel until it begins to fry, the action of which is owing to the violent evaporation of the water contained in the fat. After this is all driven off, the fat becomes still hotter, but it is absolutely necessary that the heat shall be so regulated as not to be pushed to the boiling point of the fat itself, but a few degrees below it. A temperature of about 300° Fahr. is required, and a little water should be cautiously sprinkled from time to time upon the fat while at that temperature, after the water that it originally contained has frizzled away. The process is continued until the purification is completed, and the hot fat is then strained, and if the process has been properly conducted it is found to be pure, colourless, and tasteless, besides becoming smooth like butter. Invented by M. Dubrunfaut and M. Charles Fua during the siege of Paris.—J. L.

[11482.]—**Algebra.**—If "our" correspondent "Thetamu" imagines he has solved the equations in question 11482, he is dreadfully mistaken. The equations contain four unknown quantities, to obtain the values of which four equations must be used. "Thetamu" only uses the first three, and then instead of the fourth he makes an unwarrantable assumption amounting to the following:—That certain auxiliary quantities (n and d) which he has introduced are whole numbers. There is no warranty for this in the given equations, except so far as it can be derived from the fourth equation, of which he makes no use. Any one could solve the equations in the way he has done (if that can be called a solution), by simply observing that 12 + 2 = 14 and 8 + 3 = 11, and then trying whether the values of 12, 8, 3, and 2, satisfy the other equations. But that is not solving the equations, but guessing at them.—A NEW SUBSCRIBER.

[11498.]—**Re-Scaping Old Verge Wheel.**—B. James wishes to know how to "file up" a balance-wheel I presume. First examine the teeth to see that none of the points are bent, then put on screw ferrule, put the wheel in the turns, and top the ends of the teeth true with a slip of water Ayr stone sloped off flat at the point. Take the wheel out of the turns and with ferrule still on, rest it firmly on your cork in the vice while you are filing the backs of the teeth. This must be done with a fine balance wheel file. Let the file rest well on the tooth, but more on the ends than on the middle part, as in the latter case your file is likely to act just below the point, which gets so thin that the end of the tooth bends over instead of coming to a point, and you file on wondering why it is you make no progress, unaware that the tooth is doubling over until, perhaps, you have gone so far that the tooth is spoilt. This is a common error with young beginners. The tooth should be filed more obliquely than across, and as the back of the tooth is a curve you may prevent the file from pressing too much on the middle part of the tooth by filing more or less in the direction of its length. The burrs left by the file may be stoned off in the turns. Use oil on the stone both for topping and removing the burrs.—WEST CORNWALL.

[11499.]—**Zymotic Diseases.**—I beg to thank "F. R. C. S." for his answer to my question on p. 130. I did not christen the diseases, as he is, of course, aware. For my part, I would suggest "zymoid" as far preferable. Why Dr. Farr should have selected some infectious diseases for his zymotic class, and have left others quite as "leavening" out in the cold, is, I believe, what no medical man can understand. But is not all our medical nomenclature in a pitean state? In an official medical report now on my table, I find the same part of the colon called *cœcum, caput cæcum, caput cæcum coli*, and *caput coli!* the cœcum proper being, moreover, the vermiform appendix. *En passant*, I would remark that it is very odd that from all the heaps of medical statistics published at great expense to the country, almost for the sole benefit of unprofessional members of the two Houses, not a ray of light has ever, so far as I am aware, illumined the dark maze of the etiology of diseases, or, I might add, their connection. I once attempted to show how we should proceed by means of parallel curves, and stumbled upon the undoubted fact that a certain disease now causing much agitation in the country had been mixed up by pardonable errors in diagnosis with a very innocent one. The answer to my question lands us in more difficulties. I assume that it is not due to mere chance that people do not contract zymoid diseases frequently again, and I also swallow dutifully the assertion that every particle of our bodies is, after the lapse of a few years, and although we grow visibly wrinkled and worn, replaced by a brand new one. If this brand new particle has to be leavened, the leaven must either be the disease (say small-pox), or else the leaven of something left by the disease, which serves as an antidote. Now, it seems to me, in the first case a person must be always having small-pox in some part of his body, and he would, therefore, be a chronic focus of infection. The new particle, moreover, must undergo, on its arrival, inoculation with the leaven of, perhaps, a dozen other zymoid diseases, and although the old opinion that two or more such diseases cannot exist at the same time in the body is now abandoned, yet to have to suppose this miserable "new boy" to undergo at once measles, whooping-cough, scarlatina, small-pox, and, perhaps, yellow fever, is a "facer." In the second case, when the leaven is the leaven of the result of the disease, secondary leaven, it seems obvious that then we should be able to inoculate with it, and by transfusing the blood of the leavened into a person who has not had the disease, we should leaven his body so as to ward off an attack far more effectually than we now do by vaccination. There is another remark I should like to make. If a disease is unlikely to recur from having effected some change in the body, it must have added something to the body, have altered something, or have removed something, and that being so, the health of the person must undergo some alteration permanently or for years after an attack of these zymoid or zymotic maladies, and there are strong grounds for supposing such to be really the case. The subject is one of intense interest, and I do not think practising medical men are the best to handle it. They must speak with the vulgar, although thinking, perhaps, with the wise.—M. PARIS.

[11516.]—**Veneering.**—"Joiner" should purchase No. 331, where he will find a lot of information on veneering and French polishing.—J. L.

[11516.] —**Veneering.** — Doubtless some cabinetmaker will answer the first part of "Joiner's" query, but as to the second part, he can fill in the grain by rubbing well in plaster of Paris, mixed into a thick paste with water, after that rub down with middling fine glass paper, then oil with linseed oil, rub that off dry, and proceed to polish. Make a rubber of flannel and wet it with polish (which he can buy ready to use), and cover the rubber with a piece of soft linen rag, and rub in the wood by working it about in a circular direction, not stopping long on the same place; he will have to touch the rubber outside of the rag with linseed oil to make it work easy. When he has got the grain well filled he can add a little methylated spirits with the polish for a little while, increasing the quantity of spirits each time. Finish by using spirits alone in a clean rubber, like the other. Be sure and keep the work smooth all through the process with very fine glass paper.—F. J. GODDEN.

[11524.]—**Pitch of Roof.**—The pitch of a roof is the height of the meeting point of the rafters above the level of the toe or foot of the rafter in proportion to the span—viz., supposing the span or distance between the rafter feet is 18ft., and the height is 4ft., the pitch would be called a two-ninths pitch, if 4ft. 6in. it would be a quarter pitch.—BRAHE.

[11540.] — **Preserving Tub Butter.** — If the butter is well made and pretty well salted, it ought to keep good for six to twelve months, but should be kept cool, in a cellar, out of reach of the sun, and the tub kept filled up with brine. The best time to buy butter for keeping is in the autumn. Butter made in hot weather never keeps well.—J. L.

[11554.]—**Pedestrian Tour.**—1. August, September, or even later, is the most popular time; July is generally too hot. 2. The lake air is relaxing, therefore light clothing, and a waterproof to roll up and strap on the back, is the best. The most important part of a pedestrian's outfit is his boots—they should be broad-soled, and as old as is prudent, so that they may not break into holes. 3. Opinions differ widely on this point. Some people prefer to carry all their luggage about with them, on their shoulders. I think, for two, the best plan is to have a portmanteau to hold a pair or two of trousers, three flannel shirts, a couple of night-shirts, three or four pair of undarned woollen stockings, &c., each; this might be sent to some "centre of operations," from which, or to which, the "jubilants" might work, carrying with them in the hand a light black bag to hold a night-shirt, a piece of soap, brush and comb, &c. When the centre is to be changed, send the portmanteau by coach or train, and walk up to it again, so *ad infinitum*. 4 and 5. See 6d. guides at any bookstall.—HEDERA.

[11558.]—**Refuse Paint.**—Paint skins, scrapings of kegs, &c., can be worked up by melting (boiling) them over a slow fire. This is best done out of doors, as the smell is very offensive. Let "W. T. M. D." put his skins in an iron pot, adding half a pint of raw linseed oil to about four or five pounds of skins, according to their dryness. Boil them till all are dissolved, which he will ascertain by stirring frequently. When the skins are all dissolved, take them from the fire and thin down to about the consistency of milk (it will thicken again as it cools), and strain the dirt from it, and he will find he has some good material for common work, especially if mixed with a little fresh paint.—CALLEN.

[11560.]—**Annealing Steel.**—Heat it to redness, and cover with slacked lime; let it stop till cold.—GOUX.

[11571.]—**Virginia: Its Climate and Soil.**—If "E. R. E. A." will apply to J. W. Harrington, Esq., 114, Cannon-street, London, I think he may obtain the information required.—AMERICUS.

[11686.]—**Cement for Fixing Glass Letters.**—A thick solution of marine glue in wood naphtha will answer perfectly if colour is no object. But the glass must be chemically clean, and this is not always easy. The least trace of soap or grease will spoil the adhesion of any cement. Try soda or ammonia, followed by whiting and water, clean cloths, and plenty of rubbing, and let the cement dry on the letters till the surface just begins to be "tacky" before you apply them. Many excellent recipes fail on a first trial, from the omission of some minute precautions which the sender has failed to mention for fear of taking too much space. I have found this especially the case in the answers to queries in "our" columns.—J. L.

[11589.]—**Dry Steam.**—The superheated steam in this case, I should think, must be decomposed into oxygen and hydrogen.—J. L.

[11593.]—**Lime-juice and Glycerine.** — Both "J. L." and "A. P. S." are quite out; neither of their recipes will make the article, which is really a weak soft soap or liniment of glycerine, and they have entirely left out the most important element of soapmaking, the alkali. The only materials necessary are glycerine, carbonate of potash, and lime-water, scented by essence of lemon.—MAYLAND.

[11595.]—**Starlings.**—I will describe to "Rara Avis" my cage. It is 22in. long, 12in. wide, 18in. high, outside measure. The base is of bay mahogany ⅝in. thick, and 3in. deep. The wires are set ⅝in. from centre to centre, bright tinned. The thin is No. 6 wire gauge; the upright and cross supports, of No. 14 wire gauge, are at 4in. and 9in. up from the woodwork. Across the top are five supports; to centre one the handle is attached. The wires are neatly lashed to the frame or supports by very fine tinned wire, and it makes a very smart cage. The side door is eight wires wide, and slides up as far as the first horizontal support. The end door is eighteen wires—*i.e.*, the whole width, and slides up to same bar, where it can be held with a hook. This is to give access to the food box, which is movable and made of wire, and wood bottom also; two tin cans fit into it for food and water. The shape is like a lean-to greenhouse; so when you shift it to clean and renew, this end door is dropped until food is brought. For a bath I use a white crock dish (made to order), 5in. × 3in. × 1½in. deep. Never let this go dry, the starling revels in water. This makes it necessary to have the drawer made of zinc, say ⅜in. deep. I have no seed drawer, just plain all round, and only two perches. I consider this the smallest cage allowable for starling, thrush, blackbird, cardinals, and Virginian nightingales, if you wish to keep their plumage from damage. A very pretty rustic looking cage can be made by making the uprights of dark wood, and using peeled osiers instead of wire, but still keeping them a good ⅝in. apart. Take them from the nest about the time you see them able to stand or approach the old ones to receive food. The cloth should be put over the cage at lesson time only; leave it on for half an hour after drill. The first few days they will want their food given them by hand; roll it like elongated pills, and not too dry; be liberal with hard-boiled egg amongst your scalded pea flour. Put a few bits on the edge of the cage, and give them their peck over these pieces, it's a good hint to help themselves. I omitted to include a few of the very small garden snails in shell as part of food in my communication, query 10947, page 645, No. 363, to which I refer "Rara Avis." The only hint that occurs to me is, that if "Rara Avis" intends to make his own cage, he should get a few needle points from an ironmonger, such as are used to fix gilt slips upon drawing-room walls. Take his compasses and mark off his centres on a strip of hard wood, say 6in. long and ½in. thick, drive the points through the marks up to the head, then screw on a back, like a hair-brush; he can thus mark off quickly any amount of cage stuff for the insertion of his bradawl.—JOE.

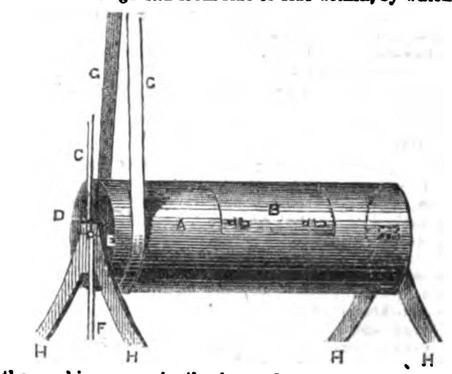
[11599.]—**Lint**—is made from old linen by means of a rather heavy knife, not too sharp, worked by the hand so as to partially cut through the linen, and then raise the cut part up on the surface, so as to make it very soft and velvety on the side operated upon.—J. L.

[11600.]—**Analysis of Water.**—The best work for your purpose is Sutton's "Handbook of Volumetric Analysis," a new edition of which has lately been published. To effect an analysis of a water in the way there described requires several titrated solutions, considerable practice, and a good practical knowledge of chemical manipulation. In my opinion a gravimetric estimation is far preferable, and though it occupies more time the results obtained are free from the sources of error which frequently obtain in volumetric analyses. Our chemical knowledge of the organic impurities in water is at present very small, and the methods employed for distinguishing the injurious and non-injurious bodies of this class are not at all satisfactory. One great point is to ascertain whether the water is contaminated with sewage of any kind; and if nitrites or nitrates can be detected in any considerable proportions, it is in almost every case an indication that noxious matter of this kind is polluting the water. Some waters, however, may contain nitrates without having received any sewage at all, and on the other hand, a water may be highly contaminated and yet not contain any nitric acid, because the oxidation of the nitrogenous matters has not reached its last stage. The presence of ammonia, or of bodies yielding ammonia, by treating with suitable reagents, is also to be regarded with much suspicion when occurring in a potable water. On this point see Mr. Wanklyn's papers on the "Ammonia Process." Dr. Angus Smith has shown that in many cases the amount of common salt in a water may afford useful indications as to whether sewage is passing into a stream or not. The use of permanganate of potassium for determining the relative purity of water has been often recommended. Its use, however, is open to many objections and fallacies, because the purple colour is destroyed by many innocuous substances.—ETHYL.

[11606.]—**Organ Pipes.**—The proper size of hole for tenor C open diapason is ⅜in., and graduate up to 3-16ths of an inch for upper F; if a wood pipe stopped, a foot having a ⅜in. bore ought to be used and graduate up: it is usual to get the feet first, and bore holes to fit. The cutting up is generally guided by the pressure of air; but if cut up a fourth of the width of mouth the stopping at foot will accommodate fancy of operator.—PROFESSIONAL ADVISER.

[11607.]—**Ebonising Wood.**—First procure an ordinary slate and hold it over the gas, lamp, or candle, until it is well smoked at the bottom, scrape a sufficient quantity into French polish, and well mix; then polish your article in the ordinary way. If there are any lumps gently rub them down with your finger, and apply another coat.—ARCHER.

[11608.]—**Boiling by Steam.**—"A. W. B." might possibly take a hint from the following:—Sixteen years ago a factory was built in this country for the manufacture of oils and manures from fresh fish, which had to be boiled in their own liquor by steam without contact with it. One of the machines used for cooking the fish revolved twenty times a minute by means of a driving-strap. This machine consisted of two drums, one within the other, resting horizontally upon two beds. A flange ran from side to side within, by which



the cooking mass in the inner drum was turned over and mixed at each revolution. The steam required for heating played between the two drums, and was applied at the side from the boiler. The machine was supplied with fish by means of a door which closed hermetically. When once hot this apparatus, with a pressure of 30lb. of steam, would cook a ton of fish in ten or fifteen minutes. The fish thus cooked resembled thick gruel, every bone being quite clean and disjointed. The same kind of machine placed upright instead of horizontally, and which was stationary during the process of cooking, baked the fish instead of boiling them. A drum, B door, closed with two keys, C steam pipe from boiler to supply heat to drum, D cock to turn steam on or off, E cock to turn off condensed steam, F pipe for escape of condensed steam, G driving strap, H beds supporting drum.—ROBT. A. WHITELOCKE.

[11608.]—**Boiling by Steam.**—There must be an additional boiler to generate steam, which many would consider a mere waste of money and fuel with such a small quantity as fifty gallons, though it may be necessary to try such a mode in "A. W. B's." case. If he cannot allow the entry of the steam into the mixture boiled by an opening near the surface of the contents, another opening for a condensing pipe being formed beside it for the escape of superfluous steam, though somewhat above the inlet pipe, by which the mixture would be constantly stirred without an attendant, "A. W. B." may send the steam through a hollow jacket around the boiler in the same way, the opening for the exhaust pipe being formed at the bottom; but this arrangement has not so many advantages as the other, and a mechanical contrivance, which will easily suggest itself, may be necessary to stir the contents of the inner boiler. One boiler may be placed inside the other, as in the pot for boiling glue, with the fire underneath, which is the simplest arrangement.—RAT-TAT.

[11610.]—**Defective Battery.**—I beg heartily to thank "Sigma" for his kind and prompt answer, and wish to add that the vibrating contact breaker does not act: there is neither shock nor vibration. Not having a galvanometer I am unable to test the coil in the way he kindly suggests.—G. F. L.

[11614.]—**Gums.**—In reply to "Meneleus'" query on p. 132 of your valuable paper, the MECHANIC, I beg to recommend him the following test of gum resins, they are all soluble in spirits of wine and trustworthy:—Olibanum, ant, thus, or incense, known in Palestine as arbor thurifera; galbanum, the bubon galbanum of Linnæus; scammony, gamboge, gum assafœtida, myrrh, euphorbia, aloes, ammoniacal gum, benzoin. —JOHN LE BAS.

[11615.]—**Teeth.**—Tincture of iron and quinine does not tend to loosen the teeth, but it certainly makes them decay. Before taking the medicine, chew a piece of gum arabic, and distribute it over the teeth with the tongue, then take the medicine and rinse your mouth out with solution of carbonate of soda. This is the only way in which you can preserve the teeth from such medicine. Tincture of myrrh and alum, separate or combined (diluted, of course), are capital things to tighten the teeth with.

[11616.]—**Engraving.**—Nitric acid, one part acid to four of water is generally used.—JOHN LE BAS.

[11618.]—**Deadening Sound.**—Let "Wickliff" set another partition of boards, a few inches, three or four, from the present one, and fill the interval with sawdust, packed together a little, as each board is nailed on, of course beginning at the bottom. This is effectual, if properly done.—H. O'B.

[11619.]—**Electrical.**—The following hints may be useful to "F. T. Z.":—(1) A Leyden jar should be well warmed and freed from dust before attempting to charge it. (2) A good connection should exist between the outer coating and the earth, and between the inner coating and the brass knob projecting from the jar. Let "F. T. Z." charge his jar with (say) ten sparks (which will be sufficient, if they are what he describes them), and then let him take the shock through himself. My first trial with a Leyden jar terminated in a similar failure, owing to there being no good connection between the outer coating and the earth. A Leyden jar should be made of as thin glass as possible.—T. SMITH.

[11620.]—**Capturing Moths.**—The method of making sugar for capturing moths is thus: 1 pint of old ale, 1lb. of coarse sugar, and 1lb. of treacle simmered together; it must not boil; when cold add three tablespoonfuls of rum, and when the fruit-trees are in blossom, a little essence of almond may also be used. Take the mixture into the fields or woods just about dusk, and with an ordinary paint-brush, lay it on in patches on the trunks of trees, then return in about twenty minutes with a lantern, and you will find the moths sucking the sugar. This is best used from May to September, but for some species, such as piniperda, instabilis, &c., you may begin as early as March. Dark warm nights are the best for sugaring, bright moonlight ones being comparatively useless.—EDWARD SUTTON.

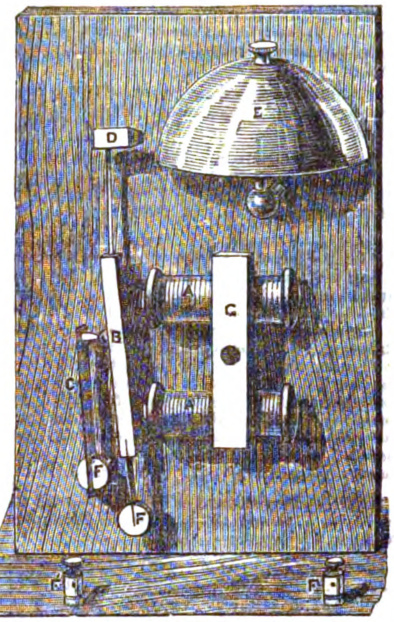
[11620.]—**Capturing Moths.** — Apparatus required: A jar, a small bottle, small paint can and brush, moderate size, a bull's-eye lantern, a small entomological clap-net, about 3ft. long. The use of the above: In the jar get 1lb. of the thickest treacle to be got; in the bottle get a quarter of a pint of best rum. When about to proceed to business put one-third of the treacle in the can, and the small bottle of rum in your pocket with the brush and lamp, take up your net and can and march to the happy hunting-grounds. On your arrival light your lamp and pour one-third of the rum into the can with the treacle, well mix with your brush, then paint the trees, railings, &c., with the above compound (about one tree or rail in twelve yards is sufficient) in patches about 6in. or 8in. square, but don't put on too thick, or it will run down the tree. The results of the above proceedings are similar to what takes place in gin palaces on "human insects." They taste, rather like it, get too much and can't get away, and so fall an easy prey to designing humanity. When the victims are arrived, which won't be long, I can assure you, they may be easily taken off with thumb and finger, or, better still, get some one to hold your lantern, and hold your net under them with one hand and knock them into it with the other, and kill in usual way—viz., a sharp pinch under the wings. The time to use the above is at night, from the middle of May till the end of October, weather permitting. The best places are woods, coppices, &c.—W. LA W.

[11621.]—**Killing Roots of Trees.**—Bore your holes and then fill with a strong solution of sulphate of copper (blue vitriol).—ETHYL.

[11621.]—**Killing Roots of Trees.**—With a 1in. auger bore a hole from outside to centre, inclining downwards, and fill full with saltpetre, plugging with a short plug.—J. WRINKLE.

[11624.]—**Bell Pianette.**—This instrument consists essentially of a number of steel tongues, varying in length from 1½in. to 6in., one extremity of which is screwed on to the sounding board, while the free end is struck by a hammer actuated by ordinary pianoforte action. No dampers are required. Each tongue will require tuning by filing up to pitch.—S. BOTTONE.

[11626.]—**Electric Bells.**—If Thomas Whalley will examine the diagram, he will have some idea how electric bells are made. A A are coils containing about five layers of wire, No. 18, covered with silk or cotton, but silk is best; in the centre of each coil is a core of soft iron, the discs at the ends are composed of brass. The wire should be wound on in one direction, that A and A may produce opposite poles. B is an armature of soft iron connected to F by means of a spring. C is also a stiff spring which makes and breaks contact with B. Near to B and C are projections tipped with platinum. One end of the wire, from the coils, is connected to F; the other end to the binding screw F, and a separate bit of wire joined to F and F. It will be seen



that, when the batteries are attached, B makes rapid oscillations, when the hammer, D, strikes the bell E. If any definite number of rings are required, the ends of the coil wire must be connected to the binding screws, and the battery current turned on and off by means of a commutator. The coils, &c., are fixed on to a vertical board, and may be inclosed in a box, except the bell and hammer.—J. THOMPSON.

[11629.]—**Skeletons.**—If "Hedera" lives on the sea-coast let him moor the animal securely where the crabs can have access to it and they will do the work he requires. If not, let him place it in the vicinity of a large ants' nest.—MOUNTAINEER.

[11632.]—**Debility.**—Before adopting homœopathy try the altera-tonic system, as advocated in the *Anti-Lancet*, to be had of any large chemist. I tried homœopathy for indigestion (and its result, gout) for several years with no effect; but I was at once relieved under the altera-tonic treatment, and have had no gout since I adopted it, although I have had many warnings of its approach, which a few pills quickly dissipated. I know a patient under homœopathic treatment for tumour who is obliged to take these pills *sub rosa* for constipation, which the former medicine does not relieve. Allopaths think they can cure by the administration of an unlimited number and quantity of drugs and counter drugs; homœopathists by the finding of a medicine suitable for each separate malady, and for that only. This seems to me an absurdity, and there is also the awkward possibility of the patient dying while the experiment is being made. The *Anti-Lancet* is opposed to allopathy, homœopathy, hydropathy, &c., many cures being recorded of the victims of each of the above systems. It goes to the root of the matter by proving that nervous debility is the one sole cause of all disease, and having logically demonstrated this, the arguments advanced in favour of the remedies advocated are equally conclusive.—AMATEUR.

[11636.]—**Desert of Sahara.**—Whilst attending a course of lectures on "Physical Geography," delivered at the London Institution by Professor Huxley, I was given to understand that there are two large tracts of land whose levels are considerably lower than that of the sea. The first of these lies to the south-east of the Caspian Sea, and the second consists of a considerable part of the Sahara Desert. Each of these is about 400ft. below the sea-level; and each abounds in shells and chalky matter, which clearly proves that at one time or other they must have formed the bed of the ocean. In the latter also the learned Professor showed that extensive pools of salt water were to be found.—UNDERGRADUATE.

[11638.]—**Silkworm Disease.** — "Muscardine," the disease peculiar to silkworms, and which a few years ago played such havoc among them throughout Europe, is a fungus growth upon the body of the insect. It is induced by overcrowding and bad ventilation in the cells or boxes in which they are kept. There is no cure when once the attack has commenced, but a good preventive has been found in sugar given as food. A still better is plenty of fresh air and fresh food.—H. G. W.

[11639.]—**Rock Inscriptions.**—I do not think there has been so much neglect in reference to the Sinaitic inscriptions as "H. E. H." and "E. L. G." imagine. Prof. Beer, of Leipsic, published, in 1840, a number of these inscriptions transcribed in Hebrew letters. The style and tenor of the inscriptions was found to be almost universally identical. They uniformly read thus: The salutation of so and so, son of so and so, or remember so and so, son of so and so ("British and Foreign Evangelical Review," 1871, p. 347). Since then other collections have been made, and have been made the subject of a good deal of discussion. It seems, however, to be pretty well settled that they are of Nabatéan origin, and that the limits of antiquity which can be given to them, are either the two centuries before or two centuries after Christ.—A. D. H.

[11644.]—**Mending Copper.**—"M. B." does not state what kind of copper he wants to mend. If a copper furnace, rivet a patch on, and then close the seams as close as possible. Make a paste of red lead and the white of an egg, and rub well in the seams and on the rivets inside the furnace with a piece of white sandstone. If for a cooking copper, you must braze a piece in; but you cannot braze it if it has been tinned. —APIARIAN.

[11645.]—**Bees: Managing Old Stocks.**—I cannot understand why your old stocks should die, unless the queen is dead; then the bees mostly die when they have eaten all the honey. I generally, in the autumn, get the bees from the country people, when they put them down, and unite them to my stocks. This makes them stronger in the spring. If you do this you must secure one of the queens, or it will cause fighting, and your stock will be destroyed. I have done several, and only had one that fought. If all the hives you use are bar hives you can easily feed by taking a comb out and filling with liquid food and put back where most of the bees are. If queenless, get a piece of comb with honey, eggs, and brood in. Fit it in your bar, and put it in the queenless hive (I should advise you not to do this until next month). The bees will soon form a queen out of one of the eggs. I have known bees to remain in a straw hive for six years. Three years is long enough for them to remain in before putting them down, or the comb becomes very black.—APIARIAN.

[11647.]—**Cabbage Plants.** — Transplant into richer soil any which have not now "run up;" feed them with weak liquid manure twice or thrice a week. If a plant has started it is too late to remedy. Pull up all such, and boil them for table.—AMATEUR GARDENER.

[11647.]—**Cabbage Plants.**—To prevent running to seed slit the stalk through the centre under the leaves and put a small wooden peg through.—J. WRINKLE.

[11647.]—**Cabbage Plants.**—Whenever "Anon" notices the plants going to seed, let him pull them up and put others in their places. The running to seed proceeds from a premature growth of the plant; they also run to seed in dry weather if they are not properly attended and watered. Plants that will run to seed are very easily noticed when they are put in. If, at the part of the stalk where the leaves ought to sprout out thickly, there is a gap, "Anon" may at once lay aside that plant as useless.—BED OF STONE.

[11651.]—**Analysing Ash of Cane Sugar.**—By treating the sugar with sulphuric acid you will convert all the bases present in the ash into sulphates. The ash of sugar generally contains chlorides, carbonates, silicates, phosphates, sodium, magnesium, and small quantities of other bodies. In all probability your ash would also contain sulphides arising from the action of the carbon on the sulphates. As the ash varies in composition it would not be possible to calculate the altered weight without knowing the exact quantity of each ingredient in the ash. Sugar is not very difficult to incinerate unless it is very impure. Have you tried inclining the crucible till it is nearly horizontal, so as to create a current of air in it? I presume that you are working in a platinum vessel; if you are using porcelain you will find more difficulty in getting sufficient heat.—ETHYL.

[11653.]—**Carving.**—I do not know whether A. H. Cooke means fret-cutting or really wood carving, but if he has not yet tried the former he will find it very interesting, and after a short time will find himself fully repaid for his pains and expense. I bought my tools and learnt the art in Germany, where fret-work is much cultivated by the middle classes. I have since bought a set of tools in England for a friend, but am not so satisfied with them. I fancy for a set of tools—viz., saw-frames, saws, drill, patterns, and wood (nut wood is the best to commence upon)—he would pay about 15s. to 20s., according to the amount of wood. The drawing shows how the wood can be the better sawn by placing it on the corner of a table, and


FIG. 2
FIG. 1

screwing the same on the table at A, by means of Fig. 2. The Fig. 1 can be easily made out of a piece of deal about ½in. thick. The object of the round hole at B is when he comes to a tender part it can be rested so that the piece is not so apt to snap off. The above is an invention of my own, which I find very useful.—C. COLMAN

[11654.]—**Cleaning Violoncello.**—Use turpentine to clean, but do not polish by the application of anything except a soft rag, and light but brisk rubbing. It is probable you may experience a little difficulty in removing the accumulated rosin between the *f* holes ...

se, carefully apply spirits of wine, but do not let it remain on the instrument long enough to attack the varnish. For the inside get a handful or two of barley (corns) warm, and put them through the *f* holes and shake the instrument, at the same time turning it in all directions; when finished, empty through the *f* holes.—DISC.

[11657.]—**Thorough Bass.**—"L. M. F." should procure Hullah's "Grammar of Musical Harmony" (3s.), with the accompanying course of exercises, 1s. (Longmans and Green). He should commence with the first chapter, reading it through several times, then work out on a music slate the exercises to that chapter, copying them when correct into manuscript music-book. —HARMONIC CHORD.

[11658.]—**Power to Drive Crown Printing Machine.**—A quarter horse-power engine is of no practical use, they are always getting out of use, and are only patronised by amateurs. Any engine below one horse-power a workman would not accept at a gift to use in his own workshop. There is a printer not far off driving his machinery by an engine of 7in. stroke and 2¾in. diameter, about one horse-power, and this printer says that he could not possibly do with a less. He only drives one machine at a time. The boiler is a vertical one of 3ft. by 2ft. This is the size that I think would be suitable. Quarter horse-power is not to be thought of.—P. W. H. J.

[11660.]—**Lead Pipes.**—"Flactem" can convey the [illegible] his greenhouse in lead pipes, but they will not last [illegible] so long as iron tubes; besides, iron can be laid [illegible] which is to be taken into account in laying gas tubes. Your gasfitter will tell you the size pipe necessary for the number of lights you purpose having, and also its price per foot.—FRANCIS J. B.

[11660.]—**Lead Pipes** (or "compo") are best for gas, and more so under ground, if not likely to be interfered with by digging, &c. Cost from 3d. to 6d. per foot, according to size of pipe.—J. L.

[11661.]—**Photography (Background).**—A simple and efficient background may be made in this way: Procure a square (at a draper's) of 9 or 10 quarter gray calico sheeting (say, about 2½yds.), make a light frame of deal, exact size, well fastened at the corners, and upon it nail the calico with stout tacks and plenty of them. Let the cloth then be coloured with a distemper gray wash, which will neither rub off nor reflect the light, and you have a cheap and efficient screen. A dull lead is a convenient colour, as it suits for any complexion or any shade of dress. Let your sitter be (say) 3ft. or even more in front, so that the screw be entirely out of focus, and then the texture of your background will not be apparent in the picture. I used such a frame for years, and found it to answer well, and, being light, I could lift from my hall where it stood to two hooks in the yard. I had no glass house, being only an amateur. The cloth tightens on the frame after drying from the white-wash brush, so that there can be no unsightly wrinkles. —SENECIO.

[11665.]—**Brown Ink.**—1. A strong decoction of catechu. The tint may be altered by the cautious addition of a little weak solution of bichromate of potash. 2. Sepia prepared from the cuttle fish. This may be obtained at any artists' colourman.—A BARRISTER.

[11667.]—**Carbon Points.**—These are generally made of graphite or plumbago, as being denser and better suited for the purpose than charcoal. I do not think they are dear; any philosophical instrument maker would know the price.—PHILANTHROPIST.

[11675.]—**Solder for Britannia Metal.**—10 tin, 5 lead, and 1 to 3 bismuth.—A. M. FESTING.

[11675.]—**Solder for Britannia Metal.**—I find no difficulty in soft soldering any metal with the aid of Baker's solution, or spirits of salts and resin.—A. LIVERPOOL.

[11676.]—**Lemonade Syrup.**—To every pound of sugar add 12 fluid ounces of lime-juice, add a few drops of essence of lemon, and dissolve with the aid of heat; 1oz. of the syrup to a tumbler of aërated water. This is A 1.—OPALINE.

[11683.]—**Height of Sea Waves.**—The assumption during all the experiments made many years ago by Dr. Scoresby and Mr. Scott Russell was, that the proper level of the sea was midway between the highest and lowest points of the waves, and, I believe, that more modern experiments on tidal levels show very little, if any, discrepancy.—A BARRISTER.

[11684.]—**Pressure on Cork of Bottle.**—The pressure on the cork will be greater when the bottle is upside down, as the cork will, in addition to the gaseous pressure, have to bear a column of (say) 6in. of water (33ft. of water gives 15lb. to the inch, about).—PHILANTHROPIST.

[11684.]—**Pressure on Cork of Bottle.**—The pressure on the cork of a soda-water bottle is = the elastic pressure of the gas + the weight of 1in. or 1½in. of liquid; if suspended cork downwards it would be = gas pressure + the weight of (say) 6in. of water; if resting on cork it would be = to gas pressure + 6in. water − weight of bottle and contents.—A BARRISTER.

[11686.]—**Cement for Fixing Glass Letters.** —A thick solution of shellac, in methylated spirits, waterproof. Having used this I can recommend it.—OPALINE.

[11686.]—**Cement for Fixing Glass Letters.** Try the following cement. Powdered orange shellac [illegible] alcohol 2oz. Place the containing bottle in a warm place. Agitate frequently until all the lac is dissolved. Apply cold. This will resist wet, and will cement strongly metals, wood, porcelain, glass, &c.—S. BOTTONE.

[11687.]—**Speeding Machinery.**—The number of revolutions of two pulleys or wheels are inversely as the diameters or circumferences; in the case of pulleys is the thickness of the belt added? (as the neutral axis, or part of the belt which is neither compressed nor extended, is in its middle). In the case of wheels the diameter or circumference of the pitch circles are taken, practically adding the depth of a tooth to the diameter of the uncut part of the wheel would give this pretty nearly. The number of teeth in the wheel in driving shaft should bear to the number of teeth on wheel of machine the proportion of 135 : 50 or 27 : 10, and the diameter of the pitch circles be in this ratio. Further information if desired.—PHILANTHROPIST.

[11691.]—**Tidal Mill.**—I think Poncelet's undershot water-wheel (with curved buckets) would be the best; it is superior to the ordinary undershot wheel, as the water loses almost all its velocity before leaving the wheel; however, as the tide changes, reversing gear would be needed. (I described a kind of screw on p. 403, Vol. XIV., which rotates in the same direction, whether the water passes up or down through it; I do not know, however, if its *modulus* is satisfactory, as compared with other wheels.) A screw revolving against water produces good results, but does it follow that water rushing against a screw would do the same? I should like some information on this myself. I think that tide mills are not sufficiently used in this country. In Germany the rapid current of the Rhine is utilised to drive floating mills; why should strong tides not be used also? As to the flux motor, I saw it in the Exhibition, but as a horse-power is 33,000 units of work in a minute, or more than 500 cubic feet of water raised 1ft. high in the minute, or upwards of 90,000 cubic feet of water to fall 1ft. in three hours, as the machine does not act constantly, the size of the dam—and the consequent expense—seems an objection.—PHILANTHROPIST.

[11693.]—**Defective Feed Pump.**—"An Engine Driver" cannot take "ours" regularly or he would have noticed the same query answered one or two numbers back. Very probably the pump is keeping him in hot water from it being allowed to become hot.—A., Liverpool.

[11694.]—**Green Fly.**—Use Gishurst's compound; to be obtained, with directions, from any respectable nurseryman. It is extremely effectual.—S. BOTTONE.

[11694.]—**Green Fly.**—Why is the conservatory too large to be smoked? Mine is 27ft. by 14ft., by an average of 9ft. high, and I find a pound of tobacco paper, price 8d., amply sufficient. Choose a calm evening, close up the conservatory tight, the plants must be thoroughly dry (I do not even water the roots on the smoking day), then set a lighted candle end on the floor, invert a 6in. or 7in. flower pot over it, on this set another pot upright, taking care the drainage holes correspond, in the latter shred the damp tobacco paper, and when all is going on well leave it shut up till morning, when you must ventilate well and syringe copiously. The third or fourth evening after smoke again, this will finish off the insects half killed by the first operation. The inverted pot must be raised a little to admit air. I use a broken one.—HAMMER.

[11694.]—**Green Fly.**—If "H. T. C.'s" conservatory is really of such dimensions that tobacco fumes are useless, he must try syringing with tobacco-water. Under similar circumstances I should remove every plant that was removable, and clean off every aphis I could find. If the conservatory had been cleaned properly last autumn, he would not now be troubled with an "army of spiders of every shape and description." He must clean it down now, or else clear the plants out and fill the conservatory with chlorine, or sulphur fumes.—SAUL RYMEA.

[11695.]—**Succession Duty.**—"C. P." can make himself quite comfortable about the legacy duty: the people at Somerset House will not let him go to sleep. The probate duty has, I suppose, already been paid; if not, that will be £30 if the entire sum left by will does not exceed £1,500. The legacy duty of 1 per cent. is calculated on the gross value of the property, which "C. P." must get valued for the purpose, or run the risk of making a false declaration of value.—SHU FLY.

[11701.]—**To Mr. Knott.**—In reply to M. Gaudibert's query (p. 159) I beg to say that I have measured ζ Cancri twice this season with the following results:—Feb. 2, P = 166 52°; Feb. 20, P = 166 93°. On each occasion the distance was estimated about 0·6"—a value which may, perhaps, be a little too small.—GEORGE KNOTT.

[11702.]—**Curry and Rice.**—I am not an Indian, but during my residence at Milan, famed for its "Risotto alla Milanese," I learned that the only requisite to obtain rice grains firm and dry consists in having the water quite boiling, and after having introduced the rice, allowing it to boil only ten minutes, when it must be immediately strained through a wide-meshed sieve. After seasoning, if found too hard, it is again placed in the saucepan (without water), and while on the fire constantly stirred. The following is a good recipe for curry:—Pale turmeric ½lb., powdered cumin 2oz., powdered coriander 4oz., black pepper 2oz., cayenne pepper 1oz., Jamaica ginger 2oz., carraway seeds 5oz., cardamoms 2 drachms. All these must be well ground and mixed.—S. BOTTONE.

[11703.]—**Ink Powders.**—Aleppo galls 4oz., sulphate of iron 1½oz., gum arabic 1oz., lump sugar ½oz. all quite dry and in powder). Mix and divide into three packets. A pint of boiling water poured over one of them produces in a few hours a pint of excellent ink. If used for copying it may require a little more sugar, say, ½oz. to the pint.—A BARRISTER.

[11704.]—**Rats.**—Undoubtedly oil of rhodium is the best; you can buy it wholesale at 6s. per ounce; if too dear, use oil of aniseed and oil of verbena, of each equal parts; add a few drops of oil of rhodium.—OPALINE.

[11704.]—**Rats.**—Oil of aniseed is said to attract rats.—SAUL RYMEA.

[11708.]—**Gas Burners.**—Gas burners are usually marked round the top with a series of rings, each corresponding to 1ft. per hour.—A. M. FESTING.

[11708.]—**Gas Burners.**—The burners in ordinary use consume from 3ft. to 5ft. per hour. Those constructed for cannel gas about 20 per cent. less than those for common gas.—A BARRISTER.

[11710.]—**Cleaning Oil Painting.**—Years ago I recollect being told that one of the most effectual ways of freshening an oil painting was with the finger and saliva, but I cannot vouch for the truth of the statement.—A. M. FESTING.

[11714.]—**Test for Sugar.**—Into a cold solution of the sugar add a few drops of tincture of iodine, if it contain starch a blue colour will be the result; for chalk add a few drops of sulphuric or muriatic acid, effervescence will ensue.—OPALINE.

[11715.]—**Testing Acetic Acid.**—"Aceticum" will easily test the relative purity of commercial acetic acid, by ascertaining if it does or does not precipitate nitrate of silver (in the first case it would denote the presence of hydrochloric acid), or if it does or does not precipitate nitrate of barium (in the first of latter cases it would denote the presence of sulphuric acid). Acetic acid may sometimes contain traces of sulphurous acid. In that case add a few drops of nitric acid to the liquor, and see if, after having boiled for a few minutes, it precipitates nitrate of barium.—F. T.

[11715.]—**Testing Acetic Acid.**—The only acids with which it is usual to adulterate this are the sulphuric and sulphurous. The former is used for the weaker acids and the latter for the so-called "glacial." The presence of the former may be detected by means of a solution of barium chloride, which, if sulphuric acid be present, gives a white precipitate, proportionate in amount to the quantity of sulphuric acid present. If there is reason to suspect that sulphurous or hydrochloric acids be present, the addition of a few drops of a solution of silver nitrate will immediately clear up the doubt, by affording a white precipitate, if such be the case.—S. BOTTONE.

[11719.]—**Gut Lines.**—If for fishing, are made from the silk receptacle of the silkworm, and cannot be obtained from sheep-guts, which are used for the manufacture of lathe bands, catgut for musical instruments, &c.—A BARRISTER.

[11724.]—**Discharge of Water over Weirs.** —I think this is mentioned in some of Weale's Series. In the case of a hole, the well-known phenomenon of the contracted vein occurs, and the actual discharge is considerably less than the theoretical. The formula $v = \sqrt{2gh}$ may be used, a large deduction to be made for fluid friction. Further information if desired.—PHILANTHROPIST.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "West Cornwall" has answered 10617; "A Barrister," 11008; "Goux," 11008; A. F. Edwards, 11196.

11275 Darkening Walnut, p. 24
11282 Preserving Plates, 24
11283 Photo. Lens, 24
11288 Hardening Iron Plates, 24
11289 Flexible Oil Painting, 24
11290 Cut-throats or Coral-throats, 24
11291 Common Sense, 24
11303 Transferring Fluid, 24
11306 Glass House, 24
11307 Design for Garden, 24
11315 Cart-wheel, 24
11316 Oxalate of Chromium, 24
11320 Marking Leather for Ornamental Stitching by Machine, 24
11325 Moulded Carbon Filter, p. 25
11326 Japanning, 25
11330 Vacuum Gauge, 25
11331 Smallpox, 25
11332 Hydraulic Jack, 25
11333 Motive Power for Amateurs, 25
11335 Eccentricity of Earth's Orbit, 25
11340 Bread Barrow, 25
11342 Analysing Cast Iron, 25
11343 Catechu, 25
11344 Australian Trees, 25
11345 Camping Stoves and Necessaries, 25
11347 Velocities of Air and Steam, 25
11349 Heating Bar Iron, 25
11350 Dairy Farming and Pig-keeping, 25
11351 Homœopathic Medicines, 25

QUERIES.

[11730.]—**Artificial Gum.**—Will any of the readers of "ours" kindly oblige me with a good recipe for making a cheap artificial gum, suitable for suspending colouring matter in, which will not precipitate?—J. Wrinkle.

[11731.]—**Hair Wash.**—I have for some time past been in the habit of using a solution of camphor and borax as a scurf wash. I do not, however, find it to answer. The camphor is never wholly dissolved; may this be fairly set down as the cause of its inefficacy? Can any reader recommend another preparation?—Excelsior.

[11732.]—**Temperature of Ice and Water.**—One kilogramme of ice and three kilogrammes of water at 79° C., are mixed in a closed vessel, the sides of which are supposed to be impervious to heat. What will be the temperature of the water after the melting of the ice (latent heat of water = 79°)? As several different solutions have been obtained, I venture to ask for a correct one.—W. N. Oswad.

[11733.]—**Cotton Spinning.**—Could any of your readers recommend a work upon cotton (practical) spinning in all its processes, with calculations for the same?—Sufferer.

[11734.]—**Engine Counter.**—Mr. William Tonkes will remember some time ago answering me the question how I would work my engine counter (situate 150ft. from engine) with electricity. (1) Will he kindly give me a little sketch how I am to make the necessary connections? (2) Will No. 10 galvanised iron wire do? (3) Should I insulate the wire? (4) Will one wire do, making an earth circuit, or would Mr. Tonkes prefer two wires? (5) Where shall I place the battery in connection with the engine and the counter (the oscillation of the counter pendulum is 1in.)? (6) How shall I arrange the mechanism to work the counter in the most efficient manner? (7) Shall I use two Bunsen cells?—Der-sunthal.

[11735.] — **Gilding on Glass.** — Can any correspondent instruct me how to perform the process of forming the diamond pattern, and of writing and gilding on glass, such as we see on the backs of glass nameplates, shop facias, &c.? The cross lines forming the boundaries of the diamonds, and the stars at the intersections of the lines, look as if the gold were burnished, but the diamond shapes look like dead or frosted gold. I fancy the latter appearance is produced by light etchings of the glass by hydrofluoric acid, if so, what should be the strength of acid used?—T. L.

[11736.] — **Extracting Iodine from Seaweed Ashes.**—I should be obliged to any reader who could inform me how to extract iodine from the ashes of seaweed.—J. R.

[11737.]—**Fairbairn's Ventilating Buckets.**—I should like information on Fairbairn's ventilating buckets for water-wheels (they promote the escape of air and admit of the buckets being readily filled with water). What modification is made in the hydraulic ram when intended to raise water to many times the fall? What is the practical limit?—Philanthropist.

[11738.]—**Cyanide of Potassium.**—Can any one tell me anything about this substance? Is it as poisonous as arsenic? What is its antidote? The saucepan containing my gold bath has all round the outside a quantity of brown settlement of some kind, is this cyanide? or what is it? Is it dangerous to live in the room in which cyanide baths are kept?—Dentiste.

[11739.]—**Economy of Fuel.**—I am using two boilers, each 30ft. long by 8ft. diameter, and 7lb. pressure, for producing steam, used solely for heating (by injection) hot-water vessels. Would there be any economy in fuel, by making use of a more modern boiler and using steam at 45lb. or 50lb. pressure, either with or without a reducing valve? I know it is admitted that something like 50 per cent. less coals would be used, if the steam were for engine purposes.—X. Y. Z.

[11740.]—**Potash Salts.**—Is there any ready means of estimating the quantity of actual potash in the compounds sold to farmers as fertilisers, under the names of kainit, potash salts, and saltpetre refuse? Their actual value depends on the potash they contain, not the soda (which we can obtain cheaply in dirty salt). The manure dealers talk of sulphates, muriates, and nitrates of potash; but I see no way of checking their representations easily available to a farmer, through not knowing how to disentangle the soda, though I can see my way to get both alkalies into a nitrate. How do the saltpetre refiners expel the soda?—Hammer.

[11741.]—**Boot and Shoe Making.**—I should like to know how the permanent black shining and glossy appearance is produced which is to be seen on the soles of new shoes, for I find that when I apply the heel ball to new soles, it always comes off when the shoes have been worn a few days in wet weather. Should the soles be quite wet or should they be quite dry when the heel ball is applied? and how hot should the heel ball iron be? An answer to the above would be a favour, and some useful information about boot and shoe making would confer a favour.—James Lonsdale.

[11742.]—**Painting Iron Bedstead.**—I want to paint an iron bedstead white and gold. Would some reader kindly say if the smooth iron will take white paint? How must I mix white paint that will not turn a yellowish shade? How must I do the gilding without using gold leaf?—Suffirer.

[11743.]—**Humea Elegans.**—I have some seeds of this plant. Would some subscriber give directions for growing some good specimens? Will they grow without artificial heat? What compost should be used?—H. A.

[11744.]—**Shorthand.**—I am in the habit of taking notes of lectures and meetings. Could any reader tell me of a system of shorthand, that is a near approach to ordinary writing? I have tried Pitman's, Taylor's, and other systems, but find the angles and straight thick and thin lines awkward after a hard day's work; and I have little leisure for studying. I have little doubt but that some of your readers use a contracted form of ordinary longhand.—Wood Sawyer.

[11745.]—**Watch Keys.**—I am anxious to know how the neat square holes in watch keys are made. Are the sides of the key supported and the holes punched?—Ethyl.

[11746.]—**Coil Construction.**—I have a coil of the following description: — Primary, 3 layers No. 16. Secondary, 5 layers No. 30 cotton-covered wire. Primary insulated from secondary by guttapercha tissue. Each layer of secondary insulated in same way. Hammer vibrates on core. Can I strengthen this coil without the use of more wire, and how?—Zeta.

[11747.]—**Canoe Voyage.**—I contemplate going for an excursion in my canoe, now building, this summer, so would be very grateful to any of your numerous readers who can give me any valuable hints, on either the management or outfit, or where to go, in England or Ireland; but most likely I shall choose the latter.—Afloat, Liverpool.

[11748.]—**Artificial Manures.**—I should be glad of information respecting the use of chemical salts, &c., in promoting the growth of plants; more particularly as regards nitrogen, phosphorus, and sulphur compounds. Information upon this subject will, no doubt, be interesting to other of your readers as well as—Guano.

[11749.]—**Cementing Iron in Wood.**—Will any kind friend inform me how I can fasten the screws in the knobs of dressing glasses? I have great bother with them frequently.—F. J. G.

[11750.]—**Circular Saw Driving.**—Will any one kindly tell me how I can fix the mechanism of the simplest kind to drive a small circular saw about 12in.? In fact, tell me all about it. I have a small wooden lathe.—F. J. Godden.

[11751.]—**Bugs, Lice, and Parasites.**—Can any of "ours" tell me if there is any herb or preparation which is prophylactic against fleas, bugs, and lice, *et hoc genus omne*? I have frequently to be in contact with unclean people, and have been sadly plagued by carrying home more than I bargained for. I have been told wormwood is useful. Is it so, and are there any other prophylactics?—M. A. B.

[11752.]—**Meerschaum Pipe.**—Can any brother reader inform me how to remove the black colour from a meerschaum pipe (produced by a solution of caustic), without injuring the real colour?—F. G. C.

[11753.]—**Crucible for Quartz.**—Can any correspondent inform me what kind of crucible is used to crystallise such a refractory substance as quartz? I am aware what salts are used to reduce quartz. An answer will oblige.—John Le Bas.

[11754.] — **Polishing Diamond.** — I have a small diamond which has been made too hot under the blowpipe, and got a coating on the surface which takes away its brilliancy. I believe that there is a process by which this formation can be easily removed, without the trouble of repolishing. I have tried various chemical means, but failed, and shall be much indebted to be informed through your valuable columns what I am to do.—Chas. Perks.

[11755.]—**Tempering Charcoal Iron.**—Would any of your readers say if it is possible to temper charcoal iron? and, if so, how it is done? If it cannot be tempered, is it possible to harden a ⅛in. or ⅜in. rod through and through? I do not mean to case harden the outside only. Can malleable cast metal be tempered or hardened through the same size of rod?—W. G. L.

[11756.]—**Power of Water-wheel.**—Will any of your numerous correspondents have the kindness to inform me the horse-power of a water-wheel 14ft. in diameter, and 22in. wide, the depth of buckets 9in., having an iron axle and rim, the other parts of wood, supplied by a reservoir 40 yards long, 7 yards wide, and 2 yards in depth; the water runs through a pipe 100 yards long, and takes 90 seconds to run through, and runs out in two hours in thrashing corn. When the water is allowed to run 4 hours, 6 hours, or 8 hours, what is the horse-power of the wheel? Also what is the best tap or a plug at the bottom of reservoir to prevent leakage?—Water-wheel.

[11757.]—**Boring for Coal.**—Would any of your readers advise me as to the best and most economical method of boring for coal?—J. H. B.

[11758.]—**English Mechanic Colony.**—Is the idea of forming a colony to settle in Tasmania—that was being got up by "Alexandra"—given up? Would "Alexandra" or any one else, please give me any information about it?—Americus.

[11759.]—**Oil Painting.**—I have an old flower piece, apparently of the English school, signed "Gregory." Can any subscriber say who he was, and at what time he flourished?—Shu Fly.

[11760.]—**Soldering Jewellery.**—Will some practical hand please say how the common gold jewellery is hard soldered? what kind of solder is used? and how is the article protected when applying the heat? I think the silver solder is too hard, as I often partially melt the job before I can get it to run.—New Pivot.

[11761.]—**Magnetism.**—In the course of a series of lectures on "Magnetism" delivered here (Liverpool) on the 22nd and 25th April, by Prof. Barrett, two experiments were tried, in order to show the change caused by magnetisation in the capability of iron to conduct light and heat. The first experiment proved conclusively that heat is conducted by magnetised iron, quicker in a direction transverse to the polar axis, than in one parallel to it; whilst the same iron in its ordinary state conducts heat equally in all directions. The second experiment proved the increase of transparency of iron when magnetised, and was accomplished in this wise. A beam of limelight was cast on a screen, passing (the light) through a tube filled with water, holding in suspension minute particles of oxide of iron. On an electric current being passed round the tube, thus producing magnetisation, a great increase in the quantity of light transmitted was apparent. Now the beam of light was passed along the axis of this semi-transparent magnet; but in the preceding experiment it was proved that heat (which is similar to light in kind, though differing in degree of intensity) is conducted faster through iron transverse to the polar axis, than parallel to it. What I want to know is this. Would not the action of the transmitted beam of light be much more apparent if it had been sent across instead of along the polar axis of the semi-transparent magnet? Perhaps some will feel sufficiently interested to try this experiment and report results.—Conatus.

[11762.]—**To take Honey from Bees by Using Chloroform.**—Will some brother subscriber kindly inform me what quantity of chloroform is required to take the honey from a hive of bees?—W. T. B., Belper.

[11763.]—**Watchmaking.**—What kind of tool is generally used for putting new cylinders in small Geneva watches? I think the Geneva turns are too heavy. Would the English turnbench do better?—New Pivot.

[11764.] — **Scrubber for Gasworks.** — Could any reader inform me how to make a scrubber for a gaswork—the size is to be 4ft. × 10ft.—and how the pipes are put inside?—Gasfitter.

[11765.]—**Astronomical.**—A tyro in star gazing will be much obliged by the following query being responded to through the English Mechanic:—On what days of the current year will the first point of the respective signs of the zodiac cross the meridian of Greenwich at midnight nearly?—C. A. S.

[11766.]—**Piano in Canada.**—I have (purchased in Canada) a 7-octave cottage piano, by Holdernesse and Holdernesse, of London. Will the "Harmonious Blacksmith," or other expert, tell me if there is any way of attaching additional bracing to make it more capable of being kept in tune, as the great extremes of temperature here, with the dry stove heat in winter, render it difficult to keep a piano, especially of cottage style, in good playing order. Also the bass notes sound somewhat wiry and harsh. Is there any remedy for this? I believe that there is a mode of "needling" up the face of the hammer to soften the tone. The action of the instrument is apparently quite new and unimpaired. I may add that I can handle tools as well as most amateurs, so could possibly add any bracings necessary myself.—H. E. K., Toronto.

[11767.]—**Horsehair.**—Horsehair, after having lain in water for a certain time (indefinite), twists and twirls about in all directions, sometimes swimming straight on, like an eel, at other times twisting itself into numerous knots around a piece of stick or straw, and as quickly untwisting itself. Is the above owing to galvanism?—A Subscriber.

[11768.]—**Cheap Filter.**—I have made a cheap filter in the following way:—I have filled the hole in the bottom of a flower-pot with sponge, then placed a layer of charcoal, then a thick layer of gravel, and on putting the water in, it ran from the sponge in a stream, instead of dripping. Is that of any consequence? if so, how can it be altered?—H. D. W.

[11769.]—**Tricycle.**—Will some kind reader inform me whether I could have a tricycle made that would be of service to me and many others who are unable to walk? I have spent money on a four-wheel which is useless to me, as it is very heavy and clumsy. My ideas through reading some ten volumes of "ours," are that a machine might be made very light (say 50lb.; after the style of one you sketched some three or four years ago, belonging to J. Hastings, with description. I propose a strong wooden frame, very light, with two wooden levers outside of frame to drive cranks attached to hind wheel, guide by feet in front, indiarubber tires all round, hind wheel to move going down hill, with levers still, a small wooden frame under frame behind, with long wooden lever to brake on ground. This brake power is used about here to two-wheeled trucks laden with fruit. A long wooden lever is attached under the truck, and rubs on the ground behind, so as to cause any amount of brake power by raising the handle and throwing the weight of the load on the lever behind. I don't want to go ten miles an hour.—J. H.

[11770.]—**Magnetic.**—I have a compass which I considered did not indicate with sufficient precision the position of north and south. Supposing the magnetism had exhausted itself, I thought to renew it by rubbing it with a horseshoe magnet, but on replacing it I found that it would not act at all, but stood anywhere, just where placed. How is that? and how can I remedy it?—H. G. W.

[11771.]—**Varnish.**—How can I make a varnish that will be flexible when dry, on calico or kid?—Apiarian.

[11772.]—**Black Lacquer.**—There is a black used by painters called black lacquer, for blacking chimney pieces, ash-pans, &c. Could any one inform me how it is made, and particulars about it?—Apiarian.

[11773.]—**Cleaning Plain Blue Silk.**—Can any contributor assist me by giving a recipe to clean plain blue silk, that is not greasy but dirty? My husband says the English Mechanic is the only publication from which I can get the information.—A Mechanic's Wife.

[11774.]—**Caulking Boats.**—Can any reader kindly inform me the best material for caulking boats, and how to make it?—Boatman.

[11775.]—**Tugboat for the River Wye.**—Can any reader tell me the best method of ascertaining the velocity of a current over a weir, and of calculating the horse-power of an engine which would be capable of driving a steamer against a given velocity of current? I wish to build a tugboat for drawing empty barges up the river Wye. The draft of water must not exceed 18in., nor the width of the vessel 8ft. amidships.—G.F.G.

[11776.]—**Commercial Geography.**—Will some one, who is acquainted with the requirements of the Cambridge Local Examinations name a text book, in which commercial geography receives full and reliable treatment? The examiners complain in their last report that "scarcely a candidate answered with any degree of accuracy a simple question on exports and imports."—Glenbogie.

[11777.]—**Postage Stamps.**—Having collected a large number of used penny postage stamps, I should be obliged to any one who could tell me of a use to put them to.—F. A. E.

[11778.]—**Sweeping Machine.**—Will some reader of the MECHANIC kindly tell me how I can make a chimney-sweeping machine, to clean chimneys with very sharp curves? or is there any machine in use that would suit me? I also wish to know if there is anything that will prevent Portland stone from vegetating.—SWEEP.

[11779.]—**Photographic.**—Will "Iodide" kindly send his further promised communication on enlargements and resinised paper.—LEX.

[11780.]—**Machinery for Cutting Envelopes.**—Would any correspondent kindly describe the machine or machinery used in cutting and making envelopes of various sizes? Does it require a different cutter for each different form and size? What gums are used and how prepared before being applied?—TIP.

[11781.]—**Lathe Query.**—I beg to thank Mr. Smither for his kind description of hook tools on p. 516, Vol. XIV. I have carried it out, and they answer very well. I should be still more indebted to him if he would describe the following:—1. A parting tool. 2. A beading tool; there is a sketch of one on p. 557, Vol. XIV., but I want to know how it is to be ground, what sort of grindstone it requires, &c. 3. The best way of cutting ferrules either iron or brass in the lathe, as I think it will be a better way of cutting them than with the saw or file. I have no doubt the answers will be useful to others as well as to—J. S. E.

[11782.]—**Band.**—I wish to form a band of English concertinas and some other instrument. Which would be the most suitable instruments along with concertinas?—DUET.

[11783.]—**Molten Lenses.**—Supposing I have a large plate of crown glass, and am acquainted with its optical properties, and then melt it until extremely liquid, and afterwards immerse therein a platinum mould whose inner surfaces are turned true to the curves which would be required if the same plate of glass was ground. The mould being overhead would fill with glass, and its respective portions being firmly held together would separate the inner glass from the outer. After also making a lens of flint glass on the above principle, and after carefully annealing the two, would they not act together just the same as if they had been ground? If not, kindly show what would have arisen to prevent them.—ALPHA.

[11784.]—**Restoring the Colour of Marble Mantelpiece.**—Can any correspondent inform me how to renew the colour of a marble mantelpiece, the upper slab of which is stained, apparently by coal smoke?—J. L.

[11785.]—**London Blackbeetles.**—Can any of your correspondents impart (from experience, not from hearsay) an effective plan for getting rid of the London variety of blackbeetles? Past experiments prove that they thrive and fatten on red lead wafers, phosphorus paste, and the like, and utterly despise such futile contrivances as traps of stale beer, treacle, &c. A thirst for discovery has lately seized them, and they have taken to exploring the upper rooms of my house—bedrooms, baths, &c., and hold nightly mass meetings on the staircase. Are the present resources of science adequate to repel such an invasion?—J. L.

[11786.]—**To "J. K. P."**—Will "J. K. P." be kind enough to inform me if he has allowed in the distance from centre of lathe mandril to centre of screw for a pinion on mandril and stud pinion to gear from?—DIGBY.

[11787.]—**Electric Signal Bell.**—To MR. TONKES.—Having made an electric signal bell upon the plan described by you a few weeks back, I find that when the current is broken the armature still remains attached to the magnet; and if I place it so far off that the spring will overcome it, the magnet has not sufficient power to attract it. If you would kindly tell me how to remedy this I should be greatly obliged.—H. G. N.

[11788.]—**Bunions.**—A friend of mine will be truly thankful if any of your learned friends can give a perfect cure for a bunion, not any appliance with a hole, but anything that will disperse it or absorb it, as walking down Welsh mountains caused the same, not tight boots.—DER MOND.

[11789.]—**Effect of Temperature on Ale.**—I am a brewer, and the ale I brew is very satisfactory in mild weather, but when I send it out in very cold weather, and the temperature of the ale gets low (say to under 50°) it goes very dull, and if the heat is raised again it comes bright. Can any of your kind correspondents give me the reason of this? I think it is because my water is very hard. If it is so, I should like to know what to do to it to prevent the above effect in cold weather.—W. A. N.

[11790.]—**Photography.**—Will some practical photographer help an amateur in a fix? I find the greater portion of my negative, after developing and fixing, marked across in diagonal lines exactly in the direction the surplus collodion was poured off the plate. Whilst pouring the collodion from plate I keep it rocking backwards and forwards. I thought, perhaps, collodion was too thick, so diluted it with alcohol, but the difficulty still exists. To precipitate silver from waste washings I am told to throw in some common salt, but I cannot learn about how much. The plan I thought of adopting is this: I have a cask capable of holding about four gallons, with a tap about half way up. I purpose filling this with washings of prints before toning (how much salt shall I then add?) and next day drawing off and throwing away all the upper part. In what form will the silver be precipitated? Will it still be held in solution at the bottom of cask? and how am I to know it has all left the upper water? How many times may a positive fixing bath be used? If many times, how am I to know when it ceases to act? if only once, what quantity will be suitable for (say) two dozen cartes? If a negative requires ten seconds' exposure in the studio, how long would the same require to be exposed in open air?—CAMERA.

USEFUL AND SCIENTIFIC NOTES.

Detecting Cider in Wine.—The adulteration of wines with cider can easily be detected by filtering and adding ammonia in excess. The apple juice will immediately deposit crystals on the side of the test tube. Genuine wine sheds a pulverulent deposit which does not adhere to the glass, and is devoid of a crystalline structure. Acetic acid will dissolve either of these precipitates. The deposit from the cider consists of flat crystals with parallel sides; that from wine shows star-shaped formations. The treatment with acetic acid shows the presence of lime and phosphoric acid in both cases, the quantity of lime in the wine being minute.

The Prizes of the Painters' Company.—The educational movement on the part of some of the London guilds is a good sign, and has not come too soon. The Painter Stainers' Company, as it was anciently called, was one of the first, in a comparatively small way, to offer medals and premiums for works connected with "the art and mystery of painting." The subject for which they offer rewards to decorators, artisans, apprentices, and others, is described as "alto-relievo and decorative painting," and the prizes, three in number, are—1. The Company's silver medal and freedom of the Company; 2. The Company's silver medal; and 3. The Company's bronze medal. These rewards are open to any under the age of thirty years, engaged in the trade, and residing within a radius of twelve miles from the Company's Hall. The specimens must be sent in between the 18th and 25th of May. It is to be hoped that some good work will be elicited. The Company do not ask for design, as the programme says the subjects may be copied either from an antique bust, cast of ornamental grouping, decorative moulding, or otherwise.

The Royal Society Soiree.—The first, which will be the only soirée for the present year, was held on Saturday evening last at Burlington House. The show of objects was all that could be desired, although there was no novelty of intense importance. In the philosophical group there were many things of interest—notably, in the first place, Lord Lindsay's photographs of the late solar eclipse, two of which were shown stereoscopically with admirable effect. At the same table were several new and important instruments by Mr. Browning, of which we may particularly mention a telespectroscope for viewing solar prominences, in which a ray of light is sent four times through compound prisms. The crystals of gold, silver, and other metals shown under the microscope in actual formation, by Dr. Gladstone, were very interesting, as was also the experimental decomposition of water and of iodide of ethyl by zinc in intimate conjunction with a more electro-negative metal. The trace-computor invented by Mr. Francis Galton deserves mention. It is applied at the Meteorological Office to obtaining from the curves of the dry and wet bulb thermometers the vapour tension of the atmosphere. By the cross wires of two micrometers being brought severally on these curves a pointer is compelled to take up such a position on a curved template as to cause the pricker of the instrument to record perfectly the vapour tension, which otherwise could only be obtained by means of complicated tables. A maximum thermometer of extreme delicacy, with index divided into tenths, so as to record to the one-hundredth of a degree of Fahrenheit, was contributed by Mr. G. J. Symons. Its range is from 65° to 85°, and it is calculated to withstand in service a pressure of three tons to the square inch. A simple hydrometer for obtaining the specific gravities of woods was shown, revised by Professor A. S. Herschel; it consists of a floating ring, to which the index is attached, and the bars of wood, cut to definite lengths, are simply immersed through the centre of the ring, when the gravity can be read off at once on the scale. Amongst the other interesting objects in this group were Mr. Napier's electro-magnetic light coin rejector; the Rev. A. Rigg's differential air-pressure gauge; the drawing of a curve from actual analyses illustrating the accuracy attained in the standard fineness of our British coinage, by the chemist to the Mint; a chart of 324,198 stars, by Mr. Proctor; Thomson's testing instrument for telegraph cables, &c.

CHIPS.

The very best way to clean a stained steel knife is to cut a solid potato in two, dip one of the pieces in brick dust (such as is usually used for knife cleaning), and rub the blade with it.

Repeated spectroscopic measurements made last year by Professor Zöllner and Vogel, in Germany, show that the velocity of rotation of the sun on its own axis is at the rate of 660 miles an hour.

According to the Abbé Moigno, in *Les Mondes*, a violent thunderstorm at Rosano (Italy), some weeks ago, was accompanied by a fall of pebbles, varying in size from a small cob-nut to a large-sized pigeon's-egg.

Annealing Steel.—Wm. Hamilton Hey (4013) will excuse my correcting his somewhat loose statement that heating steel to dull red in forge and allowing it to cool gradually in the ashes will make it soft enough for all practical purposes, as when I have finished this note I shall place a piece of red hot steel in common sawdust, and when cool it will be far softer than by the other method.—A., Liverpool.

ANSWERS TO CORRESPONDENTS.

*** All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, April 30, and unacknowledged elsewhere:—

J. B. Ward.—Wm. Whiteman.—R. Pearson.—E. Davis.—H. G. Nash.—Rev. G. S. Nichol.—Francis and Co.—T. C. H.—D. C. L.—D. H. Harvey.—S. H. Nash.—Wm. Brown.—E. S. Hunter.—John Dutton.—R. F. Fairlie.—Charles Fletcher.—A Jovial Fellow.—William Lea.—Joe. Waters.—G. W. Pagemont.—J. W. Buck.—W. Botton.—Hughes and Co.—C. A. Ball.—Rat-Tat.—Lancashire.—Cherryeater.—F. N.—F. A. Buffham.—Zeta.—P. W. H. J.—Bleaching Powder.—Ariel.—Bed of Stone.—Paddy.—S. W. Burnham.—Anglo-Celtic.—W. E. Lee.—Ralph Lowdon.—C. H. B.—T. P. Barkas.—C. Glasgow.—No. 170.—Amrotet.—M. A.—Go Ahead.—Adolescens.—Lancashire.—J. M. Taylor.—F. C. H.—Sholto Douglas.—T. T. Greg.—A Country Printer.—H. W. R.—W. F. R.—Ethyl.—M. Paris.—Albiereo.—3rd City.—A Novice.—Philanthropist.—Rudex.—J. C.—F. R. A. S.—Z.—W. R. Birt.—A., Liverpool.—E. G. L.—Senecio.—Fred. Harris.—T. C. H.—Rusticus.—G. J. C.—Jennings.—Petty Curry.—O. N. C.—Chronometer.—E. J. N.—Country Tinker.—V.—J. L.—Brake.—A Subscriber.—Musical.—Excelsior.—Workman.—Thetamu.—Not Proven.—W. H. B.—Samuel Kempling.—Perry.—Ricardo.—R. M. Hatch.—S.—Dexter Keen.—J. Starling.—Henry Page.—S. Bottone.—Wm. Tonkes.—W. L. G.—H. T. N.—Rev. W. White.—Artillery Captain.—Pattern Maker.—C. W. H.—F. A. Edwards.—S. H. L.—A. Cazala.—William Botham.—J. B. Cooke.—Dr. G. Goyard.—R. A. Proctor.—C. A. Bull.—John Rae.—C. H.—Delves.—Watts.—One Afflicted.—An Official.—An American.—An Upholsterer.—O S.—Clerk of Works.—Jackson and Shaw.—L. E. Redditt.—H. S. J.—A. M. C.—V. B.—Americus.

Communications which can only appear as advertisements to hand from J. L. A., Subscriber from the First, G. Baylis, A Nainsmith, M. W., J. P., Curious, W. T. B., Bradfordian.

FITTLE.—Have patience. If not answered, it will appear in the list of unanswered queries in due time.

GLASGOW.—Consult indices, and you will find in back numbers how to construct a telescope.

S. B.—Consult indices, and you will find in back numbers the best way of cleaning old coin. We cannot repeat questions for the benefit of occasional readers.

G. CHOUTER, W. DREW, E. ARMISTEAD, PRO RATA, see "Hints to Correspondents," over Replies to Queries.

ASTHMA.—The article referred to was merely a note bringing the subject before the medical profession. The author has not published a book on it.

AN OFFICER.—Another correspondent has this week put a question on the same subject. If answers to it are not satisfactory, write again.

E. L. G.—Yours on "Ventilation" next week, which must conclude the controversy.

DUPED.—If the maker of your Pulvermacher's chain will not answer your letters or give you any information, we must also decline doing so.

E. S. S.—We have laid down a rule to which we shall adhere at all hazards, and that rule forbids us to insert trading or commercial queries save as advertisements.

WEST CORNWALL.—A printer's error.

G. H. B.—We do not know of any work on bookbinding. You will find plenty of information in recent back numbers (especially Vol. XIII). Bookbinding is not an art. There are a few facts, termed the *modus operandi*, the rest is skill which comes of practice.

W. H. M.—The information you ask for about scientific meetings for the week is given in the *Athenæum*, the *Society of Arts' Journal*, the *Daily News* on Mondays, and other papers.

B. C. HULMER.—The treatise has not been published in a separate form. For second query write Trübner and Co., Paternoster-row, London.

PRIMROSE, S. MASON & CO., and R. W. E.—Your queries are advertisements. See "Hints to Correspondents."

H. C.—Works on telescope have been mentioned in our pages again and again.

W. C.—The reason why the query was not inserted was that a similar one was inserted and answered a few weeks before.

W. M. FLINDERS PETRE.—See our reasons in the last and preceding numbers for termination of controversy on the metric system.

PHAROS.—Inquire of a newsagent.

PARTONIAN SCHOOLBOY.—Answered by others.

PAUL GILL.—If the controversy on the decimal system were not terminated, your letter would certainly appear; but there has been too much passion and prejudice imported into the controversy to justify its continuance at present. If, at any future time, a discussion on the question be recommenced, we hope it will be considered on its merits, without linking it with the vices or the virtues of the French Revolution. We believe the decimal system will ultimately prevail for the same reason that we believe in the "survival of the strongest."

A READER.—Good food, and plenty of exercise for your first two requirements. A course of gymnastics will aid in acquiring your third, if you are naturally of a robust habit.

H. AXON and J. B.—Consult a medical man.

P. G., W. C. B., Edgar David, J. Guthrie, J. B. P. Darlington, E. L. E., J. L., One in a Fix, Emigrant, and Touchweight, are referred to indices to back vols.

F. WELLS.—The whole process of lead burning was given in Vol. XII., pp. 211, 356, and 406.

T. CRAWFORD.—For cement for aquariums, see p. 593 Vol. XII. Second query is an advertisement.

ANXIOUS INQUIRER.—We suppose you mean the telegraphic department of the postal service. Write to the Superintendent of Telegraphs, Telegraph-street, E.C.

A. F.—A description of the Leclanché cell will be found on p. 568, Vol. XII., No. 310; see also p. 616, No. 313. You ask for a good work on electricity, magnetism, &c. Have you read Mr. Sprague's articles in the ENGLISH MECHANIC?

H. B. E.—For information on water velocipedes, see p. 75, Vol. IX.; p. 121, Vol. X.; and p. 69, Vol. XII. We cannot at present speak definitely as to what we shall do with the mechanical inventions at the International Exhibition.

BARNES RICHARDS (Penzance).—We know of no published guide or handbook to advertising, but some such a thing is wanted, as there is much deception daily practised by canvassers and others. Advertisers have, however, to thank themselves in a great measure for it. They will follow each other like flocks of sheep into journals that have little or no circulation, and neglect journals of wide circulation. There is, for instance, a scientific journal published in London which has not one-twelfth of the circulation of the ENGLISH MECHANIC, but it has twice the number of advertisers. Some will ask, why is this? Because the said journal pays men an enormous percentage to canvass for advertisements, and those canvassers, not being very scrupulous in the statements they make, manage to throw dust in the eyes of advertisers, and so victimise them.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING APRIL 23, 1872.

1123 W. R. Renshaw, Kidsgrove, Staffordshire, for improved means and appliances for puddling iron.

1124 H. Stephens, Breage, and J. Harvey, Wendron, Cornwall, for improvements in crushing, dressing, and refining tin and other ores, and in apparatus employed for these purposes.

1125 P. Ironside, Lambeth, for improvements in machinery or apparatus for raising and lowering carriage steps.

1126 T. N. Palmer, Dalston, for an improved method of and apparatus for producing motive power. A communication.

1127 F. A. Harrison and C. Priestland, Birmingham, for improvements in attaching door and other knobs to spindles.

1128 H. Glaysher, Newport, Isle of Wight, for improvements in marine engines.

1129 G. Hepburn, Liverpool, for improvements in governors for steam and other engines.

1130 B. J. B. Mills, Southampton-buildings, for improvements in the manufacture of sheet iron. A communication.

1131 D. McC. Smyth, Orange, U.S., for improvements in sewing machines.

1132 C. S. Venables, Essex-road, Islington, for improvements in pianofortes.

1133 J. R. Taber, Southampton-buildings, for improvements in artificial breasts for ladies' wear. A communication.

1134 D. Dubbin, Lewisham, for improvements in self-acting stands for beer or other casks.

1135 W. R. Lake, Southampton-buildings, for improvements in the manufacture of iron bars, plates, sheets, or slabs. A communication.

1136 A. V. Newton, Chancery-lane, for an improved mode of and apparatus for preserving animal and vegetable substances. A communication.

1137 A. R. Duncan and J. Macnaughton, Edinburgh, for improvements in breech-loading fire-arms. A communication.

1138 G. Clark, Craven-buildings, Drury-lane, for improvements in shoes and boots.

1139 E. Edwards, Southampton-buildings, for improvements in steam traps. A communication.

1140 B. J. B. Mills, Southampton-buildings, for improvements in apparatus for the extraction of oil, fat, or resin from vegetable or other solid matter by chemical agency, and the recovery of the chemical employed. A communication.

1141 F. Alekan and I. Alekan, Paris, for improvements in screw studs for shirts, cuffs, and similar purposes.

1142 W. H. Hacking and T. Hacking, Bury, Lancashire, for improvements in machinery for folding and measuring woven fabrics.

1143 J. S. Christopher and J. F. Lackersteen, Lombard-court, City, for improvements in propelling vessels.

1144 J. W. Harper, Stowmarket, for improvements in the arrangement and construction of hammock-beds, more particularly applicable in tents.

1145 W. E. Newton, Chancery-lane, for improvements in distilling apparatus. A communication.

1146 J. Peris, Middlesborough, for improvements in reverberatory and other furnaces.

1147 S. Barlow, Oldham, for improvements in apparatus for the prevention of accidents upon railways.

1148 H. J. H. King, Glasgow, for improvements in apparatus for feeding wool, cotton, or other fibrous materials to carding or other machines.

1149 J. L. Norton, Ludgate-hill, for improvements in the construction of walls, ceilings, and floors of buildings and other structures.

1150 S. Sorby, Denham, Uxbridge, and J. C. Richardson, Maidenhead, Berkshire, for improvements in multiple furrow ploughs.

1151 J. L. Norton, Ludgate-hill, for improvements in the manufacture of blocks and slabs for building, paving, and such like purposes.

1152 S. Crighton, Manchester, for improvements in apparatus for regulating the feeding of machinery employed in the preparation of cotton and other fibrous materials.

1153 C. Jackson, Birmingham, for improvements in sewing apparatus.

1154 W. B. Robins, Shepherd's-bush, for improvements in hand pumps or syringes.

1155 E. F. Goransson, Sweden, for improvements in apparatus for obtaining motive power.

1156 G. Holcroft, Manchester, and J. F. Lackersteen, City, for improvements in apparatus for separating metals from their ores or other admixtures.

1157 T. C. Fidler, Emberton, Bucks, for improvements in the construction of suspension bridges and iron arches.

1158 J. Broel, Westbourne-terrace, Middlesex, for improvements in apparatus for lighting and heating.

1159 C. Catlow, Lancashire, for improvements in looms for weaving.

1160 S. Brooke, Yorkshire, for improvements in carding engines.

1161 B. Graham, Batley, Yorkshire, for improvements in apparatus for preparing wool or other fibrous substances for feeding carding engines.

1162 H. Warry, Parkstone, Dorsetshire, for improvements in various beverages.

1163 H. A. Dufrene, South-street, Finsbury, for an improved process for the preservation of textile fabrics from the destructive effects of wet or moisture. A communication.

1164 R. Griffiths, Rhual Isaa Mold, Flintshire, for improvements in the construction of steam ships or vessels, and in screw propellers.

1165 J. Davey, Cornwall, for improvements in the construction of turn-wrest ploughs, parts of which improvements are also applicable to steam ploughs.

1166 P. Rosier, Paris, for improvements in apparatus for emptying or exhausting the conduct or supply pipes of cisterns and similar structures as a protection from frost or other damage.

1167 J. Campbell, Founders court, City, for improvements in the mode of getting at the external bottom of ships and vessels for the purpose of cleaning, repairing, and overhauling them.

1168 G. Halfe, Stockport, for improvements in machinery for winding yarn.

1169 G. L. Shorland, Manchester, for improvements in grate backs for increasing the efficiency of sham register and other firegrates.

1170 J. Edge, Bolton-le-Moors, Lancashire, for improvements in boilers or steam generators.

1171 J. Barrow and C. J. Crosfield, Liverpool, for improvements in utilising certain saccharine syrups, and in apparatus employed therein.

1172 B. Ramsden, Leeds, for improvements in steam boilers.

1173 S. Kay and T. Kay, Stockport, for improvements in feeding bottles, parts of which are applicable to other purposes.

1174 R. Wilson, Manchester, for improvements in hydraulic machinery or apparatus.

1175 W. R. Lake, Southampton buildings, for an improved machine for filling metallic boot-heel shells with wood or other materials. A communication.

1176 W. R. Lake, Southampton-buildings, for an improved process of treating animal and vegetable fats or greases for the purpose of obtaining stearine and oleine therefrom. A communication.

1177 J. Hawker, Chard, Somersetshire, for improvements in steam road locomotive or traction engines, parts of which improvements are applicable to portable engines.

1178 T. J. Smith, Fleet-street, for improvements in Jacquard machinery. A communication.

1179 M. Rowlands, Pontypridd, Glamorganshire, for improvements in coke ovens and in the means of charging the same.

1180 F. G. Fleury, Southwark, and A. Tylor, Newgate-street, City, for improvements in water waste preventers or apparatus for controlling and arresting the flow of liquids.

1181 A. F. Ragon, Upper Westbourne-terrace, Middlesex, for a new or improved case for railway and other tickets, fitted with a memorandum paper or advertisement sheet. A communication.

1182 H. Bytheway, Pontypool, Monmouthshire, for improvements in annealing boxes, pots, or pans, used in tin works.

1183 C. H. Aston, Birmingham, for improvements in connection with spiral spring mattresses and frames, and spiral springs used in connection with frames, bedsteads, couches, and for other upholstery purposes.

1184 H. C. Briggs and D. R. Ramsay, Saltburn-by-the Sea, Yorkshire, for improvements in steam generating and heating apparatus to be used in connection with rotary or other puddling furnaces.

1185 W. D. Scott, Glasgow, for improvements in governors for motive-power engines.

1186 G. Davies, Manchester, for improvements in the construction of stereopticons. A communication.

1187 A. McGregor, Lancashire, for improvements in the construction of machinery for reaping and mowing.

1188 R. Shaw, Higher Walton, Preston, for improvements in drawing frames used in the preparation of cotton and other fibrous materials.

1189 M. Doubelt, Grosvenor Hotel, Middlesex, for improvements in the means and apparatus for the transmission and registration of telegraphic despatches. A communication.

1190 J. H. Teal, Tennessee, U.S., for controlling, regulating, and shifting the packing of pistons working in cylinders, as in steam, air, and water engines, air and water pumps, and other machines, while the same are in motion.

1191 N. P. Stockwell, Regent's-street, for improvements in embroidery and tuck-marker attachment for sewing machines. A communication.

1192 W. B. Thelwall, Upper Holloway, for improvements in the construction and method of actuating colossal and other figures of men, monsters, and animals for stage purposes.

1193 E. J. Hill, Pimlico, and J. L. Clark, Westminster Chambers, for an improved boat-lowering apparatus.

1194 S. H. Stevens, Crowan, and T. Williams, Helston, Cornwall, for improvements in machinery for reducing tin stuff and other partially pulverised ores and substances.

1195 W. W. Laddle, Buckinghamshire, for an automatic pulp save all.

1196 J. Pickles, Bramley, Leeds, for improvements in the machinery or apparatus employed in puddling iron.

1197 G. R. E. Fairholme, Roxburgh, Scotland, for improvements in household fire-escapes.

1198 S. Johnson and A. Johnson, Leicester, for an improved plumb rule and level.

1199 J. Hunt, Bolton, for improvements in apparatus for winding thread or yarn upon pirns or bobbins.

1200 J. F. M. Pollock, Newtown, Leeds, and J. Mitchell, Bradford, for improvements in kilns.

1201 L. Fontana, Paris, for improvements in the treatment of certain substances employed for some surgical and therapeutical applications.

1202 W. R. Lake, Southampton-buildings, for an improved burner for lamps and other illuminating apparatus. A communication.

1203 H. B. Barlow, Manchester, for improvements in apparatus for cooling wort and other liquids. A communication.

1204 F. H. A. Heyer, Leather-lane, Holborn, for an improved press for printing and copying.

1205 W. Ferry, Southampton, for improvements in cistern filters.

1206 T. J. Smith, Fleet-street, for improvements in the manufacture of buttons. A communication.

1207 G. Little, New Jersey, U.S., for improvements in electric telegraph apparatus and in circuits employed in telegraphing.

PATENTS SEALED.

2806 W. McKenzie and C. A. Cameron, for improvements in the manufacture of solidified tea and coffee.

2809 J. F. M. Pollock, for improvements in machinery for compressing bricks, tiles, and other similar articles.

2813 J. Petrie, for improvements in valves of steam engines.

2815 E. T. Hughes, for an improved liquid meter.

2816 J. Sellers and E. Hopkinson, for an improved machine or apparatus for effecting calculations, applicable to weights measures, time, and money.

2823 G. A. Vivien and P. C. Vivien, for a novel chemical composition for the preservation of wood, metal, and other substances.

2833 J. F. Wanner, for improvements in the ornamenting of garments, and of silk, woollen, and other fabrics.

2836 T. K. Mace, for improvements in hats.

2837 H. Stapfer and J. Sinclair, for improvements in apparatus for withdrawing or discharging ale or other liquor or liquid from casks or receptacles, and for raising the said ale, liquor, or liquid to a higher level.

2842 P. Lecloux, for an improved double balanced bolt or fastening for windows, shutters, folding doors, and other like purposes.

2843 J. J. Turner, for improvements in constructing the wheels of railway and tramway rolling stock.

2844 W. T. Sugg, for improvements in apparatus for distributing fluids and liquids.

2847 E. T. Hughes, for improvements in hydro-meters.

2851 W. R. Lake, for improvements in sewing machines.

2861 W. McAdam for obtaining motive power by the rising and falling of tides and in the machinery or apparatus employed therefor.

2862 W. Symons, for improvements in the construction of the framework or hull of ships and vessels.

2870 H. G. Lawson, for improved mechanism for transmitting power.

2872 H. G. Lawson, for improvements in harvesting machines.

2878 W. Pidding, for improvements in mechanism to be attached to wheeled vehicles to form a railway therefor.

2884 F. W. Webb, for improvements in locomotive engines and railway breaks.

2911 W. R. Lake, for improvements in metallic packing for the piston and valve rods of steam and other engines.

2923 R. Winder, for improvements in steam ploughs.

3037 W. Bayley, for improvements in roller blind furniture or apparatus.

3177 A. V. Newton, for improved machinery for printing from types.

3355 E. Entwistle, for improvements in railway signals.

3357 G. Evans, for improvements in the manufacture of asphalte or composition adapted for paving and other similar uses.

60 G. Lewis, for improvements in ploughs.

283 H. W. Ripley, for improvements in colouring fabrics.

412 T. Cockshott, for an improved method of laying sub-marine telegraph cables in connection with shipping in different rivers, harbours, and seas, and other places.

480 C. D. Abel, for improvements in moulds and cores and in mould and core linings and facings for metal castings, and in materials employed therefor.

563 W. C. Church, for improvements in steam engines, parts of which improvements are applicable to hydraulic rams and pumps.

593 J. Quick, sen., J. Quick, jun., and A. Cooper, for improvements in signal lanterns or lamps.

595 G. Westinghouse, jun., for improvements in pneumatic apparatus for working brakes and communicating signals in railway trains.

2839 W. Onion, for improvements in machinery or apparatus employed in the manufacture of looped or knitted fabrics.

2841 D. Wilks, for improvements in apparatus for collecting, receiving, and holding all animal refuse and manufacturing the same into manure without nuisance, particularly applicable to the collecting, deodorising, removing, and utilising human excretions and other animal matter of large towns.

2848 L. Hornblower, for improvements in the construction of walls, partitions, floors, and roofs of dwelling-houses and other buildings.

2859 S. Alley, for improvements in wheels for steam and other carriages.

2869 R. A. Wright, for improvements in apparatus for fastening purposes, especially applicable to the fastening of railway and other carriage doors.

2877 W. H. Chase, for an improved animal trap chiefly designed for catching rats and mice.

2893 G. Green, for improvements in apparatus for separating ores and other materials.

2932 J. H. L. T. Portner, for improvements in sewing machines.

2979 J. Jordan, for improvements in steam boilers and in arrangements connected therewith.

3011 A. Maw, for improvements in machinery or apparatus to be employed for the working of screw presses.

3013 A. P. Tronchon, for improvements in the construction of counters for cabs, carriages, or other vehicles.

3043 J. H. Johnson, for improvements in solidifying petroleum, schist, and other oils and their volatile essences employed for illuminating purposes, and in the purification and liquefaction of such solidified oils and essences.

3099 J. I. Sands, for improvements in the means of and apparatus for locomotion, applicable to steam carriages, also to traction and other locomotive engines, and to steam road rollers.

3178 J. H. Johnson, for improvements in artificial dentures and in bases for the same.

3183 A. M. Clark, for improvements in apparatus for reefing and furling ships' sails.

128 A. Lee, for improvements in apparatus to be applied to pipes used for heating buildings by steam.

253 B. J. B. Mills, for improvements in seal locks.

345 W. R. Lake, for an improved wood pavement.

346 W. R. Lake, for an improved machine for packing and securing blocks laid for paving and for other like purposes.

354 W. Betts, for improvements in capsules, and in apparatus to be employed in their manufacture.

355 W. Betts, for improvements in machinery or apparatus for capsuling bottles and other like receptacles.

371 F. Taylor, for improvements in the construction of bedsteads for invalids.

477 O. C. Betchell, for improvements in treating or preparing certain waste substances so as to render them useful as compositions for lighting fires.

494 F. Hills, for improvements in the treatment and utilisation of sewage and the manufacture of manure therefrom.

531 W. R. Lake, for improvements in breech-loading fire-arms.

561 F. A. Gatty, for improvements in printing and dyeing cotton fabrics.

603 W. Weldon, for improvements in treating and applying dilute chlorine.

624 G. H. Smith, for improvements in metallic alloys, and in their application to iron surfaces for preventing the corrosion of the same.

659 J. Sullivan, for improvements in chamber vessels.

679 W. R. Lake, for improvements in railway rails.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, MAY 10, 1872.

ARTICLES.

THE ENTOMOLOGIST'S HOLIDAY.

WITH the increasing warmth of the now rapidly strengthening spring many of our numerous insects are putting on the holiday garb of their ephemeral existence, and beginning to quit their winter haunts for the scene of their short, but too often mischievous career. Their ardent admirers, the Entomologists, who may be considered as their devoted friends, though probably regarded by sundry species of butterflies and moths as their inveterate enemies, are also on the *qui vive*, and are diligently preparing their paraphernalia for the coming campaign. The Lepidopterists and the Coleopterists — the moth-hunters and the beetle-catchers—are setting in order their nets and their killing-bottles; examining their cabinets for vacant spaces and noting down the species wanting. As soon as the warmer nights set in they will be out on foraging expeditions, searching for the beautiful ornaments of the woods, the coppices, and the fields as ardently as astronomers examine the markings on the moon or the rings of Saturn. Entomologists, however, have an advantage over the astronomers; for while the principal objects of interest to the latter are only to be seen at night, the enthusiastic insect-collector may pursue his hobby at every hour of the twenty-four. We are not concerned to defend our friends from the charge of cruelty which may be brought against them by ultra-sensitive minds, so long as they capture moths and butterflies for a higher purpose than the mere pride of exhibiting their achievements; for even Tennyson's sweet-hearted young lady "whose light-blue eyes were tender over drowning flies," would, we imagine, offer but a feeble opposition to the utter destruction of every thing termed a "moth." As a matter of fact, however, the study of Entomology in all its bearings is a subject of the first importance to the farmer and the practical horticulturist, if the truths which it teaches are rightly read, and the knowledge gained turned to account in a scientific manner. This, it is true, involves a knowledge of the life-history of the insects from the egg to the perfect state; but as this is not to be acquired in a day or in a year, but only by patient and unflagging observation, we have thought it probable that if a taste for collecting the more beautiful specimens of the insect world could be infused, the contemplation of them might lead to a desire to be better acquainted with the different phases of their lives, and so, step by step, to a knowledge of the humbler denizens of our cultivated fields, which though less attractive to the eye are often far more destructive in their operations. Science, we know, should be pursued for its own sake; but science, with too many, means flashy experiments and attractive sights, without which but little attention can be obtained for even the most entertaining and instructive subjects. It is, therefore, with an ulterior object that we lay before our readers a few hints for the capture and preservation of moths and butterflies—viz., in the hope that at least a moiety of those who may endeavour to make a collection will pursue the subject further, and turn the knowledge so acquired to scientific purposes.

The net forms the most important part of an entomologist's equipment, and there are as many designs for this implement as there are days in the week. The one most commonly used, however, and the most serviceable for beginners, consists of a light steel ring, jointed so as to fold up into small compass for convenience of carrying, and provided with a handle, which may be made to screw on when wanted for use. But a more easily made and just as serviceable form is the cane-net, which consists of a tubular Y or T shaped piece made of sheet brass or tin plate, into the arms of which the ends of the cane are secured, while the leg forms a socket for the insertion of the handle. There are also the clap-net, the umbrella-net (a folding net patronised by many), and a net with a handle about 20ft. long, supposed to be necessary for capturing some species. Possibly the best material for the "bag" of the net is grenadine, but this is rather expensive; book muslin answers all the purposes of beginners, and is generally used. Some lepidopterists prefer a black-coloured net for night work, as the insects can be more readily distinguished; but white should always be preferred to green for day work. The bag should be made tapering, with the seams outside; about three-fourths the length of the collector's arm; and if the ring is of steel it should be covered with thin leather. A collecting-box is not absolutely necessary, but it is at all times convenient. It should preferably be made of zinc in order that the cork may be damped—a very requisite operation on a hot summer's day. With the box, a number of pins should be carried (No. 10 is the most useful size) for pinning the captures to the cork, and a number of pill and ointment (chip) boxes, previously strengthened by pasting strips of thin calico around the joints, and with four or five small holes in the bottom. Some method of killing, or at least stupefying, the captives is essential, or on returning home after a long day, many will be found to have nearly knocked themselves to pieces and irretrievably damaged their beauty. For this purpose there is nothing better than the cyanide bottle, the mode of preparing which has been described in these pages. It is merely a tolerably wide-mouthed bottle, on the bottom of which a layer of cyanide of potassium is spread and covered with a thin stratum of plaster of Paris. When the plaster has set, three or four pieces of blotting-paper are laid on it, and a good tight-fitting cork, sealing-waxed at the top and upper part of the sides, completes the killing apparatus, which will last nearly the whole season if kept cool and properly corked. If the collector is without a killing bottle, or wishes to stupefy a specimen confined in one of the chip boxes, it is only necessary to dip a very small piece of blotting-paper in a solution of the cyanide, and drop it into the box; but this will require a pair of pincers, or miniature tongs, in order to hold the paper. A bag or basket of some kind is almost a sine-quâ-non if we would return with our treasures uninjured—a fisherman's basket, which can be instantly detached from the shoulder-straps answers very well. These will about make up the complement of the necessary apparatus for an ordinary daylight excursion when Lepidoptera are caught on the wing or "settled;" but if the night-fliers are sought, which are generally captured by "sugaring," one or two "weapons" of a different kind will be found requisite. The first is, of course, the sugar itself. Opinions vary as to the *best* compound, but the tyro will find the following probably as enticing as any:—Boil equal parts of treacle and "foots" with sufficient beer (stale will do) to make the mixture work well with a brush, neither too thin nor too thick. Place this in a bottle or the regulation sugaring tin, and just before starting to lay your traps mix with it a small quantity of rum—not too much, or the moths will fall off and be lost in the grass or underwood. Begin to sugar as soon as "dusk" has fairly set in, choosing trees with rough bark at intervals of nine or ten yards, and putting on a narrow streak about a foot from the ground up to the height of the face. Where there are no trees, bushes, thistles, and the flowers of ragwort and umbel-bearing plants may be tried, tufts of grass, and even good-sized stones. The sugaring performed, the would-be collector must trim his lamp and see there is no scarcity of oil. A lantern with a piece of plate-glass for a window is better than a bull's-eye for "sugaring," but there should be a cover for it and a strap so that it may be hung round the neck or carried in some way so as to leave both hands at liberty on an emergency. As a rule but little difficulty will be experienced in securing moths at "sugar." They may be boxed-off on the tree, tumbled into the cyanide bottle, or netted in the usual "sugaring" net. This latter is made Y-shaped or V-shaped, by securing steel wires into a socket of the requisite form, and connecting the ends by a piece of flexible wire or stout string, or, indeed, any material that will yield to the shape of the tree-trunk when pressed against it. It should be of a size convenient for supporting it by pressing with the leg against the end, so that both hands can be used for boxing or bottling, while any insects that fall are received by the net. A catching and pinning box is used by many, which is constructed as follows:—A wooden or very stout cardboard tube, at least 2in. in diameter and about 4in. long, is covered at one end with a piece of strong network (fine brass wires secured in holes at the sides and crossed would, perhaps, be an improvement), and about half an inch from the other end a slit is cut transversely for half the circumference, in which a circular piece of tin, zinc, or cardboard can be slipped so as to close the tube; a piece of cork, of nearly the same diameter as the cylinder, to which a short rod is attached, completes the apparatus. The method of capturing with this consists in placing the end of the tube over the moth, which flies to the netted end; the disc is then slipped through the slit, the cork piston inserted into the tube, and, the disc being withdrawn, the cork is pushed towards the netted end, by which means the moth is easily pinned through one of the meshes and drawn out with the cork.

We think we have now mentioned all the "weapons" necessary for a fully-armed collector, and we have left ourselves but little space to speak of the *modus operandi* of the art. As to giving any description of the species to be sought after and prized, it would be useless here, as a great deal, of course, depends on the nature and general characteristics of the hunting-grounds within reach of the entomologist. In and near London, Epping Forest is probably the best spot, especially those parts which, some distance from the "line," are beyond the usual range of the army of collectors who visit that locality. All woods are likely places, particularly in parts where trees have been felled and clearings made; so are parks, with their old trees and young plantations; hedge-rows, ponds where there is abundance of vegetation, chalk and gravel pits, and for some species of night-fliers the gas-lamps or the windows of an illuminated room. Just as in other pursuits of life, the collector who works with his head, and saves his legs and arms until their energetic use will really assist him, is invariably the most successful; a knowledge of the habits of the various species, the time and manner of their flight, the plants they frequent, and the various other minutiæ of the art, is of course of great assistance, but much of this can be acquired from manuals specially devoted to the subject, and a little practice teaches more than volumes. The enthusiastic tyro who has been rushing about all day, and, perhaps, succeeded in capturing half a dozen butterflies, which he has utterly spoilt by his rough treatment, is apt to be disappointed when he examines the "bag" of a more practised friend, who has merely pitched on a likely spot and waited his opportunity

There is, however, one method of capturing many species of Lepidoptera which requires but the minimum of time and patience. This is hunting the sallows in the spring and the ivy in the autumn; for when in bloom their visitors very rarely leave till they have recovered from the effects of the absorbed nectar, and so fall an easy prey to the collector. For this purpose a hooked stick, a shallow net, a bull's-eye lantern, and an umbrella or a sheet, are the principal requirements, with, of course, the usual boxes and killing-bottle. Having ascertained the whereabouts of the bushes, choose an evening free from wind, and with the net carried a little below and in front of the lantern examine the bushes. The moths being intoxicated frequently fall into the net directly the light is brought near them; and, if not, a gentle tap with a stick on the branch will insure the capture of the victim. For branches out of reach the umbrella is held open underneath and the moths gently shaken off the bush; or a sheet may be placed around the roots where the ground is suitable. Warm dark nights, with a light steady wind in one quarter, will, however, rarely fail to yield a goodly number of moths at sugar, and even moonlight nights are not always barren of game. Great care, is, of course, necessary in removing the captive from the net; but by the exercise of a little skill, without excitement, a very few trials will make the tyro proficient. The net must be so held that the moth cannot fly out, and a lidless box being taken in one hand is passed into the net and over the moth and grasped by the other hand from the outside. The free hand is then at liberty to take the lid and carefully slide it between the top of the box and the net, and so the insect is captured without damage. Such are some of the rudiments of the art. The names and characteristics of the numerous species can, of course, only be [illegible] from voluminous works and catalogues, or [illegible] collections; permission to view is general[illegible] by nearly all Entomologists, and nothi[illegible] calculated to infuse the spirit of emul[illegible] good look at an extensive and well-[illegible]

In these columns we should not have space to mention even the names of all the British Insects, but we may at some future time give some hints on setting and arrangement. In the mean time, we hope those who may "collect" will not rest satisfied with mere admiration of the beauties of their captures, but will endeavour to acquire a knowledge of their life-history and of their purpose in creation.

NOMINAL HORSE-POWER.

IN an article on the rating of steam-boilers, which appeared on p. 28 of our last volume, we drew attention to the desirableness, indeed, the necessity, of adopting a general and well-understood rule for estimating the horse-power of steam-boilers. A very large number of purchasers of steam-engines and boilers are uninitiated into the mysteries of calculating the power which those machines are capable of developing, and being utterly at a loss to comprehend the formulæ employed by mechanicians in estimating this power are easily deluded by designing manufacturers. We do not wish to insinuate that makers as a rule are in the habit of deceiving unwary purchasers, but, like most other businesses nowadays, there are manufacturers of engines and boilers who do not hesitate to represent their goods as being capable of accomplishing an amount of work which on trial it is found impossible to obtain with the surrounding conditions. There is, it is true, some little excuse for this method of conducting business on the part of the makers, for so long as there is no recognised rule for ascertaining and stating the power, the seller may say that it is no part of his duty to inquire under what circumstances the buyer intends to employ the engine and boiler he purchases. They may be capable of indicating the power stated when worked at the requisite pressure and piston speed; but it frequently happens that this part of the calculation never troubled the purchaser, and as the seller did not choose to enlighten him, he speedily finds himself disappointed and considers himself deceived.

Nominal horse-power is at the present time a mere name, possessing no definite value—being, in reality, rather more delusive than instructive. The rule laid down by Watt, calculated for a steam-pressure of 7lb. per sq. in. did very well for the purpose at the time, before the steam-engine had reached its present development, but it is quite inappropriate now that the average pressure is something like 49lb. on the sq. in. Still, if Watt's rule were generally adhered to, the expression "nominal horse-power" might not be so unmeaning as it is, because it would be easy to find out exactly what was intended, but the method of calculating the nominal power varies in different parts of the country and with different descriptions of engine. According to the Admiralty rule the square of the cylinder's diameter in inches is to be multiplied by the piston-speed in feet per minute, and the product divided by 6,000; but on the Clyde and in the North of England, where large numbers of engines are made, a nominal horse-power is reckoned for every 30 circular inches of piston area, counting both high and low pressure cylinders; while on the Thames 17 or 20 circular inches of piston are taken to represent a nominal horse-power. Again, the Royal Agricultural Society, in order to guide the farmers, adopted 10 circular inches as the standard in estimating the power of portable engines —a rule generally accepted by the makers and universally employed in rating that class of engine. Besides these, there are numerous other rules, giving results which differ from one another, and affording anything but an accurate idea of the power actually to be obtained.

Indications are not wanting that a remedy for this state of things will shortly be proposed which will possibly receive the sanction of authority, and so settle a vexed question. Towards this desirable solution of an acknowledged difficulty, Mr. J. Macfarlane Grey, M.I.M.E. and N.A., contributes an able paper (to the *Nautical Magazine*), and though it is devoted to a consideration of the question as it affects marine engines, there is also much in it which pertains to steam-engines generally. After pointing out that the Board of Trade should insure reliable information as to the power of the machinery in emigrant ships, he proceeds to lay down the principles on which the power of the engines should be estimated. The primary source of the power being the fuel, the rate at which that can be consumed is the first element of the sum. This Mr. Grey puts at one ton of steam coal a day per foot of furnace width, irrespective of length of bar. After calculating the quantity and the power of the steam thus produced, he proposes that the nominal horse-power of the marine boiler should be taken as 20 horse-power for each foot of furnace front. Turning to the engine, he proposes that 10 circular inches of piston area should be taken as a nominal horse-power, counting only the low-pressure pistons in compound engines, which corresponds to 14lb. effective pressure, and a piston-speed of 300ft. per minute. It will be observed that Mr. Grey proposes to reckon only the low-pressure pistons, a point on which he differs radically from the custom adopted in the North. His reasons for this we give in his own words:—"The high-pressure cylinders do not add to the power of the engine. A horse is no higher because you have used a stepping-stone to get on his back; the stone is not added to the height of the horse. So with the compound engine; the high-pressure cylinder is only a stepping-stone dividing the work to be done, but not adding to it. To include all the cylinders may or may not be a convenience in the buying and selling of engines, but in a rule for horse-power it introduces confusion, and I apprehend that, even commercially, the high-pressure cylinders have no more claim to be included than the surface condensers, or any other adjunct distinguishing a type of engine."

In order to ascertain the "nominal indicated horse-power" he proposes to add together the nominal horse-power of the boiler and that of the engine, and the formula comes out thus—

$$\text{N. I. H. P.} = \frac{D^2}{10} + 20\ F$$

where D^2 is the sum of the squares of the diameters of the cylinders, divided by 10; to the product, 20, multiplied by the width of the furnaces in feet, is to be added, and the result is said to agree very closely with the *average* indicated power, when there is surface condensation. With the jet condenser $17\frac{1}{2}$ F is to be substituted for 20 F. Mr. Grey also gives formula for ascertaining the power when the expansion and pressure form portions of the calculation.

So far as marine engines are concerned, therefore, the prospect is fairly satisfactory, for it only remains for some of the principal persons concerned to accept Mr. Grey's proposals or improve upon them to induce the Board of Trade to make regulations with which we imagine the majority of marine-engine builders would readily agree. This portion of the matter, however, is surrounded with difficulty in connection with land-engines; for though one of the Engineering Societies might be induced to publish a rule which would answer all requirements, it would not be able to enforce its observance, although, as a matter of fact, of course, obstinate makers would be in the hands of the buyers, who could refuse to purchase of those builders who declined to adopt what would doubtless become an almost universal system of rating. It may be remembered that in the article previously mentioned it was stated that the Committee of the Franklin Institute regarded their report as a preliminary one, and solicited the results of investigations from all parts of the civilised world. There is, therefore, an excellent opportunity for one of the mechanical societies of this country to join with the Franklin Institute in establishing a rule which would be recognised at least in all English-speaking countries.

As a matter of fact, whatever formula may be adopted for this purpose, it cannot be accepted as the true measure of the capability of any engine—the power actually indicated in working can alone be deemed satisfactory; nevertheless the advantages of a commercial unit of measurement are so self-evident that it is worth while inquiring whether there is not some way of stating the power developed under certain circumstances which shall be accurate for the given circumstances and be readily calculated for altered conditions. Thus, as suggested by *Engineering*, whose remarks on this subject we print on another page by way of corroboration, if an engine were rated and sold as "80 C. H. P. (60·5·400)" which would mean that it was "calculated" as capable of exerting a power of eighty horses under steam of 60lb., expanded five times, with piston speed of 400ft., a definite idea of its capability would be furnished, and the purchaser would be enabled to ascertain what its power would be under the special conditions of his own requirements. There will be little difficulty in framing simple rules by which to determine the "calculated indicated horse-power" with as near an approximation to accuracy as those of Mr. Grey given above.

The "rating" difficulty is, however, more easily solved with marine engines, for the simple reason that boilers and engines can be reckoned, as one machine, the sole duty of the former being to supply the latter; but, as a rule, boilers employed in workshops have to supply steam for other purposes than driving the engine, such as heating, washing, steaming, &c., and hence the necessity, if the rule depended partly on the size of the boiler, that the "rating" should specify the elements on which it is constructed. Some recognised unit of measurement is certainly wanted, as much for the security of the buyer as the credit of the seller.

THE SUN AND TERRESTRIAL MAGNETISM.

THE nature of terrestrial magnetism is but imperfectly understood; and the thoughts of physicists are much engaged upon it. In a recent research by Professor Osborne Reynolds, a theory is ennunciated, according to which the earth's magnetism is produced by electrical influence from the sun. His reasoning, briefly stated, is as follows:—

If an electrified body be placed near a moving conductor (such as an endless metallic band), it will induce a charge in the latter. This charge will remain opposite the electrified body, and the effect will be the same as if a current were moving in the conductor in an opposite direction to that in which the conductor moves.

Suppose, instead of an endless band, we have a steel or iron top spinning opposite the electrified body, the electricity induced on the top will have the effect of a current passing once round the top of each revolution. And this effect will be a magnetising of the top, the position of the poles depending on the direction of the top's motion, and the kind of electricity induced. The production of such a current was proved experimentally. On a glass cylinder 12in. long, and 4in. across. were fixed strips of tinfoil parallel with the axis. These strips were 6in. long and $\frac{1}{4}$in. wide, and were separated from each other by the two-hundredth of an inch, except in one part, where there was a wider interval, and the strips on each side of this were connected by a commutator with the wires of a galvanometer. The cylinder was then made to rotate rapidly before the conductor of an electrical machine. The galvanometer needle was deflected at times as much as 20°; the direction of deflection depending on the direction of motion, and the nature of the electricity induced. This, then, may be taken as proof that a magnetising current would be produced in the steel top, in the case previously supposed.

Now, the direction of the earth's magnetism has a close relation to the earth's shape. But as we know it is not in any way the cause of this shape, we may suppose that the figure of the earth, and the rotation which causes the earth to keep this figure, has something to do with the production of magnetism. There must be some influence at work, which, along with the earth's rotation, results in magnetism. What is this influence?

Many things show that the sun has some connection with magnetism. If, then, we seek this influence in the sun, we cannot suppose it to be the result of the sun's heat, or light, or attraction. But, if the sun were charged with negative electricity, it would seem (reasoning analogically from experiment) to result that the earth would become magnetic, the poles being as they are.

The only other way in which the sun could magnetise the earth would be by magnetism of its own, the sun's poles being opposite to the earth's poles. Now, this magnetism in the sun might be caused by rotation of the latter under inductive action from the earth and planets. The direction of rotation being the same, the electricities opposite the magnetism would also be of the opposite kind. Thus the sun would act by both causes. Connected with the foregoing research are some interesting observations Professor Reynolds has made on the nature of the solar corona. From photographs of the eclipse of 1871 a very clear idea is obtained of the appearance of the corona. The distinguishing features of it are chiefly these four:—

1. Its rifts and general radiating appearance.
2. The crossing and bending of rays.
3. Its self-luminosity, as spectroscopic observations have shown.
4. Its changing and flickering character.

Now Professor Reynolds was enabled to obtain a very striking imitation of this appearance by electrical action, and in the following manner:— He caused electricity to be discharged from a brass ball placed in the centre of a partially exhausted receiver, and supported by a brass rod coated with indiarubber, this rod being in connection with the machine or coil. It was negative electricity that was discharged into the globe, and it probably discharges itself on the inside of the glass, inducing a corresponding charge on the outside. Using a large coil and exhausting the receiver down to half an inch of mercury no corona was seen; the air was gradually let in and a variety of appearances followed. At first it seemed as if a mass of bright serpents were twining and untwining round the ball, then these were transformed into the branches of an oak, and then a faint corona appeared among the branches like a radiating envelope, while, as the pressure increased, the oak branches gradually faded away. The diameter of the envelope was about three or four times that of the ball, and it was strikingly similar to the solar corona in those features of the latter above referred to. It was best seen when the pressure was about 4in. In one point this corona differed from the solar corona. The shading off of the light in the latter is much more rapid than in the former; but if it were possible to make the pressure vary in the receiver this difference might be done away with.

In this way, then, according to Professor Reynolds, the theory of an electrical influence in the sun receives further confirmation.

THE WAVE-MOTION OF THE SEA.

IN estimating the motion of particles in the mass which forms a wave, there are two things, according to Captain Cialdi (in a recent work on the subject), which are not generally taken into account. One is, the motion of particles, which, being cooled at the surface through evaporation, descend, from increased specific gravity, giving place to others which are less dense. True, in the case of waves, there is a continual mixing and friction of the molecules, and the cooling is less than on a calm sea. Still, the phenomenon is not to be neglected, as the wave-surface is not always in a state of overturn, and the particle's motion in the wave is affected by this other. The second is, the extent to which the molecules are affected in a vertical direction by the action of a strong wind blowing continuously. It is known that such a wind will produce a horizontal current, varying with the depth and with the force of the wind, but it is found the wind produces an effect at depths considerably below the mass of water which is set moving horizontally. Thus it has been proved that waves break up the material at the bottom at a depth of 200 metres in the ocean, and of 80 metres in the Mediterranean.

Most of the writers who have treated of waves have taken for their example those circular waves which arise from the fall of a body into a liquid; but waves of this kind are hardly to be compared with the long parallel waves produced in the sea by wind which strikes the surface at an angle of about 18°. In the former case molecular forces and elasticity have a large influence, while the external action of wind has no place. In every case in which the wind strikes the waves, the arrest in development of the undulating mass must have important influence. The action of wind, therefore, and the reaction of the bottom of the sea, should be especially studied by those who would explain wave action satisfactorily, and the results, from experiments made on a small scale, are often falsified by what we find in the operations of Nature. In the present case, a direct study of these operations is more productive than the study of artificial phenomena.

The wave, in its normal state, may be regarded as consisting essentially of two planes equally inclined. A floating body, rising on one of these planes and descending on the other, is (by the law of gravity) retarded and accelerated in such a way that if no other force were acting, it would remain at the same point, without partaking of the wave's motion of propagation. But, practically, it is otherwise. The curved surface of a ship's hull receives a series of shocks from the rising motion of the waves, and (supposing the molecules of the wave do not rise in circles) the horizontal components of these tend to push it forward in the direction of propagation. The force resulting from these shocks is, however, far from imparting to the ship the speed with which the waves move. For waves to attain a great height or velocity, there must be a considerable extent of surface and depth of water. It is on this account that the waves of the Mediterranean are less high, voluminous, and rapid, than those of the ocean. In the open and deep sea, the dimensions and motion of the waves are generally in proportion to the velocity, inclination, and extent of action of the wind, and follow its direction; but when it becomes very furious, the height and volume of the waves diminishes sensibly. When, however, the wind is of long duration, of force not excessive, and acts on a large extent of surface, the size and speed of the waves continue increasing.

Near the coast, the progress of the waves is very much retarded and altered by the obstacle which the bottom presents, and also by the materials with which they become more and more charged as they near the shore.

We may further notice that the undulation caused by tempest in a given place is not the effect of the immediate action of the wind in that place, but arises from rupture of the equilibrium in circumjacent columns of water, and the transmission of shocks from these. For this reason, sailors are often able to know of a storm in the neighbourhood some days before it comes, and so prepare for it. In the same way the continuance of waves after the wind has fallen arises from the fact that the wind has not yet ceased to trouble the sea at a distance. As a force loses its intensity in course of transmission, the horizontal propagation of sea waves diminishes in proportion to distance from the origin, so that the sea may be calm near at hand, while large waves agitate it a considerable distance off. The height of a wave should be measured, from the bottom of the hollow, not from the ordinary surface. The distance from summit to summit is the wave length.

Wilkes, in 1839, made a careful measurement of waves on one occasion when the sea appeared regular and the waves of a great height. This was his method:—The schooner *Seagull* was sailing in the wake of the brig *Porpoise*, and distant from her by about two waves. Their relative positions did not seem to vary, and they were sailing eight knots an hour. Casting the log from the *Porpoise*, Wilkes observed that the clip, when on the top of the nearest wave, was 380ft. distant, or one-sixteenth of a mile, and the *Seagull* on the top of the next wave, twice as far, or one-eighth of a mile. The time taken by a wave to come from the *Seagull* to the *Porpoise* was, on an average, thirteen seconds. This gives 26½ miles per hour for their apparent progressive motion. For observing the height, Wilkes chose a moment when the *Seagull* was in a hollow, and the two crests were in a horizontal line with his eye, this line cutting the *Seagull's* mast at a certain height. His observation gave 32ft. as the wave height. Various observations have been made of wave height. The captain and officers of the *Inconstant* on one occasion saw waves that, as they showed, must have been more than 23·46m. (77ft.), and waves have been known to reach the top of Eddystone Lighthouse 32·48m. (about 106ft.). In estimating the motion of waves, it is to be remembered that the atmosphere exercises the pressure of an elastic force of about 2,000lb. on each foot of the wave surface, and this must be added to the weight of water forming the wave. From a series of experiments made by Mr. Walker, at Plymouth, the following inferences are made:—1. The speed of waves is retarded in proportion as the water becomes shallow, and depth facilitates wave action. 2. The speed of waves does not depend on their height. 3. The experiments made on a large scale seemed to confirm the result obtained by Mr. Scott Russell in another way—viz., that when the depth of the water becomes equal to the height of the wave, the latter breaks and becomes a wave of translation.

Among the waves observed were some moving 46ft. per second; these were wide apart and of short height. Their destructive effect on masonry was, nevertheless, very great, while certain other waves, which were higher and in closer succession, and moved 41·8ft per second, were much less destructive. The effect being as the square of the velocity, we may calculate what should be the height of waves which, moving at the rate of 41·8ft. per second, would have an equal effect with waves 27ft. in height, and moving 46ft. per second (27ft. having been the height of those observed to move 41·8ft. per second). Thus $41{\cdot}8^2 \times 27 = 46^2 \times x$, whence $x = 22$.

The height of waves in the Mediterranean has been estimated by W. Smith as in general from 4·27m. to 5·49m. (14ft. to 18ft.).

SECONDARY BATTERIES.

IF the mode of production of voltaic electricity has of late engaged much attention, the means of accumulating and transforming such electricity are not of less interest; just as, in mechanics, the question of accumulating and transforming motive force gives abundant material for inventive skill.

M. Planté has studied the subject for many years, and after careful researches on the polarisation of metals, he has constructed his secondary battery (recently described in *Les Mondes*), the results obtained from which are truly surprising.

It is well known how the Leyden jar discharges, in one strong spark, the sum of electricity it received from the electric machine. M. Planté connects a somewhat analogous apparatus with the voltaic pile. Two plates of lead (20in. long by 8in. wide), are rolled up in spiral, being separated from each other by a few strips of indiarubber. This spiral is placed in a jar containing acidulated water, and having a guttapercha cover, on which are fitted binding screws connected with the plates. Twenty such elements are placed in two rows of ten each, and charged from the primary battery, which consists of two Bunsen couples. By means of a commutator of peculiar construction, these secondary elements may be connected either for quantity or for intensity. When the elements are joined in series, an electromotive force equal to thirty Bunsens is obtained, giving a current by means of which platinum wire may be fused.

In the secondary couples, the chemical action generating the current is the reaction of hydrogen on peroxide of lead, the current from the primary pile having caused decomposition of the water, oxidising one of the plates and developing hydrogen on the other.

By the above arrangement, the quantity of electric work from the direct action of the primary pile is transformed by condensation. The case is somewhat similar to that of a hydraulic press or crane. In a pile driver, *e.g.*, a heavy body raised by degrees to a great height, by a series of successive efforts, is then left to itself, and gives back at once the greater part of the work thus expended on it. So, when, after charging, the secondary circuit is closed, the sum of the accumulated chemical actions caused by the primary current is given out in the form of a very intense current of short duration. The effect, when the couples are joined for quantity, corresponds to the fall of a very heavy mass raised a small height; when joined for intensity, to the fall of small mass raised to a great height. It is not difficult to see how these secondary piles may become of important use.

PRESERVING WOOD.

THE following are the conclusions arrived at by Herman Haupt, C.E., after an elaborate investigation as to the best means of preserving wood from decay, which we extract from *Van Nostrand's Magazine*:—

1. That so long as the cells of wood are occupied by air and moisture, no preservative solutions can be introduced, and the expulsion of air and water must be the first step in any effective process for preserving timber from decay.

2. That water can be expelled by a long-continued application of heat, but air only by expansion in a vacuum, and the combination of heat and vacuum will secure the most rapid expansion both of water and air.

3. The preservative fluid must be introduced while the cells are empty, consequently the process must be carried on in vacuo.

4. That no pressure, however great, applied externally to the surface of timber, can force any fluid into the interior so long as air or water is contained in the cells. When air alone is present there may be penetration to a limited extent, superficially, but water is practically incompressible. If, however, the pressure is applied at one end only of a log, as in the Boucherie process, a fluid may be forced through and exude from the other end.

An apparatus to fulfil the conditions which, from the preceding discussion, appear to be essential to success, must be founded on a process similar to distillation in vacuo. It must consist of at least two vessels—one a receiver corresponding to a retort, in which the material can be placed and subjected to the action of heat; the other a condenser, in which all escaping vapours can be condensed and the vacuum maintained during the process in both vessels.

The condenser may be of much smaller capacity than the receiver; they should communicate by pipes furnished with stopcocks, and both be supplied with thermometers, vacuum gauges, and pumps.

As an illustration, suppose wood is to be impregnated with dead oil or any other fluid. The receiver must be filled with the wood to be operated on, the door closed air-tight, and the air expelled from both the receiver and condenser.

The expulsion of the air may be effected in various ways.

1. Steam may be admitted at one end to drive out the air at the other end; the subsequent condensation of the steam should leave a vacuum, but, in the experiments of the writer, this plan has been only partially successful.

2. The air may be exhausted by an air-pump, but a perfect vacuum cannot in this way be secured.

3. The vessels may be filled with water and the water removed by a pump below the level of the bottom into which the water flows. This should remove all the air excepting that which escapes from the cells.

4. As the atmosphere supports a column of water 33ft. high, pipes may lead to a tank at a level about 40ft. lower, where the location is favourable, and thus by filling the vessels with water and opening cocks to allow the water to flow by gravity into the tank, a very perfect vacuum could be produced. This arrangement would be particularly favourable for maintaining a vacuum in the condenser; a pipe in the condenser could throw jets of water in spray from numerous fine perforations, and the water would consequently flow into the tank 40ft. lower, maintaining a constant vacuum without the aid of pumps. This object can be accomplished in almost any locality by placing the condenser at the top of a building or on trestle work.

Assuming that a vacuum has been created and provision made for maintaining it during the whole process, the next step will consist in the application of heat, which may be done most conveniently by steam-pipes introduced in the receiver. The length of time during which the timber must be subjected to the baking process will depend upon the dimensions of the logs, and can only be determined by experiment.

It is obvious, however, that the circumstances are favourable to the most rapid evaporation possible; the temperature can be regulated at pleasure, and the removal of pressure by vacuum will give a very low boiling point. As the vapours pass over they will be immediately condensed.

Should the vacuum become vitiated by the escape of air from the cells, it may be improved by the use of an air-pump. The condition of the vacuum will be indicated by the gauges.

When sufficient time has been allowed for the wood to dry thoroughly, cocks must be opened connecting the bottom of the receiver with a tank of dead oil, at a lower level. As a vacuum exists in the receiver, the atmospheric pressure will force up the oil and the timber will be immersed in the fluid. When the immersion has continued a sufficient length of time, which also must be determined by careful experiment, cocks may be opened at the top of the receiver to admit air. The oil not absorbed will immediately flow back to the tank from which it was taken, the air pressing upon the exterior of the cells, which are partially filled with oil while a vacuum exists in the interior, will force the oil before it, and thus coat in its progress the interior of the cells. It is probable that in this way a sufficient amount of dead oil may be introduced into the cells to prevent fermentation and decomposition, while still far below the point of saturation, and the process may prove rapid and economical.

Instead of admitting air in the manner proposed to expel the oil from the receiver, it is possible that better results may be obtained by allowing the oil to remain until it becomes heated by the steam coils, and the vapour collecting at the top expels the oil and penetrates the pores.

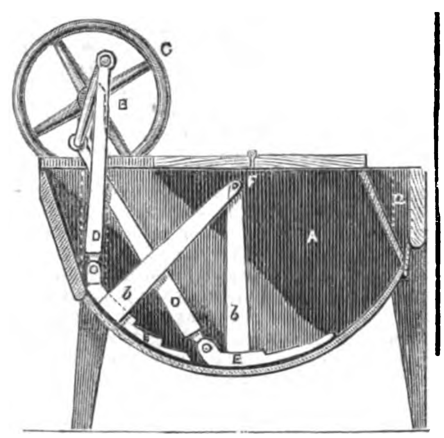
Too much oil might be introduced by this mode of treatment, and it is probable that the introduction of air, followed, perhaps, by a second bath of oil to close the cells superficially and exclude moisture, would give the best results. All these and other questions that may arise can be promptly settled by experiment, and in no other way.

This process of drying in vacuo would be well adapted to the rapid desiccation of fruits, vegetables, fish, meats, &c., with a view to preservation. The writer does not claim that he has solved the important problem of preserving timber from decay. Before he could satisfy himself or others, a series of continued experiments with suitable apparatus would be required; but it will not be considered egotistical to assume that, in several months of experiment, something has been learned. He is satisfied, at least, that none of the ordinary processes will preserve wood economically, and there is, in his opinion, no surer avenue to success in any investigation than the study of failures and their cause. He has witnessed too many failures to be sure of anything until it has been proven, but believes that in the processes indicated there are strong reasons to expect success.

A NEW WASHING MACHINE.

An improved washing machine has been patented by Mr. Key, of Union City, Indiana, of which the figure and description will be found sufficiently explanatory.

The general contour of the tub, A, is indicated in the cut, the bottom being of inverted arched form, and made of zinc or other suitable material. The ends of the tube are straight, and at one is a partition shutting off a small space, *a*, to permit the facile attachment of a wringer when desired. The legs at one end of the tub extend above the top thereof, and have bearings in their upper extremities for a double-cranked shaft, B, carrying a balance-wheel, G, itself furnished with a crank-pin or wrist, whereby the working parts of the apparatus are actuated. Each of the cranks



on the shaft, B, actuates one of the rubbers, E, through the agency of a connecting-rod, D. The rubbers are each made wide enough to extend nearly one-half the width of the bottom of the tub, and are formed with longitudinal slits, and are notched or shouldered on their upper surfaces as clearly indicated in the engraving. They have rigidly attached to them the arms, *b*, pivoted, at F, to a cross-shaft in such manner that the rubbers, when in motion, swing in a path corresponding to the curvature of the bottom of the tub. It will be seen that the rotation of the crank-shaft, B, gives a vibratory movement, alternately in opposite directions, to the rubbers, E. This works the cloths or fabrics to be cleaned repeatedly over and over, alternately expelling the water from them and allowing them to again absorb it, thereby securing the removal of the dirt.

THE STAR DEPTHS.

Mr. Richard A. Proctor, Honorary Secretary of the Royal Astronomical Society, gave his fourth lecture on this subject at the Royal Institution last Saturday afternoon at 3 o'clock. After giving a sketch of the history of the discovery of nebulæ, he discussed the researches of Sir W. Herschel into the great cluster in Perseus. He showed that Herschel's belief, that in examining this cluster with higher and higher telescopic powers he was passing farther and farther into the profundities of space, could not be correct. (He mentioned incidentally that Herschel was in his 79th year when he adopted the plan of estimating stellar profundities by the telescopic powers necessary to effect "revolution.") If Herschel was right then his observations indicated that the remotest parts of the cluster were nearly 30 times as far away as the nearest (Herschel's own numbers are as 344 to 12); but in that case the true shape of the cluster is that of a long cone (a figure compared by the lecturer to the pointer he made use of), whose axis is directed exactly towards the solar system. This is utterly incredible on *à priori* considerations; but, moreover, a star-group of so remarkable a shape would have no dynamical stability. Mr. Proctor said that he considered it as absolutely demonstrated that this wonderful double cluster is, in fact, "what it looks like," that is, a double system in which stars of a great many orders of magnitude are included. He added that he believed that as Herschel gave up in 1802 (notwithstanding the text-books) the principle of star-gauging which he had adopted in 1785, so he would have given up the principle he adopted in 1817, had he lived to apply to his observations the test of careful analysis. But he was already exceedingly old, and it was well known that for several years before his death he was incapable of prolonged or profound study. The lecturer passed then in review the various orders of nebulæ, quoting a singularly apt passage from Tennyson (in the first edition of the "Palace of Art"), where the poet laureate speaks of

> Regions of lucid matter taking forms—
> Brushes of fire, hazy gleams,
> Clusters and beds of worlds, and beelike swarms
> Of suns, and starry streams.

He discussed the laws according to which the nebulæ are spread over the heavens, showing that these laws suffice to demonstrate that the nebulæ belong to the stellar spaces. Passing thence to the gaseous regions surveyed by the Herschels, he propounded the unlooked-for theory that the more widely ranging regions of nebulous light could be better recognised by the unaided eye than with the most powerful telescope, and described the method by which he was about to test this opinion. He described the observations by which Dr. Huggins had shown many of the nebulæ to be gaseous. Passing thence to the consideration of the Magellanic clouds, and of the various orders of nebulæ seen within these objects, the lecturer pointed out that the evidence adduced by Sir John Herschel sufficed to demonstrate that these nebulæ at least were far within the limits of the sidereal system, being included in the same space with stars of the ninth and tenth order of magnitude. The lecture closed with remarks on the variability of certain nebulæ.

Upwards of thirty photographic illuminations were exhibited by means of the electric lamp. The lecturer promised to exhibit among the illustrations next week a chart showing all the stars visible to the naked eye *over the whole heavens*, properly distributed throughout as respects richness. In this, the closing lecture of the series, he will also present a synoptic view of all the theories of the stellar universe hitherto propounded, including the theory to which he has been led by his own researches.

RECURRENT VISION.

Professor Young has adopted this name for the following optical phenomenon:—

In the course of some experiments with a new double-plate Holtz machine, belonging to the college, I have come upon a very curious phenomenon, which I do not remember ever to have seen noticed. The machine gives easily intense Leyden jar sparks, from 7in. to 9in. in length, and of most dazzling brilliance. When, in a darkened room, the eye is screened from the direct light of the spark, the illumination produced is sufficient to render everything in the apartment perfectly visible; and what is remarkable, every conspicuous object is seen twice at least, with an interval of a trifle less than one quarter of a second—the first time vividly, the second time faintly; often it is seen a third, and sometimes, but only with great difficulty, even a fourth time. The appearance is precisely as if the object had been suddenly illuminated by a light at first bright, but rapidly fading to extinction, and as if, while the illumination lasted, the observer were winking as fast as possible.

I see it best by setting up, in front of the machine at a distance of 8ft. or 10ft., a white screen having upon it a black cross, with arms about 3ft. long and 1ft. wide, made of strips of cambric. That the phenomenon is really subjective, and not due to a succession of sparks, is easily shown by swinging the screen from side to side. The black cross, at all the periods of visibility, occupies the same place, and is apparently stationary. The same is true of a stroboscopic disc in rapid revolution; it is seen several times by each spark, but each time in the same position. There is no apparent multiplication of a moving object of any sort.

The interval between the successive instants of visibility was measured roughly as follows:—A tuning fork, making 92¼ vibrations per second, was adjusted so as to record its motion upon the smoked surface of a revolving cylinder, and an electro-magnet was so arranged as to record any motion of its armature upon the trace of the fork; a key connected with this magnet was in the hands of the observer. An assistant turned the machine slowly, so as to produce a spark once in two or three seconds, while the observer manipulated the key.

In my own case, the mean of a dozen experiments gave 0·22" as the interval between the first and second seeing of the cross upon the screen, separates results varying from 0·17" to 0·39". Another observer found 0·24" as the result of a similar series.

Whatever the true explanation may turn out to be, the phenomenon at least suggests the idea of a reflection of the nervous impulse at the nerve extremities, as if the intense impression upon the retina, after being the first time propagated to the brain, was there reflected, returned to the retina, and from the retina, travelling again to the brain, renewed the sensation. I have ventured to call the phenomenon "recurrent vision."

PHOTOGRAPHY FOR THE UNINITIATED.*

(Continued from p. 91.)

HAVING led you through the various steps required in the production of the negative, we have at last reached that portion of our operations known as printing—silver printing. The negative, as you know, is the reverse of the object in nature from which you made it; in other words, white is black, and black is white; this fact following in greater or lesser degree throughout the shadows and feebly lighted portions of the view made. Just in the proportion in which you have secured this fine grading from absolutely clear glass in deep shadows to absolute opacity in positive high lights, and have secured the intermediate grades of opacity, is your negative a good one. From a good negative a good print can easily be made by following any of the formulæ suggested by the many writers who practise our art; but from a bad negative no yet discovered formula will make you a good print. You might as well attempt to build a chimney 100ft. high upon a poor foundation, and have it stand plumb, as to make a good print from a negative deficient in good qualities; both are bad from a bad foundation. I shall not, in this part of the process of picture-making, offer to you any new formulæ, but, as in those given you for negative work, simply call to your notice to formulæ which, by practice, I know to be good.

Albumen Paper.

Of this there are very many brands; all are at times faulty, all are liable to vary. Whether such is due to the paper alone, to the albumen and salting used in same, or to the conditions of atmosphere under which it is albumenised, or to its subsequent place of storage, or more or less to all, are questions not now important to consider. In purchasing, always require the paper to present, upon holding between you and the light, an even body, free from wave lines of uneven albumen; also, an evenness of gloss when viewed across the surface; also, a freedom from spots, small and black, in the body of the paper.

By reference to p. 561, Vol. XIII., you will find that I named one 8 by 10 deep glass dish for silvering paper. To suit this dish you will have to cut your albumen paper 8 by 10, which will give you two prints. To cut paper handily, I advise you to have a board made 2ft. square, upon which to lay the whole sheet, albumen side up; upon it lay a pattern 8 by 10 of cardboard, and around it pass a sharp knife. If you lay half a dozen sheets upon a board, one upon the other, and then turn the face of the upper one down, you can cut with great rapidity, and avoid touching the albumen face with the fingers, a point always well to guard against.

Silvering Solution.

For this I will give you several formulæ:—

No. 1.—Water, 20 fluid ounces; silver, 800 grains; nitrate ammonia, 40 grains; alcohol, 1¼ fluid ounces.

No. 2.—Water, 32 fluid ounces; silver, 1,125 grains; muriatic acid, 40 drops.

Shake this well, and finally render it slightly alkaline with liquor ammonia. After using three or four times, add a few drops of acid, and neutralise with ammonia.

No. 3.—Water, 19 fluid ounces; silver, 4 ounces; liq. ammon. conc., 12 drops.

This will render the solution of silver cloudy, with a heavy brown precipitate, which allow to settle, and from off which decant the clear solution, to which add—Alum, 10 grains; after shaking well, add—Water, 29 fluid ounces.

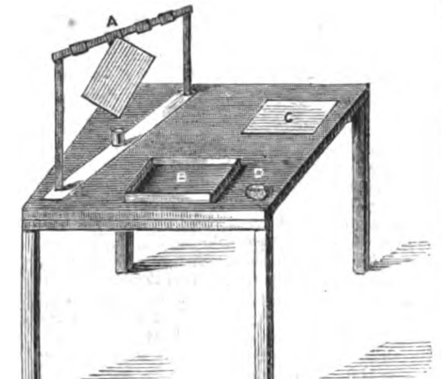
Either of these formulæ work well. The first (No. 1) I have used for years; it is simple and effective. The second (No. 2) is known as Hugh O'Neil's: it works to a charm. The third (No. 3) is Anthony's alum bath, and is better than either 1 or 2, in that it preserves the paper after silvering, and is in other respects equal to any bath within my knowledge. Neither of these baths will materially discolour with papers generally in use; the little they do can be easily removed by placing them in the sunlight for a few hours, and filtering.

In making up your silver solution, first determine how much you require by measuring the capacity of your dish when filled one inch deep. Always filter the bath before using, and have at least half an inch of solution in the dish. Some paper discolours the bath badly. Such I should not bother with; there is plenty which does not.

Silvering.

Pour carefully into a dish the silver solution, avoiding air-bubbles; draw down the buff shades of your room, or light the gas, as bests suits you. This work may be done in a moderately lighted room, for the paper is not sensitive to such light while wet. At your left hand arrange a wooden rod, forty-two inches long and three-quarters of an inch square, upon which, nine inches apart, glue pieces of cork half an inch thick and square. Support this wooden rod sixteen inches above the table, so that under each freshly-silvered piece of paper you can place a small glass to catch the drops of silver. Immediately before you is the glass dish with the silver solution. At the right of it is placed the paper you have cut, also a pin-cushion well supplied with good quality of medium pins, the kind that do not double and bend when stuck into anything harder than butter in hot weather.

This sketch will serve to explain the arrangement of your table when silvering paper. A the frame, with corks glued on the wooden rod 9in. apart, upon which I have placed one piece of paper; under it a



glass to catch the drops of silver. B is a glass dish. C is paper cut and ready for silvering. D is a pin-cushion. Now let me try to explain just how to silver a piece of paper. First, I will sketch a sheet of paper as it lays before us face down, and mark it with letters in each corner. Bend up a small corner at D at right angles to face, so as to better take hold of it in removing it from the silver, and so that this little corner may be kept dry, through which to stick the pin. Now take hold of paper with left hand at corner A, and with right hand at corner D; keep left very low and right very high as you place it on the silver, so that the bend in paper may be as close to corner A as possible; let this rounding or bent part first touch the solution; keep the finger holding the paper at A as near the solution as you can without touching, and hold well over to left side of dish, lowering slowly and steadily the right hand; thus the contact of the paper will be diagonally across the sheet, and will expell to right side of dish all bubbles that may incline to form. Bubbles, if formed at all, will most likely be at first point of contact close to A. Carefully lift at A with a small glass rod, and remove any that may appear, lifting the paper half its length from this end for examination, and immediately do the same at D end.

After the paper has lain for from one to one and one-half minute, lift it at corner D by the bent-up portion with left hand, stick through it a pin, and raise slowly and steadily from the solution to wooden rod, where you will fasten it upon the first cork, albumen side out. After all four corks are filled, proceed to remove paper from cork one to dark room for drying.

You will observe that the paper as pinned to the cork has curled or twisted; corner B and C have turned inward. On the lower corner, which is A, soak off with a piece of blotting-paper any drops which may be clinging thereto, and stick on a small piece of same paper to absorb any more that may pass down while drying. Next remove the pin from corner D, and put it into corner B; carry it into the dark-room and hang it up to dry. The object in removing the pin is to stop the curling in the same direction as it started. After the paper has nearly dried, the pin should be removed from A and placed in C. This will prevent twisting to a great extent. After your paper has become bone-dry, which, if the day is good, will be within an hour, you will require to treat it to a dose of ammonia before printing. This operation I will leave until my next.

* From the *Photographic News*.

AERONAUTICS.

THE result of the experiments with the apparatus for obtaining the data of the fundamental principles of aëronautics which we alluded to as in course of construction in our article on this subject on p. 373 of Vol. XIII., were reported at the recent meeting of the Aëronautical Society. The experiments were carried out at Messrs. Penn's Engineering Works by the Experimental Committee appointed by the Council of the Aëronautical Society of Great Britain to determine the relation between the velocity of the atmosphere and its pressure upon plane surfaces of varying dimensions and degrees of inclination. The instrument and experiments were made by Mr. Wenham and Mr. Browning. Mr. Wenham, in the absence of the latter, explained the nature of the instrument used. The experiments were considered to establish a law that the lifting force of inclined planes, carried horizontally through air, was increased in the direct ratio that the sine bears to the length of the plane, or the height of the incline to the base. Thus, if, instead of stating the angles in degrees, they said "one in ten," or "one in three or four," as the case might be, this would at once express the proportion in which the lifting force exceeded the resistance. The average of all the results was very near to this, making a little allowance for the surface friction of the plane through the air. At 45° the two forces were equal; above that, the proportions were in inverse ratio, as the lifting force was less than the direct. It had been stated that the resistance of wedges or cones through the air was diminished directly in the ratio that the height or diameter of the base bore to the length of the cone. The experiments did not confirm this, but showed the resistance to be less in proportion as the angle became more acute. The Chairman, Mr. Brook, and a few others made some remarks, and a vote of thanks was given to the Messrs. Penn for the assistance they had rendered in making the experiments. Mr. Head read a paper "On Flight," the object of which was to show that it was possible for man to fly through the air if a proper machine were made for that purpose. Mr. Head seems to have come to this conclusion from observations on the flight of birds.

THE WORTHLESSNESS OF BEEF-TEA.

THE experiments of Gustav Bunge lead him to conclude that the common opinion, that beef-tea and extract of meat are as valuable articles of diet as tea, coffee, or alcohol, is totally unfounded; that the refreshment they give is only due to their warmth and pleasant taste; and that their chief value is that they enable a person to take with appetite a larger amount of dry or tasteless food than he could otherwise do. The statements of Liebig, that the addition of some meat-extract to vegetable food increases its nutritive value, and that the extractive matters of meat, and especially creatine and creatinine, are the materials for muscular work, have been disproved by Voit and Meissner; and the idea that beef-tea and meat-extract were beneficial on account of the salts they contain is an unlikely one, as these salts are already present in excess in ordinary food. It has been said, however, that they did good by acting as stimulants, like coffee, tea, and alcohol; and this seemed to be confirmed by the experiments of Kemmerich. He found that small doses of meat-extract quickened the pulse, but large ones produced paralysis of the heart and death. This action on the circulation he attributed to the potash-salts contained in the extract, as the ash alone produced the same effects as the quantity of extract from which it had been got. As Traube, Gultman, and Podkopaew, found that potash-salts slackened the pulse but never quickened it, and as Kemmerich's experiments on man gave an indefinite result, and the only animals he used were rabbits, Bunge investigated anew, in Professor Schmiedeberg's laboratory, the action of meat-extract and of potash-salts on man, dogs, cats, and rabbits. On taking himself, or introducing into the stomach of a dog, a quantity of meat-extract mixed with flour, and containing 5 or 6 grains of potash-salts—a quantity sufficient to kill two rabbits—he found that no effect whatever was produced on the pulse or temperature. Large doses of meat-extract first quickened the pulse and then paralysed the heart. The quickening does not seem to be due to the potash-salts, but to their i troduction and to the distension of the stomach; for the author found that muzzling the animal, introducing a tube into the œsophagus, and distending the stomach with water, all quickened the pulse. When a solution of salt or sugar was used instead of water, the quickening lasted longer, because the fluid was more slowly absorbed and the distension less quickly removed. Extract of meat, deprived of five-sixths of its potash-salts by means of tartaric acid, caused death—not like the potash-salts by paralysing the heart, but probably by desiccating the tissues. Sodium-phosphate has a similar action. This is diminished by injecting water subcutaneously after the sodium-phosphate has been introduced into the stomach.

Potash-salts injected subcutaneously into rabbits quicken the pulse by causing pain, but they do not alter either the number or force of the heart-beats in dogs or cats, either when given subcutaneously, by the mouth, or by injection into the blood, except when given in fatal doses, and then they lessen them both in number and force. They have little action on the temperature or on the blood-pressure.

The poisonous action of potash-salts has been much exaggerated. When injected almost directly into the heart through the jugular, a very small dose will cause death by cardiac paralysis; but very large doses are required when administered subcutaneously or by the mouth. Bunge reckons the amount of potash-salts taken daily in potatoes by many Irish labourers at 100 grains. It is probably impossible to produce cardiac paralysis in man by potash-salts introduced into the stomach, as the large quantity necessary would be ejected by vomiting.—*British Medical Journal.*

THE PROGRESS OF GEOLOGY.—COAL-MEASURES AND COAL-SUPPLY.*

(Concluded from p. 168.)

It has been urged as a fatal objection to the discovery of coal in the south-east of England, that the coal-measures become unproductive and thin out under the Chalk, as they range from Valenciennes towards Calais, and, therefore, that the coal-trough or basin ends there. It is perfectly true that the coal-measures do thin out between Bethune and Calais, but not in the sense of their dying out owing to their deposition near the edge of a basin. In that case, each seam, each stratum, would gradually become thinner and disappear; but such is not the fact. None of the beds of the Belgian coal-field are thick. The average does not exceed 2½ft. At Valenciennes it is the same; whereas M. Burat states the mean thickness of the beds actually increases westward of Bethune to more than 2½ft. With respect also to the extreme end of this basin, the lower beds there brought up correspond with the bottom beds of the Hainault basin, where the lower 650ft. consist of unproductive measures. The thinning-out is, in fact, due to denudation, just as the Bristol coal-field thins out at Cromhall to resume in the Forest of Dean, or the coal-field of Liége thins out at Nameche to resume at Namur in the great field of Charleroi and Mons.

The deterioration of the coal in the small coal-field of Hardinghen, near Boulogne, has also been adduced against the occurrence of workable coal in south-eastern England, but Mr. Godwin-Austen has shown that this Hardinghen coal-field is one of those small local developments of coal-bearing strata intercalated in the Mountain Limestone, and is of older date than the great Belgian coal-field. It has, therefore, no bearing on this part of the question.

Another objection to which much weight has been attached is that the coal-field of Bath and Bristol forms an independent basin, cut off both on the east and on the west by ridges of Millstone Grit and Mountain Limestone, so that there is an end of the eastern extension of the coal-measures. This is quite correct as far as regards the western edge, and is probably the case on the eastern, although as the edge of the basin is there covered by Secondary rocks, some uncertainty still exists about the disposition of the Palæozoic rocks under them. Admitting, however, the basin to be complete and isolated, that is no proof that the older Palæozoic rocks prevail exclusively to the east; for the coal-measures of the Somerset basin maintain their full development to the edge of the basin, and are there cut off by denudation, and are not brought to an end by thinning out. They form really part of a more extended mass, of which we have there one fragment; while on the west another portion exists in the Welsh basin, and another in the newly discovered small basin of the Severn valley.

This last basin is entirely covered by the New Red Sandstone; and as the Welsh basin is bounded on the east and the Bristol basin on the west by Mountain Limestone, the same argument as the one above might have been used to show the impossibility of coal occurring in this intermediate area.

But the fact is, it is the very nature of this great line of disturbance to have minor rolls and flexures of the strata at, or nearly at, right angles to it, and so causing breaks in the coal-trough, which would otherwise flank it without interruption; thus the Aix-la-Chapelle coal-field is separated by older rocks from that of Liége, which is again separated by a ridge of Mountain Limestone from that of Hainaut. So in the case of south-western England, we have the several basins of South Wales, Severn Valley, and Bristol, separated by tracts of Mountain Limestone and Old Red Sandstone, the extremes of the intervening belts of older rocks being two miles at Nameche and eighteen miles in Wales. These barriers are clearly only local, and the division of the coal-measures into separate basins appears to be their ordinary condition along this great line of disturbance. The length of the two known portions of the axis included between Pembrokeshire and Frome, and between Calais and Westphalia, is 472 miles, and in this distance we find eight separate and distinct coal-fields. The combined length of these eight coal-fields is about 350 miles, leaving about 122 miles occupied by intervening tracts of older rocks; so that nearly three-quarters of the whole length is occupied by coal-strata. I consider that a structure which is constant (so far as the axis of disturbance can be traced above ground) is, in all probability, continued under ground in connection with the range of the same line of disturbance; and I see no reason why the coal-strata should not occupy as great a proportionate length and breadth in the under-ground and unknown as in the above-ground and explored area.

With respect to the possibility of denudation having removed the intervening coal-measures, enormous as the extent of denudation must have been previous to the deposition of the Permian strata, we cannot admit its exceptional action in this case. Denudation has removed from the crest of the Mendips a mass of strata possibly equal to two miles or more in height, and from that of the Ardennes as much as three or four miles, and it has also worn extensive channels between many of our coal-fields, so that the power of such an agent cannot be denied. But it is a power of planing down exposed surfaces rather than of excavating very deep troughs. Notwithstanding its immense planing-down action on the Mendips and Ardennes, deep troughs of coal-measures are left flanking their northern slopes.

We have alluded before to the great length and narrow width of the Belgian coal-fields. That of Liége is forty-five miles long, with a mean width of less than four miles, whilst that of Hainaut and Valenciennes is 119 miles long, with a width scarcely greater. The presence of lower Carboniferous rocks under Harwich, and the wider range north and south of the Bristol coal-field, renders it possible that the trough in the intermediate area may have a greater expansion than in Belgium; but we have nothing else to guide us, unless it be that the lateral pressure in the intermediate ground was probably less than in the Ardennes and the Mendips, where it has exercised its maximum elevatory force. In that case the coal-trough in this intermediate area would be less compressed and more expanded; so we might consequently here look to find larger coal-basins than either those of Somerset or Liége. The position of these basins I am disposed to place farther north than Mr. Godwin-Austen, and should therefore look for them not in the valley of the Thames, or on the line of the North Downs, but under South Essex, Middlesex or Hertfordshire, Oxfordshire, and North Wiltshire.

The strata on the south side of the Liége coal-field rise abruptly against highly inclined and faulted Devonian rocks, and on the north side they rise at a less angle beneath Cretaceous or Tertiary strata. In the Hainaut coal-field the overlying strata have a greater extension. Under these strata the coal-measures are succeeded by the Mountain Limestone, and then by Devonian or Silurian strata; but with one or two limited exceptions their outcrop is hidden by the newer strata which stretch uninterruptedly northward over the rest of Belgium. The Palæozoic strata have, however, been met with near Brussels, under Tertiary strata, at a depth of about 600ft. and at Ostend at a depth of 985ft. of which 682 consisted of Lower Tertiary strata, 210ft. of Chalk, and 93 of coloured marls. It appears, therefore, not improbable, that the Tertiary and Cretaceous strata of all Belgium may repose directly on a floor of Palæozoic rocks; and as there is reason to suppose that all these rocks have a strike parallel with that of the Ardennes, folds in the strata may bring in some under-ground coal-basin or basins in parallel lines to the north, in the same way that small troughs of coal-measures are brought in again in the Ardennes to the south of the great coal-trough.

We may, I think, look for a prolongation of this old Palæozoic surface of highly inclined, contorted, and faulted rocks at no very great depth under the same Wealden, Chalk, and Tertiary area of the south of England. For, although the old Palæozoic surface descends rapidly from about 300ft. above the sea-level in the Boulonnais to 1,030ft. below it at Calais, it rises at Ostend 47 higher than at Calais, and crossing the Channel, it is found at Harwich within a few feet of the same depth as at Calais, from which it is eighty miles distant in a northerly direction. Passing westward from Calais, we find the Palæozoic rocks under London (105 miles distant) 102ft. higher than under Calais, and 106ft. higher than at Harwich. Allowing for irregularities of the old surface as evinced by the well at Crossness, near Plumstead, which was still in the Gault at a depth of 944ft. or some 14ft. below the level of the Palæozoic rocks at Kentish Town, we may still consider that in the area between these three points, and possibly throughout the south-east of England, the Palæozoic rocks will probably be found not to be more than from 1,000 to 1,200ft. beneath the sea-level.

Projecting the line another 100 miles westward, we reach the neighbourhood of Bath and Frome, where the coal-measures are, as before mentioned, lost at a depth of about 450ft., beneath Liassic and Jurassic strata. In the intermediate area between that place and London no trial-pits and no wells have been carried to a depth of anything like 1,000ft. beneath the sea-level. The deepest well with which I am acquainted is one near Chobham, in Surrey, through Tertiary strata and Chalk to a depth of about 800ft. or of 550ft. beneath the sea-level.

There are, however, in all this area certain indications of the proximity of old land and of pre-Cretaceous denudation, in the presence of quartz and Lydian pebble-stones, accompanied by secondary rock fossils in the Lower Greensands of Surrey, and in the like old rock pebbles, with the addition of slate pebbles, in that formation in North Wiltshire; while the banks of shingle, Bryozoa, and sponges of the same age at Farringdon, point to still and sheltered waters, probably of no great depth, and to adjacent dry land. Again, on the north of London, we have in the Lower Greensand of Buckinghamshire and Bedfordshire shingle beds consisting almost entirely of fossils derived from Jurassic strata, with a remarkable collection of larger quartz, quartzite, and other rock-pebbles, derived probably from the old Palæozoic axis.

On the south also of the great Mendip and Ardennes axis coal-strata may possibly be found just as they are found on both sides of the Pennine chain; for in either case the measures are cut off and broken through by these chains of hills. In South Wales certain folds of the older strata seem to render it probable that the coal-measures may pass under the Bristol Channel, forming a trough which prolonged eastward would pass along the south side of the Mendips. Trials in the latter area, have, however, shown that the New Red Sandstone, Lias, and Oolitic series attain an infinitely greater thickness than on the north flank of that range, so that it is not likely that the coal-measures would lie at a less depth than from 1,500 to 2,000ft.

In this country the newer strata, overlying the Palæozoic rocks on our presumed anticlinal line, have been sunk through, without result, in the lowest beds of the Wealden at Hastings to a depth of 486ft.; in the upper beds at Earlswood, near Reigate, to a depth of about 900ft.; and, on the presumed synclinal line of Carboniferous rocks, through Chalk at Chichester, to a depth of 945ft., and at Southampton, through Tertiary strata and Chalk to a depth of 1,317ft.

To the south of all the area we have now described, there existed during the Carboniferous period, the ranges of the older Palæozoic strata of the Hunsdruck and Vosges—of the old crystalline rocks of Central France, fringed on the east and north with small outlying coal-basins of the old Palæozoic rocks of Brittany—and of the Silurian rocks of South Cornwall—forming the old land-surface, fringed by the great coal-growths subtended northwards through Northern France, Western Prussia, Belgium, and England, to the Silurian uplands of Central Scotland on the north, and those of the Welsh and Cumbrian highlands on the west, and possibly to those of the Scandinavian hills on the north-east. After the formation and consolidation of the coal strata, the southern area of this great Carboniferous basin was then subjected to that remarkable disturbance which, for a distance of above 800 miles, exercised that excessive lateral pressure by which the older underlying strata were squeezed and forced up into the series of sharp anticlinals forming the axis of the Mendips and Ardennes, while portions only of the Carboniferous series were preserved from the denudation which followed, in deep synclinal troughs flanking the main axis. The central and northern portions of the great Carboniferous basin, which were not raised by this disturbance, were then overspread by strata of the Permian series; after which the northern section of the original coal area was traversed by that other great disturbance at nearly right angles to the former one, by which fresh portions of the coal-measures were brought up in our central and northern counties, still leaving other deeper-seated portions to be afterwards covered by Triassic and Jurassic strata.

At a much later period the emerged southern area of Palæozoic rocks, including the westward prolongation of the great coal trough of Belgium, or portions thereof, was submerged and covered over by the several formations of the Greensands, Chalk, and Lower Tertiaries now forming the surface of the south-east of England.

The trials to discover these possibly productive coal-basins must necessarily be attended with considerable uncertainty. We shall have to feel our way. Of our hope of their ultimate success I have

* An abstract of the annual address of the President of the Geological Society.

given you the reasons. Nor could such trials near London scarcely fail of some important results; for, even if we did not hit at first upon the coal-measures, it is probable that the Lower Greensand would at some spots be reached, so that the inestimable additional benefit of a large and steady supply of pure water might also be obtained, and, with proper care to prevent undue interference, might be maintained for all time.

ON EARTHQUAKES AND VOLCANOES.*

By AUGUSTUS LE PLONGEON, M.D.

1. What is the Cause of Earthquakes?

THIS is a question of more than ordinary importance, since it has occupied the minds of philosophers in all ages, in all countries. It is a question that has been much debated in academies and other temples of learning. And still it remains a puzzle to the learned men of our modern times.

The ancient philosophers seem to have been far ahead of us in this particular, as in many other branches of knowledge; for while they were able to predict days—nay, months—in advance of the occurrence of our mother earth's convulsions, and warn their contemporaries of the impending danger, those possessed of the greatest scientific attainments in our age, are unable to recognise the premonitory symptoms and announce to the world the time when, and the place where an earthquake is to take place—notwithstanding they can read in the atmosphere all the meteorologic perturbances which occur, and prognosticate the storms and other phenomena which these changes foreshadow.

Many are the theories, quite antagonistical some of them, that have been launched on the vast ocean of speculation. All of them, no doubt, more or less plausible, resting on some scientific fact or other, have met with opposition. All have been impugnated, proved inaccurate and faulty. None has unveiled the hidden truth; and the mighty problem stands yet unsolved.

Facts are certainly not wanting to serve as milestones on the road of inquiry. And the laws that govern every phase of the phenomenon, well known to the wise men of our days, if properly applied, will cast their bright light, and illuminate the darkness that hangs over it.

Geology teaches us that, from epochs lost in the deep abyss of time, the earth has quaked; and natural philosophy, together with the discoveries of vigilant scrutinisers in the arcana of nature, have told us of the laws that govern these various manifestations of its wonderful vitality, and taught us that motion is life, and life is for ever and ever.

Why, then, it may be asked, are the causes of earthquakes yet a mystery? Simply because we have entered on the study of these phenomena, surrounded by the preconceived ideas, the prejudices, and bias, either scientific or religious, that had been inculcated in us by the teachings of our predecessors, instead of stepping into the sacred precincts of the great temple of nature, our minds free and unshackled from all prepossessions, ready to receive the revelations of the mighty arcana with candour and good faith.

I do not pretend to be wiser than any of the learned men who have investigated the subject, for I am the last among the worshippers of science. But having studied the phenomena in the midst of the terrible convulsions that have shaken the American Continent to its very basis, of late, and applied the different facts that I have observed during many years' residence in countries subject to earthquakes, to the touchstone of the natural laws that govern their manifestation, free from all undue bias, either scientific or religious, I have tried, from my observations, to draw all possible reasonable and scientific conclusions.

It is the result of patient and careful investigations that I humbly submit to your criticism in this cursory article, with the hope that it will meet with your approbation.

I have said that:—"The Ancient Philosophers were acquainted with the Cause of Earthquakes." This might be considered a bold assertion on my part, if I had not their writings and those of the historians of antiquity to back me up.

We all know that the wanton destruction, by fire, of the 700,000 volumes of the library of the Temple of Serapis, has deprived us of the knowledge of the scientific truths discovered by the wise men of antiquity. The few works, however, that have escaped the fanatical wrath of the ignorant Mahometan chieftain, and the deplorable hastiness of the Roman general, manifestly show that the philosophers of old had indeed given their earnest attention to the study of the very question we are about to elucidate; and that, owing to their diligent inquiries, and their knowledge of the laws that govern the phenomena, they had discovered some of the causes, if not all, of the earthquakes. We read in Philostratus, that Anaxagoras, who was thoroughly instructed in the science of the Egyptians, foretold the falling of stones from heaven, and that there should be an earthquake, in consequence of the mud which he perceived on the surface of the wells.[1]

Marcellinus[2] asserts the same thing, and so does Diogenes Laertius. Appellonius gave it as his opinion that the earth was composed interiorly of a mixture of bitumen and sulphur in a constant state of incandescence, and when a current of air penetrated the chinks and caverns, a fire was kindled, a flame was produced that burst out from the mountains, and streams of liquid fire; this being the cause of volcanoes and earthquakes.[3]

Jamblicus[4] tells us in his "Life of Pythagoras," that Pherecides, merely by testing of or looking at the water drawn from a well, advised the inhabitants of Samos to put themselves in safety, for they were threatened with an earthquake, which, in reality occurred.

Pausanias,[5] in his "Itinerary of Greece," whilst pretending that the earthquakes are phenomena produced by the anger of the gods, enumerates, however, the signs by which they are preceded and foreshadowed. Among these he mentions the water in the wells becoming turbid and emitting fetidity.

Pliny the Elder,[6] in his Natural History, after speaking at length upon the subject of earthquakes, endeavours to imagine means to prevent the phenomenon, and gives it as his opinion, that to some extent it might be hindered by boring very deep wells in the countries where they are of frequent occurrence.

This same author, in another chapter[7] of the same work (and Cicero,[8] in his "de Devinatio," concords with him), says that Anaximunder foretold to the Lacedemonians, not only an earthquake, but also the falling of the summit of the Taygetus, a mountain of Lacona. The event confirmed his prediction.

In the thirteenth century, a monk, in order to oblige the Emperor Andronic to recall from exile the patriarch Athanasius, threatened him with divers plagues—with an earthquake among them. The earthquake really occurred in Constantinople within three days after the prediction.[9]

The illustrious Buffon,[10] speaking of the proofs of the theory of the earth, relates that at Bologna, in Italy, in the year 1695, everybody saw with great surprise the waters becoming turbid four hours before an earthquake.

Agathino Longo,[11] in an historical and physical memoir on earthquakes, asserts that an identical phenomenon took place a few days previous to the earthquake that was felt in Sicily during the month of February, 1818.

Does not Mr. Cadet de Metz,[12] in his Natural History of Corsega, tell us that, after having observed during the month of December, 1782, very dense sulphurous vapours covering the plains of Calabria Citeriore, he came to the conclusion that an earthquake was near at hand, and he predicted the catastrophe which took place at the beginning of 1783?

And, lastly, did not Senor Vidanre,[13] a learned Peruvian, on hearing certain subterranean noises of a peculiar character, predict, four months in advance, the earthquake that destroyed a part of Lima, in 1818?

And I, myself,[14] predicted six months in advance the terrible earthquake that on the 13th of August, 1868, laid to the ground the strongly built city of Arequipa, and many others in the southern provinces of Peru.

Will you reject the testimony of so many writers and historians? Will you say with Cicero: The thing is impossible? No, I am sure—for as a scientific man you know that the arcana of nature become unfolded to our gaze more and more every day; you know also that every day some of the laws that govern its phenomena are discovered, and that nothing is impossible to the human mind in the scope of discoveries and scientific investigations.

Impossibility is the by-word of ignorance, unknown among us, the worshippers of science.

2. That the Centre of the Globe we Inhabit is not Liquid Fire

is generally admitted by most of the scientific men of our age. It does not enter within the limits of a cursory article like this to enumerate all the facts that can be adduced to prove that it is most probably a compact mass of metals and minerals, with a rather thin crust of oxides to cover it. I say thin, comparatively, of course. But to prove it I will merely speak of the heat that has been observed to exist in the different strata where man has penetrated; I will try to show that this heat is simply superficial and influenced altogether by different causes than central fires.

It is a fact demonstrated and proved that electro-magnetism is the active agent that produces all the phenomena of life that takes place at every moment of time before us, continually changing and producing new beings and new species of being. I consider that electro-magnetism is the life of this immense living body on which we exist as parasites; and that in the same manner as heat is developed in the human body through electro-magnetism's agency, which causes the blood to flow rapidly, and circulate with force, throughout the entire system, producing thereby a continuous friction in each and every of its parts, engendering what is termed animal heat—this being greater where there is greater affluence of circulating fluid, and therefore a greater friction—so also are the same electro-magnetic agents the source of the internal heat of the earth. How far this internal heat reaches towards the centre, is unknown, and will most probably remain unknown for ever to man.

The laws of nature are as simple as they are immutable. When studied, we find that they act alike in all things, advancing from the simple to the complex. We find nature very economical of the means employed by her to produce her creations, and most prodigal in the variety of those.

Let us take her for our guide and proceed from the simple to the complex.

The science of electro-magnetism is a comparatively new one, which will eventually lead to great discoveries, and give us the explanation of many phenomena that to the present day have remained unexplained.

The heat seems to augment progressively as we descend towards the centre of the earth. But the progression is not constant. At places the heat increases rapidly, at others very slowly. This difference has for a long time puzzled geologists. At last they have come, not to a definite, but an approximate conclusion, by admitting that the heat increases 1° for every 27 metres; Beudant pretending, however, that it augments 1° for every 33 metres, on every point of the globe. But such is not the case, for there are, perhaps, not two places, even in the same locality, where the heat is the same at the same depth.

However, for the sake of demonstration, let us admit it is so, and that the heat increases progressively 1° for every 33 metres we approach nearer to the centre of the planet. What will then be the consequence? At 3,000 metres the heat will be sufficient to cause the water to enter into ebullition. At 20,000 metres, the supposed thickness of the crust of the earth, all silicates will melt. At 80,000 or 100,000 metres, all metals, even the most refractory, will be in fusion; the diamond volatilised.

As the semi-diameter of the earth is 6,366,000 metres, the heat at the centre will then sum up the prodigious amount of 250,000° of heat. Think of it—250,000°. Can you imagine such heat and not be yourself volatilised instantaneously?

Can any man with common sense ever believe such nonsense? Why, Beudant himself is surprised at the awfulness of the offspring of his own science; his pet frightens him, for in his "Course of Natural History" he tells us: "That if anything is capable of astonishing any one, it is that no more catastrophes should take place in our days on the surface of our planet, particularly when we consider the enormous disproportion which exists between the diameter of the melted matter and the crust of the earth, which is only 20,000 metres. This thickness is but very small when compared to the terrestrial radius, which is more than 6,000 kilometres. On a globe of 1 metre it would be represented by 3 millimetres approximatively. That would not be the thickness of a sheet of paper on one of our ordinary terrestrial globes."

These are, verbatim, the words of the savant geologist. Yet there is another thing that astonishes me more than that; it is that a man of his acknowledged science, if he calls himself sane, can possibly cherish and seriously advocate such an idea, now that we are perfectly conversant with the laws which govern the expansion of gases, and those which regulate the march, attractions, and gravitation of celestial bodies; and Mr. Beudant knows, certainly, as well as ourselves, that only a temperature of 12,000° is required to volatilise all and everything known to man on earth. If his theory was true, at 320,000 metres under our feet there would be nothing but gases floating on an immense furnace of 230,000° of heat to expand them more and more, and a very thin shell of 20,000 metres to contain them and resist the immense pressure caused by their increasing expansion.

Who, in the name of common sense, will admit of such an absurdity? There is no central fire; there

* From Van Nostrand's Magazine.

1 Philostratus—"Life of Apollonius," Book I., chap. ii.

2 Ammionus Marcellinus, Book XXII., chap. xvi.

3 Philostratus—"Life of Apollonius," Book V. chap. xvii.

4 Jamblicus—"Life of Pythagoras," Book I., chap. xxviii.

5 Pausanias—"Itinerary of Greece" (Achaic., chap. xxiv).

6 Plinius—"Natural History," Lib. II., chap. lxxx.-lxxxi.

7 Ibid., chap. lxxix.

8 Cicero—"De Devinatio," Lib. I., chap. l.

9 Pachymer—Lib. X., chap. xxxiv.

10 Buffon—Natural History, Art. XI. On the proofs of the theory of the earth.

11 Agathino Longo—Biblioteca Italiana, Settembre, 1818.

12 Cadet de Metz—Natural History of Corsega, pp. 138-147.

13 Vidanre—Moniteur Universel, 27th of August, 1828.

14 Le Plongeon—Jesuits and Peru, p. 482.

cannot be. What does the science of the skies tell us on the particular? Listen!

We all know that the astronomers, in order to calculate the course of the celestial bodies, are obliged to know exactly their weight and volume. They, of course, had to determine that of the earth, in order to compute its motions in space, and its relations with its other companions and co-travellers. Their computations have been so accurate that they can determine the exact time of the apparition of comets. When eclipses, conjunctions, &c., are to take place, by the astronomical observations, taken four or five thousand years ago by the Chaldean and Egyptian priests; by those of the ancient Chinese astronomers, as that of the eclipse of the sun, mentioned in the "Chou-King," which took place during the ninth month of the year 2159 B. C., all of which within the last century have been proved perfectly correct. We have come to the knowledge that no variation whatever has taken place, in the volume of the earth at any rate, from those remote times to our days. If the planet had contracted, as some pretend, the rapidity of its rotation would have necessarily increased, and such is not the case.

(*To be Continued.*)

EXPEDITIONS TO THE NORTH POLE.

A CORRESPONDENT of the *Daily News* writing from Frankfort-on-the-Maine, sends the following information on this interesting subject:—

According to advices from Stockholm the projected North Polar Expedition, under the control of Professor Nordenskiöld, is almost ready for sea, and Swedish geographers entertain great hopes of success for the new undertaking. The expedition will have on board, I am informed, besides Professor Nordenskiöld, Lieutenant Palander, of the Swedish navy, who has already had some experience in Polar exploration, having accompanied the Swedish Expedition of 1868; also a physician, a physicist, and several other savants, who will accompany the expedition for the summer, returning from Spitzbergen in the autumn; making in all, with the crew, twenty persons. The principal object of the expedition, which is not expected to return before the summer or autumn of 1873, is to reach the Pole from high latitudes by means of sleighs drawn by reindeer—an enterprise in which the German geographer, Dr. Petermann, of Gotha, does not place much faith. The expedition will take with it from Gothenburg a portable house, of nine rooms and kitchen, which is to be put up on the Seven Islands, in 80° 38" northern latitude — the most northern point, I am informed, at which an expedition has ever wintered in these regions. Great importance appears to be attached by Professor Nordenskiöld to the cargo of fifty reindeer, which he will ship from Norway, together with the necessary fodder and a number of Lapps to attend them. The scientific mission of the expedition is as follows:—

During the autumn the expedition will take soundings eastward of Spitzbergen; the eastern part of Spitzbergen is to be thoroughly surveyed; a series of continuous meteorological and magnetic observations for the space of an entire year are to be made; pendulum observations for determining the oblate form of the earth, refraction observations, besides a series of careful observations of the abundant animal life found in the Polar Ocean in these high regions. The scientific gain, it is expected, will be exceedingly valuable. The chief object will, however, be to attempt in the spring of 1873, after pushing as far as possible northward by vessel, to proceed by sleighs drawn by the reindeer in the direction of the Pole, and if possible to reach that point. In this attempt Professor Nordenskiöld casts overboard Dr. Petermann's idea of an open ocean extending to the Pole. Lieutenant Payer, of the new Austrian Expedition, has also expressed the view that Nordenskiöld's idea of reaching the Pole by sleigh is not to be thought of. But the Swedes place great confidence in the leader of the expedition, who is undoubtedly an energetic and skilful man, well acquainted with the North Polar regions, whither he has already made no less than five voyages. The Nordenskiöld Expedition has the support of the Swedish Government. I think it is to be regretted that the Germans do not greet it more warmly, though the feeling is very comprehensible where national rivalry is at play.

Dr. Petermann and the great majority of the German geographical societies have given their entire support to the new Austrian Expedition, which is to sail from Bremerhaven about the end of June, and which Dr. Petermann greets as "the greatest event in the history of modern Arctic explorations." The object of the Austrian Expedition will be the farther navigation of the ice-free ocean which they met with last summer to the east and north, and the exploration of the Arctic Ocean to the north of Siberia. The plan of the voyage is as follows:—

The expedition being provisioned for a period of three years, the first winter is to be spent on Cape Tscheliuskin, the most northern promontory of Asia; during the second summer the exploration of the Central Polar Ocean is to be continued, and an effort made to reach the Pole; the second winter will be spent on the new Siberian Island, and the third summer will be employed in reaching Behring's Straits and an Asiatic or American haven. The Austrian expeditionary vessel is a three-masted schooner, 118ft. long, 25½ broad, 13½ deep, provided with an effective engine of 95 horse-power, and coals for forty days.

There are several other North Polar Expeditions in preparation. A certain Count Wilczek, who has already given 30,000 florins to the Weyprecht-Payer Expedition, has chartered a small vessel, and intends to accompany the Austrian expeditionary vessel as far as the most northern coast of Nova Zembla, taking with him provisions for the larger vessel. Dr. Petermann also reports that two Norwegian steamers of the seal fishing fleet—Captain Jensen of Drummen, with the steamer Cap Nor, and Captain Svend Foyn, an enterprising whaling captain, with his steamer, will proceed, after the fishing season is over, in the direction taken by the Austrian Expedition, and make explorations in the Siberian ice-sea (the Polynia), of course with an eye to future business. France, too, is bestirring herself, and a certain Gustave Ambert issues a circular, declaring his intention to take an expedition in the same direction as the Payer-Weyprecht one. This expedition was to sail from Havre in April. Ambert has in view not only scientific but "practical results, the acquisition of new lands, the discovery of new fishing grounds," &c. Another French explorer proposes to get at the North Pole by way of balloon. He has not yet hit upon a plan of getting back again, however, with the news of his discovery, in case his gas gives out, it being very doubtful how he will procure a fresh supply so far north. The American Expedition, under Messrs. Hall and Bessels, will proceed from the American side, after wintering, and attempt to reach the Pole in the course of the present summer. Thus the great international race for reaching the North Pole has again commenced in earnest, though America has certainly got a good start. Captain Koldewey, the leader of the former German Expedition, has also a scientific voyage in view, which, however, creates little interest in Germany, whose sympathies and material support have been directed by Dr. Petermann in favour of the successful Austrian voyagers of last year, Messrs. Payer and Weyprecht.

FALSE HAIR.

FALSE hair appears as necessary in the United States as in this country, and the following particulars extracted from the *Commercial Bulletin* (U. S.) will afford some little insight into the business done in this commodity:—

Formerly, as ladies grew in years and their hair became thin, a false "switch" was procured, and combined with the growing hair to repair the ravages of time. Great care was taken to conceal the fact that false hair was worn, and it was only to her most intimate lady friends that the fact was whispered even. But now all this is changed. Nineteen-twentieths of all the women in the country who make any pretence to dress wear false hair or some artificial equivalent, and the lady who, no matter how luxuriant her tresses, should presume to appear in society without supplementing their natural growth with "rats," "mice," "switches," "bands," or some other specimen of the wigmaker's handiwork, would find herself so hopelessly in the minority, and so laughed at by all, from her dressing maid to her most intimate friend, that resistance would be impossible, and surrender at discretion imperative.

Where the Hair Comes From.

The hair which adorns the heads of our belles and matrons comes mainly from the heads of the peasant women of France, Germany, and Italy. The hair buyer, supplied with sundry stores best calculated to captivate the rural eye, travels from village to village, seeking out those whose wealth of hair gives promise of a handsome price in the Paris market, the great centre of the hair trade, and drives the best bargain he can in obtaining it. Sometimes the price is paid in money, but more generally in finery of various kinds, such as ribbons, cheap laces, trinkets, &c., a trade in which the buyer realises a handsome profit both ways, and the seller parts with the adornment which Nature has provided for almost worthless ornaments which she will soon tire of and throw aside.

Having completed his purchases, the buyer takes or sends the hair he has collected to the broker, who buys it at a price which pays the buyer well for his trouble. It next goes into the hands of the merchant, under whose supervision it is cleaned with meal, sorted as to length and colour, and put up in packages weighing from one to four ounces, each consisting of hairs of uniform length and colour, but not all the product of any one head.

How Hair is Ruined.

Strange as it may seem, the hair which grows upon the heads of our fashionable ladies has no commercial value. Through much crimping, curling, and dosing with various hair "invigorators," "restorers," pomades, &c., it not only becomes variegated in colour, but hard and brittle, rendering it wholly unfit for use in the manufacture of hair work. Indeed, it is found that the more people "take care" of their hair, the more they injure it, while those European peasants who let Nature take its course, and seldom even comb their hair, produce the finest and most delicate article.

Its Value.

In the shape in which the buyer brings it in from the country, this hair is worth about 30 dols. per pound, in gold. After it has been sorted, the different lots vary in value according to length and shade, from 1 dol. 50c. to 100 dols. per ounce. Indeed, it is almost impossible to set a limit to the outside price of choice lots of long hair of desirable shades, for so difficult are they to obtain, and so urgent is the demand from parties with whom money is a secondary consideration, that the fortunate holders can set their own price and be sure of a customer. "A switch of very light gray hair," said a dealer, "thirty-six inches long, and weighing five ounces, is worth 1,000 dols., and can rarely be found at that price."

Substitutes.

In a country like ours, where fashion is a law to the poor as well as to the rich, it has been necessary to provide some cheap substitute for human hair, in order that factory and shop girls, and others of slender means, may vie with their wealthier sisters in the adornment (?) of their heads.

For this purpose, several substances are in use. The first material applied to this purpose was jute, which, after passing through several processes, is reduced to a long and glossy fibre which, in general effect, closely resembles hair, and which, owing to its comparative cheapness, rapidly came into general use. By means of dyeing, it was produced in all possible shades, and was eagerly bought in the shape of "switches," "waterfalls," &c.

Its Injury to the Skin.

In the process of adapting jute to this use, *nicotin*, the essential principle of tobacco, and corrosive sublimate, a most deadly mercurial poison, are used. It is also rendered exceedingly brittle, and breaks as easily as spun glass. The small particles find their way through the air to the scalp, and, their edges being ragged from the combing process, act like so many poisoned barbs, which, entering the pores and being held in place, introduce the poison beneath the skin, and cause irritation and ulceration. It is owing to this that the idea became current that the jute contained animal parasites that bored into the skin and laid their eggs beneath it. The most careful examination has failed to discover any vestiges of animal life in jute, but the little barbs we have spoken of have been distinctly seen protruding from the pores of the scalp, and the sores they produce give every evidence of being the result of mercurial poison.

Linen and Cotton.

A more recent and harmless substitute for human hair is found in fine cotton and linen thread, dyed to the proper shade and sized to give it the requisite gloss, and then made up into the various forms in which it can be used. Switches of this material are sold at retail for about one dollar each, a price at which a very handsome profit is probably realised by the dealer.

Silk as a Substitute.

Probably the best substitute for human hair yet introduced is silk fibre. Its fineness and strength render it peculiarly suitable, while its brilliant lustre adds to its resemblance to the real article. It is used both alone and in connection with real hair, especially in those cases where a switch just sprinkled with gray is required. To produce this effect, dark hair and gray silk fibre are taken in unequal proportions, varying according to the shade desired, and woven together, the result being with difficulty distinguished from a combination of real hair, yet costing, owing to the immense price of long gray hair, a moderate sum comparatively. Bands and braids are also made of silk, the exposed portion only being of this material, and the filling of jute or "combings."

The Extent of the Trade.

Formerly hair work was sold only in a few of the leading hair-dressing establishments. Now large and expensive stores are devoted to its sale in the large cities, nearly every dealer in fancy articles keeps some of the grades of so-called "hair goods," and in every country store neat cardboard boxes, containing switches, *chignons*, and other head gear, are offered for sale. So long as fashion holds its present course, every woman in the land nearly is a customer, and thus an enormous bulk of business is done, paying handsome profits to all engaged in it. At first the percentage of profit was extremely large, but competition has reduced this materially. But the volume of business has increased in a like ratio, and the sale of hair and hair work continues to be exceedingly profitable.

PERFORMANCE OF A LOCOMOTIVE.

THE following extract from a letter, detailing the performance of one of Baird & Co.'s (U.S.) locomotives, will be read with interest:—

"Engine 422 has been taken into the shop for repairs, and as her performance has been an extraordinary one, you will, I am sure, desire to know some of the particulars of her career thus far.

"She was placed on the road on the 17th day of October, 1867, and ran until the 14th day of May, 1871. During the whole of this time she hauled fast and heavy passenger trains over Middle Division, and made the wonderful run of 153,280 miles, losing only three trips, which was during November, 1869, to have six new flues put in and to clean the mud out of the waist of the boiler. She also lost six round trips in May, 1870, getting in a larger tank, to enable her to make the run from Altoona to Harrisburg (112 miles) without a stop.

"This, however, was no fault of the engine, and should not be counted against her.

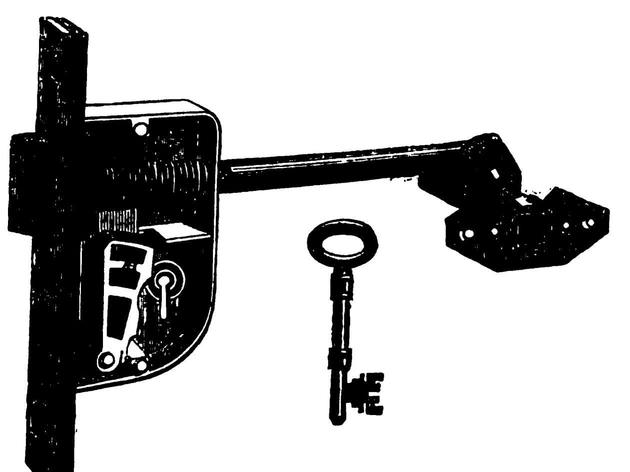
"As an offset against the nine trips lost, she made 11½ extra trips between Altoona and Harrisburg.

"The total cost for repairs up to the time she was laid off amounted to 3,727·06 dols., or 2·44 cents per mile. Our book account makes these amounts somewhat greater, but I have deducted all items not actually running repairs, such as the new tender, cost of applying air brakes, etc., which, although under our system of accounts are necessarily charged to repairs, actually do not belong there.

"When Engine 422 was taken into the shop, she was reported as run down in the working parts, but uniformly so; all the bearing surfaces being smooth and good, and her general condition being better than is usual with engines taken in for repairs. The cost of placing her in thorough repair is estimated at 1,262·73 dols."

SAMELS' PATENT STANDARD LOCK.

THERE are one or two features in the new "Standard" Lock, recently patented by Messrs. Samels & Co., well worthy of notice. The illustration given will readily convey an idea of the principle adopted. The working parts of the lock are confined in a small case readily inserted in a door without weakening it by making the large mortice necessary for most of the locks now used. The rod of the latch works in a hole easily bored with a common auger, and may be of any length, allowing the handles to be fixed as far as desired from the edge of the door. The construction of the lock is very simple, but yet affords greater security from violence than that given by many other locks.



The principal advantages derivable from its use are notably the great saving of time required for fixing, the effectual securing of the handles from lateral play, and the prevention of any wearing away of the woodwork by the action of the square spindle, by means of the bearing, which extends through the whole thickness of the door.

Yellow Solder.—The Prussian Society for the Promotion of Industrial Advancement at Berlin offers as a prize a silver medal or its value, and the sum of 1,875 francs, to the inventor of a yellow solder, possessing the properties and qualities of ordinary tin solder, and to be used for soldering brass or similar alloys so that the seams will not be visible.

Osseine, Gelatine, Osmazone.—M. E. Monier, in an essay in *Les Mondes*, expounds the divers nutritive and physiological properties of the three substances just named, which are often confused together. Osseine is nutritive, as proved in the case of dogs, wolves, and similar animals, who can digest bones and excrete the inorganic matter. Gelatine alone, and osmazone (largely contained along with salts in extract of meat), are not by themselves nutritive, but, especially the latter, aid the digestion as condiments.

Fruit Syrups.—It appears that a considerable trade is carried on in fruit syrups, which, on the *lucus a non lucendo* principle, contain no fruit whatever, but are artificially prepared from solutions of sugar flavoured with ether and coloured with aniline dyes. There are fortunately various tests for this disgraceful imposture—such as nitric acid, which, when mixed in equal volume with real fruit syrup, causes no change, but turns the imitation yellow. With solution of carbonate of soda, the artificial remains unchanged, and the real becomes lilac or green, so that the preventives against making our interior an ethereal dye-house are easily obtained and put in force.

NOMINAL HORSE-POWER.*

WHAT is a nominal horse-power? This is a question often asked, but one which, under existing circumstances, it is impossible to answer. Under these circumstances "nominal horse-power" has long ceased to be a term possessing any definite value, and has gradually come to be considered as little better than a nuisance; and this being the case, it is not surprising that it should have been proposed to do away with it altogether, and rate engines by their indicated power alone. We have ourselves advocated such a change on more than one occasion, and we have as yet met with no arguments which incline us to modify the opinion we have several times expressed, that the indicated power alone can be regarded as a satisfactory measure of the capability of any given engine. But while this is the case, we are by no means blind to the commercial advantages to be derived from the employment of a unit of measurement which can be applied to an engine before it is constructed, and, therefore, before it can be tested by the indicator in the usual way; and it is the desirability of possessing an unit of this kind which brings us to the immediate object of the present article.

When a competent engineer is called upon to design an engine to do any specific amount of work —such as to raise a given quantity of water, for instance—the term nominal horse-power never enters into his consideration. Having decided upon the pressure of steam which is to be employed, and the ratio of expansion and piston speed at which the engine is to be worked, it is perfectly easy to ascertain the diameter of cylinder which will be required to develop the power which it is considered necessary that the engine should indicate. Now, under such circumstances, this required power may be termed the "calculated indicated power," and it forms just such a unit of measurement as it is desirable to possess for commercial purposes. But if we reverse the operations, of which we have just been speaking, and attempt to rate any given engine by calculating approximately what indicated power it would develop, we are met at once by important practical difficulties, which are by no means to be easily surmounted. The first and most important of these arises from the fact that the indicated power of any given engine may vary within very wide limits, according to the circumstances under which it is worked. Thus, a given engine may be equally capable of being worked with steam at from 30lb. to 50lb. pressure, with a cut-off varied from one-sixth to three-fourths of the stroke, and with a piston speed of from 200ft. to 600ft. per minute, and the question would at once arise as to which set of conditions should be assumed in determining the "calculated indicated power." In instances where the conditions of working are known, the approximate indicated power of the engine could, of course, be readily calculated; but it would scarcely be fair to assume that because under certain conditions an engine would develop, say, 80 indicated horse-power, that, therefore, it should be rated at that horse-power under all conditions of working.

These considerations tend towards the conclusion that any commercial unit of measurement applied to steam-engines must not simply state the power which any given engine is capable of developing, but must also indicate the circumstances under which that power would be developed. A ready way of affording this information might very easily be planned. Thus, if, for instance, it was generally understood that an engine rated at "80 C.H.P. $\begin{smallmatrix}60''\\5\\400\end{smallmatrix}$" was calculated to develop 80 indicated horse-power when worked with 60lb. steam, fivefold expansion, and at a piston speed of 400ft. per minute, the rating would not only give a definite idea of what the engine was capable of performing under the circumstances stated, but would also enable an estimation to be made of the power which it would develop if worked under other known conditions.

An objection, which will perhaps be urged in some quarters against the adoption of any system of rating founded on the calculation of the approximate indicated horse-power, is that the use of such a system of measurement would involve calculations of a more complex character than it would be desirable should be requisite for obtaining the commercial rating of any given engine. This, however, is an objection to which we are not inclined to attach any great importance. Let it once be determined to employ a system of rating similar to that we have suggested, and it will be a comparatively easy matter to frame simple rules, applicable to different classes of engines, which would enable the "calculated indicated horse-power" to be determined with the requisite degree of accuracy.

We may take the opportunity of directing attention to one important point of difference between land and marine engines, which must be borne in mind in framing rules for the former, and this is that, whereas on shipboard the engines and boilers may be considered together, in dealing with land machinery they must be treated separately. It thus happens that one of the best rules suggested by Mr. Gray, namely, that which takes account, not merely of the proportions of the engines, but of the steam-generating power of the boilers in connection with which the engines are worked, would not be applicable in general land practice. In factories, boilers frequently have to supply steam for other purposes besides driving the engines, while it is also not uncommon to find two or more engines supplied with steam from one range of boilers; so that, as we have said, no rule involving reference to the dimensions of the boilers can be employed in rating stationary engines, and hence the necessity—to which we have already alluded—of the "rating" stating specifically the conditions under which the engine is worked.

Of the various obstacles in the way of introducing a satisfactory system of rating steam-engines there is, however, none so great as that of finding authority to enforce such a system, supposing it to be once determined upon. In the case of marine engines the Board of Trade may probably do much, and may, if they choose to take the trouble, introduce rules which would eventually be largely, if not universally, adopted by marine engine builders, in the same way as the Royal Agricultural Society's rule is generally accepted by the makers of portable engines. But the action of the Board of Trade in the matter, though it would undoubtedly do good service to a certain branch, would not affect the engine-building trade generally, and it remains for some body of recognised standing in the profession, such as the Institution of Civil Engineers, or, perhaps, more appropriately, the Institution of Mechanical Engineers, to take up the subject, and after investigating it thoroughly, to issue rules for rating engines, which might be generally accepted by all engine builders, in this country at least, to the utter abolishment of the present nuisance of "nominal horse-power."

* From *Engineering*.

The "Patent Cat Exterminator."—The American "grand pig-sticking machine" must yield the palm to the latest novelty, "the Patent Cat Exterminator." This is truly a fearful and wonderful invention. It is described as a large sheet-iron cat, "with cylindrical attachment and steel claws and teeth." It goes by clockwork, and a small bellows inside causes the tail to swell, and also "by a tremolo attachment" causes the patent cat to utter those wild cries so familiar to the sleepless. Being duly wound up, the machine is placed on the roof of the house. Its diabolical yells attract every cat within half a mile. Then the iron teeth and claws go to work, and with lightning rapidity all the assailants are torn to shreds. It is said that on some occasions as many as 50 or 100 domestic pets are slaughtered in a single night.

Prizes for Art Workmen.—To encourage technical education in the design and execution of works of art in the precious metals, the Goldsmiths' Company have resolved to give the following prizes, viz.:—An annual prize of £50 for the best design for some article in gold or silver which, when manufactured, shall exceed 80oz. in weight; an annual prize of £25 for the best model of some such article as aforesaid; and an annual prize of £25 for the best execution and workmanship of some such article as aforesaid. Also, three annual prizes of £25 each for (1) the best design, (2) the best model, (3) the best execution and workmanship of some article in gold or silver which, when manufactured, shall be less than 80oz. in weight; and annual prizes of £25 each for the best specimens of (1) chasing or *repoussé* work, (2) engraving, and (3) enamelling in the precious metals. Originality is necessary to obtain either of the prizes for design, and no copy shall be the subject of a prize. The prizes will be awarded in November. It has also been decided to found a travelling scholarship of £100 per annum, to be awarded by the wardens to a student who has shown exceptional talent, and who shall have obtained a prize for design for three successive years, in order to enable him to study art in the precious metals on the Continent.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

AN ASTRONOMICAL CATASTROPHE.

[4086.]—Does "E. L. G." really suppose that his arguments from the action of water upon a soft quiescent heap of clay or sand are at all applicable to the form, past or present, of the earth's surface, or the effect of the various agencies we now see modifying the form of that surface? If we assume the conditions we can always attain any result we please. But if, without desiring to establish any particular theory, we endeavour to trace back in our imagination the various conditions of the earth and its original formation, then if one thing is more absolutely certain than another, it is that the original condition of the earth was *not* that of a mass of clay, mud, or sand, subjected to the abrasion of falling torrents of water; for if, again, anything in geology has gained the rank of a fact, it is that clay, mud, and sand are the products of the wearing away of old solid rocks, and that these destructive products pass again into solid (so-called primary) rocks under the influence of forces readily to be conceived and partially to be observed. Furthermore, if the conditions of the earth had ever been anything like those employed by "E. L. G." as the argumentative basis for his notions, the only possible result would have been the reduction of the earth to a true spheroid of rotation, covered with water over its whole surface. That is the condition of things which one set of natural agencies, the disintegrating forces of sun, rain, and rivers, are ever tending to produce; they wear away the hills and transport their materials to the depths of the sea. But the other set of forces (absent from "E. L. G's." heap of clay), very possibly due mainly to the gradual cooling and contraction of the earth, and to the uneven thickness of its external crust, produce an opposite effect; vast tracts of land are steadily rising, almost as if forced up by the pressure of the materials added to the sea bottom; in other parts an occasional upheaval occurs, of which we see abundant evidences in the "faults" in our mines, where whole series of strata are split, and one part lifted bodily through hundreds of feet; in other cases the strata are simply tilted edgeways; in others, as at Vesuvius at this day, vast masses are raised in a fluid condition. Are we to shut our eyes to all these operating causes which produce excrescences, which, sharp at first, are converted by the disintegrating forces into that rounded and undulating contour so dear to "E. L. G."? And are we to accept his pure dictum, and without one particle of evidence, assume with him that this contour is the result of cataracts, and further, to assume that these cataracts are caused by comets, as to which comets what knowledge we have may be described as testifying that they do *not* contain or consist of water, and that their mass is far too small to produce any universal deluge by contact with one, even if they were nothing but water?

Every geological fact which could be attributed to a deluge is just as readily explained as due to those local floods which are constantly happening, and which would result from any great upheaval; but that any such deluge ever covered the whole earth at one time and destroyed all its inhabitants is absolutely negatived by many facts inconsistent with such an occurrence having happened—at all events, within very many thousands of years. Notably is it inconsistent with the distribution of life, animal and vegetable; take as one fact that the native quadrupeds of New Holland, from the kangaroo to the rat (so-called) are marsupial, a class existing elsewhere only as a few rare species.

The misfortune is that this which is purely a matter of fact and of evidence is mixed up with religious opinions, and consequent passion and prejudice, and thus there is generated a supposed antagonism between religion and science which does not really exist, but which is due to the advocates of each taking up a partial and erroneous view and ignoring the link which should bind them together.

I will tender to "E. L. G." another form of "astronomical catastrophe," which may help him to demolish Lyell and all the geologists, if he can only prove 's occurrence, though such a trifle as that, perhaps, ..ed not be insisted upon. I once met with a book ..illed, I think, "The Electrical Theory of the Uni..rse;" it was written by an exceedingly clever and widely-informed foolish person, evidently suffering from intellectual dyspepsia and dreams, due to ill-digested facts. This book contained an immense amount of shrewd argument mixed up (as is usual with universe theorisers) with a good deal of downright nonsense, and no little of hasty and baseless assumption. The author showed that the earth was once where Neptune now is (and that it was before that a comet), and is gradually running into the sun, hardening and condensing in its progress, the moon being now, from its smaller size and consequent more rapid progress, such a hardened dead world as this must by-and-by become when all its liquids and gases have been condensed. He then made the very reasonable guess that when the earth was in the position of Jupiter, Saturn, and the other distant planets, it must have had, like them, some half a dozen moons, and the nearer of these approaching their primary one by one fell down, and their wreck formed the Alps, the Himalayas, and great mountain ranges. Now, for this idea there is more evidence than is necessary for "E. L. G.," because the Alps and the Andes, &c., are actually to be still seen, and must have come from somewhere, while as to "E. L. G.'s tale of a comet—where is the water gone to? Sigma.

P.S.—The more this idea is considered the more it would seem to suit those who must find a reason for a deluge. In the last moon that may have fallen, it is quite possible there was a good deal of sea left, and this showered down would account for the inland salt lakes and for the fish not having been killed as they would by fresh water; besides, the sudden shock would have sent our seas up in a shower of spray to come down again in cataracts, besides accounting for a good many geological facts. It will certainly answer better than that very shaky comet's tail, for "E. L. G." and all those who want a theory, and are not too particular about evidence.

"M.R.C.S." ON VENTILATING.

[4087.]—The joke of Charles II. on the courtierly founders of the Royal Society has surely been too recently called to our notice for "M.R.C.S." (let. 4043, p. 151) to expect success in trying it anew on me already! He asks me to "kindly to explain how it is" that all warm-blooded animals are benefited (?) by drawing back "into their lungs a large proportion of the air that has just left their lungs" (but not their body), "such being the universal arrangement for respiration," which "cannot be disputed by any one who *remembers* that a large proportion of the air expelled from the lungs" remains in "air channels to mingle with and help to warm the air drawn into the lungs;" a patent "respirator" in short, of mephitic air instead of platinum wires!

He then proceeds to adduce, apparently in support of this astounding physiological dogma (to me at least, I confess, as new as astounding), the single fact, well known, that breath exhaled by a forcibly deep expiration contains proportionally more carbonic acid than ordinary breath. I fail to see the least bearing of this on his doctrine. It merely shows that commonly much of the air exhaled has either not entered the lungs or not been mephitised. It nowise proves any mephitised air, or even any that has been in the lungs, to be afterwards retained in the body; but whatever it might prove or disprove (and I would be all attention to the evidence for any such novelty as our "M.R.C.S." has propounded); whatever may be Nature's arrangement with any air while retained *in the body*, what can this possibly have to do with "ventilating"—*i.e.*, with a builder or ventilator of buildings?

Surely my business, and "Philo's," and "An Architect's," in building or ventilating, is with air that has left not only the *lungs* of people or animals but their *bodies*. Does "M.R.C.S." mean to tell us Nature has anywhere arranged for any breath which has once left a man's nostrils to be "drawn into" them or another man's again? Knowing how wide is the Mechanic's circulation, we must suppose him to have been born and bred in too warm a climate to have noted a phenomenon familiar in all places that have any winter. Cold air, by condensing the vapour of our exhaled breath, makes it visible, like steam-cloud from a kettle; or, in the Arctic regions—so voyagers have told us—like smoke from a pistol, and visible half a mile off. All of us, away from subtropical latitudes, then, often have ocular demonstration of how Nature disposes of men's or animals' breath. We see it shot from the nostrils forward a foot or two, and then mounting up skyward, so that no negation seems plainer to us than that Nature has *not* arranged for one particle of it to be inhaled again, or, rather, *has* arranged against *any* being re-inhaled. Not so do our builders arrange (or rather buildings arrange themselves), for it were ridiculous to use of nineteenth-century English work any language implying personality above itself, it is a product of *development*, nowise of *mind*. All our architecture (or at least, all inhabited) so develops itself as (exactly contrary to the above, Nature's *visible* development) to retain *all* the exhaled breath possible, as *long as* possible, and to be rebreathed as *much* and as *often* as possible, with the particular amount of aëration or inblow then and there existing. Of course, be your form of shelter what it may, a sufficient wind through your room will carry away exhaled breath without permitting time for it to be re-inhaled more than under the open sky. But my position is, that whatever be the amount and nature of air-inlets, or of supposed outlets (which latter, I believe, I have said, as well as "M.R.C.S.," must, in any place that has a chimney, go finally *into* the chimney; but *that* is far from all, or the chief matter about them to attend to), whatever amount of intake or outlet openings there be, whether two square *inches* or two square *yards* to each cubic yard of chamber, in any case your architecture, through ignoring this (as it does nearly every other worthy object of rational building) has come to retain and return to you your exhaled breath as fully as possible (with the said amount of openings), and make you re-breathe it as much and as often as possible (under the same condition). I say that if this retention and re-breathing were the main objects aimed at, then they could not be better insured (in the face, of course, of a given amount of air openings), by any contrivance than by most of our newest dwellings and public buildings. Neither "Philo," nor "An Architect" has disputed this broad charge—will "M.R.C.S."?

What *can* I say, when he asks me (p. 153) "to prove that the air at the very top of a room" (the rooms I am complaining of) "is materially different except in temperature from" the rest? That is precisely what any denier of my charge has to prove! I complain that the top air is *not* materially different, whereas it *ought to be* so, and *is* in any really ventilated place, as a lantern. The highest pint of air at any moment, say, in a lighthouse, is not the warmest indeed, but is the *worst*, the least respirable in the building, which it is just leaving. So it ought to be in every room, but is *not*, and that is the gist of my complaint. In mere living or assembling rooms, the air next the ceiling (owing to that ceiling's malformation) is not materially worse than any below. All is, as nearly as possible, equally foul; the structure being such as to cool and send down all that attempts to escape, and mix up the whole as rapidly and thoroughly as possible. The top stratum, instead of being the worst, is merely the warmest; which it ought *not* to be, for every breath cools in rising, just as the lighthouse lamp-vapours do, and are less hot at the outlet than when leaving the flames. To make the uppermost air in a lantern the hottest, or its top hotter than it now is (without increased flame), is always very easy! You have merely to stop the right outlet, and instead thereof make wrong ones; in short, assimilate it to a dwelling-room, church, or any English building! The top air will then be at once made the hottest and cease to be "materially different except in temperature" from any other in the lantern. But no one dare thus treat a lighthouse, observe. For light costs oil or gas or electric force, and oil or gas or force costs *money*. Where you are dealing with merely such rubbish as human life and health, mere architects' work, not engineers', blind chance and development may rule all. But not so when actual *value* has to be economised by the right ventilative form of structure. None dare erect a lighthouse as bad and absurd pneumatically as a Queen's sitting-room, or even no better than Barry's last House of Commons (blundered into after a quarter-million's worth of experiments); for in the lantern, right aëration, the contriver well knows, involves more than human life, even sixpences!

The last question of "M.R.C.S.," whether upward drainage is essential, as well as that which he says he "will believe when he sees it done," lies in a nutshell. He has only to accept the challenge from which "Philo" has run away (pp. 589, 637, Vol. XIV.), and settle both points by experiment. I defy him or any one to make a place without upward drainage stand the simple fire and bird test; and I engage to satisfy it with no more area of air-passages than he names. E. L. G.

[This letter must conclude this attenuated discussion.—Ed.]

OUR SUMMER VISITORS OF THE FEATHERED TRIBES.

[4088.]—These are for the most part quite a different class of birds to our winter visitors. They consisted principally of water-fowls, and came from the northern latitudes, seeking food and shelter in our milder land, but our summer visitors come from the sunny climes of the south to sojourn here for awhile, and enliven our woods and fields with their joyous songs; and though the former species were more in number, and afforded more sport for the gunner, yet the return of our summer friends is more welcome, and the birds themselves are better known, and certainly more loved, for who does not rejoice to hear the cuckoo's note, or who does not love the twittering of the martin above his window, or of the swallow on the chimney-top?

And we cannot wonder at this: they come to us in the spring, when the earth is clad with green, and life, and joy, and hope appear on every side; neither can we wonder that the migration of birds should in every age have excited the interest of man. The unerring instinct which at fixed periods of the year induces them to leave one clime for another, and leads them not only to the same country, but to the same spot, is truly astonishing. Linnæus makes mention of a starling which built in the same tree for eight years, though it migrated every autumn; and swifts and swallows in our own country have been marked and found to return to the same spot for many years; and doubtless many other species would be found to do the same if the experiment were tried. Bird-fanciers also tell us how uneasy and restless caged birds become when their fellows are leaving for other lands, and often do not survive the trial very long. But we must hasten on to the birds themselves, leaving this interesting subject of migration to some future time, or to abler hands.

Taking our visitors in systematical order, and not as they arrive, the nightjar (*Caprimulgus Europæus*) stands first on our list. This bird has an evil name, but it is well for it that it is without any true reason; in days long gone by the poor bird was accused of sucking the teats of goats, and from this absurd accusation received the name of goat-sucker, a name which even to this day it has never lost. It arrives in this country towards the end of May, or beginning of June, and again leaves us about the middle of August, returning, it is said, to Africa to spend its winter. In habits it is semi-nocturnal, solitary, and rather a shy bird. Next on our list comes the white-bellied swift, or alpine swift (*Cypselus melba*); this bird belongs to the well-known group of *Hirundinæ*, or swallow tribe, several members of which are among our most familiar friends; this one, however, is not a common visitor to us, having but rarely been found in Britain. The common swift (*C. apus*) arrives here early in May, and leaves towards the middle of August, making a shorter stay than any other of the swallow tribe. Its black plumage and harsh piercing voice are not attractive, but its powers of flight are truly wonderful, and deservedly claim our admiration. The common swallow (*Hirundo rustica*) is always a welcome and a favourite visitor; it builds a shallow cup-like nest, open all round the top, generally under our eaves, though frequently in the chimney-top, from whence it is often called the chimney swallow. It usually arrives in the beginning of April, and leaves in September, winging its way back to Africa. The forked tail, and the absence of the white patch above the tail, easily distinguish it from the house martin. The purple swallow (*Progne purpurea*) has occasionally, though very rarely, been found in this country; North America is its true home, where it is said to be much beloved and protected. The sand martin (*Cotile riparia*), like others of the tribe, puts in its appearance in April, and leaves early in September; it is the smallest of our Hirundinidæ; its nest is made in holes scooped out of sandy banks, and often in such great numbers that the banks are literally honeycombed. The common or window martin (*Chelidon urbica*) usually arrives here a little later than the swallow, but it is so familiar a bird that we need only mention its name here.

The bee-eater (*Merops apiaster*) is a very rare visitor, its true home is Africa, though it is common in many parts of Southern Europe. The hoopoe (*Upupa epops*) is also another African bird which visits us; in the southern counties it is not uncommon, but it is very rarely seen in the northern; its beautiful plume of feathers makes it a very conspicuous object, and like other rare birds it is sure to be persecuted instead of protected. It is said never to have been known to breed in England.

We are now come to a group of birds which are rightly called warblers, for they contain amongst their numbers some of our sweetest song-birds. They are not much known in Scotland, but most of them are common with us. The white-throat, nettle-creeper, or hay-chat (*Sylvia undata*), is a lively and pleasing songster; it comes to us about the middle of April, and leaves towards the end of September; low bushes, hedges, and underwood, are its favourite haunts. The garden white-throat or greater pettychaps (*S. hortensis*) is another summer bird; it is ever on the move, though seldom coming in sight as it flits about the bushes, thick hedges, and low underwood, warbling out its sweet and mellow tones, which are fuller and richer than those of the last-mentioned bird. The chiff-chaff (*S. rufa*) is the smallest of our warblers, and the first to arrive, often making its appearance in the beginning of March, and stays with us till the middle of October; it has even been seen at Christmas, so that it seems likely that some of its members may remain with us throughout the year. The willow wren (*S. trochilus*) is another of our migratory warblers; it arrives here about the end of March, and leaves about the end of September or beginning of October. The wood warbler (*S. sibilatrix*) visits us in April, and leaves again in August; like the two last species this bird builds a domed nest—that is, one shaped like a ball, with a small hole at the side for an entrance, and it is placed on or very near to the ground. The lesser white-throat (*S. Curruca*), comes to us towards the end of April. The song of this warbler is not so pleasing as most of the others, for though low, some of the notes are rather harsh. The blackcap (*S. atricapilla*)—so named from the black patch of feathers on the top of its head—is, with the exception of the nightingale, the finest and most powerful of our British songsters; indeed, some of its notes are thought even to surpass that bird. It is generally heard about the end of April, seldom before, and though they leave in September a few birds are sometimes seen in the winter. It frequents woods, orchards, and groves, particularly those which are thick and bushy. Next on our list comes the much celebrated nightingale (*Luscinia Philomela*), or sweet philomel. Very little need be said about this well-known bird; it generally comes to us about the middle of April, and leaves again in August. In the southern and midland counties it is a common bird; but in Yorkshire and the North of England it is rarely, if ever, seen. Its song, though heard sometimes during the day, is louder and sweeter at night; indeed, it is during the twilight and evening hours that it loves to pour forth its warbling melodies. In some parts of England the grasshopper warbler (*Salicaria locustella*) is not an uncommon bird, in others it is very rare. Being of shy and retiring habits it lives in localities which are overgrown with long grass, sedges, and such like, amongst which it dives if disturbed. It is called grasshopper warbler from its peculiar kind of note, which greatly resembles that of the field cricket or grasshopper. It arrives here in April and leaves in September. The sedge warbler (*S. phragmitis*) is a most indefatigable songster, and arrives in this country about the beginning or middle of April, and leaves towards the middle of September. It frequents reeds, sedges, and osier beds, seldom appearing far above their tops, and in these quiet retreats its song may be heard throughout the livelong day, and often during the night. The last of our true warblers, the reed warbler, r reed wren (*S. arundinacea*), is nearly as great a songster as the sedge warbler. Its haunts, too, are the waterside, amongst the willows and reeds, and where the herbage is thick and deep to afford it a hiding-place. Like that bird, too, it sings during the night as well as the day. Its nest is ingeniously fastened to the reeds, and remarkable for its great depth. The bird arrives in England about the beginning of April and leaves in September.

The wheatear (*Saxicola œnanthe*), usually arrives towards the middle of March, and leaves about the end of September or beginning of October. This is a very highly-prized bird, but not on account of its song, but for the delicate flavour of its flesh, so that the bird gets sadly persecuted throughout its sojourn with us, particularly in the autumn, when they become very fat, and many thousands are caught and sold in the market. The stonechat (*Pratincola rubicola*) and the whinchat (*P. rubetra*) are two pretty birds, and not uncommon in furzy districts, or where the broom trees abound. The former bird might, perhaps, be called both a visitor and a resident, as numbers of them remain with us all the year round, but very few of the latter are found during the winter. The two birds are often confounded with each other, but the stonechat is readily distinguished by its black head and neck, which in the whinchat is speckly, with a white band over the eyes. This latter bird comes to us in April and leaves towards the end of September. The pied wagtail (*Motacilla Yarrellii*) and the gray wagtail (*M. campestris*) are only migratory birds in the North of England, remaining all the year through in the southern counties, but the yellow wagtail (*M. sulphurea*) or, as it is sometimes called, Ray's wagtail (in honour of that distinguished naturalist) leaves us entirely in September, and returns in the spring. The tree pipit (*Anthus arboreus*), or tree lark, is another of our summer birds, and arrives in the end of April, and departs in September. The mode in which this bird ascends and descends the trees is remarkable; settling on some outside twig it ascends by little flights from twig to twig, singing out its not altogether unpleasant song, till it reaches the topmost branch, where it will sing for awhile, and again descend by similar successive flights till it reaches the ground. In some districts the ring-ouzel (*Turdus torquatus*) is not an uncommon visitor; in habits it is a wild and shy bird, loving the wild moorland, hilly districts, and rocky glens, far removed from human haunts; it comes to us in April, and leaves by the end of September. The song notes of this bird are few, and though loud and wild, are not unmusical. The beautiful golden oriole (*Oriolus galbula*) is an extremely rare bird with us, but having been occasionally found in Britain it claims passing notice here. Two species of flycatchers are found in England, the spotted flycatcher (*Muscicapa grisola*) and the pied flycatcher (*M. atricapilla*), and both, as might be supposed, are summer visitors; the former is common, especially in the southern countries, but decreasing as we proceed northward; it is a late arriver, often not making its appearance till the end of May; it is found in gardens, copses, and shrubberies, particularly where flies abound; the latter bird is not uncommon in some localities, though never found in any great numbers; it arrives here in April and leaves in September. The whole of the under part of this bird is white, while in the former the front of the neck and breast are speckled.

The red-backed shrike (*Lanius collurio*) or lesser butcher bird, is not uncommon in many places; its food consists not only of insects, but also of small animals, reptiles, and unfledged birds, which it impales upon thorns, after the manner of the rest of its kind, before devouring them. The time given for its arrival is the end of April or the beginning of May. The woodchat shrike (*L. rufus*) is sometimes found here, but generally speaking is very scarce.

The pretty wryneck (*Yuux torquilla*) now claims our notice. It belongs to the order of *Scansores*, or climbers, birds which have their toes placed two in front and two behind, which arrangement enables them to climb up the trunks and branches of trees with great facility. The wryneck heralds in the cuckoo, appearing just before that bird. It is often called the cuckoo's mate or cuckoo's footman. Its food consists principally of ants and their eggs, using the tongue to pick them up with instead of the beak; and wonderfully is it adapted for this purpose, the bird being able to extend it some little distance beyond the beak; and it is horny at the tip, and covered with a glutinous substance, and so rapid and unerring does it dart in and out that the ants disappear like magic. The voice of this bird is not very musical, but when once heard is not easily again mistaken. That welcome messenger of spring, the cuckoo (*Cuculus canorus*), is a visitor more often heard than seen. It arrives in April and leaves in August. It is well known that the cuckoo never builds a nest or hatches its own eggs, but trusts this important duty to some other bird, generally to the hedge-sparrow, the pied wagtail, or the meadow pipit, though sometimes this business is forced upon the lark, chaffinch, or blackbird. But perhaps it is not so well known that the young cuckoo is not at all merciful to the young birds that are hatched in the nest with it, but throws them all out, remaining sole occupant; and not only is this instinct instilled into the cuckoo at a very early stage of its existence, but it is also peculiarly formed by Nature to accomplish these feats, the shoulders being very broad, with a slight depression down the back, in which the young birds are lodged, while the little cuckoo shuffles to the edge of the nest and tosses its burden over.

Next on our list comes the passenger pigeon (*Ectopistes migratorius*). This is, rightly speaking, an American bird, where it is met with in prodigious numbers; but with us it can scarcely be called a visitor, it having been so very few times found here. The turtle dove (*Turtur auritus*) is a very pretty bird, especially the male, and the smallest of our wild pigeons. Its entire length is a little over eleven inches, and weighs not more than six ounces. It arrives here early in May, and leaves by the beginning of September.

The quail (*Coturnix communis*) is another regular summer visitor, though never found in any great abundance; in many places on the Continent, as well as in Asia and Africa, it is found in prodigious numbers, flocks of many thousands being seen in the course of the day. In general appearance and manners it strongly resembles the common partridge; but differs from that bird in being a polygamist, and the care of bringing up the family is left to the female bird. It comes to us in May and leaves in October.

The great plover (*Œdicnemus crepitans*) comes to us in April, and leaves in September; it is not an uncommon bird in marshy places and open downs, but is nearly confined to such districts; its call strongly resembles a very shrill whistle; it seeks its food principally during the night. The dotterel (*Charadrius morinellus*), or foolish dotterel, was in former times a much commoner bird than now; on its first arrival it frequents heaths and open grounds, but these it soon leaves, and betakes itself to high hills and mountains, particularly those bordering on lakes; like the last-named bird it is a nocturnal feeder. The ruff (*Philomachus pugnax*) and the reeve are the same species of bird, the former being the male, and the latter the female; the male is so named from having a most capacious ruff of feathers round the neck; which can be raised or lowered at the will of the bird; this ruff, however, is only found during the breeding season. They were once very common visitors to our fenny districts, but are now fast decreasing, owing to the drainage and cultivation of those localities. When fat the birds are much prized for the table. They arrive in April, and leave by the end of September. The corncrake (*Ortygometra crex*) is a regular visitor to most parts of Britain, though rarely found in any numbers; it arrives about the same time as the quail, when its cry of "crake! crake! crake!" may be heard at almost all hours of the day and night, particularly during the evening, but to tell whereabouts the bird may be is a difficult, if not impossible, matter. We are now come to the last bird on our list of summer visitors, the spotted corncrake (*O. porzana*.) This bird is by no means so common as the last; but still it is known to visit some of our marshy lands, and to breed there. And now having finished these brief notes on our summer birds, I must conclude without any further remark upon them, my letter having already run to such a length.

AVON.

GRAVITATION AND REPULSION.

[4089.]—WITH reference to Mr. Proctor's accusation in letter 4053, p. 172, that I endeavoured to convey the impression of Ganot being on my side, because in letter 4008, p. 144, I commended the able reasoning in Book III., Chapter 2, of his "Elementary Treatise on Physics," I have to remark this is so far from the fact that the very first statement in Book IV., Chapter 1, is opposed to my ideas concerning the physical forces of matter—namely, "Gases are bodies whose molecules are in a constant state of repulsion." I deny the existence of a repulsive force in nature, and invite Mr. Proctor to give a single instance of its action.

T.A.

"T. A." AND GRAVITATION.

[4090.]—IT seems the corrected "proof" of letter 4053, page 172, did not reach you (as usual) in time. In it I modified the remark at the close of the letter, considering that, after all, "T. A." might be able to explain what looked to me like a *suggestio falsi*. Should this appear to be the case, "T. A." will oblige me by considering my apology as made herewith.

RICHARD A. PROCTOR.

[The corrected proof did not reach us in time.—ED.]

COAL-CUTTING MACHINERY.

[4091.]—THE introduction of such machinery as alluded to on p. 140 is not a question of economy only, or even chiefly. If such machines are to be worked, as the most promising now are, by compressed air, which, when it expands on escaping, becomes very cold, their use will introduce large quantities of fresh and cool air in the very places where the men are working, adding greatly to their comfort, and something to their safety. One I saw working reduced the temperature of the gallery about ten degrees in an hour, which would have been considerably raised by a dozen lamps and a dozen pair of lungs, had not cold air been introduced. A still more important advantage will be that the pitmen will be saved from the most dangerous and injurious part of their toil—that of holeing—*i.e.*, undermining the seams of coal. On the average, 416 pitmen are killed a year by falls of coal or roof, and a far larger number crushed and maimed—a large, but to me unknown, proportion of which accidents occur by coal unexpectedly falling upon the men when undermining it. To this danger, those who work the machines will be very much less exposed, as they need not lie beneath the coal at all, as the hewers must do when holeing. I have no clear evidence that holeing is injurious work, but cannot doubt that working in so constrained a position—with the mouth and nose full of coal dust, which has to be coughed up as black spit—must be hurtful, and I know that metal miners complain greatly of the somewhat similar work of beatin[g] the borer as very trying and exhausting, and it is ju[st] the sort of work one would wish to have done by m[a]chinery, if it can be.

P. H. HOLLAN[D]

VENOMOUS SERPENTS.

[4092.]—In the discussion on this subject printed in the last volume, I ventured to doubt (p. 368) whether any warm-blooded animal is proof against the poison of the thanatophidia save one of their own kind. It has also been frequently asserted, sometimes in well-informed quarters, that the mongoose is able to throw off the effects of the cobra-bite, by partaking of a certain herb, which it immediately seeks when bitten. I have recently come across some further information on this point which I beg to submit to your readers. It is from an assistant of Dr. Fayrer, and will be found in the Transactions of the Boston Natural History Society for March, 1871. I learn from this that the mongoose, when attacking the cobra, seizes it by the neck or throat, and usually retains its hold for a few seconds, at the same time sucking the bood from the large vessels in its neck. Sometimes the snake and mongoose roll over together several times, and there are some so ignorant of the habits and powers of these animals, as to suppose that during this time the weak jaws of the cobra are holding the mongoose, and on seeing the blood about its head and mouth think that it comes from wounds on its own body, received from the fangs of the cobra.

Another mistake is often made in supposing that the blood frequently seen on the cobra's nose comes from a wound inflicted there by the mongoose. And assuming this to be the case, the question was often asked how the mongoose bit the cobra's nose without receiving in return wounds from the cobra's fangs. On carefully observing the movements of the cobra when snakes and other animals were put into its cage, Mr. Sceva found that it would strike at them with its nose without opening its mouth, and in many instances the cobra, by striking past them, would bruise its nose on the side of the box, or against the wire-netting in front, causing it to bleed. This occurred in every case he witnessed of cobra encounters with the mongoose.

Dr. Fayrer made the mistake in one of his first experiments of thinking the mongoose bitten when it was struck by the nose of the cobra, and as the mongoose did not die, his report, published in the *Indian Medical Gazette*, stating that the animal was "bitten," was regarded by some as conclusive evidence that the poison must have entered the blood, but could produce no bad effect on it. Dr. Fayrer, however, soon discovered that when animals were put into a box with a cobra it was very difficult to tell—merely by watching the snake's movements—whether they were bitten or not; and in nearly all the experiments made afterwards he had the animal secured, and the fangs of the snake applied to any part of the body required, or the poison taken from the snake and injected under the skin with a hypodermic syringe. Several experiments were made on the mongoose by both methods, causing its death in every case.

Mr. Sceva believes that hogs attack and kill poisonous snakes in almost every part of the world. He has never seen a hog at the commencement of his attack upon a poisonous snake, but on one occasion he saw one with both fore feet on the snake's head and neck while he was tearing open the body with his teeth. He has met with many people in North and South America, and in India, who thought that the venom of snakes could not affect the hog, but this supposition has been proved by careful experiments to be incorrect. In India he had seen a hog bitten on the ear and on the inside of the fore leg; the action of the poison and the time of the hog's death were shown to be about the same as in the case of dogs.

"E. L. G." will thus see that, in the opinion of one who has experimented with the living animals, hogs are not proof against cobra-poison. Whether in the event of a bitten hog not dying, there was no poison injected, or its "fat" coat protected it, we cannot easily decide; but the venom of these terrible reptiles once in the blood, no human power seems able to prevent death.

SAUL RYMEA.

CO-OPERATIVE SOCIETIES.

[4093.]—The system of duplicate cheques I described would, of course, be imperfect unless the cheques are given in all cases; nor, indeed, unless there be a money-taker as well as a seller, and unless collusion between them be prevented. If, however, the seller be required to give a cheque in all cases for the money he receives, if the omission to do so be treated as a serious fault, or even as presumption of dishonest intention, and if all customers be requested to see the cheques written in the book, and that they correspond with the money paid, the system, though not perfect, would be an important guard against either mistakes or fraud, or the suspicion of it.

The plan described by "Loach," besides being much more troublesome than the cheque system—which is much less costly than he seems to suppose—is open to the very serious objection that it affords no protection to the buyer against short weight or inferior quality of goods, against which it is even more important to guard than against direct embezzlement.

I think the cheque system the better plan of the two, but there is no objection, except the trouble involved, to the adoption of both. The advice of "F. C. S.," that those interested should read the report of the discussion at the Co-operative Congress, is very wise. In many stores it is customary to allow to customers not members a share, though a smaller one, of the so-called profits—more properly, savings of cost in retailing. The adoption of this plan renders the cheque system less imperfect, but even without it the effect is useful, as is found by some omnibus proprietors, *e.g.*, those of Plymouth, who require their conductors to give every passenger a cheque, and who, I believe, generally do so.

PHILO.

DRILLING MACHINE.

[4094.]—In reply to "Linum" (let. 4039, p. 151), the small wheel below F (see p. 57) is a ratchet-wheel. The crank E has a spring fitting this wheel. The crank is worked backwards and forwards on the wheel like any ratchet-brace.

C. CHURCHILL.

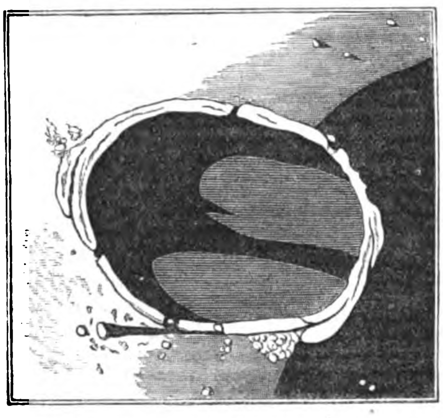
RAISING WATER BY TIDAL POWER.

[4095.]—I think the power of the tides might be used to supersede manual labour for raising water to baths. Suppose, for example, that the rise of the tide is 10ft., a reservoir might be built, or embanked from the shore, and fitted with a sluice, the water passing in and out to work a hydraulic ram. In a rising tide, when it was half tide, the sluice would be opened so as to admit the water gradually into the dam or reservoir, maintaining a fall of 5ft. for nearly three hours, and working the ram for three hours; the sluice would then be closed and the ram stopped, the dam being full; when the tide had half ebbed, the water would be allowed to flow through the sluice and actuate the ram until low water. The ram would need to be turned half round at each tide, or it might be contrived to have its waste water to fall into the sea or into the dam, as was required by the falling or rising of the tide. For example, if the dam had an area of 400ft., 2,000 cubic feet of water would pass through the ram during each tide, and a quantity of this, depending on the height of the baths, would be raised to the bath-rooms (say 250 cubic feet each tide, to a height of 20ft. or 25ft. above high water), or a float attached to a lever might be used to work a forcing-pump. If the float displaced 500lb. weight of water, and was raised a foot high by the waves six times in the minute, it would give 3,000 units of work in the minute, or rather more than a man's power at pumping. I should like the opinions of correspondents.

PHILANTHROPIST.

PLATO.

[4096.]—I inclose a drawing of Plato as I saw it with an excellent 8¼in. clear aperture on April 16 at 9.20 p.m. I noticed that the shadows on the floor had not so good definition as the exterior ones. Know-



ing that Mr. Birt and other observers are readers of the MECHANIC, I thought it would be interesting to know if they observed such a phenomenon. Also, may I ask Mr. Birt if the floor is supposed to be convex, as I noticed that the longest shadow rapidly shortened, and that the edge of the floor was not so bright as the centre?

J. W. D.

[This drawing of Plato is the *earliest* that I remember to have seen in which the shadows are depicted as having fully taken shape. As a companion to Mr. Elger's sketch (ENGLISH MECHANIC, December 15, 1871, No. 351, p. 332) it shows the shadow of the rock δ extending along the floor, with its characteristic truncated termination just within the east border. Mr. Elger's sketch exhibits the same shadow much shortened, illustrating "J. W. D.'s" remark "that the longest shadow rapidly shortened." The floor of Plato is by no means level; as seen under oblique light it dips to the east and west borders, occasioning the phenomenon witnessed by "J. W. D." of the edge of the floor not being so bright as the centre. As regards the definition of the interior shadows not being so good as that of the exterior, Mr. Neison noticed on the 17th and 19th of April the interior objects, especially the streaks, to be less distinct than objects on the exterior slopes, which were sharp and well defined. The gaps in the south, west, and north portions of the wall are well shown in "J. W. D.'s" sketch. Instrument, 8¼in. aperture.—W. R. BIRT.]

THE DELUGE.

[4097.]—May I be permitted to express my hearty thanks to "E. L. G." for his letter (4068), "One Proof of the Deluge," which I think of so great value that, for my two years' subscription to the ENGLISH MECHANIC, I consider myself well repaid by this letter alone? It will be an additional favour if, in his next communication, he will kindly mention the publisher and the date (of latest edition) of the work of which he speaks highly: Colonel Greenwood, "On Rain and Rivers."

Sandhurst, Torquay. P. H. GOSSE, F.R.S.

THE ALCOHOL QUESTION.

[4098.]—In differing from Dr. Richardson as to the cause of the accelerated action of the heart while under the influence of alcohol, Mr. Barwick has, *more suo*, (let. 4052, p. 171) taken a "leap in the dark." Mr. Barwick assumes that after the administration of alcohol the blood is too "suddenly carbonised and hydrogenised" (for there is no proof that it is so), and on this assumption he propounds the theory that "accelerated heart-beats may be from rapid oxidation," leaving your readers to suppose that he has discovered a point overlooked by Dr. Richardson. Now, I have read the article on p. 109 somewhat more carefully than is my wont—for it happens to be written in a style which I should like to see adopted by the teetotallers—and I fail to perceive whence Mr. Barwick obtained his idea of "rapid oxidation." True, if the blood had more than its proper proportion of carbon, it would require more rapid oxidation; but the heart has no sense, it could not know this, and consequently would not pump the blood to the lungs in a more rapid and larger stream unless it received a monition from some source which governs its action. This would make alcohol a stimulant of the heart's action, and this Dr. Richardson is convinced is an erroneous idea. Again, accelerated heart-beats must precede accelerated oxidation, and there is no proof that, even if the blood is "carbonised and hydrogenised," it can be accomplished "too suddenly"—whatever value Mr. Barwick may attach to that expression. There is also no proof that alcohol is split up into carbon, hydrogen, and oxygen in the system; and if there were, his crude hypothesis fails, because rapid oxidation means increase of temperature, which should be sustained while there is any excess of carbon to be burnt. This is contrary to observed facts, for, according to the article on p. 109, there is a steady decline of the bodily temperature after the slight increase exhibited on the surface has radiated, and dram-drinkers know that "drops" require to be indulged in with increasing frequency to keep the cold out.

But suppose we say the accelerated heart-beats *are* caused by rapid oxidation (which reads very like the cart before the horse), if Mr. Barwick had consulted a friend it is very likely that "two heads" would have come to the conclusion that after all Dr. Richardson might be right; for what would be the cause of accelerated heat-beats in the following case:—Given "Saul Rymea" in a narrow lane with impassable hedges, and a mad bull rushing at him, what is it that makes his heart go about three times as quick as it ought to? It can't be "too suddenly carbonised and hydrogenised" blood; is it not rather caused by the conveyance to his brain, through the optic nerve, of an alarming fact, which so acts upon the sensorium as to cause paralysis of the "organic nervous supply of the vessels which offer resistance to the heart"? Other cases will suggest themselves to Mr. B., showing that the action of the heart is regulated by the brain and not by the amount of carbon in the blood. Alcohol is really a true narcotic: it first unhinges those parts of the brain which govern the nervous supply of the vascular system, and so on, step by step, till the nervous centres which govern volition and speech are involved, the last to go off duty being the "seat of life"—the centre which actuates the heart. Now, if Mr. B. can show *how* alcohol so affects the brain, he will be doing a service to science; but he need not bring up ideas that are utterly incapable of holding water, or hypotheses that have been examined and laid on one side as unsatisfactory.

I do not pretend to reconcile the statement in the article that the effects of alcohol and chloroform are "very similar" with Mr. Barwick's dictum that "chloroform's effects are widely different," but the P.S. shows how well able he is to speak on the point. I cannot say either whether there is an accumulation of "molecules obstructive to atomic recombination" because I do not know what he means, or to what the "it" refers. Perhaps some of those better versed in physiology than Mr. B. or myself will explain.

SAUL RYMEA.

ORNAMENTAL TURNING.

[4099.]—Your illustration (p. 146) of a tool for turning short round rods is calculated to mislead any one seeking useful information. No one can cut soft wood with a tool set in a radial line, it must be set at a tangent to the circumference of the rotating wood to be of any use in cutting, and the same cutter-frame will only serve for one diameter of rod.

SMITHERREENS.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4100.]—The object of rifling is to present inequalities in the form of the ball in different directions successively, so that they may not act as rudders to divert the ball from its course; also, as the centre of gravity of the ball does not quite coincide with the, direction of the line of propulsion, the rotation of the ball avoids also this source of deviation. A rifle ball leaving the muzzle at a velocity of (say) 1,000ft. per second makes about 150 turns a minute, but it loses its rotary force more rapidly than its projectile force, and thus at long ranges shoots indifferently. (See "The Story of the Guns," by Tennent). By my plan, the force of rotation, slow at first, would increase. Of course, it is on the principle of Barker's Mill. I had not seen a description of Boxer's rocket when I wrote it; I fear, however, the motion in my ball would be too slow. The holes might point backwards so as to ignite the composition by the fire of the gun.

PHILANTHROPIST.

CONCRETE MULTIPLICATION.

[4101.]—I BEG to thank "Sigma" and "E. L. G." for their replies to my letter (3965), but would like to ask the former wherein lies the extraordinary oversight which he says I have made. I quite agree with him that multiplying pounds by pints or yards is a proposition savouring somewhat of lunacy, but multiplying pounds by pounds or shillings is rather different, and seems to me no more absurd than multiplying feet by feet or inches, as in the example given in my last letter. I may here quote "E. L. G." to the effect that "feet multiplied by feet do not make square feet. Not at all." So say I. Neither do pounds multiplied by pounds necessarily make square pounds. In fact, the expression pounds multiplied by pounds, like that of feet multiplied by feet, is merely a "compendious way of expressing an arithmetical dodge."

Since writing the foregoing, it has occurred to me that, perhaps, "Sigma" may think that arithmetics do not give rules for the multiplication of moneys, weights, &c., in the way referred to. If so, I beg to submit to his notice the following rule, culled from a book now before me (not by Hind):—"Problem: To multiply pounds, shillings, and pence by pounds, shillings, and pence, a pound being taken as the integer." This is the rule: "Pounds multiplied by pounds produce pounds; pounds multiplied by shillings—every 20 is a pound, the rest shillings; pounds multiplied by pence—every 12 is a shilling, the rest pence; shillings multiplied by shillings—every 20 is a shilling, every 5 is three pence, and each 1 is two farthings, and four-tenths of a farthing; shillings multiplied by pence—every 5 is a farthing, and each 1 two-tenths of a farthing; pence multiplied by pence—every 60 is a farthing, and every 6 is one-tenth of a farthing." The author then proceeds to give several examples, all of which I omit for the sake of brevity, and adds the following note:—"The above question (referring to one of his examples) was given in a former edition of this work, but finding so few who could be brought to understand it, the author has entered into it more fully. To those who still stumble at this problem, he begs to refer them to the first and second books of Euclid's 'Elements.'"

My object in writing on this matter, is to draw attention to the fact that the opinions of the leading authorities in "our" journal are at variance with the rules laid down in books published for the instruction and guidance of students. Surely these rules should be omitted or altered, if they appear so absurd to those who are qualified to judge, as every step taken in a wrong direction has to be retraced by the beginner, and the ground gone over again, with more or less of labour and pain. For my own part I always use the rule of practice for such calculations, and consider it the easiest and best.

No. 170.

[4102.]—I BEG to remark that the explanation of "Sigma" (let. 4009) as to concrete multiplication is not satisfactory. It is equally absurd to talk of multiplying feet by feet as it is to speak of multiplying pounds by pounds. A foot multiplied by a foot has no meaning, nor can the process produce a superficies—a thing of perfectly different nature. The arithmetical process of multiplication has no such creative power, nor is it "because there is such a thing as a square" that "linear" feet can be multiplied together, but because we introduce the important step or hypothesis of giving a new and arbitrary meaning to the unit of which the "product" represents the multiple—*i.e.*, that instead of the linear unit, of which the abstract number in the multiplier and multiplicand are the multiples, the unit shall in the product be a superficial foot—*i.e.*, that one foot multiplied by one foot shall be taken to represent a superficial square foot, an hypothesis perfectly arbitrary, as with equal reason and correctness we might assume it to be a rhomboidal foot, the notions of squareness and obliquity being both alike foreign to the idea of multiplication. Another step will be necessary—viz., on this assumption to show that the result holds good for all numbers, or the process may be reversed.

The simplest explanation, as far as arithmetic is concerned, is to suppose the unit changed prior to, and not subsequently or in consequence of, multiplication. If 10ft. multiplied by 12ft. means anything practically, it can only have the arbitrary meaning of the number of square feet in a surface of these dimensions. The best way to ascertain this number is to take a strip along one side a foot wide, say 12ft. long. This will be 12 square feet, for taking a square foot as the unit, and multiplying by the abstract number 12, we get 12 square feet. There will evidently be 10 such strips, and again multiplying by the abstract number 10, we get 120 square feet; and there is no mystery in the matter, nor have we incurred any risk to our personal liberty for having endeavoured to multiply together concrete quantities! M. A.

FASTENING LOOSE WINDOW SASHES.

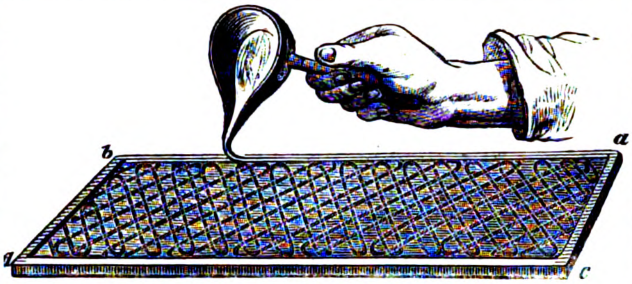
[4103.]—THE plan described at p. 152 seems a convenient one for preventing loose window sashes rattling, but it is a pity they should be pressed quite closely together, so as to prevent the entrance of air into a room at one of the places where it is best it should enter, for enter it must somewhere if an open fire be burning, and if it enter between the sashes so as to displace air previously cooled by contact with the cold glass, more air can be admitted with less loss of heat than anywhere else, except at the top of the window. It is easy to intercept dust and to check too strong a draft, without stopping the entrance of air altogether. PHILO.

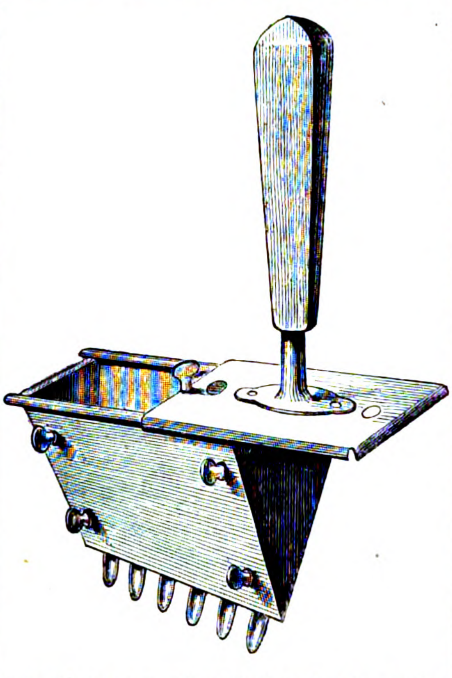
IMPROVED MEANS OF MANUFACTURING CONFECTIONERY.

[4104.]—THE manufacture of confectionery has lately received attention in your columns, so possibly the following may interest some of your readers:—

Monsieur A. E. C. Landry, cook to the Turkish Embassy, has recently patented in England and France, through our agency, an invention for improvements in the manufacture of sultanes and other similar articles of confectionery, and in the apparatus employed therefor, whereby the said articles are made in a much more rapid, perfect, and economical manner than at present.

To make the cylindrical parts of the sultane, or other similar article of confectionery, which has hitherto been attended with much difficulty and labour, Mr. Landry employs a flat mould *a*, *b*, *c*, *d*, similar to that shown in illustration; this mould is made of a suitable metal or alloy of metal, and is cast, or otherwise formed, with a raised lozenge pattern or design, the sides of the raised lozenge-shaped parts being slightly inclined; or the mould may be formed with any other desired design or pattern.





To make a sultane the prepared sugar in a liquid state is poured into the sunken parts of the mould until a sufficient thickness is obtained, but so as not to run over or cover the raised parts of the mould. When sufficiently cool, but while yet in a plastic state, the sugar is rolled over a tin or copper cylinder, and the two ends joined by any of the means well known to confectioners. By this means M. Landry obtains, in a short time, and with but little labour, a hollow cylinder of sugar formed with openings, of the size and shape of the raised parts of the mould. The voluted or other ornamental parts of the sultane, such as the borders, &c., may also be formed by moulds.

The second illustration shows a view of M. Landry's apparatus for forming hair sugar. It consists of a box or receiver made of copper or tin, and provided with a sliding lid, to which is fixed the handle of the apparatus; the ends of the box are fixed to the sides by screws as shown, so that the box may be easily taken to pieces for cleaning; in front of the strips or projections at the bottom of the box are slits for the passage of the sugar. To use this apparatus, the box is filled with sugar in a semi-liquid state, and the apparatus being held in the position shown, the sugar will pass through the slits in the bottom of the box, and along projecting pieces in thin streams or hair sugar, which may be guided according to the effect desired.

L. DE FONTAINEMOREAU & CO.

ELECTRICAL SPARKS.

[4105.]—MY statement that I had been told by a young lady who was well known to me that she had frequently, in America, lighted the gas by electric spark from her finger, the electricity being apparently excited by friction of the soles of her slippers upon the carpet, but that she could not do this in England, because, as she supposed, of the air being less dry, was treated as an impossibility by one correspondent at p. 62, while another (Mr. Tonkes) seemed to consider that in no part of America was the air likely to be very dry, because in other parts ague is often prevalent. I have lately received confirmatory evidence from another lady (whose truthfulness, also, is above suspicion) that in certain seasons the phenomenon is quite common in the neighbourhood of New York, as the correspondent quoted by "G. J. H.," at p. 148, states that it is at Boston. I learn from my informant that some persons only seem able to perform the experiment, but why I have not learned; that it needs for success hard frost out of doors and dry heat within—*i.e.*, a great difference between the dew point and the temperature—and that the feet often have to be repeatedly rubbed upon the carpet to excite the electricity. My informant believes that ordinary slippers were worn, not those with guttapercha soles.

If the theory of those who would pass as authorities on electrical science does not correspond with well-authenticated facts, if not the theory, at least the theorists may possibly be mistaken. It would become them in future to be less positive and more polite.

PHILO.

[When a correspondent makes an extraordinary statement, as "Philo" did, which was discredited, he should, when offering confirmatory evidence, as "Philo" professes to do, authenticate his facts. It is not enough for an anonymous correspondent to repeat observations communicated by an "informant" in America, and it is unreasonable to expect that men accustomed to look at facts scientifically will be influenced by such a mode of teaching. In such matters correspondents will be credited and respected in proportion as they are precise as to persons, places, and dates.—ED.]

A GUN-COTTON ENGINE.

[4106.]—THE invention of a controllable gun-cotton has possibly provided such a material as I have considered necessary for the fuel of an engine, which should be at once comparatively light, somewhat powerful, and, above all, consume a substance in which great mechanical force is resident, without occupying considerable space. A machine of such a character is obviously of the greatest importance. It would probably have considerable influence on the study of aëronautics, while it would certainly be invaluable on tramways in the event of proving safe and uniform in its action.

The conditions above mentioned seem to me to point in the direction of explosives, but as they are so violent in their action, formidable obstacles to their employment in this direction are presented. But by the invention of the controllable gun-cotton, which is said to be moderated in its explosive properties by the application of saccharine matter to the filaments, it does seem to me that, if no considerable loss of force is sustained by the addition of the moderating elements to the extent requisite, some approach to its employment as a source of mechanical force is at hand. May I, therefore, ask some of your practical readers whether an engine with a cylinder into which a cord of such prepared gun-cotton is driven, and portions exploded by being cut off at the orifice, permitted to fall between the poles of a battery inclosed therein, and so to propel the piston by the agency of the evolved gases, presents any obviously insurmountable defects? It would be necessary to realise the condition that but a small quantity of cotton would be consumed at each charge, and not to confound the violence of the concussion resulting from the firing of a piece of artillery, which has to do immense work at a considerable distance from the seat of the development of force, with the working of an engine subject to a somewhat uniform pressure upon its motion, and for which some means might be devised of approximating the production of force to the amount of resistance to be overcome; in which case I apprehend the concussion would be reduced to an inconsequential minimum, and the evenness with which the quality of gun-cotton may be prepared would go far to fulfil the conditions.

E. J. N.

THE FAIRLIE LOCOMOTIVE.

[4107.]—WILL you kindly find room for the following few lines in reply to Mr. Amos Appleyard (let. 3966), also to Mr. G. A. Boyd (let. 4041)?

It is clear from the style of reasoning in Mr. Appleyard's letter that he does not understand the principle of the Fairlie engine. It would appear that weight of rails, their maintenance, weight on wheels, wear of tires, equal loaded wheels, absence of oscillation, perfect articulation, absence of friction, have no meaning for him, hence his proposal to build ordinary engines (if he could) as powerful as the Fairlie tried not long ago in Yorkshire.

Mr. Boyd could have easily supplied himself with the information he seeks, as it has been frequently published, and, I believe also, in your very excellent journal. However, to save Mr. Boyd the labour of searching, I now give him shortly the information he seeks. Why Mr. Allan did not do so I am unable to say; but as the letter was addressed to me, I gave it for the benefit of your readers, just as it is. "Welsh Pony" and "Giant": cylinders, 8in. diameter; stroke, 12in.;

wheels, 24in. diameter; representing at the periphery of the wheels, with 1lb. pressure, 32, or 64 for the two engines. "Little Wonder": cylinder, 8 3-16in. diameter; stroke, 18in.; wheels, 28in. diameter; representing at the periphery of the wheels, with 1lb. pressure, 62, or only 96·8 per cent. of the "Giant" and "Pony." The "Wonder" weighs 19¼ tons on 8 wheels, load equally distributed over each. The "Pony" and "Giant" weigh 10 tons each—that is, 20 tons on the same number of wheels. The "Pony" and "Giant" are four-wheeled coupled tank engines. It is quite true that some one out of a lot of identical engines may turn out more economical or more extravagant in fuel than others, but I never yet heard of a difference of 25 per cent.—Mr. Spooner asserts the saving to be over this—on the work done.

I think Mr. Boyd is in error in saying Fairlie bogies were ever used before the first engine on this principle was built.

It should be understood that the Fairlie engine is proposed for economy pure and simple, the nature and extent of the traffic having nothing to do with the question. It only happens that Fairlie engines have been ordered for duties which could not possibly be performed by the ordinary engine—necessity has here driven the purchasers to this type of engine; but because necessity compels this it does not follow that a great economy would not result by employing the engine on the ordinary duty. I assert most confidently this would be the case, and I am in hopes of seeing the engines employed for every duty which can possibly be required for a locomotive.

If Mr. Boyd would only think for a moment he would find the great economy of a Fairlie engine arises out of its running without oscillation with only half the weight on the wheels, and yet giving out as much force as the ordinary engine. You can remove a bogie from a Fairlie engine and substitute another without dropping the steam in the boiler. If Mr. Boyd will take the trouble to obtain my specification of my radial carriage and waggon couplings he will be better able to say whether it is the same as described in the "Encyclopædia" to which he refers. Not knowing what is in the latter, I cannot enlighten him; perhaps some one of your numerous readers would do so.

I have built and am building engines on 2ft. 6in. gauge to work gradients of 4 per cent: and curves of 150ft. radius. R. F. FAIRLIE.

WEIGHT OF THE EARTH AT CREATION AND NOW.

[4108.]—I HAVE to thank "E. L. G." for his letter (4068, p. 175) in your last number, in which at last he gives us something tangible to go upon. As he appears to rest his case entirely upon physical appearances, I will not trouble you with any palæontological evidence to the contrary; but will content myself with pointing out one or two causes at present in action which seem capable of producing the sweep vales and undulations which he attributes to the action of a flood; one of these causes is the solubility of lime in rain-water, this acts precisely in those parts of the country where there are few streams—that is to say, where the ground is so porous that the water percolates through instead of forming surface rivers; each drop of rain carries off a particle of limestone, and so in time rounds off the edges. This action is well marked in the chalk downs; in fact, in all countries where soft limestone forms the superficial stratum; but in those places, such as Wales, where the hard palæozoic rocks predominate, we get the ravine formations, so graphically described by "E. L. G.," because all the rain collects in surface streams, not being able to permeate the strata. The other cause to which I have alluded acts universally in this and higher latitudes, and rounds off the edges, more or less, of both hard and soft rocks. I mean the action of alternate freezing and thawing. It seems to me that these two actions are capable, either separately or combined, of explaining the phenomena in question, without calling in the aid of comets, or any other extraneous agencies whatever.

P. SANTALINUS.

THE ATOMICITIES, VALENCIES, &c., OF MODERN CHEMISTRY.

[4109.]—IT is amusing, were it not to some extent pitiful, to observe the page upon page of conflict and disquisition on the varied aspects of useless hypothesis; but it is encouraging that Mr. Bottone "is beginning to doubt the existence of valency;" and G. E. Davis and "many other chemists have for some time past denied it *in toto*."

Quite on a par with this is the intensely hypothetic character of molecules, as apart from atoms. If I understand rightly, Wurtz and some others regard the triatomic N or P as forming a molecule PCl_3, which combines with another molecule, Cl_2. "But," says G. E. Davis, "this harmonious reasoning is destroyed when we unite PCl_3 with one-half molecule of O, or replace the 2 Cl with one atom of O, or one-half molecule of oxygen. Surely there is no molecular force where there is no (whole) molecule. . . . I do not believe in molecular combination." But, in reply to "Eclecticus," he is obliged to resort to this hypothetic bewilderment, and the voltaic circuit consists of an interchange, not of atoms, but of molecules. "'Eclecticus' is quite right about the relative weights of platinum, &c., deposited, with reference to one H in the circuit, or atomically; but for every diatomic Pt there are two H liberated molecularly." Be it so; but, like all shifts and dodges, this is incomplete. Truth is simple, and cannot easily be circumvented; and the greatest point with "Eclecticus" was that one atom of Pt, Cu, or K replaced one H in the type ammonia, &c.

I have long wondered at the idea of molecules, and half considered them as useless or unmeaning; I shall henceforth, or until I see some evidence of their existence, consider them as mischievous and confusing.

Why is not an equivalent of cyanogen, of ethyl, or of ammonium, as essentially atomic as any metallic or other element? They all evince chemical functions perfectly identical, and replace each other, atom for atom. "But," says an objector, "one is an element, the other is a compound." Granted; but what is an element beyond the expression of human ignorance? Berzelius thought his vanadium was an element; we now know it is a compound. All unnecessary assumption is weakness, and the great fact to lay hold of is, that elements (or radicals) combine with or replace elements, and the atomicities, the valencies, &c.—or, as I should put it, the ratio or type of combination—is mainly dependent on their difference of electro-characters.

By the same law, and in the same relative way, compounds unite with or replace compounds, whence result double oxides, double chlorides, and double sulphides. G. E. Davis says, "The chlorides of the heavy metals unite with the chlorides of the light metals." There have been many riddles propounded in the name of atomic weights, but none of these things will stand a fair and close investigation, not even the beautiful and very useful law of vapour densities. It would be easy to show that weight stands for nothing, where relative chemical force means everything. The alleged diatomic oxygen unites with alkaline metals in the ratio of 1 to 1, with some others 2 to 1, ascending to bismuth and gold 3 to 1, while with its upper or nearer congeners, acids are formed with 5 and 7 to 1. Where, then, are the definite valencies or atomicities, *per se*? and a closer examination will show tendencies to all the intermediate ratios of 1¼, 2½, 3½, &c.

These plain facts of old chemistry, with the ½ vol. O, are strictly paralleled with the 1 vol. monad chlorine, and the same law equally applies to the iodides, bromides, sulphides, &c. G. E. Davis takes up the challenge of "Eclecticus," and essays to prove that Pt replaces 2 H, and gold 3 atoms. We remark, first, that the proof aims at too much, because it is the diatomic Pt which ought to replace 2 H, as it undoubtedly does, being 2 atoms; whereas, if Mr. Davis be correct, this Pt must replace 4 atoms of H. This, therefore, leads to my second remark—viz., the attempted proof is utterly irrelevant and invalid, for by it we can prove either 2 or 4.

Modern chemistry is becoming exceedingly rich in facts of substitutional displacement, but all cases prove that these metals, whether diatomic or triatomic, only replace 1 H, as in the varied chloride of ammonium, H_3HNCl; chloride of auro-ammonium, H_3AuNCl; chloride of plat-ammonium, H_3PtNCl. How, then, does G. E. Davis prove the contrary? He says, referring to the old notation:—

$$\text{Trebly condensed molecule of water } \left\{\begin{matrix} H \\ H \\ H \end{matrix}\right\} O_3.$$

$$\text{Auric oxide } \{ Au''' \} O_3.$$

$$\text{Doubly condensed molecule of H chloride } \left\{\begin{matrix} H \\ H \end{matrix}\right\} Cl_2.$$

$$\text{Platinum bichloride } \{ Pt'' \} Cl_2.$$

Hoffman similarly notates 14 condensed molecules of water, &c.; but, in the name of common sense, what are these molecules but fictions of the imagination? And with such license, what may we not prove? We thus prove that platinum replaces 4 atoms of H; the modern Pt is notated thus, $PtCl_4$. Therefore—

$$\text{Quadruply condensed molecule of H chloride} \left\{\begin{matrix} H \\ H \\ H \\ H \end{matrix}\right\} Cl_4.$$

$$\text{Platinum tetrachloride } \{ Pt'' \} Cl_4.$$

Further remark is quite unnecessary.

ECLECTICUS.

A STUDENTS' COMPLAINT.

[4110.]—MAY I be permitted to pour out my complaints to your readers? perhaps some are similarly situated, and if so, united action may remedy the evil? Then, sir, I sent in my name for examination to the Local Committee of Science in the town wherein I reside. In due course I presented myself for examination, other students also being there. The time appointed for giving out papers came and went, and so on for half an hour. About twenty minutes to eight (instead of at seven) I commenced my paper. It was well within my grasp. I exulted, and scribbled away as hard as I could. One or two catch questions caused some trouble; time went by, and write as fast as I could, by ten o'clock I had answered six questions. I thought that I should get my three hours, but no, the gentlemen conducting the examination asked for my papers. We did not commence till late, I said. Time is not up. "I can't help that," was the answer, and I had to deliver up my paper. According to Government instructions, the gentlemen who attended during the first part of the examination, and who were not punctual, had been relieved by others who were punctual, and probably had other engagements requiring punctuality. Now, sir, I have to suffer for this. I had no time to look over my answers again, or to finish the required number. The examiner, of course, has nothing to do with this, and I fail, not because I can't answer the questions, but because inexorable fate compels me to scrawl on without regard for "method" or anything, and to do three hours' work in something like two and a half hours.

A DESPERATE CHARACTER.

DR. CARPENTER AND PERSPECTIVE.

[4111.]—IT is extremely disheartening to discuss any matter with "E. L. G." (let. 4044, p. 152); he is so very Laputan. I am only astonished that a man of his mathematical attainments should believe in what is called parallel perspective. I am quite sure there is, in strict truth, no such parallelism possible. Pictures are nothing to go by, because we all know they are conventionally arranged. Let me remind "E. L. G." that when we look at any object bigger than a mere spot, we must, to see it all, move the eyes, which is equivalent to altering the direction of the camera. Let us, instead of the exceeding high tower, take a long wall perfectly equal in height. Now we know that the very first axiom in perspective is that all objects diminish as the distance increases. We also know that a straight line can touch a circle but in one place. Let "E. L. G." station himself in front of this wall and he will see at once that the height diminishes even within the 45°, which he may, perhaps, include in his view. If the wall were infinitely prolonged, would it be the same height as far as visible? "Oh! but," "E. L. G." would say, "you must not move your eye or your camera." Then you will see, not a wall, but a small portion of a stone or brick. Therefore, the top of a high tower being farther from the eye than its base must, although really of the same breadth, appear to an uncorrecting eye narrower. Which was to be demonstrated. M. PARIS.

[4112.]—THE difficulty raised by "Bobo" (let. 4067) p. 175), and which has more than once, I believe, been raised even in your pages before, is more real and practical than "Bobo" probably imagines; for though artists have never to represent a tower ten miles high, or any earthly straight object with one part forty times as distant as another part, this is really required in representing some phenomena of scientific interest, as auroral beams. I know not whether these beams are usually perpendicular to the earth's surface, or so directed that all their feet prolonged downwards would meet in her centre; but this certainly *was* the case in the only two displays I have been lucky enough to witness of decided "merry lancers," or separate beams, or "streamers." Though the forms of the curves, or lower curtain edges, whence they seemed to ascend, were very different (after making all allowance for perspective), yet all the lances, it seemed obvious to me, would meet in the zenith, to which some, indeed, nearly extended, and must thus have been all vertical, while much longer than "Bobo's" ideal tower, their feet being certainly some scores of miles, and tops some hundreds from the ground. And this parallelism contradicted all paintings and diagrams I had seen, which (being assumed, as we habitually assume all pictures to be, on vertical planes) yet never represent the beams by paralleled lines, but either diverging upward or (much less commonly) converging upward. The latter would be right if we suppose the painter, for the sake of embracing more sky, to have assumed an overhanging plane of projection, in delineating the auroras I saw.

This has occasionally been done, even in representing (or at least photographing) some remarkable scenes, mountainous or even architectural. The most singular and instructive case is a stereogram, that I recommended to the notice of M. Paris in one of his perspective puzzles, that was published some years ago, of Salisbury spire, viewed from the ground, within, I think, less than 100ft. (or a quarter of its height) from its base. To view that stereogram intelligibly, you have to place it in a 6in. stereoscope, stand with your back to a window, and look up toward a point in the ceiling two yards inside the window, when the effect will be marvellous; the architecture towering up all solid, square, and plumb, though in the views regarded apart it is a confused, tumbling mass of distorted turrets and pinnacles, as if thrown in a heap, like toys out of a box; and not even, like the toys, each piece rectangularly or intelligibly formed in itself!

E. L. G.

[4113.]—IN perspective, I believe, the rule for limiting the amount of view represented in a picture is that the rays of light coming from the extreme objects on either side to the eye should form there an angle of 60°. This applies vertically as well as horizontally. By this rule, in order to sketch a tower of the supposed height, one must be at the distance of about seventeen or eighteen miles. According to "Bobo's" own showing, one must, at a distance of a quarter of a mile, look in two separate directions in order to see the whole of the tower, which, of course, makes it necessary to have at least two separate pictures to represent it. It is rather hard to expect to see shown in one drawing that which cannot be seen in one view. CERVUS.

FAITH, SIGHT, AND MYTHOLOGY.

[4114.]—WHEN I remarked (p. 146, let. 4011) that our valued "F.R.A.S.," instead of supporting his scoff at the "quasi-mythical Noachian Deluge" (p. 61) by any single bit of either his own science, or geology, or even what goes for geology in England nowadays—even a bit of Lyell or Scrope—had "only given us" a most notorious or sensational line or two from a writer so extremely ungeological and professedly unlearned in physical science as Bishop Colenso, "exactly copied with all its blunders," I did not think any one would suppose this to imply *verbal* copying. Of course any one who referred to the bishop's preface would see that "F.R.A.S." had not copied its words; and, as he tells us he has this week made his first acquaintance therewith, of course he had not *directly* learnt the matter therefrom. But nevertheless it had reached him from that source, and he had *unwittingly* reproduced nothing else than the bishop's hypothetical argument, point for point, and blunder for blunder, with all the Chinese exactness I have said! The explanation of course is, that though he had never seen the book, this particular bit of blundering (either its words or its matter) he could scarce avoid having seen, with all educated England; because there was no newspaper or periodical in England seven years ago that could let Colenso alone, and probably not a single notice of his book, long or short, which did not either quote or paraphrase this very sentence! The reproduction by "F.R.A.S.," therefore, is very natural, though he may as little know whence he got it as he knows what farm grew the corn of his this morning's breakfast roll.

But the astounding marvel of this matter, which will some day yet excite great attention, is this: that not merely your correspondent, not merely many another "F.R.A.S.," not merely all these newspaper critics, and the bishop's hundred answerers, for these ten years; but the bishop *himself*, in edition after edition, was, and remained, and remains, so very far from *once* caring to ascertain whether there were any such facts as the hypothetical ones that he meant to argue from,—so very far from this, as never even to have taken the small care to understand his own argument! never even once to have made it go on all fours, by so much as setting down on his paper the hypothetic facts necessary to have made it any argument at all! Just turn to the sentence, as quoted by "F.R.A.S." (p. 171, let. 4048, line 11), which is as the bishop, observe, has republished it about twelve times—and suppose every word verifiable (as probably it is), and *verified*—"Volcanic hills of vast extent, which must have been formed" (of what? say "adamantine" lava, as our correspondent, "Manus," forms those in India) ages before the Noachian deluge" (say, with "F.R.A.S.," 60,000 years ago), "and which are covered with light and loose substances, that must have been swept away by a flood, but do not exhibit the slightest sign of having ever been so disturbed." Marvellous! Probably some are "covered," too, with grass or bushes "that must have been swept away by a flood, but do not exhibit the slightest" disturbance!

You see, the episcopal wanderer into geology, and equally our astronomical one after him (who reproduced this precious feature with Chinese exactness (let. 3960, p. 117, par. 2), each of them is in too furious a hurry even once to see (the bishop once in ten years!) that to make any argument at all, he should have told us that the very *same* things which were older than Noah were undisturbed! or that the very stuff he says is undisturbed, the *same* stuff is older than Noah! This identity neither of them *once* implies! Says Colenso, "Hills which must *have been* formed ages before" Noah, and "*are* covered" (not *were* covered, observe) "with light and loose materials," &c. Says our "F.R.A.S." (p. 117), "Mr. Scrope and every one who has examined . . . *the volcanoes* . . . are agreed in referring them to a period . . . &c. . . . Pliocene." And then, "on the steep sides of these cones *lie* undisturbed, scoriæ," &c! The *hills* antediluvian, and the *coverings* on them undisturbed, ergo there has been no flood! Well, by the same rule, how could there be a bishop ten years ago in Natal, when the coat Dr. Colenso wears was not made?

"Oh, of course, he *meant* to write that the *covering* was completed those ages ago, as well as the hill; or else that a flood would have swept away hill as well as covering." Of course, we know he *meant* to write some such thing, every one means to write something and not nothing. But here is the point: though he *meant*, he *never wrote* it! Your authority for turning history and oracles upside down, putting out your eyes and "walking by faith," is a man so far from ascertaining whether facts or figments are his foundation, as not even to care (in ten whole years) once to write *what he means!*

Well, our "F.R.A.S." finding he has got himself into a job here, and not being able *this* week to furnish us with the pumice-stone evidences, that you may not be kept waiting quite in the dark, proceeds to favour us with a professed quotation of (or rather through) his new episcopal instructor, from Professor Owen, who is doubtless all that he says. But this italicised passage (p. 171) really strikes me as rather stale news either to a Christian or Unchristian "Young Men's Association." Why, supposing any one so *very* Christian as to have seen no book but the Bible, it would hardly have been news that a "*notion of the divergence of all existing air-breathing or drownable animal species from one Asiatic centre*" (and the present geography) was untenable; supposing so anile a "notion" to exist. Let us see (Gen. ix., 10, "And I, behold, I establish my covenant with you, and with your seed after you; and with every living creature that is with you, of the fowl, of the cattle, and of every beast of the earth with you, *from* all that go out of the ark, *to* every beast of the earth." That is not much like any such "notion." What *could* the "knowledge" be that the Christian young men needed a professor to tell them was "incompatible" with it? Were they ignorant whether Australia joined Asia? whether there were any ornithorhynchus or kangaroo? whether pumas and jaguars could get to South America through the northern ice?

Where did I complain that the Geological Society ignored anybody? or that any of them refused information civilly asked for? Only one was ever asked by me for any, and was very courteous, and gave information I shall produce in due time. Meanwhile, as it is "F.R.A.S." and not I, who gave your readers the pumice-stone statements, I cannot see what business any of us have writing for information except from or through *him*. Does he mean to retract them as mistakenly supposed to be known, or to show us *how* they are known? As for our "bettors," and the paper in which I offered not a *bet* but a subscription toward the expense of settling this matter of fact, it was not *Bell's Life*, as he conjectures, but the High-Church *Guardian*, wherein Colenso (then in England) and sundry opponents (all clerical, and all assuming his science absolutely faultless, only *unknowables* wrong!) and defenders (as the late Professor Daubeny, and Professor Ansted, F.G.S.) were writing all at once, and of what they wrote I can assure him the end is not yet.

E. L. G.

TERRESTRIAL GRAVITATION.

[4115.]—I THANK Mr. Proctor for his reply to my letter, but I am still of opinion that the proof given by Thomson and Tait, of the attraction of a sphere on an external point is independent of the integral calculus, even with his extended meaning of the calculus, and I think Mr. Proctor will at once admit it, as he states that he would consider "a simple proof of the problem, such a proof as is given of the corresponding problem, for the attraction exerted by a spherical shell on a particle within it." The proof I refer to is just such a one. Shortly, it is as follows:—A line being drawn from centre of attracting sphere (C) to attracted particle (P), a point (V) is taken in that line, so that C P : r : : r : C V; r being radius of sphere, it is shown that if any double cone of very small vertical angle be drawn, having vertex in V, the elementary spherical areas H H', included within the conical surface on opposite sides of sphere, exert an equal attractive force on P; the resultant consequently bisects the angle H P H', but the line P C also bisects this angle.

The expression for the attractive force of these two opposite elementary areas, H H', is found to be $2\rho\omega\frac{r^2}{CP^2}$, ω being the solid vertical angle of the cone. Consequently the total force of the whole spherical shell must be equal to $\frac{4\pi\rho r^2}{CP^2}$; 4π being the sum of all the solid angles that can be described about a given point. The numerator of this expression represents the whole mass of the spherical shell, and the denominator the square of the distance of the attracted point from the centre of the sphere.—*Q. E. D.*

Now, in order to understand the complete demonstration of the above, no further knowledge is wanted than elementary geometry and the rudiments of trigonometry. I should be happy to send a more detailed demonstration if any of your readers not acquainted with the calculus should like it.

F. N.

NEW DOUBLE STAR IN VIRGO.

[4116.]—THE following fine double star was found last night:—

VIRGINIS = P XII., 104, 12h. 23m. 23s., S. 12° 40′: 6½, 12 : 356¼° : 3″.—This interesting double is *p*, and nearly equidistant from two 6m. stars about 1° apart, lying *n* of δ Corvi. These bright stars (not shown on Proctor's maps) are 45 B and 48 B Corvi of Argelander. The position angle given above is the mean of two or three micrometrical measures, but as the telescope was moved only with the tangent screw, the result is perhaps but little better than a careful estimate. No attempt was made to measure the distance. The companion, however, was seen perfectly with the strongest possible illumination. Having seen this pair but once, I cannot speak very positively of its difficulty with a 6in. aperture, but judging from this occasion, though the companion is a delicate object, it could hardly be called a severe test. I may be mistaken, as the night was a very good one. This star is B. A.C. 4213. Among other pairs picked up and since found catalogued was OΣ256, the distance of which is given by Otto Struve as 0·5″.

I would call the attention of Mr. Knott and Mr. Bird particularly to this new pair, and also to the new double *np* γ Crateris mentioned in a letter forwarded a day or two ago (4024, p. 148). The pair also there given in Sextans, the place of which had not been carefully determined is Weisse X 242, 10h. 15m. 15s., S. 9° 7′.

Is there not some mistake in the magnitude of the companion to γ Crateris, given in Loomis's "Practical Astronomy" as 14? It would seem to be nearer 10 or 10½ now, and is a very easy object.

Chicago, April 12. S. W. BURNHAM.

NEW DOUBLE STAR IN HYDRA.

[4117.]—THE following double star, found last night, is not in any of the catalogues of double stars that I have:—

HYDRÆ = L. 17586, 8h. 47m. 55s., S. 8° 16′: 7½, 9½: 170°: 1·5″—about three-fourths of a degree *s.* of 17 Hydræ (Σ1347), and easily found. The magnitude of the primary is given from Lalande. As I have seen this pair but once, and then with a bright moon, the estimates of position and distance, and particularly the magnitude of the companion, may need revision.

Chicago, April 20. S. W. BURNHAM.

VIEWING THE SUN.

[4118.]—MR. BERTHON has found his ingenious plan very successful, but does not the single concave lens introduce a little colour—also a little spherical aberration for high power? Has Mr. Berthon tried this plan against the Hodgson (or Herschel) plane? With a concave lens silvered there must be a half focus somewhere not far from the plane; would not a convex of long focus be better still?

T. H. BUFFHAM.

ANTS, &c.

[4119.]—IN the *Illustrated London News* for November 30th, 1861, there is a notice to the effect that, according to the statement of a gentleman in Texas, "An ant there forms a hole in the ground, and raises the earth around it; outside it lays the earth smooth, and destroying all the weeds around, but a species of grass, the seeds of which, when ripe, it gathers and hoards." How much truth there is in this tale I cannot say; but I have seen a statement to the effect that an ant (*Atta providens*) at Poonah, has been observed by Colonel Sykes to make store of the seeds of a kind of millet. But I believe that all the British ants are animal feeders, excepting their love for sweet things, in search for which they may attack fruit. The use made of their carnivorous propensities by the anatomist is well known. I was very much amused some time since in watching several ants conveying a caterpillar, the size of which must have required great comparative strength on the part of its diminutive captors. Some years ago (I have no dates) a small red ant made its appearance; it chiefly infested a warm room used for drying purposes, though it was also found in other warm places on the premises; it was evidently a foreigner, for it could not stand the cold, and there was every probability of its introduction with some bags of sugar. Before this the blackbeetle and black cockroach had been far too plentiful about the place, but these remarkably decreased in numbers; whether this was really the result of the introduction of the ants I will not pretend to say; but I actually caught them in the act of feeding on a blackbeetle, it was lying on its back not quite dead, and covered with the little red ant; a little brown cockroach, about 1in. long, also a foreigner, was in high favour with it; and empty skins were to be seen in plenty. It was interesting to see these little insects following each other in regular paths, in different directions, apparently with some definite object in view, but which I could never discover. They were very fond of yelk of egg. We caught great numbers by placing a basin of water in their way; they would crawl over the edge of the basin, and when once they got into the water they had no power to get out again. It has been said that ants will not pass over chalk; I took the opportunity of testing this by drawing a circle of chalk around them, but their escape was evidently no difficulty to them. From when these ants first made their appearance their numbers appeared to increase until we were swarmed with them. Though I have kept no dates I can say with safety that they were plentiful in the warm room for three years at least, almost certainly more. I never observed any with wings; if the sexes are invariably winged in the ants, as I have understood, how were the numbers kept up for such a length of time? I think I must have noticed them if any winged ones had made their appearance. The conditions of existence were evidently unfavourable, and their extinction progressed as stated by Darwin; the species first becomes scarcer and scarcer until it is ultimately lost; not one has been seen for some time now, and the small brown cockroach has disappeared with it. The *Blatta orientalis* is found in the basin of water in which we used formerly to catch the ant, along with a fresh arrival, a large brown cockroach about 2in. long.

J. C.

BRIDGE CONNECTING ENGLAND AND FRANCE.

[4120.]—I HAVE read with interest "S. D.'s" letter (3879, p. 62), on the proposed bridge connecting England and France. Although I cannot pronounce a decided opinion before further experiments are made on the many valuable suggestions proposed by him, I may state at once that I was so much interested with the novelty and importance of the plan given for building the bottom towers that I immediately set about testing the veracity of the principle.

The shroud employed by me was simply a straight tube 9ft. long, 1ft. 2in. in diameter, closed at the top end and open at the bottom. The open end was sunk down 4ft. 7in. through sand and gravel by means of weights applied at the top, when the pump and vacuum gauge were attached, the depth of water being 1ft. 3in. When the pump was applied it was a few minutes before any indication of a vacuum could be observed, but the moment the gauge indicated the fact of a vacuum being formed, each stroke of the pump speedily increased it up to 7lb. per sq. in., when a further sinking of the tube took place, the vacuum at the same time decreasing 1lb. per in., but by continuing the pump it soon rose to 9lb. and, after standing for upwards of six hours, it still indicated 8½lb.

If Mr. Douglas, or any reader of the ENGLISH MECHANIC, can explain why the pump required to be kept in motion for at least three minutes before any indication of a vacuum could be perceived, it would oblige me, as otherwise I am inclined to think that his plan of building the bottom towers, &c., will be found practical.

A FRIEND OF PROGRESS.

WATERCRESS.

[4121.]—I SEND you the following paragraph, taken from a local paper. I think it may not be uninteresting to some of your readers:—"*Caution to Eaters of Watercress.*—A correspondent of a Bristol contemporary writes:—'On Saturday last a man passed my house crying fine fresh watercresses. One of my boys ran after him and bought a pennyworth. Fortunately, before being placed on the table, my attention was called to them, and I found that three-fourths of the lot were composed of water cowbane (*Cicuta virosa*), one of the most virulent of English vegetable poisons.'"

V.

IMPROVED SCALE FOR THE LENGTHS OF PIANO STRINGS.

[4122.]—SOME years ago a pianoforte-maker of my acquaintance, who had then not been established many years, whose business was then less extensive than it has since grown, and who, although accustomed to copy, almost slavishly, the productions of Messrs. Collard, was nevertheless much too intelligent not to perceive the imperfections of all the scales then in use, said he would willingly give me a £5 note if I would design for him a really good scale which, while being safe, inasmuch as that it should cause but little or no danger of broken strings, should considerably improve the power and quality of his trebles. Probably, although things are somewhat better now, the tenor and bass have also been so greatly improved in power since then that modern trebles are yet relatively as weak as the trebles of ten years ago were to their contemporary basses, consequently the need of improvements in the trebles is little, if any, less now than then, so, without any intention of competing for the above prize I—now my experiences having become considerably more varied and extended since that time—proceed to assist in supplying what I have good cause to believe yet to be a practical want.

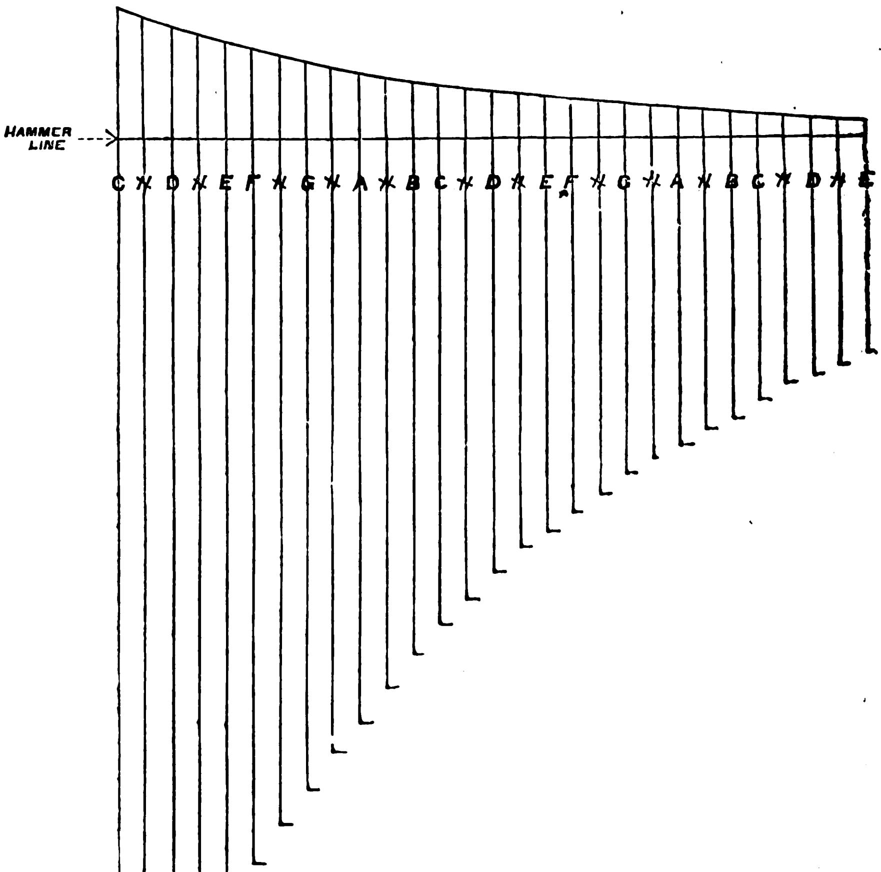
The subjoined diagram represents the full lengths of the strings for two octaves and four semitones only. For saving room the centres of each of the notes are drawn less than half the distance from the note next above or below it that they ordinarily occupy, it being usual, when all the notes are equally spaced at the hammer line, which is far preferable when practicable, to make the distances from the centres of each of the notes equal to that from the centres of the keys to each other.

Probably most practical pianoforte makers will consider this scale objectionably long, and until I had experience of the enormous tenacity of the steel music wire, made by Messrs. Smith and Houghton (notwithstanding all that rashness which is the too common characteristic of amateur designs), I really should have "funked" the consequences of subjecting strings to so severe a strain as these lengths necessitate; but after the experiments of Mr. Chew, I consider this scale quite a safe one, provided proper care be taken of the instrument, and its strings never suffered to become rusty, which evil thing is rather apt to make the writer ditto.

Mr. Chew, who has unlimited faith in his extraordinarily long middle C, once said to me "the power of a piano is simply a question of the amount of tension to which its strings are subjected." Now, without admitting this assertion to its full extent, for, practically, the power of that instrument is also greatly dependent on the rigidity of its soundboard, the force with which its strings are struck, and the character of the material with which its hammers are covered;—probably, next to the judicious construction of its soundboard, the suitable covering of its hammers, the form of their striking surfaces, the distance from the bridge of their places of impact, their weight, and the velocity with which they are impelled;—there is nothing which so greatly influences the power and timbre of its sounds as the lengths and thicknesses of the strings employed to cause it to produce sounds of any given pitch.

As a rule, the longer and thicker, within reasonable limits, the strings of a piano are, the more powerful and the clearer the sounds it produces—at least, in the treble, and, probably, the proportions of no portion of the instrument have undergone greater variation than its strings. In the earliest example of a square piano I ever saw, made in England about 1768 or 1770, by Zumpé, the middle C strings were only 18in. long, of No. 7 iron wire. Instead of half a yard, Mr. Chew, who has probably carried out the improvement of increasing the length of piano strings further than any of his predecessors, makes his middle C just double that length; in other words, a yard long, and he assured me that after more than two years the No. 21 wire, with which that note was strung, had become but little stretched, and its pitch not much lowered, which is not surprising, when we consider that a wire, after being stretched pretty nearly as much as it can bear without breaking, can hardly be expected to become stretched much further; and I think when the pitch of the F strings—ordinarily 3ft. long—is raised to C, the fifth above F, this operation, although somewhat within the limit of the breaking strain, and, therefore, quite a possible truth, may fairly be termed "a stretcher."

From 18in. of No. 7 to 36in. of No. 21 wire for the same note, or, perhaps, for a sound fully a semitone, if not a whole tone higher (for our concert pitch has risen considerably), is a long stretch, and I opine it will be some time before we generally agree to stretch it further. Increase of thickness has, however, already been carried out to a much larger extent. On middle C I have tried strings whose sizes varied from No. 16 to No. 32, but found little benefit. When the size of the wire was increased beyond No. 26, so long as their vibrations were caused by the blows of hammers, and not by the action of a fiddle-bow, in which case it seemed hardly possible to use strings too thick. I also tried No. 24 on C, 3¼in. long, and the tone was simply abominable. No. 20, the same length of wire, produced a tolerable sound, and No. 18 one of yet better quality. I preferred No. 17, which is as thick as it seems desirable to use for that note, but I found both the quality and power improved when it was made ½in. longer. Middle C 34in. long, with No. 23 wire, I found to be of very disagreeable quality, both short and harsh, perhaps because the instrument was not suitably bellied, also because the hammer stuck too near the bridge—viz., at one-sixth of the string's length.



Experience has convinced me that all so-called equal tension scales are very objectionable. If we make the treble strings of a piano long enough to produce sounds of great power and fine quality, those of the middle and bass parts of its compass must be too lengthy, and are necessarily too tight to vibrate long. The tone becomes "short," especially if their thickness be increased in anything like the proportions needful to induce breadth or fulness of quality. On the contrary, if we copy J. J. Hawkins or Robert Wornum, by employing wire of the same thickness throughout the compass, we are compelled to sacrifice both power and quality in the tenor and bass for the sake of the high treble which Mr. Wornum carried up to C, and strung with No. 15. This afforded a very good treble, but a very poor tenor and bass. Messrs. Broadwood, in their pamphlet, published for private circulation, A.D. 1861, describe a so-called equal tension scale, and I believe Mr. Chew prefers the same. No doubt equal tension scales are the very easiest of all to construct, because the lengths of the strings for each note may be obtained mechanically, without the trouble of calculation, by means of the diagram engraved in Messrs. Broadwood's pamphlet on grand pianofortes above referred to.

In the accompanying design and the specification of the lengths and thicknesses of the strings below C above the lines, I have endeavoured to make the best compensation between the theoretically best lengths and practical requirements which I felt able to do. I am far from expecting pianoforte-makers will for some time to come—unless the tenacity of steel music wire be generally increased until it equals Messrs. Smith and Houghton's hard-drawn wire—be willing to adopt my lengths for their notes. All pianoforte-makers have a wholesome terror of very long scales, because a broken string, which costs but little to replace in the factory, costs them, after the instrument is sold and delivered, not only the pecuniary sacrifice entailed by sending the tuner to the purchaser's residence, but also a loss of reputation, for most purchasers of pianos assume a broken string to be a proof of either bad workmanship or inferior design. Pianoforte-makers, like all other manufacturers who obtain their livelihood by supplying the requirements of the unenlightened public—"Those who live to please must please to live"—cannot afford to make what they believe to be the very best, because, as a rule, the very best don't sell best. Just as Solon, when asked "Are these the best laws you can make?" replied, "No! They are the best you unenlightened Athenians can bear," so pianoforte-makers make the best instruments John Bull, his wife and daughters, can bear, or are willing to purchase.

Should my very practical friends the pianoforte-makers fear to suffer from broken strings they can insure, at the cost of some power and quality, by taking the length of my D string for their top C. My C's will then all become B flats, and my A flats become F sharps. This change, however, being only one of lengths, and not a change of species, neither they nor their customers need fear being "bitten" by those domestic pests which are the namesakes of those notes. If this be done the C's will be reduced to 2in., 3¾in., 7¼in., 13¾in., 23⅞in., and 45½in., which lengths, with the excellent and tenacious wire in ordinary use, need not frighten the most timorous of pianoforte-makers, because the pitches of treble strings of those lengths might be raised about four semitones without breaking them, which seems an ample margin for ordinary contingencies. The scale thus obtained—if inferior to that shown in the diagram—would be a very great improvement on those in ordinary use, in which pitch C is about 12in., and the C's above it about 6in. and 3in. long. Besides affording more powerful sounds of clearer quality, and standing in tune much better than shorter strings do, I may remark this scale is but little longer than that of a modern drawing-room grand piano which I lately saw, constructed (I believe within two years) by Messrs. Collard. Now that firm, of all others, is noted for safe scales, so we may assume that any pianoforte-maker who adopts my suggestion to make his C strings the same lengths of those of the D's in the diagram and specification, will be in no danger of being "bitten" either by the blacksmith or by the musical, not insective, F sharps and B flats he may himself construct.

I did not carry the subjoined specification of the lengths of the strings below C above the lines of the treble staff below tenor C, because very few uncovered strings longer than about 4ft. are required for the tallest cottage pianos, or even the popular 6ft. grands. Sooth to say, the latter, when the action is below the strings, cannot well be made to admit strings unless they be oblique, exceeding 4ft. 8in. long, provided the bridge on the soundboard be not objectionably near its end. A 6ft. grand piano, with its hammers above its strings, but posited beneath its keys, may have strings about 7in. or 8in. longer, but a really satisfactory down-striking action it has not yet been my good fortune to become acquainted with; probably the very best of that evil family is the German action, introduced, I believe, by Mr. F. Greiner, and used in those excellent, if not very powerful, instruments the "compact" square pianos, manufactured by Messrs. Stodart some twenty years ago. The chief defect of these instruments was that the hammer (which was lifted by the key) did not rise quickly enough for rapid repetition; but it is obvious this might easily have been remedied, either by using lighter hammers, the key balance remaining unaltered, or, at least, but slightly altered (this would have enabled the same preponderance of the key to have lifted the lighter hammers more quickly without increasing the weight of the touch); or, if doing so could be allowed, by increasing the load of lead inserted in the keys, which would have caused them to lift the original (heavier) hammers quicker. Should any of my fellow-readers be tempted to construct a tall cabinet or long grand piano, they will find tolerably good lengths for uncovered strings below tenor C in the scale of the grand upright cottage piano figured in No. 285 of ENGLISH MECHANIC, but after all no very great accuracy in setting out the lengths of strings for notes below tenor C is necessary; a few inches makes no sensible difference in the power or timbre of their sounds. Along with the subjoined specification I have also stated the lengths of the C strings of Broadwood's long scale grand, and of Mr. Chew's, assuming he, like them, employs what is termed an equal tension scale. The remarkable differences of length are matters worth cogitation. I need hardly add the lengths of nearly all my strings are quite arbitrary, and simply a matter for judgment based on experience; at least, I know rule when equal tension is departed from.

Specification of the lengths of the strings in the improved scale, below C above the lines; also lengths of the C's of same, of Mr. Chew's, and of Broadwood's longest scale, copied from their pamphlet on grand pianos:—

All the notes of new scale from C above the lines to tenor C inclusive.				The C's only of new scale.	Ditto Chew's scale assuming equal tension.	Ditto Broadwood's long grand scale.
B	$8\frac{3}{4}$	$15\frac{7}{8}$	$27\frac{3}{4}$	... $2\frac{2}{10}$	... $2\frac{1}{4}$	... $1\frac{3}{32}$
A♯......	$9\frac{1}{4}$	$16\frac{5}{8}$	$29\frac{3}{8}$	... $4\frac{2}{10}$	... $4\frac{1}{2}$	... $3\frac{3}{16}$
A	$9\frac{3}{4}$	$17\frac{3}{8}$	$31\frac{1}{4}$	... $8\frac{8}{10}$	... 9	... $6\frac{5}{16}$
G♯......	$10\frac{1}{4}$	$18\frac{3}{16}$	$33\frac{1}{8}$	... 15	... 18	... $12\frac{5}{8}$
G	$10\frac{3}{4}$	19	$35\frac{1}{4}$	... 26	... 36	... $25\frac{1}{8}$
F♯......	$11\frac{5}{16}$	$19\frac{7}{8}$	$37\frac{1}{4}$	... 50	... 72	... $50\frac{3}{8}$
F	$11\frac{7}{8}$	$20\frac{3}{4}$	$39\frac{1}{4}$			
E	$12\frac{1}{2}$	$21\frac{5}{8}$	$41\frac{1}{4}$			
D♯......	$13\frac{1}{8}$	$22\frac{5}{8}$	$43\frac{3}{8}$			
D	$13\frac{3}{4}$	$23\frac{5}{8}$	$45\frac{1}{4}$			
C♯......	$14\frac{5}{16}$	$24\frac{3}{4}$	$47\frac{3}{4}$			
C	15	26	50			

N.B.—The wide differences in the lengths of the same notes in these scales seems worth consideration.

THE HARMONIOUS BLACKSMITH.

MICROSCOPICAL.

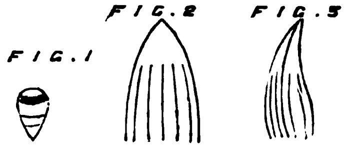
[4123.]—"H. P. H.," in his microscopical notes of last week, wishes for a cement which will keep in essential oils. I cannot help him in that, but I can make a suggestion which I am surprised has not occurred to him before; it is simply to withdraw the superfluous oil with blotting-paper, and substitute Canada balsam dissolved in benzole, when he will have a preparation that does not require cement. This plan was recommended by Prof. Ludwig Stieda in "Max Schultz's Archiv.," but he prefers creosote. For the benefit of those who use glycerine I will quote from the same author a recipe for a cement which I rather think is to be procured in England. It is as follows: Rub up some oxide of zinc with turpentine to a paste, then add to each drachm (gr. 60) one ounce of a solution of gum dammar in turpentine of the consistence of syrup. P. SANTALINUS.

CLIMAXODUS AND A NEW REPTILE TOOTH.

[4124.]—I HAVE recently had a considerable accession to my collection of Northumberland coal-measure fossils, and among those added are two of very great interest to palæontologists—viz., a minute tooth of *Climaxodus*, and a fine and peculiar tooth of a large new labyrinthodont or reptile. The smallest teeth of *Climaxodus*, previously described—and they have not the true *Climaxodi* form, but are somewhat *Petalodontoid* in appearance—are three-eighths of an inch in length, while that now before me is one-eighth of an inch long, and one-tenth of an inch broad; it is crossed by two well-defined ridges, has the distinct characteristics of a fully-developed tooth of *Climaxodus*, and is without doubt the smallest specimen of *Climaxodus* that has yet been described as belonging to our northern coal strata, and is probably the smallest *Climaxodus* tooth that has yet been discovered in any locality. The annexed sketch, Fig. 1, represents the tooth of twice the natural size, and its resemblance to the larger *Climaxodi*, will at once be apparent to those who are acquainted with this peculiar form of dental armature. Figs. 2 and 3 represent a front and side view of a reptile tooth, which is new to the Northumberland coal-measures, and which is, I believe, new to science. The length of the tooth is five-eighths of an inch, its width at the base is three-eighths of an inch, and its thickness at the base is one-fourth of an inch. Fig. 2 illustrates a front view of the tooth, which is curved forward, as represented by the side view, Fig. 3. The tooth near the apex is tolerably smooth, but from the base up two-thirds of the body of the tooth there are a number of widely separated delicate grooves, and between the grooves there are broad but not bold convex ridges. The tooth, as seen in its side aspect, is represented by Fig. 3; it is considerably curved, and from the apex to about two-thirds along the body of the tooth it is characterised by a peculiar form of cutting edge, the lanceolate character and form of which differ from the form and lanceolation of any other teeth of Northumberland coal-measure labyrinthodonts or reptiles, the teeth of which are known. *Anthracosaurus*, *Loxomma*, *Strepto-*

FIG. 2 FIG. 3

FIG. 1

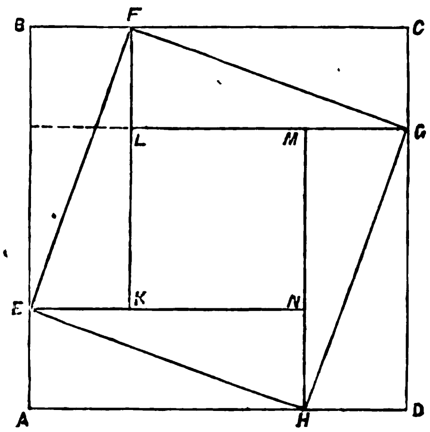


dontosaurus, and *Orthosaurus*, have lanceolate teeth, but none of them resemble that just described. *Pteroplax*, the teeth assigned to which are pre-eminently doubtful, are lanceolate, but unlike that figured; *Amphisaurus*, *Leptognathosaurus*, *Batrachiderpeton*, and *Labyrinthodontosaurus*, the teeth of which are circular; and *Macrosaurus*, *Mesosaurus*, *Megalocephalus*, and *Amphicalosaurus*, the teeth of which are unknown, are the only large labyrinthodonts and reptiles yet found in our Northumberland coal-measures. None of the labyrinthodonts or reptiles named have teeth which at all resemble that which has for the first time been described and figured in this communication.

T. P. BARKAS, F.G.S.

A NEW PROOF OF PYTHAGORAS' THEOREM.

[4125.]—THIS theorem (Euclid I., 47) is justly considered as the most important theorem in geometry. The following figure renders its truth so palpable that it may be worthy of a place in the ENGLISH MECHANIC:—



A B C D is a square, and equal lengths, A E, B F, C G, D H, being cut off from its sides, the figure is completed. Now, it is easily seen that E F G H and K L M N are squares; and that the eight triangles, A E H, E N H, B F E, F K E, C G F, G F L, D H G, H G M, are equal. Moreover, the figure A H M L F B A is made up of the two squares, A M and L B, and also of the square K M, and the four triangles forming the two rectangles, A N and K B. Again, the square E G is made up of the square K M, and the four triangles, K F E, L G F, M H G, N E H; therefore the squares A M and L B are, together, equal to the square E G; or, in the right-angled triangle A H E, the squares on A H and A E are, together, equal to the square on E H.—*Q. E. D.*

The proofs of several other less important propositions, some of which form part of Euclid II., could be easily deduced from the same figure.

C. J. RECORDON.

THE ECONOMY OF SMALL BIRDS.

[4126.]—WITH a slight hope to induce those individuals callous to everything but their own selfish amusements or paltry gains to forbear acting the part of a human blight upon the natural produce of the earth by destroying in the breeding season the eggs and capturing the young of those beautiful and most useful creatures wisely appointed to keep in check destructive vermin, I wish to say a few common-sense words of expostulation. Those birds which are more especially insectivorous would at first sight seem to have a more particular claim to human kindness and protection, though it will be found that some of those which live on a mixed diet, such as the finch tribes, consuming as they do large quantities of the seeds of noxious weeds, likewise contribute in their special province to the farmer's benefit, and also deserve justice and fair play, as such feed their young chiefly on grubs and caterpillars. Even the common sparrow, although generally pretty omnivorous, has been reckoned to destroy daily while feeding its young such a multitude of grubs as to constitute a heavy balance in its favour, being a circumstance which those who seek its destruction would do well to consider. The well-known devourers of the seeds of noxious weeds, birds of the goldfinch and linnet class, likewise eat greedily those blights of vegetation, the aphides or plant lice, which they search for with great assiduity. Our hedges are depopulated of these beautiful and useful little creatures, either to supply the shops or for the heartless amusement of children. Those that are of the unquestionably beneficial classes, being chiefly insectivorous, do not escape the snare or the gun directed by the thoughtless or the utterly heedless. Now, among those tribes of birds may be mentioned in particular for their utility, the swallow and the starling, and often both are wantonly and foolishly shot down from sheer ignorance or thoughtlessness. The latter may be said to be in particular a most valuable assistant to the agriculturist, owing to its peculiar habits. I fully concur in the forcibly expressed opinion of "Joe" that it should be protected from injury. This bird has an especial predilection for fly maggots and other larvæ. They may be seen in flocks during the hot months busily engaged among sheep and cattle, who—doubtless better appreciating their good offices than the ruthless bird murderer—suffer them to run over their backs and sides whilst laying down or grazing, whilst their little friends kindly relieve their bodies from the stinging gadfly, and the sheep from ticks and the horrible fly maggots, which, but for such assistance, would burrow deep festering holes in their skin. I have myself seen such holes eaten out of the wretched creature's hides as large as a walnut, full of maggots, which the farmer well knows to his cost are a source of trouble, detriment, and expense. Now, it is the especial province of all birds of the starling genus (and there are many varieties of them in other countries, all with the same habits) to frequent flocks and herds in order to devour their parasitical and other stinging pests. It follows plainly, therefore, that every one of them that is shot down is a pecuniary loss to the farmer, who must then needs find a substitute for this natural and wise intention of things by the free application to the animal's hide of tick and maggot ointments, many of which, if powerful and corrosive enough to destroy the vermin, would very likely, by absorption, do some mischief to the creature's health. Who that has seen the worried cattle on a hot summer's day racing frantically over the fields trying to escape the bloodsucking gadfly, and who has also, as I have, witnessed on other occasions the friendly offices of their little feathered attendants, but would feel indignant at their wanton and wicked, and foolish destruction? How the proboscis of the cattle fly with its obtuse spongy suctorial end obtains an entrance into the skin I cannot explain, but it certainly is gradually insinuated deep down into the skin, and the fly then fills itself slowly with blood like the mosquito, this operation occupying some two or three minutes or more, till gorged—a curious fact which some entomological contributor will perhaps kindly explain. It would be well if common sense and kindly feeling were sufficient guarantee against bird murder, but, as unhappily such is not the case, a supplementary "Land" to the "Sea-birds Protection Bill" is a thing very much to be desired by all who wish to see the equal balance and wise providential arrangement of things neither disturbed nor disorganised. ANIMALS' FRIEND.

DR. LIEBREICH AND TURNER.

[4127.]—HAS not Dr. Liebreich jumped to a conclusion rather too hastily, as regards Turner at least? Mr. W. Matthieu Williams has published a letter in a contemporary bearing upon this question of streakiness in Turner's pictures, and as I have noticed similar effects from watery eyes myself, I have made an extract for the purpose of obtaining opinions from some of "our" contributors. Let them try to look at a landscape under the conditions mentioned, and I am much mistaken or they will see it as Turner painted it. Mr. Williams says:—

"On p. 67 of 'Through Norway with a Knapsack,' published in 1859, speaking of some of the peculiar midnight sunset effects of the North, I said that 'Turner, like an eagle, has dared to face the sun in his full glare, and to place him in the middle of his pictures, showing us how we see a landscape with sun-dazzled eyes, when everything is melted into a luminous chaos, and all the details blotted out with misty brightness.'

In all these peculiar pictures that I have seen the sun is thus placed in the middle of the picture, and just sufficiently above the horizon (from about 10° to 20°, or at most 25°) to pour his rays about perpendicularly to the curvature of the eyeball, when the face is in position to contemplate a landscape. I have frequently repeated the experiment of contemplating a landscape under such circumstances, and on every occasion of submitting to such torture have seen all the effects of even the most extravagant of Turner's later pictures, which are so well described by Dr. Liebreich. I have seen the 'vertical streakiness, which is caused by every illuminated point having been changed into a vertical line,' with an 'elongation, generally speaking, in exact proportion to the brightness of the light,' and that 'there proceeds from the sun, in the centre of the picture, a vertical yellow streak.' These appearances may arise from an affection of the crystalline lens of my eye similar to that attributed by Dr. Liebreich to Turner, or it may be due to something else much simpler, and which is more or less common to all human eyes. If the simpler explanation based upon normal conditions covers the facts, it certainly must be the more acceptable.

My explanation of the vertical streaks is this: When we thus look full-faced at the sun, the dazzle produces slight inflammation or irritation, and a flow of tears. The liquid accumulates, and rests upon the lower eyelid, forming a little pool, the surface of which has a considerable vertical curvature—*i.e.*, the lower part of the retained tear curves upwards from the surface of its base at the root of the lower eyelashes to its summit contact with the conjunctiva. Thus in a vertical direction it must act as a lens of very short focus, it must refract and converge the rays of light in a vertical plane, and thus produce a vertical magnifying effect, the definition of which will, of course, be very confused and obscure, on account of the irregular curvature, and the fact that the eye is focussed to the distant objects. This want of directive focussing will limit the distortion to the bright objects whose vertically magnified images will be forced upon the attention.

To test this explanation, let any one select a bright afternoon, and at about 6 p.m. or a little later, at this season, gaze sunward upon any landscape free from London smoke or other medium of solar obscuration. At first, if his eyes are not very sensitive, he will see a circular sun, but presently, as the tears accumulate, the vertical elongation of the sun and general 'vertical streakiness' will appear. When I tried the experiment last week the sun appeared like a comet with a brilliant vertical conical tail, the point of which rested on the horizon. But I was then slightly troubled with what is called 'a cold in the head,' and my eyes watered very vigorously, and thus the conditions for producing fine Turneresque effects were highly favourable. On carefully drying my eyes these effects were, for a moment, considerably diminished.

I have adopted another method of testing this explanation. Having caused the eyes to become somewhat suffused, I bring the upper and lower eyelids so near together that the liquid shall occupy a sensible depth—*i.e.*, from the conjunctiva to the base of both upper and lower eyelashes, and by compression be bulged or curved outwards, in the vertical direction. On looking through this tear-filled chink at a gaslight the vertical elongation is remarkably displayed, and it extends upwards or downwards or both, according to the position of the liquid. When looking at the sun and landscape with the eyes fully opened (which is very painful), the elongation is chiefly downwards, and obviously connected with the tear on the lower eyelid; but if the eyelids be nearly closed to diminish the intensity of the light, an upward elongation is also commonly visible."

The other peculiarities of Turner are necessarily contingent on this "wateriness" of eye, and are, no doubt, faithful reproductions of what appeared to him. If this is the true explanation, however, it will spoil a good anecdote I remember reading of the painter, to the effect that Turner having sent in a quiet-toned piece to the Academy was very much annoyed at finding it hung in close proximity to pictures containing masses of brilliant colour, and actually put in it a large spot of vermilion, which he afterwards turned into the morning sun just above the horizon, and altered the whole character of the piece. P. B. M.

SILVERING THE SURFACES OF FIELD LENSES.

[4128.]—I AM receiving applications from some of your correspondents to silver them the convex surfaces of the field lenses of their Huyghenian eyepieces. Will you kindly allow me through your columns to explain to them that these lenses cannot be silvered while in the brass cells, and that, generally speaking, the cells will have to be sacrificed in any attempt to take them out, as there would not be brass enough left to bevel them in again? A cell requires to be made for the purpose when the lens has to be silvered, and must contain a counter cell, so that the lens can be removed and replaced at pleasure. It is rather a nice matter to silver a surface lens with a film of a particular thickness, and this thickness should vary according to the aperture and focal length of the telescope it is required for. This is just one of those experimental jobs that should be done by the observer himself, as if a fair charge were made for the time consumed in doing such a matter by an optician it would certainly cause dissatisfaction.

Those of your correspondents who are fond of experimenting will find the following simple contrivance answer their purpose tolerably. Take a film of thin microscopic glass, or fine mica, and silver it on both sides thinly (this is easier than silvering it on one, and it answers better), leave it unpolished, and mount it at an angle of 45° in the eye-tube in front of the field lens, or second-glass. Make a hole of 1in. diameter at the side of the tube for the reflected heat to pass out through. This contrivance could be made for one shilling. JOHN BROWNING.

PIANOFORTE CONSTRUCTION.

[4129.]—"THE HARMONIOUS BLACKSMITH" (letter 3934, p. 95) is trying to show the possibility of imparting to the hammer in the treble of a piano a greater power than that which we usually can get. Now, he must either fail to show it, or he has actually discovered perpetual motion. But I differ from him. I take half a dozen wheels or levers and arrange them so that when the first wheel or lever moves five-sixteenths of an inch, the last wheel or lever must move two inches. Now that lever or wheel which moves five-sixteenths of an inch is the key, and that which moves two inches at the same time is the hammer in a piano. Supposing we take two such machines, one for the treble and one for the bass of a piano, where then is the possibility to gain more power in one than in the other machine? Certainly we can arrange one machine so that the last lever or wheel moves quicker in the beginning of its path, then it requires more power; and the other slower, which requires less power in the beginning of its path, or *vice versâ*—more power we cannot get. And besides this we cannot make this difference, for it would be a touch on one side of the piano, and a "poke" on the other. This will be quite clear to any one: if we suppose the lever for the bass end moves quicker in the beginning, then it requires more power; and the lever for the treble moves slower in the beginning, then it requires less power; but then the touch in the bass must be light at the end, while that in the treble must be heavy—in fact, we should have to poke the key right down before the lever or hammer would reach the strings, because it would move but little in the beginning. "The Harmonious Blacksmith" has put the damper below the centre of the hammer, some four or five inches below the striking-point on the strings; that will certainly not do; we want the dampers just where the hammer strikes the strings, or as near as possible; if we put them much lower they will create a sound something like *mean*, and if the hammer rebounds once more, which it certainly will before it comes to rest, it will sound *mee-an-an*. Then the "Harmonious Blacksmith" will, to avoid this, require a damper-rail, lifters, socket, and all the rest of it, like other mortal pianoforte makers.

J. H. SCHUCHT.

COMPRESSIBILITY OF THE ATMOSPHERE.

[4130.]—WITHOUT laying claim to the title of a learned correspondent, I don't think that it is established as a fact that if a truly bored gun be aimed and fired horizontally that the ball will rise, as the difference in the density at upper and under side would be too minute to influence it. The theory of the top spinning is decidedly wrong, as a top spins because, when motion is communicated to any body, such body will endeavour to travel in a straight line through the angle of least resistance, but being restrained from doing so by the circular form it is constantly endeavouring to fly off at a tangent; and as long as the velocity is maintained sufficiently the body has an equal tendency to fly away in all directions, and the effect of gravitation is nullified. A top would undoubtedly simply spin much longer in vacuo. Has J. M. Taylor witnessed the following experiment? Let A represent a piece of cord with one end attached to ceiling, on the other a loop; B, a heavy wheel and axle caused to spin quickly, and then one axis placed in loop, the wheel will continue in same position as in drawing, and the cord remain plumb until the velocity falls.

Liverpool. A.

[4131.]—WITH reference to the top part of letter 4040, page 151, it has been found that a top will spin much longer in a vacuum, the friction of the air not retarding its rotation. The top is supported by the rectilinear tendency of its particles being sufficient to overcome the force of gravity. Each particle endeavours to move in a straight line in one plane; the attraction of cohesion converts the motion into a circular one. The plane of rotation remains as in the gyroscope parallel to itself until other forces preponderate. The steadiness of the earth's axis is insured in the same manner. M. PARIS.

[4132.]—THE fact of the lower strata of air being more dense than the higher would not account for a bullet fired apparently horizontally being deflected upwards, as it is if it be reflected from a surface of water, for the difference of density of the air just above and just below the bullet is almost infinitely small, not as that of water is to that of air—about 800 to 1. It is impossible that a bullet really fired horizontally should rise, but the fact is so frequently asserted that I presume it must often appear to do, and that this cannot be accounted for by slight irregularities of the gun, as those would cause deviations in various directions with different guns, not more frequently upwards than otherwise. I suspect the reason of the apparent deflection being, as is commonly stated, most frequently upwards, is that the gun is unconsciously raised slightly, at the instant after the trigger is pulled, by the shooter's left hand, which has to hold the gun against the pull on the trigger by his right, for it is scarcely possible to hold anything steady when the balance of resistance to force is suddenly changed. If the gun were fixed in a frame, it would be thrown upwards at the same instant when the pull on the trigger ceased, unless, indeed, the frame were perfectly rigid and inelastic, as it may, practically speaking, be made.

Mr. Taylor is mistaken in supposing that a top would not spin in a vacuum; it would spin longer if its motion were unresisted by air, and it would very soon cease spinning in water. The difference in the density of the air at the surface of the earth and very near it is quite inappreciable, and can produce no such effect as he suggests. PHILO.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4133.]—MR. CASH (letter 4069, page 176) will see, from what I have before said on the subject, that if the qualities of his glass are what he has stated he cannot expect with his radii to get a perfect object-glass. He will also easily understand that it is very difficult to make out wherein he may have failed in workmanship simply from a description of the appearances he may observe in his telescope. The sign of want of spherical correction is a sort of fog or atmosphere when looking at the circle as described by Mr. Cash, and the want of correction for colour causes it to show up on pushing in or drawing out the eye-tube, but if the object-glass is placed square on the tube those appearances would surround the image and not spurt out from it. A want of homogeneity in the glass causes wings, but not, I should say, such as described by Mr. Cash, and I should think it probable that in some way or other he has pinched one or other of the lenses in the cell, which he ought to be very careful not to do; in fact, with a large object-glass, it is almost necessary to give the lenses a spring bearing to allow of the requisite amount of tightness in all temperatures without any pinching. I should strongly advise Mr. Cash not to complicate the thing by adjusting screws, but to place the lenses in a carefully turned cell, and screw them down by means of a ring in the ordinary way, with just sufficient tightness to prevent their falling away from their bearing on the fore part of the cell and no more, and possibly three pieces of millboard placed inside the brass work of the cell might prevent any shifting across and keep all tight in that direction. Before finally screwing the lenses down he should turn them round on each other until he gets the best effect, as generally it makes considerable difference which portion of their edges are in contact.

As to Mr. Cash's definition, I think the less he says about it the better, and he really needn't trouble himself, for if he succeeds in making a decent telescope it will not very much matter whether he knows exactly what a lens is or not. HENRY T. VIVIAN.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

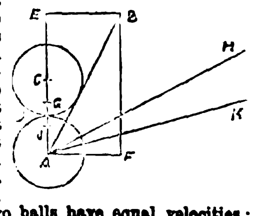
HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[8615.]—**Whitworth Lathe.**—To J. K. ENGLAND.—I have drawn out a table of factors for you, which you can have with the letter I wrote to accompany it to the Editor of the ENGLISH MECHANIC; but it is too long to expect him to print it, so you had better write to me at Pitcairn's Library, King's College-road, N.W., and I will forward it to you.—J. K. P.

[10640.]—**A Reason Wanted.**—Mr. Jerard Smith (p. 152) will find, I think, that it is rather inflation of the lungs than expiration to which the advantage is due in lifting heavy weights. This, at any rate, is Sir David Brewster's view of the matter. Mr. Smith is not alone in giving a reason for this fact, which he has often verified, and at the same time heading his information with "A Reason Wanted." Sir David Brewster gives the same reason—viz., the bracing of the cords, &c., about the joints or fulcrums round which they act, and then calls the experiment "inexplicable." Thus, important as his explanation is, he was not fully satisfied with it. He looked for something more, but missed it in this way. The four men lifting and the fifth man lifted, could not, he says, be lighter for the air they have inhaled, but the heavier. Very true, but there is an increase of the bulk of each body in greater proportion than that of the weight. There is a displacement of the fluid atmosphere by each expanded body without proportionate increase of gravitation; for the air inhaled is heated and expanded. The atmosphere, therefore, becomes to this extent a lifting power, as in the case of the fire balloon. The simplest illustration of this lifting force is afforded by the swimmer. In floating he rises by inflating his lungs with air, and is more deeply immersed when he has expelled it again. He is, of course, the heavier for the air he inhales, and according to the quasi-philosopher's reasoning should rather sink than rise. He does not, because the air he inhales is lighter than its equivalent bulk of water which it has displaced; and so the air which the lifter inhales is, by expansion by heat, lighter than the equal bulk of atmospheric fluid which it has displaced. That stout men float so much more easily than others is due, no doubt, in part to the greater heat developed within. This is not put forward as the principal, but as an additional, reason for the fact so often verified.—J. M. TAYLOR, Seer Green Vicarage.

[10664.]—**Angle of Reflection and Incidence.**—I feel greatly obliged to "F. N." (p. 152) for the trouble he has taken to supply me with the details of the interesting experiments of M. Athanase Dupré. I am sorry to confess I know less of mechanics than I do of billiards, but have frequently endeavoured to account for the effects of side and strength. The following is the effect of strength and my view of the "rationale;" and if I err, and I fear I do, I shall feel greatly indebted to "F. N." if he will point out my error and set me right :—Place the red ball on the spot, and place the white in a position 3ft. 5in. from the top cushion, and 16in. from the side cushion, measuring from the face of the cushions; play at the red a half ball with gentle strength, so that the red returns from the top cushion to the pyramid spot, the white ball will run into the top corner pocket. Place the red again on the spot and place the white ball in a position 4ft. 5in. from the top cushion and 19¼in. from the side cushion, measuring, as before, from the face of the cushions; again play a half ball but with a quick stroke with great strength, and the white will again run into the pocket. The difference in the angles formed by the path of the white ball in these two strokes is about 18°, which I account for as follows :—Let A, travelling in the direction A B, strike C at rest; at the point D decompose the velocity A B into its components A E and A F, draw the parallelogram A E B F, the velocity A F is not affected by contact, but the velocity A E is first reduced to one half, and the ball C receives a velocity equal to E C, at this moment the two balls have equal velocities; the elasticity of the balls now comes into play, and with the lighter blow the velocity A C is further reduced to A G, and the ball C receives a corresponding increase of velocity, and the ball A takes the direction A H, being the resultant of the forces G A and A F. Now with the harder blow the velocity A C is reduced to A J, and the ball "A" takes the direction A K, being the resultant of the forces A J and A F.—BILLIARDIST.



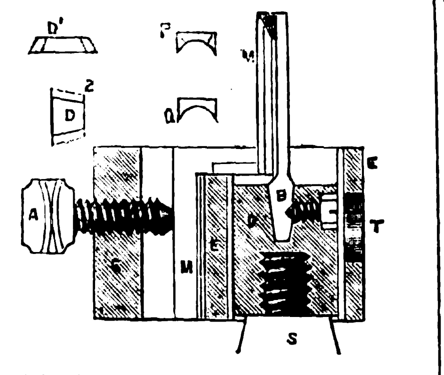
[10702.]—**Terrestrial Gravitation.**—"T. A." asks for proof that the attraction of a sphere is equal to what it would be if all its particles were at its centre, but you could hardly spare space for what occupies four pages of Maclaurin's account of Sir Isaac Newton's discoveries (3rd edition, 1775, pp. 297 to 300) which, besides being too long for quotation, is not needed to show that the attraction of a spheroid to a body on its surface must be greatest at the points nearest to its centre, as those points must evidently be at a less mean distance than any others from all the other points of the spheroid, and therefore that bodies there situated must be more strongly drawn by the joint attraction of all the particles contained in the spheroid. I think Mr. Proctor would consider Maclaurin's so-called geometric demonstration to be one of integration disguised.—PHILO.

[10781.]—**Fastening Escape-Wheel in Lever Watch.**—The remarks by "A Yorkshire Pivot" (p. 152) fail to convince me that a soldering iron should form any portion of a watchmaker's tools, or that there was any necessity for the use of soft solder in the case of "S. H. L.'s" escape-wheel. If "Y. P." thinks it would be easier for an inexperienced workman to turn a collet on the escape-wheel arbor than on a plain arbor suitable for the purpose, why could it not be done without solder in the one case as it would be in the other? I fear his "simple method" would prove more embarrassing to the inquirer, and more injurious to the watch, than the right and proper method of going to work. It is a remarkable fact that watches suffer more at the hands of incompetent workmen than from wear and tear, though even for a hundred years. Again, our northern friend, in his first communication on the subject, says he uses a copper bit for soldering the job, yet in his second communication he informs us he would have done the job without solder. He also alleges three instances of the use of soft solder in the original manufacture of watches, verges, balance-staffs, and fusee caps. It is entirely incorrect that English verges are soft soldered in the collet, neither are balance staffs treated in that way. And with regard to fusee caps, they are certainly soft soldered in verge watches and in some lever watches, but in Geneva watches (entirely omitted by our correspondent) there is none whatever; therefore there is yet a large proportion of watches in which there is not a particle of soft solder in the original composition. "Y. P.," in concluding his remarks, half admits his weakness for solder, yet congratulates himself that after twenty years' experience he can give watch querists a "few practical wrinkles." Oh, these "few practical wrinkles"! How frequently are they brandished before the eyes of "our" readers, yet how seldom do their possessors make them available for the general good!—WEST CORNWALL.

[10954.]—**Circulation of the Blood.**—I may be wrong, and shall be very happy to be corrected if I have made an erroneous statement, but as the presence of carbonic acid is always attended, to a certain extent, by the absence of (uncombined) oxygen, may not we infer that death from respiration results from oxygen starvation alone? If M. Paris means the effect of carbonic acid, exclusive of the absence of oxygen, he may quote any number of gases, and death through respiration, would, therefore, be the result of so many causes.—C. W. H.

[11057.]—**Watchmaking.**—If the pallets, stones, and acting parts of wheel are polished, oil does more harm than good, but in the absence of good workmanship, oil is the best friend you can find. If I had been asked about oiling staff holes of a good English lever or pocket chronometer. I should have said no. I have long since done away with the practice, having experienced this in trials I have made with the class of watches mentioned. What I told "J. O." I practise myself, and also what I have stated here. I have been engaged on new work nearly twenty years, and I may say what I send to "our" MECHANIC in answer to queries is what I have experienced and know, and no more.—INDEPENDENT CHRONOMETER.

[11101.]—**Mortices in Hard Woods.**—I forward a section of the former, hoping "Leander" will be able to understand the whole arrangement. The affair for cutting the angular hole is not to revolve, but is to be bolted upon the headstock by its foot; this sketch is a section through the centre of chuck mortice E E E, chuck drill or bit C A being the set-screw for morticing-tool, and M M the morticing-tool, it being in section at D double dovetailed (see D 1 and D 2), that it may be

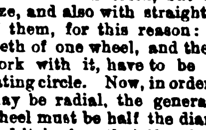


inserted in the chuck more readily, and held firmly. P is a section of the tool, or rather more front or end of the tool M, and Q a section of it through the line below M; the dotted line along M is the boring bit, which runs in close proximity to M, but still clearer of it. G is the lathe spindle, and the chuck for holding the bits screwed upon it; there is a hole at T for the purpose of tightening the set-screw to hold the bits. The tool M is nothing more nor less than a double buzz which the wheelwrights use, with this difference, the semicircular section in the step, and the mouth having two cutting angles instead of one, the said two being at right angles.—JACK OF ALL TRADES.

[11120.]—**A Question of Sight.**—The solar rays are almost parallel, and by ascribing too much divergency to them, I admit I may have looked at the sun too much as a point. Shadow, however, is the space surrounded by direct rays, but itself unreached by any one direct ray, whilst the direct rays reach the shadow's boundary all around, imparting to it its modified shape of the intercepting object. Intercepted rays, by repeated reflection, soften a shadow somewhat, as angularity distorts shape—hence "penumbra," a partial shadow. "E. L. G." seems "well up" in his subject, but when we speak of shadows extending three diameters farther in July than in January, we should state not only the hour of the day, but whether we mean shadows parallel to objects or else at what angle; for I certainly thought he meant the shadow of upright objects as cast on the earth's surface, which he may attribute to my stupidity. "E. L. G." is quite right as to the ratio between speed of sound and speed of light. My 170 × should be 170 × 5280 ×, to convert miles into feet, so that speed of sound through air is to speed of light through interstellar ether as 1 is to about 881,000, being 1,130ft. per second for sound, and 180,000 miles per second for light. As for Regnault's experiments at Paris, "E. L. G." says: "At different degrees of heat, though with the very same number of atoms in the same pipe, the speed differs." Why, it is impossible for equal number of uncompressed aërial atoms to occupy equal space at different temperatures. Fill a bladder with air, and increasing heat extends the amplitude of the atomic vibrations till the bladder bursts; but these atomic vibrations are not more those of nitrogen or oxygen than those of the ether uncaptured by chemistry, and which we may call "ultramicroscopic." But "E. L. G." says that with air varying in density as 5 to 1, and the distance of atoms as about 19 to 11, the velocity of sound was just the same at a given temperature. Now, air varies in density only by degree of temperature or mechanical compression; under compression atoms would be closer and temperature higher simultaneously. He says "heat or cold alters the rate, though the atoms be at one unaltered distance; but distance of atoms alters it not at a given temperature." I say, except under special mechanical pressure, varying temperature alters the distance between atoms as exhibited by expansion and condensation; so that the experiments may but show that effects of external temperature are counteracted by applying mechanical force, which alone can maintain equal atomic distance under different degrees of heat. I never said air was "a number of things kicking one another;" but I know if the pulsations of solar combustion were communicated by a needle from the sun to "E. L. G.'s" eye, the pulsations would reach him instantly, instead of occupying a second to pass over 180,000 miles. I continue to believe that rate of speed of sound shows, or is a key to, the vacuity or distance between atoms of air, and that the rate of speed of light and heat is a key to the distance between the atoms of the ultramicroscopic ether of interstellar and all space. In reply to "Saul Rymea," I say I quoted from Gutch's "Register" for 1859, that 11,090ft. was sound's speed through cast iron; it gives steel 17,000, water 4,900, and wood as varying from 4,636 to 17,000. If heat increases atomic velocity as it increases amplitude of swing in vibration, it may suffice to account for adding about 5 per cent. to a rise in temperature of 80° C. My object has not been to show rates of speed, but that rates of speed are a key to the distances between atoms, or rather the total vacuum length in the line of transit.—J. BARWICK.

[11123.]—**Lantern Pinions.**—Since I wrote my rejoinder on this subject to "Tubal-Kain," on p. 125, I have obtained a copy of "Camus on the Teeth of Wheels," published by J. Taylor, 59, High Holborn, 1806. The editor states that Camus in the original French does not give "the generation of the epicycloid curve, nor its application, so as to render it familiar to practical mechanics." (See p. vii., preface.) Afterwards (p. 5) in the body of the work, he says that "in pinions which have few leaves or spindles, as 5, 6, 7, 8, and even 9, the true radius ought always to be greater than the primitive radius. Now, I must confess, that on first reading this sentence I was a bit staggered; but when I came to examine it, I found that the signification of it is this—viz., that pinions of greater numbers than the above may have their true radius (which is what he calls the outside measure over all) reduced by filing away the tops of the teeth down to the end of the primitive radius, which is what we call the radius of the pitch circle; but that these small pinions must not be treated so on account of the very large angle each successive tooth passes over during the revolution of the pinion, which makes the teeth go out of contact too soon, unless they are left with long points. This filing away of the points of the teeth of a wheel or pinion only when driven, but not when it is the driver, is mentioned by Denison in his 1860 (fourth) edition of "Rudimentary Treatise on Clocks and Watches" (p. 267), and I adopted it in the dial work of my regulator clock with advantage. Now, looking a little further into "Camus," let us read "Advertisement," as it is somewhat oddly translated, on p. 70, second paragraph :—"As they cannot hope to form the teeth" quite true, in order to prevent shocks, "machinists may prevent this inconvenience by making the primitive diameter of the wheel a little larger than it ought to be in regard to that of the lantern or pinion." In the third paragraph (p. 71) he explains that though the motion obtained this way is somewhat smoother than that of badly-shaped teeth which are not so fiddled or cooked, yet the relative velocities of the wheel and pinion are rendered very uneven as every tooth passes, or in other words the uniformity of the velocity is destroyed. In the fourth paragraph he says that similarly when the pinion is to drive the wheel (and never to be driven), the primitive circle of the pinion may be enlarged to prevent shocks, but he at the same time shows that a lantern pinion is unsuitable for driving a wheel at all, and that in that case a leaved pinion must be used instead, so we may put the enlargement of the lantern pinion recommended by "Tubal-Kain" on one side as unpractical. I do not think "Camus" a suitable work for students to read, as his teaching is now behind the march of improvements in machinery, for he does not give a single illustration of a tooth with a hypocycloidal flank, which should be adopted in all cases where wheels of more than two different diameters have to gear with each other. Any single pair of wheels can be made to run together with radial flanks to their teeth, but no third wheel of another size, and also with straight flanks, will work with both of them, for this reason: the tops or points of the teeth of one wheel, and the flanks of that which is to work with it, have to be struck with the same generating circle. Now, in order that the flanks of the teeth may be radial, the generating circle used for either wheel must be half the diameter of the opposite one, and it is clear that if a third wheel of another size is introduced, those generating circles must be either greater or less than half of its diameter, and therefore unsuitable for making its flanks radial, and if much greater would make the teeth impossible. The whole affair is to be found properly explained in Willis's "Principles of Mechanism," of which, I am glad to say, there is a new edition out, and in Binns's "Second Course" of Orthographic Projection, which proposes a modification of Willis's scheme, though without departing from his principle of construction, and resulting in a superior proportion of tooth. I need hardly say that Willis's "Odontograph," or tooth drawer (not extractor), renders the setting out of wheel teeth a matter of the greatest simplicity, and any one can construct one for himself out of a piece of cardboard, from the directions given in Willis's work. There is, however, a mistake in the last column, fourth line of table of places of centres, opposite "No. of Teeth, 16," where 191 is printed for either 131, or more probably for 119, in the old edition, and a similar mistake in the same place in the new edition, but I think the figures are not the same in that. In conclusion, I will only say that when I made my regulator clock I did not use a depthing tool, but calculated all the diameters of the wheels, and set out the pivot holes with dividers from a scale of hundredths of an inch, and that the clock goes, which I am absolutely certain it would not if I had used enlarged pinions.—J. K. P.

[11168.]—**Wood Rods.**—Reduce the strip of hard wood nearly to the required size with an ordinary smoothing plane. And having a lathe with a hollow mandril screw on a chuck holding a crown saw of required diameter, the reduced strip on being passed through will come out as round as if turned. In the absence of a hollow mandril the strip may be placed in an ordinary lathe, and the crown saw (made in the form of a common screw nut, with projecting saw, to be made according to Fig., which represents a section, the saw to be filed out of the edge S S), held in hand and pushed along the revolving strip.—SUFFOLK AMATEUR.



[11196.]—**Drowning.**—Speaking from my own experience I would say that there is no truth in the supposition that drowning persons invariably rise to the surface three times, neither more nor less, before death. In one case I saw a drowning person rise four times before he finally disappeared, and on another only twice. An exhausted swimmer will sink and rise many times before nature finally gives out. The number of times a drowning person rises to the surface depends upon his muscular energy, and the tenacity with which he clings to life.—J. Hopkins.

[11223.]—**Stereotyping.**—If "Saul Rymea" or any other obliging correspondent will kindly give details, it will, I think, be welcomed by many. To avoid giving further trouble in this matter may I here ask a few questions? 1. May not the metal be poured over the cast instead of immersion? 2. Does the process of making the cast injure the type by filling it up or in any other manner? 3. What is the cheapest and best metal to use?—A Country Printer.

[11272.]—**Diastase (U.Q.).**—May be purified by repeated solution in alcohol and precipitation in water; but it cannot be obtained perfectly pure.—W. L. G.

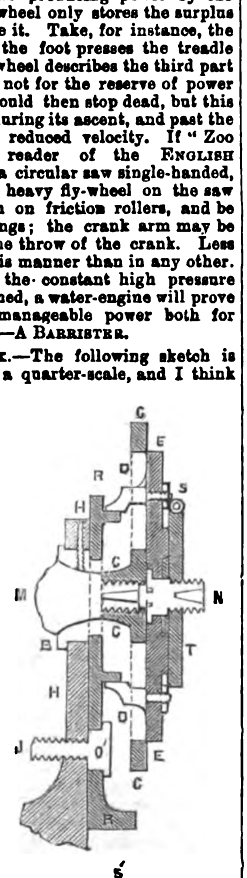
[11275.]—**Darkening Walnut (U.Q.).**—Egyptian asphalte dissolved in benzole and turpentine makes a fine transparent stain for darkening walnut, and makes a good imitation of that wood if applied to poplar, or wood of similar grain.—A Barrister.

[11282.]—**Preserving Plates (U.Q.).**—Years ago I made many experiments in this subject. I succeeded in getting honey and sugar plates to act as quickly as wet collodion, but found they could not be depended upon for more than half an hour or so. I abandoned the process in favour of the collodio-albumen, which gave me far better results.—A Barrister.

[11283.]—**Photo. Lens (U.Q.).**—I should recommend "Aremac" to obtain what is called a half-plate portrait lens of a good maker. This will be suitable for portraits, cartes de visite, and small landscapes or groups. I commenced with a quarter-plate, and progressed until I have a whole-plate portrait and a large landscape lens, but found them so cumbersome that if I had to begin now, I should choose the above. I prefer landscapes taken with a portrait lens to those taken with a single lens.—A Barrister.

[11333 and 11457.]—**Motive Power for Amateurs.**—Are we never to be free from the perpetual motion incubus? I thought this subject was tabooed in the pages of the English Mechanic, but it seems to be perpetually cropping up in one disguise or another. "Zoo Andra" fancies he can multiply his power by means of a huge pendulum, the only effect of which would be to waste a portion of it, from whatever source derived. "Novi" proposes to use coiled springs as a motive power, forgetting that only a fraction of the force employed in coiling the springs is utilised, and he makes no provision for the latter operation: how is this to be done? Even the practical Samuel Smither speaks of producing power by the use of a fly-wheel; a fly-wheel only stores the surplus power, it does not produce it. Take, for instance, the fly-wheel of a foot-lathe; the foot presses the treadle only during the time the wheel describes the third part of a revolution, if it were not for the reserve of power in the wheel the lathe would then stop dead, but this reserve carries the crank during its ascent, and past the dead point, with slightly reduced velocity. If "Zoo Andra," or any other reader of the English Mechanic wishes to use a circular saw single-handed, the best plan is to fit a heavy fly-wheel on the saw spindle, which should run on friction rollers, and be cranked outside the bearings; the crank arm may be adjustable so as to alter the throw of the crank. Less power will be wasted in this manner than in any other. I believe that wherever the constant high pressure water supply can be obtained, a water-engine will prove the cheapest and most manageable power both for amateurs and mechanics.—A Barrister.

[11372.]—**Oval Chuck.**—The following sketch is as near as can be, about a quarter-scale, and I think will convey all "L. S." requires. It is—well, I may say, the long section, as it is through the length of slide. M is the mandril of lathe or mandril nose; B is the steel bush; H the head stock; R R the eccentric thing which gives the oval motion the same as the original used, but dispensing with those long arms, screws, and branches upon the headstocks, which are in the way and unsightly. This you can clear away at a moment's notice, and it can be applied to any lathe of ordinary type, and the ordinary face-plate used for the foundation of chuck. J is a jamb-bolt which holds it fast against the headstock, and K in the old sketch shows the projection and screw for adjusting the same which passes through the head of nut, which is made of a T shape, serving for



a nut for the adjusting screw as well as jamb-bolt; D D are rubbing pieces that act upon the ring, and give motion to the long slide E E, to which they are bolted with a tail bolt or tag, the holes into which they are inserted being made long to compensate for wear and tear as well as adjustment; C C being the ordinary face-plate with four slots in at right angles, which is the foundation plate upon which the other is built or mounted; G is the micrometer screw which works in the edge of wheel; the head is left long for a few rings to be put upon it and divided, and instead of having a square end on for a key to fit on is made with a square hole drifted in, that you may never be at a loss to find a key to turn it. The numbers I have found useful for minute work I have given. T is the dividing plate which is fixed in its place by the round-headed screw which serves for a screw nose for chucks, &c.; a spare one or two are very useful, one being furnished with a taper screw for wood-work. They are screwed in from behind with a fork screwdriver, and serve for a swivel for the dividing plate to turn upon. S 1 is the screw in the old sketch; the screw is represented as a left-handed one, which is a mistake.—Jack of All Trades.

[11393.]—**Metallic Harmonicon.**—If "Tuba" (page 154) will read well "Zoo Andra's" excellent description of the musical glasses in his possession (page 103, No. 11393), and look at Fig. 1 in accompanying diagram, I think he will see at once what "Zoo Andra" means by "similar to an inverted aquarium." Should "Tuba" fail to see the meaning, let him get a tumbler with a stalk and break off the round flat stand at the bottom, so that the tumbler has a tang, and he will then have a model of a moderate-sized musical glass. But if he tries to produce a musical sound out of it in the manner described by "Zoo Andra," he will be disappointed. "Zoo Andra" (page 103, No. 11393) asks if pressed glasses would do as well as blown ones. I beg to inform him, no. In the English Mechanic for April 19th, I advertised a set of musical glasses in the "Exchange Column." I was, in consequence, inundated with letters, upwards of twenty asking for information as to structure, &c. I answered every one, giving as much information as I could spare time for. One gentleman at Sleaford said he was in communication with a glass manufacturer on the subject; perhaps he or some of the others who stated their intention of endeavouring to construct a set, and asked my advice, will, for the benefit of "Tuba" or any other brother reader who may have a like intention, state through "our" journal their success.—Samuel Kempling.

[11398.]—**Stings of Bees, Hornets, and Wasps.**—"H. B. E." is very much mistaken with regard to the stings of these insects. The fact is that the sting of a wasp is more sharply and more numerously barbed than that of either the bee or the hornet.—R. H. H.

[11423.]—**Surgery.**—To "Jack of All Trades" (p. 154).—Some years ago, when it was my business to peruse the official reports of our naval surgeons, whom it appears to be the fashion now to run down, but in my humble opinion very unjustly, considering their top-hamper, I read an account of a successful search for a broken needle by a cunning sea-leech. A tar had broken a needle in the palm of his hand, and the place having healed was undiscoverable by sight. Whether the bit of needle took to walking in its sleep or wanted to get out I do not know, but Jack finding that he could not use his hand, told his sad tale to the doctor. The doctor magnetised a sewing-needle, and, suspending it "de more," with this divining-rod found the exact spot, and cutting down, duly unfleshed the offensive steel. I may add that in case of an abscess forming the needle might be drawn out by means of a magnet, as recommended by, I think, a continental surgeon.—M. Paris.

[11443.]—**Warming Greenhouses.**—I could not answer "Anxious" sooner, as I only take the monthly parts, but if he only wants to keep his plants and not to have a hothouse, I think he will find my plan by no means a bad one. My greenhouse is not a small place, but along the front I put some hooks, and have an old sail, which in cold weather I hang up over the whole front. Supposing the weather is frosty but fine, I leave the sail down till between two and three o'clock; and during part of the time I open the windows. Damp is the great enemy, and during frosty weather, and especially the month of December, the plants should have, I might say, no water, or next to none. Well, as I said I shut all up a little before three, and in the course of an hour or two more, according to the cold, or I light the lamp and all is safe for the night. Of course "Anxious" knows that the size of the lamps differ, but one with an inch wick gives a great deal of heat. It requires no pipe, and does no harm. All that is wanted in a mere greenhouse is little water to the plants, as much fresh air as possible when it don't freeze, and it is quite sufficient if the frost is just kept out. The lamp should have one of the globular glasses: it is best.—E. T. Scott.

[11448.]—**Chronometer Balance Spring.**—The watch you speak of, I think, must be a lever with a common compensation balance. My opinion is, these balances are only put to watches to improve the appearance. I have many times removed them, and put gold ones in their place. You ought to have a good English lever for £6 5s., but the seller, no doubt, got a good profit. If you have a gold balance put to the watch, and the spring properly adjusted, it ought to keep good time.—Independent Chronometer.

[11524.]—**Pitch of Roof.**—Supposing the span or distance between the walls the same way you want the principal, say, 18ft., that would be 6 yards, and I always reckon 10in. to the yard, that is 5ft. high at the ridge. Some reckon 9in. to the yard. My father before me would not make them more than 9in. to the yard, and the reason was that the slates held enough to the slate laths, while there is more stress on them with the 10in. yard, but the roof is better. For an ealing roof reckon double or 20in. to the yard.—Birstall.

[11525.]—**Fresh-Water Aquarium.**—I use a bell-glass aquarium 33in. diameter at the top; height of water, 8¼in.; plant, Anacharis. The great mistakes of aquarium keepers are these:—1. Too much light. The remedy for this is: Hang a green-coloured cloth over the aquarium, and let the light in on one side only. 2. Overstocking. I think for this size, three minnows, one small newt, three or four water-snails (the largest, as they are the most useful), one eel (very small!), and one small roach. Have a tin cover made to fit the aquarium; the upper part must be of perforated zinc, this will keep the dust out, except the very little that enters the holes. I cannot make out what "Auon." (page 156) means by a cassavery.—V.

[11531.]—**Water-Wheel.**—In reply to "P.W.H.J." (p. 156), I have some reason to believe that he is not really practically acquainted with motive-power engines, for he says no really practical man will now advocate a rotary engine. "Would it surprise him to learn" that I have in my possession a rotary (water) engine that will beat any reciprocating engine, in spite of all he may say to the contrary? It is fitted up with every appliance required to test its power, and after overcoming its own friction it is found that 95 per cent. of what is due to the power of the water expended is obtained. I know that this statement will be considered an exaggeration, but when it is understood that my engine of 10 horse-power is got up expressly to test a principle in the motion and pressure of liquids it can be imagined that I have no interest in over-stating its merits.—D. S.

[11551.]—**Cement.**—Seeing the conclusion "Jack of All Trades" comes to in reference to cementing meerschaum, I recommend the inquirer to try the following, as kindly given by "M.R.C.V.S." under the name of "A Really Good Cement," Vol. XIV., p. 612. From practical experience I find it first-class.—W. K. Donaldson.

[11552.] — **Meerschaum.** — "A., Liverpool," says that he has never known a composition pipe to float lightly in water. I can sell him pipes by the gross which are daily sold as meerschaum pipes and are only composition. They will float in water, but he must remember that they are mere sham pipes, not meerschaum.—C., Glasgow.

[11566.]—**Equisetum.**—I am very much obliged to "M. D." for his kind offer, but I asked the question on account of observing the pollen gathered by myself, being desirous of calling the attention of our microscopists to a particularly curious object. I do not dabble much in microscopic work, being obliged to save my eyes all unnecessary fatigue. I should, however, be glad to learn from "M. D." what other pollens show such motion, as I have tried a great many without effect.—M. Paris.

[11569.]—**Telegraph Posts.**—The reason, I believe, the lower 3ft. is left unpainted or untarred, is not from economical motives, but to prevent the rotting from taking place so soon as it would do if painted or tarred. Wooden posts should never be coated with any waterproof material, such as paint, tar, or varnish, for at least 6in. above the ground, in order that the moisture from the ground may have free vent. If confined fermentation will always be set up, and what is called dry rot is produced, dry rot being nothing more than slow combustion of the tissues.—Brake.

[11571.]—**Virginia, Its Climate and Soil.**—"E. R. E. A." would get all information at the *Free West* office, Alexander A. Wise, 9B, New Broad-street, London. Ask for the "Virginia Settler."—Carpenter.

[11601.]—**Cracked Oven.**—Make a cement of steel filings and common yeast, and fill the crevice tightly while the oven is cool.—T. A. Bradley.

[11610.]—**Defective Battery.**—As "G. F. L." now says that the vibrating contact breaker itself does not act, it seems pretty clear that the defect must lie in the primary circuit; but it is one of those things which it is impossible to pronounce upon without first seeing and testing the apparatus, because failure may be due either to fault in the apparatus or to some oversight of the operator. As a rough test it may be well to screw the contact breaker down, connect one pole of battery to coil, and the other to a coarse file, and with a wire from the other connection of the coil (primary) scratch the file. If the circuit is right there will be a shower of sparks.—Sigma.

[11618.]—**Deadening Sound.**—The following simple method answered well in my office some years ago. Cover the joints of the boarded partition on both sides with unbleached calico (thicker the better), cover the whole of the partition with coarse brown paper, and then with room paper to suit taste.—Thos. A. Bradley.

[11619.]—**Electrical.**—If the glass of the jar is sound and good, and fitted as described, it ought to work well. Perhaps it has been standing on some insulating material while being charged, such as a dry woollen table-cover. It is possible, however, that the surface of the jar was damp. If there is a moist, heated atmosphere in the room, it will keep the glass damp, and conduct away the electricity as fast as it is generated. A number of people in the room will cause this state of things, and even a few may do harm by standing about the table, their breath falling on the apparatus. I have been, on several occasions, making electrical experiments in crowded school-rooms, and found it almost impossible to charge the jars; but as soon as the doors were opened and the crowd dispersed, so that the damp, heated air was driven out, the indicator on the jars would at once rise to its usual height. The room should be kept as well ventilated as possible.—OCCASIONAL PHOTO.

[11624.]—**Photography.**—I, likewise, live in the country, and have used nothing but rain water for photography for a good many years, and find it all I could desire. If the district is clear of smoky works, and the rain carefully caught without splashing on the ground or anything else that would pollute it, there is very little of either organic or mineral matter in it. As a precaution, however, it is well, after filtering, to add a few drops of silver solution. Shake well, and stand the bottle in the sunshine for a day; this will throw down all the impurities in it, which can then be filtered out, and the water is much purer than a great deal of the distilled water used by photographers. Instead of placing it in the sun try a weak solution of permanganate of potass, added carefully till a slight pink tint remains, then filter.—OCCASIONAL PHOTO.

[11626.]—**Electric Bells.**—If Thomas Whalley will refer to p. 564, Vol. XIV., he will find a description of an electric bell by Mr Tonkes, but instead of a rigid bracket marked D, I would recommend a spring bracket reaching up to the magnet, with a back nut to the screw.—W. BOLTON.

[11632.]—**Debility.**—I have often wondered what class of people they are who patronise Solidway's pills and other marvellous panaceas. But that wonder is somewhat satisfied by the reply under this head on p. 182. There is no necessity to defend either allopaths or homœopaths against the charges of "Amateur," which carry their own refutation broadly written in those very words he uses to stigmatise the medical profession. I am curious to know, however, by what occult erudition the author of the altera-tonic system has convinced your correspondent that the "one sole cause of all disease" is nervous debility. Only fancy, cholera, which sometimes strikes and kills in twelve hours, is produced by nervous debility! Typhoid, eczema, rheumatism, heart-disease, and other ailments exhibiting the most opposite characters, are all occasioned by nervous debility! Even our children, those we regard as strong and healthy, are suffering from nervous debility, for do they not take measles, whooping-cough, scarlatina, and smallpox much more readily than the "lean and slippered" shadow of a man with scarce a sound nerve in his body, whose every sense is tottering to ruin? Really, it is surprising how readily even readers of the ENGLISH MECHANIC swallow the theories of the quacks, and hesitate not to fling hard words at scientific men. Whence, for instance, did "Amateur" obtain his peculiar idea of the system of the allopaths?—SAUL RYMEA.

[11663.]—**Steam Power.**—"T. W. J. M." has not stated whether the firebox communicates by several small tubes or a single flue. This would make a considerable difference in the heating power. This boiler might make steam for half horse-power; but it seems improbable, because small boilers seldom approach to their theoretical efficiency. He has not mentioned either the pressure of steam or the resistance that the engine would encounter. The engine might run all right when empty, and yet stop when the work is thrown on. The area of the bottom end of firebox is 19·635 sq. in., of which probably 19 sq. in. will be effective area. This makes out the evaporative power of the boiler to be about one-seventh horse-power when working in everyday work; it may reach to one-sixth if the fuel employed is charcoal. If the boiler works the engine at all with an adequate amount of resistance proportioned to its size, either the speed must be reduced, or it will work at a very low pressure. I will work out the pressure that the boiler would sustain. Let P be the pressure, then, $1 \times \frac{11}{14} \times \frac{400 \times 2}{1728} \times \frac{P}{1} \times 2 = \frac{1}{6}$ by supposition; $\therefore P = \frac{1}{4}$lb. This is, of course ridiculously low for a high-pressure engine, and it can only be remedied (without a larger boiler) by lowering the speed. Next, for the weight of fly-wheel. The rules given in the books are of no use for so small an engine; in fact, they were never intended for such. I have seen engines working of about that size with 18in. diameter fly-wheel. The size that I should recommend would be 18in. diameter to centre of rim, thickness of rim 2in., breadth 1in. The wheel to have five spokes ½in. thick. The rim will weigh about 20lb., and the boss and arms about 15lb. to 20lb. more, total 35lb. This may seem rather heavy, but I have found it advantageous to err in excess with small engines.—P. W. H. J.

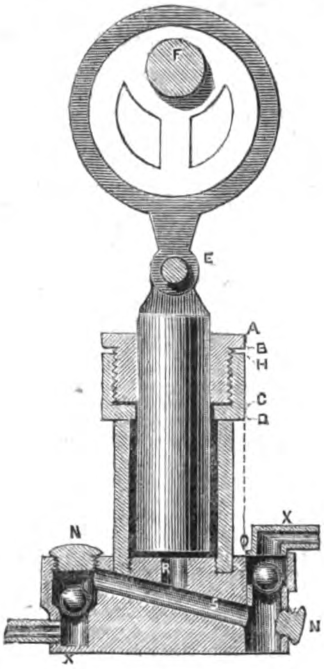
[11664.]—**Polishing Bullock's Horns.**—Well scrape with glass or steel scraper, afterwards with finest glass cloth, then with powdered bath-brick and oil, and finally with rotten stone and flannel, or old cloth or felt hat.—JACK OF ALL TRADES.

[11664.]—**Polishing Bullock's Horns.**—First scrape with glass to take off any roughness, then grind some pumice-stone to powder, and with a piece of cloth wetted and dipped in the powder, rub them till you get a *smooth* face. Next polish with rotten stone and *linseed oil*, and finish with dry flour and a piece of clean *linen rag*. The more rubbing with the stone and oil the better the polish.—A. E. F. F., Clapham.

[11666.]—**Qualitative Analysis.**—The chief impurities of water are carbonates and sulphates of calcium and magnesium. (1) Carbonate of calcium may be detected by boiling, being deposited as "fur" (it is always precipitated when a solution of an alkaline carbonate is added to a solution of that base). (2) Chloride of calcium is detected by adding a solution of silver nitrate, a white precipitate of silver chloride falls, insoluble in nitric acid, but soluble in ammonia. (3) Calcium sulphate: 1°. Test for calcium. Add a solution of ammonium oxalate, which forms with a lime-salt a white precipitate insoluble in acetic acid: 2°. Test for sulphuric acid. A solution of barium nitrate gives with sulphuric acid a precipitate of barium sulphate insoluble in all acids. A drop of pure water evaporated on a slip of glass leaves no mark.—W. L. G.

[11667.]—**Carbon Points.**—The best carbon points you can procure can be got from the gas-works. I purchased a piece of carbon for 3d., broke it into pieces with a hammer, filed up the bits into points with a rough file, and became possessed of as many as I shall ever require. This carbon is sublimed upon the roofs of gas retorts, and is exceedingly hard.—J. HOPKINS.

[11669.] — **Trunk Engine.**—This engine would drive a boat of 4ft. or 5ft. long, but 3ft. is too small. The practice of the leading model-makers is to put a single cylinder trunk engine of 1in. stroke to a 3ft. boat. I inclose directions and drawing for making force-pump. Take a piece of rod brass, turned down to ⅜in. diameter, bore a hole ⅜in. diameter through it for seven-sixteenths of an inch long, and the remainder drill with a hole a shade larger than five-sixteenths of an inch in diameter. At ½in. from the end with the larger hole, turn down to ½in., to the length of ¾in., you will then have something like the section A S in the drawing. This pipe is then to be fastened into the brass block, having a section like X X. This may be an oblong piece having a ring



turned in its centre to fit the end of the tube. It may be soldered on with common soft solder over a spirit lamp, and then finished off in the lathe. The holes R S have to be drilled before it is soldered, and then the holes N N plugged up. They may come in useful afterwards when the valves want cleaning. The plunger is easiest made out of a piece of brass tubing, plugged up with melted lead at one end. The plunger to be five-sixteenths of an inch in diameter, and 1⅛in. long. The stuffing-box gland to be turned out of a piece of solid brass, like A in the drawing, and tapped to fit H D. The eccentric band will be difficult to make without a casting, though with a deal of trouble it may be cut out of a piece of ⅛in. brass plate. Another plan, which is easier, but does not look so well, would be to turn a brass ring out of ⅛in. brass plate, and tap three brass rods into it, meeting in a small brass ring, for E to work in. The distance from F to E he must find out by trial. The metal employed must never be less than one-sixteenth of an inch. Any further information, if I am able, I will gladly afford.—P. W. H. J.

[11673.]—**Hydraulic Rams.**—There is only one kind of hydraulic ram, and with this you can theoretically lift to any height, but when it has a high lift there is a great amount of waste water, and but a small quantity is supplied at the exit pipe. It seems sometimes to require a small river to supply a house that is situated on the top of a hill; besides that, the valves do not last long. I should only think it suitable for moderate lifts.—P. W. H. J.

[11675.]—**Solder for Britannia Metal.**—Use tinman's fine solder, two parts tin, one part lead; use chloride of zinc, otherwise spirits of salts killed by adding as much zinc as it will dissolve.—W. BOLTON.

[11675.]—**Solder for Britannia Metal.**—See indices. Where several have been given.—JACK OF ALL TRADES.

[11676.]—**Lemonade Syrup.**—Take 3lb. of good loaf sugar and one pint of water; boil, skim, and cool, till about lukewarm; then add 600 grains of citric acid dissolved in a pint of water, one ounce of tincture of orange peel, and 30 drops of essence of lemon; stir well together and allow it to settle for twenty-four hours, then pour off from the sediment, if any.—J. L.

[11677.]—**Rendering Wood Incombustible.**—A very excellent way to render wood incombustible is to soak it in a strong solution of alum and the sulphate of copper. About one pound of alum and one of sulphate of copper should be sufficient for 100 gallons of water. These substances are dissolved in a small quantity of hot water, then mixed with the water in the vessel in which the wood is to be steeped. The timber to be rendered fireproof can be kept under the liquor by stones or any other mode of sinking it. All that is required is a watertight vessel of sufficient dimensions to hold enough of the liquor to cover the timber, which should be allowed to steep for about four or five days. After this it is taken out and suffered to dry thoroughly before being used. A plan of rendering the wood partially fireproof would be to whitewash it two or three times. You will probably require a glue to hold against fire, here is the recipe:—Mix a handful of quicklime in four ounces of linseed oil, boil them to a good thickness; then spread it on tin plates in the shade and it will become exceedingly hard, but may be easily dissolved over the fire, and used as ordinary glue.—P. W. H. J.

[11680.]—**Mildew in Boat Sails.**—You will not find anything better than dilute carbolic acid for this purpose. Sprinkle them well over with a solution of one part of commercial acid in fifty parts of water.—ETHYL.

[11680.]—**Mildew in Boat Sails.**—"Kirkway's" safest plan is to dry the sails thoroughly, in the open air if practicable, and to sweep them well on both sides with a strong hair-brush, having sprinkled it beforehand with water, in which a little ammonia has been dissolved. Do not roll the sails up while wet, as it is damp which has produced the mildew. If "Kirkway" wants to disinfect the sails, or prevent infection, carbolic acid is a good thing for the purpose. It might also prevent the depredations of moths and small insects; but I cannot say what effect the acid might have on the sails.—RAT-TAT.

[11681.]—**Water Glass.**—This substance, being soluble in water, would not answer for the purpose mentioned by your correspondent.—J. L.

[11685.]—**Canary's Song.**—Has "Exon" ever tried hard-boiled eggs and maw seed? I have found it an infallible cure whenever I have tried it, and would strongly recommend "Exon" to try it also. Many birds do not sing about this time. I have three that do not; the only way I can account for this is that it is the breeding season. Sparrows very often destroy the song of the canary by their chirping. I should advise "Exon" to keep the bird in a room where he will not hear them. Sometimes birds lose their voice altogether for some considerable time after moulting, especially if they do not moult freely, but when warm weather comes in they get it back again. When birds are moulting, there is nothing better for bringing them through than a rusty nail in their water, which may be kept in all through the winter, as it strengthens them very much.—BED OF STONE.

[11687.]—**Speeding Machinery.**—Multiply the diameter of the driving-pulley on the shaft into the number of revolutions of the driving-pulley, and divide the product by the required number of revolutions of the machine-pulley—thus: Driving-shaft running 50 revolutions per minute, diameter of driving-wheel 3ft., speed required on machine 135 revolutions per minute. Then $\frac{3 \times 50}{135}$ is required diameter of machine-pulley $= \frac{150}{135} =$ 1ft. 1⅓in. Similarly for number of teeth. Multiply the number of teeth on the driving-wheel by the number of revolutions per minute of the driving-wheel, and divide the product by the required number of revolutions of the machine. Thus, if the number of teeth on driving-wheel be 54 $\frac{54 \times 50}{135}$ is the number of teeth on machine-wheel $= \frac{2700}{135} = 20$.—W. L. G.

[11687.]—**Speeding Machinery.**—Divide 135 by $50 = 2\frac{7}{10}$ to 1, that is pulleys 27in. and 10in. Now for wheels multiply by 3·1416, or 3, and adding 1 to every 20 or 21, and either divide by the number of teeth you require, will give you the pitch, or by the pitch will give you the number of teeth, and the above will be the pitch line or any other in proportion got by multiplying both by the same number.—JACK OF ALL TRADES.

[11687.]—**Speeding Machinery.**—The diameters of the wheels are to be in inverse proportion to the speed. For instance, let D be the diameter of one pulley, and D′ the diameter of the other; and let S be the speed that the first pulley is working at, and S′ the speed of the other. $\therefore D : D' :: S' : S$ (always let the letters with the dashes represent the greatest number); $\therefore D \times S' = D' \times S$; and substituting the numbers you have given, $\therefore D \times 135 = 50 \times D'$ $\therefore$ the diameter of the driver is 135in., and the diameter of the other is 50in. The teeth of wheels can be managed in just the same manner, wheels having teeth of the proportion of 50 : 135, or any multiple of the By the formula that I have given, the number of can be got for any speed. I will give an example:—Suppose a shaft revolves at 300 revolutions, and another at 400 per minute, to find the number of teeth for each cogwheel. Substituting in the formula $D \times S' = D' \times S$; $\therefore D \times 400 = D' \times 300$; $\therefore$ number of teeth in driver = 300, and number in follower = 400. Numbers can be cancelled or multiplied on each side of the equation, to make the wheels convenient for manufacture.—P. W. H. J.

[11687.]—**Speeding Machinery.**—Suppose your driving-shaft runs 20 revolutions per minute, to be increased to a 100 revolutions in the same time. Let a wheel be keyed on the shaft 5 times as large as the secondary wheel, as 100 is 5 times 20. In the case given the shaft is supposed to run 50 revolutions, and he wants to drive a machine 135 revolutions for every 50, putting a wheel 135in. in circumference on the driving shaft, and connecting it by bands or otherwise with a secondary wheel of 50in., would obtain the desired end, or if "A Reader" wishes to use smaller wheels, dividing the numbers of revolutions by 5, which gives 10 and 27; then a wheel 27in. in periphery would drive a secondary wheel of 10in. 135 revolutions for every 50, 27 for every 10, or nearly three times as fast. The diameter to the circumference is as 3 : 1 or ⅓ nearly, or for greater accuracy multiply by 3·1416 for the diameter from the circumference; the number of teeth in each wheel depends on the size chosen.—RAT-TAT.

[11688.]—**Cleaning White Sheepskins.**—Let "Housekeeper" hold the skin over the steam of boiling water, wool side up. Throw back the fleece, and as the skin becomes softened by the steam, brush it briskly with a hair-brush, using powdered chalk, whiting, or pipe-clay. Rinse it in cold water, using soap if necessary, and apply the brush in bringing back the fleece to its former position. Dry in the open air.—RAT-TAT.

[11694.]—**Green Fly.**—Try syringing them with a solution of the concentrated tobacco-juice, which is now sold at a cheap rate for this purpose, duty free. A florist informs me that this is the best remedy he has tried.—ETHYL.

[11695.]—**Succession Duty.**—It depends upon whether the leaseholds are held for a long or a short term. If the value of the lease is evidently greater than the value of "C. P.'s" life, interest duty will be payable as upon an annuity equal to the net annual value of the property during his life. But if "C. P." is a young man, and the lease has only a few years to run, duty may be paid on the saleable value as on a capital sum. In the former case the duty is payable in eight half-yearly instalments, and in the latter in one sum. "C. P." may prepare and pass the accounts himself, but I would not advise him to do so.—SHYLOCK.

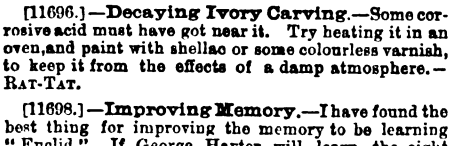
[11696.]—**Decaying Ivory Carving.**—The following extract from Layard's "Nineveh" may encourage your correspondent to seek for further information: "In many cases the ivory ornaments were so completely decomposed that they could not be removed. Those preserved, and now in the British Museum, were restored in England by an ingenious process, which replacing the gelatinous matter, and thus reuniting the decaying particles into one solid body, gave them the appearance and consistency of recent ivory."—X. X.

[11696.]—**Decaying Ivory Carving.**—Some corrosive acid must have got near it. Try heating it in an oven, and paint with shellac or some colourless varnish, to keep it from the effects of a damp atmosphere.—RAT-TAT.

[11698.]—**Improving Memory.**—I have found the best thing for improving the memory to be learning "Euclid." If George Hayter will learn the eight books of "Euclid," I will guarantee that he will have a tolerable memory, and be possessed of an argumentative power, which is of immense use in learning anything—nay, everything else. When at school I had the worst memory in my class, but by perseverance in learning these books, I acquired a surprising facility for learning other things that I could never otherwise have hoped for. This method I consider better than the plan of learning poetry, because it engages the mind more fully, and when the memory is at fault the mind assists it.—P. W. H. J.

[11701.]—**To Mr. Knott.**—My friend Mr. Knott will, I know, pardon my replying to a question addressed to him by C. Gaudibert. In May, 1868, I observed this star (ζ Cancri) with great care, and under peculiarly favourable circumstances, on two successive nights, the 7th and 8th, with my 18in. equatorial reflector, when A and B were much closer than they are at present. Not having a micrometer at that time, I had no means of ascertaining the distance; but an idea may be formed from the following diagrams of the discs as seen with

1 2 3 4 5 6



different apertures. No. 1 being with 8in., No. 6 with 18in., and the others with 10in., 12in., 14in., and 16in. respectively. With 8in. the disc was very nearly round, with 18in. the two stars were just separated, and no more. They may now be divided with 8in. On April 30 and May 2, at 8 p.m., I was fortunate enough to secure a satisfactory set of distance measures, the mean of which is 0·583″; I think I may safely say the distance is not greater than this. The mean of the measures of position is 162·9°; powers used, 500 and 752. The small star has thus retrograded 80° in eight years; Mr. Dawes' last measures, in 1865, being—position = 243°, distance = 0·6″; the stars having been closing up for 22 years previous to that date.—H. C. KEY.

[11703.]—**Ink.**—Take ½oz. of sugar candy and 2oz. gum arabic, and just cover with sufficient water to dissolve them; take acetate of iron, and fill about the same height as the gum, and well shake; now brush it over a plate of glass, or pour it into a dish and evaporate, and when dry powder it and put up in a bottle for use, or a tin canister will do. Now take the best galls, very finely powdered, and if you place ½oz. of this in hot water and pour off, using from ½oz. to ¾oz. of the above, you will find you will have a pint of good ink. If not strong enough you can add more; it will keep for years, and stand any climate. You must keep these powders separate, or one will destroy the other, and both will become useless; they are best prepared in the way I mention. Either hot or cold water will do, but if you want a clear free ink decant the clear. Acetate of iron is made by digesting some iron filings in vinegar, having subjected them first to a red heat.—JACK OF ALL TRADES.

[11704.]—**Rats.**—A single drop of oil of linseed on the tongue of a common steel trap will be a first-class bait. Oil of rhodium is equally as good; but the cheapest and most convenient bait is as follows:—Of good oatmeal take two parts and roast meat dripping one part, mix them together, and roast them just before going to bed; bait the traps with this mixture hot, and before morning you may be sure of having, at least, half your traps occupied. I have known a trap five times occupied in one afternoon in broad daylight.—BED OF STONE.

[11704.]—**Rats.**—"M. A. B." desires to be informed of a method to destroy rats; for his satisfaction and the public good generally, please to accept of the following:—Take nux vomica beaten into fine powder by the apothecary, one ounce, or less, as you have occasion, mix with butter or hog's lard into a paste, and put pieces of about the size of a hazel nut into pieces of thin writing paper, and put them into the holes; it will kill them without the danger of poisoning anything else; should a cat or dog meet with one of these doses, it will make them very sick, but a spoonful of oil will cure them.—RALPH LOWDON.

[11706.]—**Optician's Lacquer.**—The following recipes I have heard spoken highly of:—8oz. of shellac, 2oz. of sandarac, 2oz. of anatto, ½oz. of dragon's blood resin, 1 gallon of spirits of wine; or 8oz. shellac and 1 gallon of spirits of wine. The article, if it is not a casting, should be heated slightly, and the lacquer should be applied by means of a soft camel's-hair brush. If the article is a casting, it will require a little more trouble to turn out a creditable article. It is to be dipped in nitric acid, but before that it is to be well cleaned from sand and dirt. It is then washed and placed in clean water until ready to be lacquered. It is then to be taken out and placed in the hot oven for a few minutes, and then taken out when quite hot, and either of the lacquers applied to the parts required.—P. W. H. J.

[11706.]—**Optician's Lacquer.**—One drachm of gum benzoin dissolved in one ounce of spirits of wine at proof strength. The article should be thoroughly cleaned, and warmed as hot as the hand will bear, and the lacquer applied with a soft brush, and immediately placed under cover to avoid atmospheric dust whilst drying.—J. L.

[11708.]—**Gas Burners.**—Perhaps the following table will be of use to "Loach." It is the result of the experiments of Dr. Fyfe:—

Burner.	Consumption per hour.	Light given, comparative.	Illuminating power per foot of gas burnt.
	c. f.		
Jet, 5in. high.........	1·0	1·0	1·0
Small fishtail........	1·98	2·80	1·45
Large fishtail........	2·60	4·0	1·53
Small bat'swing.....	3·0	4·40	1·46
Large bat'swing.....	4·60	8·40	1·87
Argand of 40 holes	4·50	7·84	1·74

—P. W. H. J.

[11711.]—**Time at our Antipodes.**—This will depend on whether the Antipodes are inhabited by persons arriving there from the east or from the west. By the time that two travellers round the world, who have left a given meridian at the same time by directly opposite courses, meet again on another meridian, one will have gained an hour for every fifteen degrees of longitude he has passed, and the other will have lost in the same proportion. Consequently, one will be twenty-four hours in advance of the other, one considering the day of the week (say) Tuesday, while the other considers it Monday. The same effect would be observed by a traveller arriving after a tour of the globe at the same meridian from which he started. If his return occurred on a Monday he would, if his course had been easterly, have gained a day, and would consider it Tuesday. If, on the other hand, he had gone round the world from east to west, he would have lost a day, and would consider the day of his return Sunday (Herschel's "Outlines," section 257). Practically, as regards Australia and New Zealand, I imagine (speaking under correction) that, since the course of vessels sailing thither lies, as a rule, round the Cape of Good Hope, to say nothing of the overland traffic vid Galle, time is reckoned in the same direction—that is to say, the Australasians are in advance of us. Moreover, the longitude of New Zealand is within 180° east of Greenwich, and it is, therefore, more natural that time should be reckoned by the shorter distance, and that our time should be considered ten or eleven hours slower than Australasian time instead of fourteen or thirteen hours faster.—V. B.

[11713.]—**Composition for Moulding.**—The following is used by gilders:—Mix 14lb. of glue, 7lb. rosin, ½lb. pitch, 2½ pints linseed oil, 5 pints of water (more or less according to the quantity required). Boil the whole together, well stirring until dissolved, adding as much whiting as will render it of a hard consistency, then press it into mould, which has been previously oiled with sweet oil. No more should be mixed than can be used before it becomes sensibly hard, as it will require steaming before it can be used again. Another recipe is this:—Make a very clear glue with three parts of Flanders glue and one part of isinglass, by dissolving the two kinds separately in a large quantity of water, and mix them together, after they have been strained through a piece of fine linen to separate the filth and heterogeneous parts which could not be dissolved. The quantity of water cannot be fixed because all kinds of glue are not homogeneous, so that some require more than others. The proper strength may be found by suffering the glue to become perfectly cold, it must then barely form a jelly. The glue is then to be gently heated, then mixed with sawdust sifted through a fine sieve. The moulds are then to be oiled with nut oil, and the glue pressed into the mould, covered with weighted board, and then set to dry near a stove. When the casting is dry it is to be trimmed.—P. W. H. J.

[11715.]—**Testing Acetic Acid.**—Evaporate about an ounce to dryness, it should leave little or no residue. If any remains, dissolve in water and add a few drops of solution of barium chloride and hydrochloric acid, if a precipitate forms it shows the presence either of a sulphate or of free sulphuric acid. To distinguish the latter from the former add a few grains of pure cane sugar to an ounce of the acid, and evaporate to dryness at a heat of about 120° C. The residue will be blackened when free sulphuric acid in any quantity is present. It may also contain hydrochloric acid, which could be easily known by diluting the acid with water, and adding silver nitrate. If a white curdy precipitate falls it is due to the presence of chlorine. Dilute another portion of the acid with water, and pass a current of sulphydric acid through it. A blackening denotes the presence of lead or copper. These are the usual impurities in vinegar. Sometimes capsicum or red pepper is used to make it pungent, and to make it appear stronger than it really is.—ETHYL.

[11715.]—**Testing Acetic Acid.**—Sulphuric acid is added in small quantity to vinegar to check the decomposition or mothering when the acidification is complete. Sulphuric acid is best detected by barium chloride, or barium nitrate dissolved in water: upon addition of sulphuric acid in any soluble state of combination a white precipitate is formed insoluble in nitric acid. Nitric acid, when boiled with a solution of indigo in sulphuric acid, bleaches the indigo solution. Hydrochloric acid may be detected easily by solution of nitrate of silver; upon adding the former or any soluble chloride to the latter, a white curdy precipitate of chloride of silver falls, insoluble in nitric acid, but freely soluble in ammonia of cyanide of potassium.—W. L. G.

[11722.]—**Eyebrows Falling Off.**—Has not "Subscriber from the First" some other symptoms denoting ill-health, of which this is only a minor manifestation? Plumbum (lead) in poisonous doses will occasion the hair on the eyebrows to fall off, and we homœopaths say it will consequently stop it. Is subscriber in any way engaged in a trade where he inhales the fumes of lead? If so, that is the cause, and confirms the homœopathic proving of lead. If the falling off is not caused by lead he might try it. From some homœopathic chemist procure a sixpenny bottle of plumbum, No. 3 trituration, and take a grain (as much as will lie on a threepenny piece, not piled up) morning and evening, in a little water on an empty stomach.—WATTS.

[11722.]—**Eyebrows Falling Off.**—Rub with a little olive oil and rose-water.—RAT-TAT.

[11723.]—**Defective Contact Breaker.**—I have been in the same bother, but got over it. I have now had an electric bell at work, with one pint Daniell's, for nearly five months; but being in a warm place I have had to add some acid solution to porous cell. I made it, also a coil (I used bottling wire for the coil, which, I think, is superior, being bright, soft, charcoal wire), made a machine, covered my own wire, &c., from instructions given in "ours" to others by Mr. Tonkes and other kind correspondents. I found the fault of my contact breaker was owing to the screw being fixed to a rigid arm, the vibrations gradually unscrewing the screw. I have now mounted the screw on a spring arm similar to the spring the armature is mounted on, and added a nut to the screw to tighten it when in its proper position. The springs must be of a proper strength, which a few trials will determine.—W. BOLTON.

[11724.]—**Discharge of Water Over Weirs.**—I extract the following from Templeton's rule for the number of cubic feet discharged in any number of seconds. Multiply together the number of seconds, the width of the weir in feet, and the co-efficient taken from the table, the product will be the numb of cubic feet discharged in the time. (There is a tr given that gives the value of k for different depths.) The value of k in the case mentioned is ·29171. ∴ 86,400 × 4 × ·29171 = 100,597·876 of cubic feet, and if any other of the elements of this question was wanting, it could be found, with the help of the others, by substitution.—P. W. H. J.

[11728.]—**Adjusting Balances and Main-springs.**—The information respecting balances will be found on pp. 102 and 279, Vol. XIV. of the ENGLISH MECHANIC. The balls on an adjusting rod are used to slide up or down until they nearly balance the power of the mainspring for the first revolution after the chain is wound up, and by which the force of all the other revolutions is compared.—WEST CORNWALL.

[11729.]—**Teeth of Spur Wheels.**—If a "Pattern Maker" gets an odontograph, an instrument (price 5s.) invented by Professor Willis, of Cambridge, he will find in it correct information for setting out forms of teeth, so that any two wheels of a set may work truly together. The use of the instrument is very easily learned.—GO-AHEAD.

[11730.]—**Artificial Gum.**—Dextrine, also called British gum, would probably suit "Wrinkle." It would be much cheaper to buy than make, as it is prepared in enormous quantities. I give the recipe on a small scale:—Malt (crushed small), 1lb.; warm water, 2 gallons; mix, heat the whole to 145° Fahr., add of potato starch 5lb., raise the heat, to 160° Fahr. and mash for about twenty-five minutes, or until the liquid becomes thin and clear; it must then be instantly run off, and raised to the boiling point to prevent the formation of sugar; after boiling for three or four minutes the whole must be filtered and evaporated to dryness by a steam heat.—A BARRISTER.

[11731.]—**Hair Wash.**—If "Excelsior" consults "ours," p. 140, he will find an excellent recipe for the hair and many other purposes. I have used ammonia for years. My head is entirely free from scurf, the hair smooth and glossy, and I seldom require pomatum. Pour a few drops of ammonia into a basin of tepid water, and wash the head thoroughly, at the same time using a little soap. Well rinse in warm water.—M. POPE.

[11732.]—**Temperature of Ice and Water.**—Let x be the temperature of the water after the melting of the ice. 3 kilogrammes of water on passing from 79° C. to $x°$ will lose 3 (79 − x) units of heat; whilst 1 kilogramme of ice will absorb on passing from 0° to $x°$ a quantity of heat represented by 79 + x. Consequently we have the equation $3\ (79 - x) = 79 + x$, from which we conclude x = 39·5° C.—F. T.

[11736.]—**Extracting Iodine from Seaweed Ashes.**—"J. R." will easily extract iodine from seaweed ashes by mixing them with dioxide of manganese and sulphuric acid, heating moderately, when iodine will evolve in fine violet vapours, which will condense if received in a cool recipient.—F. T.

[11736.]—**Extracting Iodine from Seaweed Ashes.**—Kelp (the half vitrefied ashes of seaweed) is exhausted with water and the solution filtered; the liquid is then concentrated by evaporation until reduced to a very small volume, the chloride of sodium, carbonate of soda, chloride of potassium, and other salts, being removed as they successively assume the crystalline form. Oil of vitriol is now added in excess to the residual dark brown "mother" liquor (iodine lye), and the evolved gases are either kindled or allowed to escape by a flue; the liquid, after standing some time, is filtered, heated to about 140° Fahrenheit, and mixed with as much binoxide of manganese as there was oil of vitriol employed; the whole is then introduced into a cylindrical leaden still, furnished with a very short head, and connected with two or three large globular glass receivers, and heat is applied, when fumes of iodine are evolved and condense in the receivers. During the distillation very great care is taken to watch the process, and prevent the neck of the still becoming choked with condensed iodine. For this purpose the head of the still is usually furnished with a movable stopper, by which the process may be watched, and additions of manganese or sulphuric acid made, if required. To render the product pure, it should be passed between blotting paper, and then resublimed in glass or stoneware.—A BARRISTER.

[11738.]—**Cyanide of Potassium.**—It is really astonishing that "Dentiste" has not met with a serious accident for using, with so little precaution, cyanide of potassium. This substance is one of the most deadly poisons known, and second only in that respect to prussic acid or nicotine. Compared with it, arsenic is quite harmless. Its best antidote is a mixture of the following substances:—Sodium carbonate, ferrous sulphate, ferric sulphate.—F. T.

[11738.]—**Cyanide of Potassium.**—This is one of the most powerful and dangerous poisons known; it is, in fact, solid prussic acid. The only available treatment is instantly to place the head and face of any one poisoned with this drug (or with prussic acid) under a powerful stream of water from a tap or pump, but a delay of a very few minutes would be certainly fatal. It is impossible to say what the precipitate in "Dentiste's" bath is unless we know what it is composed of; he speaks of a saucepan, in that case probably all the gold has been precipitated. Cyanide baths give off fumes which are very unhealthy.—A BARRISTER.

[11747.]—**Canoe Voyage.**—Having been used to the sea for some years past, and having a skiff of my own in which I take long trips, I shall be glad to give "Afloat" any information I can on the subject. 1. I think "Afloat" would find it the safest and wisest plan to keep to the English coast, as going far from land in a small boat is too great a risk. In going along the coast, in case of being caught in a breeze, "Afloat" might find a suitable place to run his canoe on shore, and haul up whereas if in the middle of the Irish Channel he may stand a good chance of going to Davy Jones's locker. I should think the best trip "Afloat" could take would be to the south of Wales and up the Severn; he would, no doubt, be able to reach some place of interest each day, and find accommodation for sleeping. 2. As regards the fitting of canoe, &c., preparing is preventing, and "Afloat" before starting should be well fitted out, and at one end of canoe have a water-tight cupboard or locker, where he might keep the following articles, which would prove useful:—A small compass and binnacle, which he would require in case of fog, or not reaching the intended place till after dark; also some hand charts of the coast he intends to go. I have always found them most useful things in going along a strange coast, they give you nearly every information you require, are not very large, and each one takes in about sixty miles of the coast, they cost about 1s. 6d. each. A *Nautical Almanac* would also be a very useful thing to have. "Afloat" would have the time of high water at different ports, all the lights, buoys, courses from place to place, &c., or for a few shillings may get a book in connection with the charts; all these above could be obtained at any marine shop. 3. I should recommend "Afloat" to have a lug sail fitted to his canoe, that he may use when he has a fair wind, I have one to my boat which answers well, and saves a great many miles pulling. All the gear is made very light, and the sail, made of unbleached calico, is hoisted by a halliard which is attached to a traveller which runs on the mast, and the gaft hooked to the traveller. The sail is a large one that I might take advantage of light winds, but will reef down to half its size when wanted; it is very compact, can be hoisted or taken down without having to move, and when down does not take up much room. I shall be most happy to give "Afloat" any information I can through your valuable paper.—JACK TAR.

[11748.]—**Artificial Manures.**—If "Guano" is sufficiently acquainted with the French language I should advise him to read the following book, "Recherches Chimiques sur la Végétation," par M. George Will, Professeur au Museum d'Histoire Naturelle de Paris, as it is the best book, in my opinion, published about such matters.—F. T.

[11748.]—**Artificial Manures.**—The information requested would doubtless be exceedingly interesting. Several years' experience as a consulting farmer (not, however, pecuniarily interested) has taught me that a good soil should originally contain silex, alumina, lime, and magnesia; the two latter, however, can be supplied if absent for little more than the cost of carriage, when the former earths are absent, as on chalk and peat soils, the farmer must make a surface soil by carting marl on it, if he can get it; but silex alone—viz., pure sand is not worth even carting. Now for manure: if the soil does not contain sulphur, chlorine, and soda, these can be given cheaply to it in gypsum and refuse salt; then all we want more are potash, phosphorus, and the valuable stimulant nitrogen; how to obtain these cheaply is the farmer's problem. Coprolites and bones will give us the phosphorous with the less valuable lime and magnesia. Superphosphate gives us the same ingredients with sulphur; the bones give a little nitrogen. Peruvian guano gives us much more, but both these valuable manures are deficient of potash, hence their failure on a non-potassiferous soil to raise good crops of potatoes, which are great potash requisitionists; so we must supply this alkali in seaweed or kainit. Saltpetre would be a glorious fertiliser, but it is too dear. Nitrogen I have called a stimulant, for its presence greatly excites growth, and if used alone will rapidly exhaust the soil. Hence the landlords' prohibition of the use of soot and gas liquor, and the old farmers' prejudice against guano, which is about as sensible as a merchant having a prejudice against his cheque-book because its use diminished his balance at the banker's. It would be an interesting experiment to crop successively a patch of land manured with nitrate of ammonia alone, and note the results both on land and the produce. What salts plants and crops of various kinds really require, and how far they possess power of substitution of one ingredient for another, *e.g.*, soda for potash, lime for magnesia, can only be decided by a series of careful experiments, far out of the power of an individual farmer to make; they should be made by a Government department, and the results published for the benefit of the community at large.—HAMMER.

[11756.]—**Power of Water-Wheel.**—In your issue of this day (May 3), I see a query from "Water-Wheel" requiring the power of a water-wheel under three distinct times of supply—viz., 4h., 6h., and 8h. All who are in any way acquainted with hydraulics must be aware that unless the head or fall of water is known or given, no power can be arrived at. I shall and am always ready to answer such queries; but unless the most essential part is given, I must decline even attempting a reply. In this case there are several of the most important data missing. Let your correspondent give the following, and no more is required:—The fall or head in feet or decimal parts, the principle of wheels to be adopted, the size of pipe to be used and distance, the mean contents of each bucket, or, if he cannot arrive at such, give a sketch of the shape, giving principal dimensions, to enable the mean contents to be deduced, also whether buckets are iron or wood, and, if possible, approximate weight of wheel, so that the velocity may be arrived at from the revolutions given.—J. GILLAIRD.

[11761.]—**Magnetism.**—The second experiment has nothing to do with "increased transparency of iron;" the particles are simply arranged in polar order with their longest axis in the line of the tube; this, of course, diminishes the obstruction offered to the passage of light when the particles are floating about in all directions. If the beam of light were sent across the tube, probably the light would be diminished, owing to the concentration of the particles in that direction.—SIGMA.

[11770.]—**Magnetic.**—I am of opinion that "H. G. W.'s" needle was all right if he had let it alone. He has probably neutralised it by using the wrong end of his horse-shoe magnet in his manipulations, or he has rubbed in the wrong direction. If he will examine his horse-shoe magnet he will find the north pole marked. Let him use this pole alone, and stroke the needle from north to south, as marked upon the needle, repeating the process until it again becomes magnetic.—J. HOPKINS.

[11770.]—**Magnetic.**—In answer to "H. G. W.," I beg to say I think he must have rubbed the needle with the magnet in an improper manner. The proper way would be as follows:—Apply the magnet directly in the centre of the needle, in such a manner that its north pole would be near the south pole of the needle, and its south pole would be near the north pole of the needle. Then draw the magnet from end to end of the needle with a little friction (keeping both poles of magnet upon it). After a few such rubs, return the magnet to the centre of the needle, and withdraw it, when I have no doubt he will find the needle magnetised. If "H. G. W." applied the magnet to the needle with their respective poles in the same direction, the magnetic state of the needle would be destroyed, owing to the repulsive tendency of like polarities. I should mention, that if a needle is magnetised at all, it must point in the proper direction, provided no magnetic substance is present to interfere with its directive power.—DU FER.

[11774.]—**Caulking Boats.**—An excellent material now very much used for this purpose is cotton yarn. It is spun for the purpose and made up into balls like lamp wicks. It may generally be purchased at a cheap rate at any sea-side town.—A BARRISTER.

[11785.]—**London Blackbeetles.**—Introduce a hedgehog to your cellars or kitchen and it will soon demolish all such pests. Proved.—M. POPE.

[11786.]—**To "J. K. P."**—This query should have been headed "Screw Cutting," as it refers to a query (No. 11426), under that title, on p. 51, to which I gave an answer on p. 104. I have in consequence had to search the back numbers, at some trouble, having forgotten in the meanwhile all about the name of "Digby" and his requirements. "Digby" has only to remember that the wheels are not all in a line, as the joint of the wheel-plate gives great choice of position, and he will then see that if the change wheels are not too coarse in their teeth, he will have room to put on any reasonable variety of trains.—J. K. P.

[11788.]—**Bunions.**—If the case "Der Mend" refers to is a hardening of the skin or corn on the joint of the great toe, it may be relieved by frequent bathing, and using a felt corn plaister; if the great toe is turned away from the straight line of the inner side of the foot, wearing boots large and wide at the toes, and fastened firm round the instep to prevent the boot slipping, will be a great assistance, and will allow the toe to grow back to its old line; but if it is an enlargement of the bony joint (exostosis), I am afraid there is no help for it, as the many cases daily seen prove. Iodine ointments and strong liniments are sometimes recommended, but they have no more effect than to destroy the cuticle of the skin.—R. T.

[11790.]—**Photography.**—Try another sample of collodion; it is impossible to say what is the matter with it without knowing the composition and state of the old collodion. When necessary it should be diluted with sulphuric ether, and not with alcohol, as it is the former which has evaporated, and most collodions have as much spirit added to them as they will bear before they reach the consumer. It does not signify how much salt is added to the precipitating tube, so long as the quantity is in excess of the silver, which is precipitated in the form of gray mud, being, in fact, in a metallic form finally divided. A positive fixing bath, if sufficiently large, may be used for months; if only a small quantity be employed it quickly deteriorates. I should think, from many experiments I have made, that the exposure required in a glass-house would be four or five times as much as in the open air.—A BARRISTER.

A Remarkable Locust.—In a lecture on spontaneous generation recently delivered by Dr. J. C. Dalton, the well-known Professor of Physiology at New York, he remarks that there is no point connected with the habits of animals surrounded by so many obstacles to a complete elucidation as that of their reproduction. The deposit of eggs in one season, which are not hatched until the parents are dead, or have disappeared, for example, Professor Dalton illustrates by the case of an American locust (*Cicada septendecem*). A period of seventeen years elapses between the hatching of the larva and the appearance of the perfect insect, the larva all this time remaining buried in the ground, while the life of the insect in its perfect state does not last over six weeks. A brood of these locusts appeared in the city of New York in 1843, and again in 1860; they return, the Professor remarks, with their accustomed regularity, their next appearance being in 1877.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "W. L. G." has answered 11272; "A Barrister," 11275, 11282, 11283.

11352 Fox Skin, p. 49
11355 Model Steamboat, 49
11356 Candied Peel, 49
11366 Blankets, 49
11368 Precious Stones, 49
11375 Brickmaking in Canada, p. 50
11379 Wardian Case, 50
11383 Sulphur Soap, 50
11385 Salt, 50
11389 On Fortifications, 50
11395 Foreign Wood, 50
11396 Ivory Handles for Whips, 50
11397 Sting-proof Gloves, 50
11404 Analysis of Albite, 50
11412 Painting, 50
11416 Crossbow, 50
11420 Sewing Machine Extras, 50
11424 Botany, p. 51
11425 Fitting New Roller and Lever to Watch, 51
11430 Lapidaries' Tools, 51
11433 Porous Charcoal, 51

QUERIES.

[11791.]—**Col. Stuart Wortley's Emulsion Process.**—Will any photographic reader kindly give the details of this process—the composition of the preservative and the developer, the time of exposure, &c.—R. M. H.

[11792.]—**Compound Engine.**—Could any of "our" readers tell me what proportion the high pressure cylinder should bear to the low pressure cylinder? Also the size of steam receiver for a given size of engine?—FALSTAFF.

[11793.]—**Area of Chimney.**—Can any of "our" readers tell me of a rule to determine the area of a chimney, from a given area of firegrate surface? I have a small heating furnace to make; the area of firegrate is 800 square inches. I should like to know what size of chimney it will require.—FALSTAFF.

[11794.]—**Clutch for Driving-Wheel of Veloce.**—I should be glad if any readers would kindly describe and sketch me a clutch for the driving wheels of a veloce. Essentials: 1. An instant, certain, and firm hold of the driving-wheel, at the commencement of the stroke. 2. Self-acting release at the end of the stroke. 3. Noiselessness during the interval between the strokes. 4. Simplicity.—J. W. TAYLOR.

[11795.]—**Rough Pitch, &c.**—To HENRY W. FIELD.—I return thanks for information in the ENGLISH MECHANIC, of December 22, 1871. Would you again favour me with some information on rough pitch, and how to ascertain the breadth of tool for cutting screws?—THOMAS BRADSHAW.

[11796.]—**Coloured Printing Inks.**—An "Amateur Printer" would be greatly indebted to any person who may be kind enough to inform him the method of mixing the different coloured printing inks, such as yellow, violet, &c.—H. W.

[11797.]—**Preserving Moths and Butterflies.**—Can any of "our" readers oblige by telling me the easiest way of preserving small moths' and butterflies' bodies from decay? I have tried camphor, and that does not have the desired effect.—CHERRYEATER.

[11798.]—**Uncoiling New Wire Rope.**—I shall be obliged if any readers will inform me the proper way to uncoil a new wire rope. Not having had much practice, I am sometimes troubled by the rope twisting very much, when uncoiling by hand, thereby making it difficult to handle, and damaging the rope, besides loss of time.—BOILER-MINDER.

[11799.]—**Botany in Cornwall.**—Would any reader kindly inform me whether there exists a list of the flowers, &c., found in the north of Cornwall, round Bude, stating places where they may be found—also the best book, with plates, for naming the specimens?—T. A. D.

[11800.]—**Electrical.**—I should be glad to know the way by which (1) the electromotive forces of two different kinds of battery are compared; (2) the means of estimating the resistance, both internal and external, of a battery, in terms of a given length of wire, using the T galvanometer, both for 1 and 2. I know that this is possible, but don't see my way quite clearly. Perhaps "Sigma," or some other of "our" electrical friends would help me.—T. A. D.

[11801.]—**Question in Trigonometry.**—Perhaps some kind reader would give some information as to how the following question in trigonometry could be solved. The sides of a triangle, A B C, are given as follows:—A B = 1127; A C = 1044; B C = 953·9. If P be a point within the triangle, at which the sides subtend each an angle of 120°, find the values of A P, B P, C P.—NUMA.

[11802.]—**Date of Patent.**—Can any one please inform me of the date of the patent described in the ENGLISH MECHANIC, No. 324, June 9, 1871, called "An Improved Bakers' Oven"? I have been at work upon such an idea, for a smelting furnace, for some 3 or 4 years, and would if possible, be glad to learn the date of this American patent.—A SUBSCRIBER FROM THE FIRST.

[11803.]—**Euplectella spinosa.**—Can any of your correspondents kindly give me a description of Euplectella spinosa?—A CONSTANT SUBSCRIBER.

[11804.]—**Estate Agencies.**—I should be much obliged if your correspondent, a "Thirteen Years' Agent," who so kindly answered my query on the above [illegible] 11251, p. 153), would now give me further information on the following particulars:—(1) Which are the countries in which a beginner is most likely to succeed? (2) Would that beginner experience any difficulty in finding a gentleman who would be willing to take him as a pupil? (3) What are the usual terms for such education? (4) At what age ought it to commence? (5) How long is it generally continued? (6) What is the usually accepted social position of an individual following this profession?—L.

[11805.]—**Extracting Gelatine from Bones.**—Would the person who informed me that to extract gelatine from bones would require 4lb. pressure give further information? I have tried 4lb. and up to 12lb. without success, and have steamed them till quite soft. The French and Germans obtain it from this method with great success, so please inform me the reason of my failure and what bones you used, and the length of time they require to steam. Do the bones require to be subjected to any chemical preparation before steaming?—R. NEWHAM.

[11806.]—**Power Loom Weaving.**—I should be much obliged to any one who could inform me of any work on power loom weaving, as I want to get some information about the various improvements lately made in weaving plain calico, and the best sort of healds, reeds, and picking and tappit motions?—LANCASHIRE LAD.

[11807.]—**Preserving Heat and Boiler.**—Will any of our readers kindly give advice as to the following:—We have a vertical boiler, half of which and a quantity of steam-pipe is exposed. What is the best covering to keep in the heat and prevent the plates scaling away with rust? Also a few hints how to arrange a sieve to work by power would be deemed a great favour by—SIMPLEX.

[11808.]—**Photographing the Sun.**—Will some one of "our" many astronomical correspondents give me information in reference to photographing the sun? I have tried a flash exposure (slit ¼in. wide) on 3in. achromatic, but all the negatives are solarised, or burned up; also tried with aperture capped down to 1½in. Any suggestions would be acceptable to—PASSYUNK.

[11809.]—**Cool Air in Hot Climates.**—I am living in Malta, with the prospect of remaining here some years, and am told that the summer heat is great and trying, the nights being nearly as hot as the days. Now, if ice can be manufactured cheaply, I see no reason why large houses should not be supplied with a steady flow of cool pure air at a very moderate expense, but this is a matter for landlords to take action in. My object in writing is to see whether, by the kind assistance of some of your practical and ingenious subscribers, an unfortunate tenant, liable to sudden changes of quarters, may not be able to adopt some plan for securing cool and fresh air whilst asleep or quite quiet. I believe a patent has been taken out for making ice by the alternate compression and expansion of air, and, if this answers, it is evident that about 1,000 cubic feet of air could be reduced 15° in temperature, instead of converting 1lb. of water into ice. According to a late number of "ours," cars have been actually propelled by means of cases of compressed air, then, why should not a box bed or miniature sitting room be constructed of some non-conducting material, and be furnished with one of these cases, so arranged that the air in escaping from it should draw in a current of external air, cooling it to 60°, exactly as it cools the water in the ice-making machine, and at the same time driving out the hot respired air? What a boon some such arrangement would prove in India. I shall be much obliged for information as to nature and cost of machinery for compressing air, and of cases to contain the air, and to whom I might apply to try and get this idea carried out. Also for any suggestions of some more feasible plan.—C. H. B.

[11810.]—**Colds in the Head, &c.**—Will some one kindly acquaint me with a remedy for continual colds in the head, accompanied by a constant stuffing of the nostrils, and consequently producing a most annoying and disfiguring enlargement of the nose?—X. Y.

[11811.]—**Lime-juice and Glycerine.**—Will "Mayland" (reply 11593) kindly say the quantities each of glycerine, carbonate of potash, and lime-water?—COUNTRY BARBER.

[11812.]—**Aerated Waters.**—Will a brother reader kindly inform me whether I can make the above in small quantities, and if so, give particulars of same, to be used for lemon and other syrups?—COUNTRY BARBER.

[11813.]—**Oatcake Making and Baking Machine.**—Could any kind reader inform me if he knows whether such a machine is made for making or baking oatcakes? I know in some parts of Lancashire oatcakes are sold wholesale very much, and I have been told there are machines in existence for this purpose. Are there?—T. E.

[11814.]—**Lathe Queries.**—Would "J. K. P." inform me if there is any other way of fitting a double coned mandril than the (to all appearance) complicated one of Whitworth's, I mean, for a single gear lathe? In what way are the lighter lathes of the ornamental makers fitted? Are theirs different, or is Whitworth's considered the best method?—ANGLO-CELTIC.

[11815.]—**Fishing Rods.**—Can "Jack of All Trades" tell me if the first-class English rod makers use any particular kind of plane for rounding or finishing their rods? as I was informed by an Irish maker that the superiority of English rods resulted from some secret of the kind. Also could he give me the secret of the brown stain used for the ashen butts?—ANGLO-CELTIC.

[11816.]—**Fixing Balance-Wheel on Verge.**—I should be obliged to "Yorkshire Pivot" or "West Cornwall" if they would tell me the best method to fix the balance-wheel on the verge. I have had to put a new verge in; the brass was too high to hammer down, and pivots too long, which was very difficult, not having the proper tools. I am obliged to both of them for their recent information. I hope they will not quarrel about which gives the best information. I did use solder to fasten the escape-wheel in lever watch.—S. H. L.

[11817.]—**Portland Cement.**—Could any of your numerous correspondents give the best plan of kiln for burning Portland cement, and how long it requires to burn the same, and what proportion of fuel to cement burnt? Also what kind of machine used for crushing before entering the mill, to be ground fine? Any practical advice on the above will oblige—RELWOT (Hungary).

[11818.]—**House Heating.**—Fuel being extremely dear on the Continent, could any of your numerous correspondents give a practical plan of heating four rooms with one fire, they all being on one floor, and forming a square? Say from the cooking stove, it being placed in one of the four rooms.—RELWOT (Hungary).

[11819.]—**Roof of International Exhibition Building.**—On what principle is the glazing of the above roof done?—H. B. E.

[11820.]—**Gas Bags.**—I shall feel very grateful if some kind reader will oblige me by answering the following questions, to enable me to construct a gas bag and pressure boards for oxygen gas:—1. What kind of twill is employed for the bags, and where obtainable? 2. How are the seams made in the twill, and how is the tubing connected? 3. Is there any difference in construction of the bags used for oxygen and hydrogen? 4. How are the pressure boards made?—J. HUGHES.

[11821.]—**Holly.**—Can some one tell me how holly ought to be treated in order to preserve the extreme whiteness of the wood? That which I have cut down and seasoned in a dry room, though good and sound, is not white.—X. X.

[11822.]—**Slide Rest.**—Would "J. K. P.," or some other reader, kindly give me the sizes for a 3½in. slide rest, as I should like to fit one up for my lathe? I am going to make my own patterns; as I have no planing machine, I shall have to fit them by hand. A few hints as to the best way of doing the same would greatly oblige—AMATEUR ENGINEER.

[11823.]—**Holtz's Electrical Machine.**—Will some one of my fellow subscribers help me in a difficulty? I am endeavouring to make a Holtz's electrical machine, like the one figured on p. 90. I cannot succeed in cutting the windows and central hole. If any one will tell me the proper method, I shall be very much obliged.—J. STARLING.

[11824.]—**Punching Machines.**—Can any reader tell me the best kind of steel to make punches to punch through ½in. bars, and the best way to temper the same?—A CONSTANT SUBSCRIBER.

[11825.]—**Testing Bleaching Powder.**—Would some of our readers give me the means of testing chloride of lime or bleaching powder? Can none of our able chemists give this test, as it would be of great service to me and perhaps a few more of our readers, as I have seen the question asked before, and it has not been answered.—BLEACHING POWDER.

[11826.]—**Tinning and Soldering.**—Seldom a week passes but questions on this subject are asked and answered in the ENGLISH MECHANIC, but I do not recollect any reason given why the articles are tinned. During the articles on the "Amateur Workshop," which appeared in an early volume, it was stated that rosin was employed, and sometimes tallow, to prevent oxidation of the surfaces to be tinned, and I think if this was the only condition necessary, then rosin would only be required for tinning iron, &c.; but as we require chloride of zinc or salammoniac, &c., to tin iron, &c., I suppose there must be some other reason for these substances being used, besides the preventing oxidation on the surface of the metal, particularly as these things seem more likely to favour than retard such oxidation. Can any of our talented correspondents give us any information on this subject? I have set up a theory of my own to account for it, but as I am not able to carry out the requisite chemical manipulations to prove its correctness or otherwise, I shall be thankful for the information from those who may know better than myself. My reason for asking this question is, that as the solder and the surface of the metal seem to be so well amalgamated, then if the conditions requisite for this amalgamation were thoroughly understood and could be applied to the whole of the particles of the metal when in a molten state, it may be a step in the direction of alloys of metals not at present used, say an alloy of iron with lead or tin, which, while possessing the rigidity of iron, would yield more easily to the file or turning tool.—A. B.

[11827.]—**Sight.**—I want the opinions of some of our oculist readers on the following:—I cannot see distant objects at all distinctly, things appearing double or treble if very far off. Printing the size of that in the MECHANIC appears most distinct at the distance of 4in. from my eyes, and when writing I often find my cheek touching the (6in.) penholder. I cannot read the name over the shop window across the street, and the letters composing it are 6in. high. At experimental lectures I lose half the pleasure and benefit from not being able (from the middle of the lecture-room) to see what is done by the lecturer at the table. When out for a walk with others, a distant object, say a house or church, is pointed out, but I cannot see it, when it is plainly visible to others. But how is it that I can, by looking through a pinhole, held close to my eye, read the name opposite, count the windows in a distant house, and read letters 6ft. off, which, otherwise, appear only a lot of misty strokes? Is mine a case of myopia, or is it weak sight? I do not fancy it is the latter, as I can see well enough when objects are brought sufficiently near. Should I wear spectacles (and, if so, how may I know the degree of concavity?), or what other remedy can I adopt? What are the "invisible" spectacles?—W. P.

[11828.]—**Duration of Boiler.**—A common saddle boiler has been in constant use for heating my plant houses rather more than eleven years. Is there any reason to conclude, merely from its age, that it is becoming unsafe? By what tokens may approaching insecurity in a boiler, from wearing out, be suspected? If mine be replaced, which is considered the best form of boiler? Is the double L a very good one in all respects?—P. H. G.

[11829.]—**Tackle Poles.**—Will some correspondent kindly tell me the best way to fasten two poles at the top for a block tackle, with loops for hanging on the block and fixing guys?—A. B.

[11830.]—**Indicating Tablets for Electric Bells.**—I should be much obliged if some of "our" electrical friends would explain the construction of the indicating tablets for electric bells. A sketch would assist.—W. BOLTON.

[11831.]—**Thermometer.**—Can any of "our" correspondents inform me of the reason of the mercury [illegible] thermometer dividing, so that it registers [illegible] degrees higher than the actual heat? Also [illegible] would oblige.—A. G.

[11832.]—**Paper-hanging, Sizing, &c.**—I have lately built a house, and would like to know which is the best means to be used before putting on the paper-hangings. Should the walls have a coat of size? or should they be coloured with brown umber or some such colour? or is the paper best put on the bare walls just as the plasterers left them? and what time should elapse after plastering before the paper may be put on? The stone jambs of fireplaces I want to paint—should they be sized, and how many coats of paint should they have?—J. F. R.

[11833.]—**Smoky Chimney.**—I have a fireplace in a back kitchen, the flue of which runs up the eaves at the back of the house. The chimney-pots' tops are 7ft. above the eaves, while the ridge is 9ft. The consequence is, when the wind blows over the ridge, the chimney smokes. As it would be expensive to raise the chimney on account of the difficulty of scaffolding, could any form of chimney-pot be used that would prevent the smoke?—J. F. R.

[11834.]—**Springs.**—Will "Jack of All Trades" kindly give the process adopted to temper gun-lock springs, as those are made in Birmingham. I can make them after a fashion, but not satisfactorily. I harden by immersion in water when at a red heat, and then fry them in tallow until the tallow is burnt up, allowing them to cool in the pan. If a lead and tin bath is used, will he kindly give the proportions of the metals?—AN OLD GUNNER.

[11835.]—**Arsenic in Wall Papers.**—Can any of "our" readers inform me of a simple and easy mode of ascertaining whether any preparation of arsenic has been used in colouring wall papers? I believe the very bright and vivid shade of green called "Scheele's green" is a chemical compound of arsenic and copper, and the application of a drop of liquid ammonia to the paper will indicate the presence of the latter metal, by turning the green to a bright blue; but I have heard that some of the less brilliant shades of green paper really contain arsenic, and in these its presence is not so readily detected.—G. C. C.

[11836.]—**Voicing Organ Pipes.**—I am now far advanced in the construction of a small organ, having everything ready for the metal pipes. Now, I am but a poor man, and could not see my way to purchase metal pipes, so I made a row of zinc ones, but try as I will, I cannot get anything but a cracked note out of them, and I am persuaded that this is owing to the voicing. Why should I fail? I am not acquainted with any organ-building friend, and know nothing of the subject but what I have learnt in the MECHANIC, but nowhere can I find a clear explanation of the voicing. Would some kind friend assist me out of the difficulty? I have a row of S. Diapason, one of flute with the bevil of the mouth inside, and a row of zinc pipes; they all want voicing; how must I proceed? I have still room for another row of metal pipes. Would it be breaking the rules the editor has laid down to ask where I should get them cheapest, and what would be the cost?—ALEPH.

[11837.]—**Organ Bellows.**—Will "J. D." or any other correspondent kindly tell me the dimensions of bellows required to supply efficiently an organ containing the following stops, and if these described by "J. D." will be large enough for the purpose?—

GREAT ORGAN CC TO G, 56 NOTES.

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9	Sesquialtra, 3 ranks	
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—Y. Z.

[11838.]—**Clock Pallet.**—Would "Yorkshire Pivot" or "West Cornwall" give the best method of making an anchor-shaped pallet for an eight-day cased clock, or any other shape?—LANCASHIRE AMATEUR.

[11839.]—**Plates Chemically Clean.**—I hear that Dr. Anthony says, in a paper read to the Photographic Society, that he finds cleaning his plates in a bath of cyanide of potassium to be the best means of making them chemically clean. It seems to me that the sensitising bath would be spoiled by introducing plates cleaned with cyanide, and if the plates be washed under the tap after using cyanide I fancy that they might become greasy or otherwise unclean. I should feel greatly indebted to any fellow reader for a few suggestions regarding this or any other expeditious mode of making plates chemically clean.—ADOLESCENS.

[11840.]—**Whooping Cough, &c.**—Will a subscriber kindly inform me how to make balsam of horehound and aniseed? also an effectual remedy for whooping cough?—T. C. H.

[11841.]—**Human Relics.**—Will any correspondent oblige me with a little good information regarding the oldest human relic in the world? I believe it is to be seen in the Etruscan Vase Room at the British Museum. If I mistake not, it is the skeleton of Pharoah Mykerinus.—RALPH LOWDON.

[11842.]—**Indiarubber Gig Apron.**—Will any reader of the MECHANIC kindly inform me how to prevent the above sticking together when sat upon?—Z.

[11843.]—**Iron Castings.**—Will some fellow reader give me some information respecting the method of obtaining a solid casting when a wrought-iron bar is put in? I have tried by putting the bar in red-hot, but this does not answer.—PERRY.

[11844.]—**Rabbit Skins.**—The "Hampshire Farmer" has not responded to my inquiry about the red weed. I fancy it is the *persicaria*, which has a pink or reddish hue over the whole plant, and is a great weed wherever it gets a chance of seeding and growing. My rabbits are now increasing so fast that I shall soon be putting them to account, but as we mean to eat, not sell them, I want a hint as to preserving the skins. Can any of our friends say how they should be dressed in a simple ready way?—SENECIO.

[11845.]—**New and Excellent Sun Screen.**—Will Mr. Berthon (let. 4037) have the goodness to explain how the film of silver is deposited? He says the process is "extremely easy, and may be done by any one in a few minutes." I suppose an ordinary concave lens answers the purpose—it need not be a Barlow?—ALBIREO.

[11846.]—**Gold Beating.**—Can any reader explain the process of beating gold-leaf?—AN AMATEUR GILDER.

[11847.]—**Curry.**—Will some contributor kindly give a recipe for making curry? Captain White's is generally considered best. Is the recipe of this known?—PETTY CURY.

[11848.]—**Conic Sections.**—How must a cone be cut to produce the different conic sections—viz., the ellipse, the parabola, and the hyperbola, especially the two latter?—RUSTICUS.

[11849.]—**Printing in Canada.**—Would some subscriber having correct information kindly say what would be the prospects of a printer in Canada with a small capital (say £150)? and would it be advisable to take the cash or material?—A COUNTRY PRINTER.

[11850.]—**Pitches of Screws.**—I shall feel obliged to any of your readers, practical shipbuilders, who will give me the following information. A known vessel of fine lines, whose displacement is 3,500 tons, is propelled by an 18ft. screw, of 28ft. pitch, at the rate of 14 knots per hour, the screw making 55 revolutions per minute. Its disc area is 254 sq. ft. Is it probable that another vessel of like displacement, but drawing only 10ft. of water, could be propelled by three or four screws of about 16ft. pitch and 9ft. diameter, making 100 revolutions per minute at the same rate, assuming the position of the screws, lines of vessel, midship section, skin resistance, &c., to be equally favourable for speed in both cases? or would power so applied be wasted, and result only in churning the water? I should be glad to know, also, whether pitches of from 15ft. to 20ft. have been found admissible in practice for screws of about 10ft. diameter. I am under the impression that Rennie, about the year 1856, made some experiments, giving favourable results, with small screws driven at high velocities, and read a paper on the subject at a meeting of the British Association.—T. C. H.

[11851.]—**Supercargo.**—Will some obliging reader inform me what are the duties of a supercargo on board a merchant ship, what qualifications should a person have to fill such a situation, and what salary would he receive for going to Australia? Are such jobs easy to get?—O. N. C.

[11852.]—**Pallet Springs.**—Will "Jack of All Trades" tell me of what size and number the wire most suitable for making the above should be?—MUSICAL.

[11853.]—**Pedal Harmonium.**—Will any brother reader give me the dimensions for a set of 29 pipes for a pedal harmonium, the reeds to be 16ft. tone, and how to put the reeds on to them? Also a plan for a foot-blower for the bellows, which is a single feeder, 10in. fall.—G. J. C.

[11854.]—**Raising Salt Water.**—How is salt water usually raised to bath-houses? Is there any other way except by manual labour? How many feet above high-water is usually necessary for the water to be raised to enter the bath or bath cistern?—PHILANTHROPIST.

[11855.]—**Hygrometer Motive-Power.**—What is the substance that turns the index of the hygrometer that is generally on the top of the wheel barometer or weather-glass? I have tried catgut, but without success.—THOMAS DUNLOP.

[11856.]—**Military Examination.**—Would some one advise me on this subject? The requirements for this examination include mathematics, modern languages, and history ancient and modern, with geography. Does this include all the different branches of mathematics? If not, how many? How many modern languages are required? I would be thankful for a few hints on this examination relating to the age of the candidate. Perhaps "Sword and Pencil" or "Artillery Captain" would answer this.—ARIEL.

USEFUL AND SCIENTIFIC NOTES.

Caution about Potatoes.—The use of potatoes is a preventative against scurvy, if not an actual cure for it. Potatoes that have been exposed to the air, and have become green, are unwholesome; and new potatoes—*i. e.*, unripe ones—have much to do with the prevalence of cholera, and such like diseases, during the summer months.—*Food Journal.*

Fruit and Grape Wine.—The main point of interest in distinguishing between the wines is, says Dr. F. Vorwerk, that the phosphoric acid present in genuine grape wine is combined with magnesia, while in fruit wines it is present in combination with lime. The simple addition, therefore, of ammonia (1 part to 9 parts of wine) will produce in genuine wine, after twelve hours' standing, the well-known precipitate of ammonia-phosphate of magnesia.

Flexible Marble.—There has been exhibited in America a flexible marble slab, which is procured from the Portland quarries, Vermont. Professor Hay, of the Western University, of Pennsylvania, describes its constitution as—carbonate of lime, 97·50; magnesia, a trace; silica, 2·05; water, 45 = 100. The above composition and its crystalline character together proclaim it to be a true marble, and, at the same time, a pretty pure specimen of that mineral. The indubitable flexibility of the slab is its most remarkable feature. Dana states that "some of the West Stockbridge marble is flexible in thin pieces when first taken out." The slab in the possession of Mr. Holliday is about 2in. thick, and is nearly as flexible as an equal thickness of vulcanised indiarubber.

New works will soon be erected on a large scale at Cambuslang, Scotland, for the manufacture of steel rails by the Siemens-Martin process.

At Reay, Caithnesshire, a very large deposit of hematite ore of a superior quality has been found, and satisfactory reports are made by the surveyors.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

	£	s.	d.
Amount previously acknowledged	834	1	4
N. R. Y.	0	5	0
George Luff	0	5	0
Arthur Booty	0	2	6
	834	13	10

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, May 7, and unacknowledged elsewhere:—

Wm. Whiteman.—A. C. F. F.—J. B. Ward.—Epps and Co.—J. B. Smithson.—Edmund Broderip.—S. A. Sholl.—H. Hicks.—Wm. Bacon.—Fred. Harrison.—E. A. Fry.—John Barlow.—Ede Brothers.—Wm. Botham.—J. and A. Pumphrey.—G. G. Bussey.—C. H. Scott.—A Three Years' Subscriber.—John Dutton.—Samuel Kempling.—R. Rogerson.—A. B. Macdowall.—T. T. Greg.—The Harmonious Blacksmith.—Tucton.—E. L. G.—A. B.—Augustus Avame.—R. A. Proctor.—W. R. B.—One at a Loss.—H. H.—J. R. Leicester.—A. O. P. M.—Busy Bee.—Wm. Tonkes.—T. P. Barkas.—Cantab, M.A.—H. B. E.—Robert Morton.—J. W. Fennell.—E. W. S.—W. and Sons.—A New Correspondent.—E. P. T.—R. P. Smith.—R. Johnson.—W. H. Godfrey.—J. Griffiths.—W. H. Gaines.—L. T.—J. H. Hinds.—C. H. Wingfield.—B.—E. L. D.—Joseph Barwick.—Emily.—An Old Practical Miner.—J. H. Savage.—David Williams.—Alfred.—J. W. Fennell.—E. Elgar.—Woodman.—W. B. N.—Arithmer.—J. Russell.—Youngster.—Vulcan.—P. Davidson.—A Reader.—John Waring.—Amateur.—Richard Lenton.—J. B. R.—J. H. Wilkins.—Aspiring Professor.—Thetamu.—A Cripple.—Un Irlandais.—Philanthropist.—Catolic.—J. B. Whitehead.—Aspirant.—W. B.—Shylock.—C. W. M.—Screw-Cutter.—W. N. B.—J. P. P.—G. W. C. H.—Anglo-American.—Frank P. Purvis.—S. W. Burnham.—American Mechanic.—F. Collis.—E. A. K.—One who is Puzzled.—James Dyne.—Pi.—Matthew Annis.—J. K. P.—Saul Rymea.—A New Reader.—M. P. M. I. S.—Prentice.—M. Morgons.—R. S.—James Largue.—G. W. P.—Bed of Stone.—Nicotine.—M. R. B.—Arley Mine.—C. S.—G. W. K. L.—Improver.—T. F. S. M. R.—Fred. Harris.—Thos. Tremayne.—James King.—S. H. L.—Richard Holden.—An English Mechanic.—A. C. Lowe.—S. H. Cash.—Sarah.—F. E. T.—Constant Reader.—Gas.—A Nonenity.—Gamba.—A Poor Machinist.—Cordwainer.—L. C. E.—000.—Jack of All Trades.—A Well Wisher.—Anxious.—Osa.—W. T. B.—A Chicago Subscriber.—W. R. Birt.—Oxon.—Furniture Maker.—Leader of Brass Band.—Musical.—S. Taylor.—Thos. Sandeman.—F. E.—W. Bull.—A Joiner.—J. B. Forbes.—J. H. Vale.—E. E. W.—J. T. Little.

Communications which can only appear as advertisements to hand from Delves, Adver, Workman, F. G. W., J. H. Savage, A Joiner, W. Bull, Calculator.

AMATEUR GILDER, E. J. R., W. L. Clarke, and S. W., are respectfully requested to consult indices of three last vols. of ENGLISH MECHANIC.

J. A. G.—Your query involves the whole history of the American Continent. How considerate! There are a few people who appear to think that the ENGLISH MECHANIC was made exclusively for their especial benefit, and you are one of them.

MUSCOVADO thanks "Cocoa-Nut" for the kind and courteous manner in which he favoured him with information on Jamaica.

A SUBSCRIBER (Lewisham) and 3RD CITY are referred to indices to back vols.

R. M. HATCH.—You appear to require all the minute details of Col. Stuart Wortley's dry-plate process. As we do not recollect them we have inserted your query. The developer is an alkaline one—if we recollect rightly carbonate of ammonia, and the preservative is a gum and tannin formula.

ONE AFFICTED.—Consult a medical man.

D. Y. Z., and GO-AHEAD.—Write Lockwood and Co., Stationers' Hall-court, for a catalogue.

W. F. R.—We know of nothing but hair powder.

AMBOLE.—You cannot expect us to give space for the unimportant details you want. Write Millikin and Lawley for their pamphlet, "Model Steam Engines and How to Make Them."

RALPH LOWDON.—We scarcely think your conjectures concerning the Roman name of the Trent deserve the space they would occupy.

P. W. H. J.—Drawing to accompany reply 11656 (Boiler for Small Steamboat) is mislaid, or was not sent. Will you send another?

RUDEZ.—Inexpensive; advantage nominal; must be done personally.

A. H. C.—The illness of your birds is doubtless due to the cause mentioned, and no remedy will be thoroughly effectual short of substituting tinned wire for the corroded copper wires at present in the cage.

PADDINGTON.—We believe it has been decided that a person may not alter his ancient lights without endangering his right to them, that is, if the alteration be an enlargement or increase. In such case the owner of the adjacent property may entirely obstruct them until they are reduced to the original form and number, but no longer. Ancient lights cannot, however, be obstructed merely because the owner has opened new ones, but only where in obstructing new lights, he unavoidably obstructs the ancient ones also. See "Every Man His Own Lawyer," p. 72. We believe a book on the subject has been published by Mr. Homersham Cox, but forget the name of the publisher.

H. BIRCH.—What do you want to know? The idea of the caliper compass referred to is, of course, founded on the fact that the circumference of a circle is 3·1[illegible] times that of its diameter.

TELEGRAPHIST.—Culley's "Handbook of Practical Telegraphy," 14s., Longmans and Co.

P. E. T.—Zinc tubing would be better and much cheaper.

L. E. L.—Write to the Commissioners for the Reduction of the National Debt, Old Jewry, or procure prospectuses from half a dozen of the best insurance companies. Your distilling apparatus is identical in principle and form with several that have appeared in our columns.

M. O.—We will illustrate the contrivance if you will send a fuller description. A sketch showing the action of the machinery in the central pedestal would be desirable.

C. J. SMITH.—Glass-making was fully described in the ENGLISH MECHANIC about two years and a half since.

T. N. B., BOILER FEEDER, and M. A. send queries which can only appear in the advertisement columns.

E. G. CLARKE.—Please send drawing.

J. H. HOLMES, of Cambridge, says, in answer to our note a week or two since, he has invented a successful hair-cutting machine.

B.—You don't attempt to answer "E.L.G.," but criticise his involved sentences in still more involved sentences. If "E. L. G." is diffuse, he says something worth listening to; you are diffuse and say nothing.

J. RAE.—You are not the first who has complained that our print is too small for most of our readers. We may possibly make a slight modification at the commencement of a new volume.

J. RICHARDSON.—Consult last few numbers.

A. HILDEBRANDT, Hon. Sec. of the Manchester English Mechanics' Society, has sent us a report of the last year's proceedings of the society, including a list of the papers read, and also a list of the subjects discussed, including "Heating Surfaces and Firegrate Area of Steam Boilers," "The Lever," "The Pendulum," "Balancing of Locomotives," "Railway Wheels and Axles," "Feedwater Heaters," "Feeding Apparatus," "Incrustation of Steam Boilers," &c. But what practical good can be realised by our readers by merely recording the names of the subjects discussed? Our readers would, no doubt, be glad to know the salient points of the discussion, which might lead to a still deeper and wider discussion in our columns. The formation of English Mechanic Societies in Edinburgh, Manchester, Bristol, and elsewhere, may be of advantage to local members, but what they have gained in some instances our readers have lost, as the prominent members, or some of them, who used to give the scores of thousands of ENGLISH MECHANIC readers the benefit of their experience now confine their teachings to local limited societies. So a movement which was at one time hailed with satisfaction has not proved an unmixed blessing. We are in favour of the largest amount of knowledge to the largest number of persons. Though we cannot find room for a dry record of names and subjects of papers read, we should be glad at all times to give the essence of such papers and discussions.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING APRIL 30, 1872.

1208 L. T. Grousain, Paris, for improvements in infants' cradles or cribs.

1209 E. Peyton, Birmingham, for improvements in spring mattresses and other elastic surfaces for sitting and reclining upon.

1210 A. M. Clark, Chancery-lane, for an improved motive-power engine, applicable also as a pump. A communication.

1211 W. H. Davey, Islington, for improvements in washing machines.

1212 N. Thomas, Glasgow, for improvements in heating feed water supplied to steam boilers.

1213 W. A. Lyttle, The Grove, Hammersmith, for improvements in poles for telegraphic and other purposes.

1214 J. Kite, Vauxhall, for a new or improved apparatus for basting food in cooking.

1215 J. W. Gray, Billiter-street, City, for a new or improved lithoidal composition to be used as a paint and for other purposes. A communication.

1216 A. Cochrane, Gracechurch-street, City, for an improved mode of and apparatus for facilitating the teaching of languages, arithmetic, and other sciences (such as chemistry and anatomy) in which diagrams or pictorial illustrations are required.

1217 J. E. Outridge, Lewisham, Kent, for improvements in equilibrium slide valves.

1218 A. M. Clark, Chancery-lane, for an improved process of hardening tiles and other moulded articles. A communication.

1219 A. Paget, Leicester, for improvements in apparatus for raising, propelling, and distributing water and other liquids.

1220 W. Scott, Bilston, Staffordshire, for improvements in the bottom plates and bearers for puddling and balling furnaces.

1221 W. Broughton, Derby, for communicating between railway passengers and the guard and driver of railway trains.

1222 R. Maynard, Whittlesford, Cambridge, for improvements in portable mahinery for husking and dressing clover and trefoil, and other similar kinds of seeds.

1223 W. A. Gilbee, South-street, Finsbury, for improvements in the manufacture of shells and shot and in the machinery or apparatus employed therefor. A communication.

1224 E. Simcox and W. Banks, Birmingham, for improvements in box irons.

1225 A. E. Webb, Jamaica-street, Stepney, for a method of destroying the labels on bottles, jars, and other similar vessels on the cork or stopper being drawn therefrom.

1226 G. Westinghouse, jun., Southampton-buildings, for improvements in apparatus for working brakes on railway trains by compressed air, parts of which improvements are also applicable to brakes worked by other means.

1227 T. Midelton, Stratford, for an improved method of securing greater adhesion in railway locomotive engines.

1228 R. Maynard, Whittlesford, Cambridge, for an improvement in horse-shoes and drills.

1229 C. G. Kleberg, Martin's-lane, City, for improvements in the manufacture of sugar and in the apparatus employed therein. A communication.

1230 W. Richardson and J. Fidler, Oldham, for improvements in cotton gins.

1231 W. Cunningham, Dundee, for improvements in snipping, combing, and beating jute, flax, and other fibrous substances, and in the machinery or apparatus employed therefor.

1232 L. Pochet and L. Lemoine, Paris, for an improved system and machinery for removing smoke, vapour, and gas proceeding from locomotive engines in tunnels of railways.

1233 H. H. Doty, Bury-street, St. James's, and E. T. Gardner, Strand, for improvements in roof lamps for railway carriages.

1234 L. W. Pritchard, Kensal-green, for improvements in valves.

1235 W. C. Holmes, Gracechurch-street, City, and W. Hollinshead, Peckham, for improvements in the process of manufacturing gas, and in the apparatus employed therein.

1236 J. K. Collett, Cardiff, Glamorganshire, for improvements in packing and preserving butter.

1237 M. Cendle, Glasgow, for improvements in sewing machines.

1238 F. Durham and H. E. Hupton, Lowestoft, Suffolk, for an improved indicating or checking apparatus.

1239 B. Naylor and T. Gelderd, Leeds, for improvements in machinery or apparatus for tilting barrels, casks, or other receptacles.

1240 H. Gahn, Sweden, for improvements in cosmetics called "amykos."

1241 J. Bain, Liverpool, for improvements in screw-drivers. A communication.

1242 C. W. Vick and J. Cooke, Stroud, Gloucestershire, for improved machinery for feeding, preparing, and carding engines.

1243 S. W. Rich, Chenies-street, Tottenham-court-road, for improvements in the manufacture of sulphates.

1244 W. R. Lake, Southampton-buildings, for improvements in steam engines and parts connected therewith, chiefly designed for the propulsion of street vehicles. A communication.

1245 A. M. Clark, Chancery-lane, for improvements in drying and bleaching fabrics and fibrous materials, and in apparatus for the same. A communication.

1246 A. M. Clark, Chancery-lane, for improvements in locomotive engines and carriages and permanent way for the same. A communication.

1247 J. Lewis, Preston, for improved studs for sharpening horse-shoes for frosty or slippery roads, likewise applicable to boots and shoes.

1248 J. Witty, Manchester, for improvements in the manufacture of packing material.

1249 E. Gardner, West Strand, for improvements in lamps to enable them to burn hydrocarbon oils.

1250 C. F. Whateley, Birmingham, for improvements in railway, ship, and other lamps.

1251 M. Mayer and A. V. Deshayes, Paris, for improvements in embroidering machines.

1252 G. Cazes, Paris, for improved machinery for screwing boot and shoe soles and other articles.

1253 J. Oppenheimer, Manchester, for improvements in recording votes and in apparatus connected therewith.

1254 J. H. Johnson, Lincoln's Inn-fields, for improvements in magneto-electric machines. A communication.

1255 W. E. Gedge, Wellington-street, Strand, for an improved draught apparatus for steam-engines. A communication.

1256 C. Powis, Gracechurch-street, City, for improvements in umbrella and parasol slides or runners.

1257 W. R. Lake, Southampton-buildings, for improved processes of treating phosphatic rock and other phosphatic substances for the extraction of the phosphoric acid or soluble phosphates therefrom. A communication.

1258 M. Benson, Southampton-buildings, for improvements in elastic hose stockings for horses. A communication.

1259 P. Prince, Derby, for a self-acting regulator for the variations in the length of metallic wires employed in working signals on railways, &c., when caused by atmospheric temperature.

1260 B. Clark, Bilston, Staffordshire, for improvements in connecting crochet needles or crochet hooks to their handles.

1261 S. Chandler, sen., S. Chandler, jun., and J. Chandler, Southwark, for improvements in apparatus for cleansing water-closets.

1262 J. Chadderton, J. Allmark, and B. Haigh, Dukinfield, Cheshire, for improvements in cocks and water gauges.

1263 T. D. Eagles, Fenchurch-street, City, for an improved method of warming or heating rooms, railway and other carriages, and which is also applicable to general domestic use. A communication.

1264 W. A. Lyttle, The Grove, Hammersmith, for improvements in the preparation and utilisation of bituminous asphalte.

1265 E. A. Cowper, Great George-street, Westminster, for improvements in the process of converting wood and other fibrous materials into pulp, and in apparatus therefore.

1266 J. H. Johnson, Lincoln's Inn-fields, for improvements in apparatus for facilitating the examination and repairs of the submerged parts of ships or vessels. A communication.

1267 H. J. Smith, Glasgow, for improvements in extracting metallic oxides and in precipitating oxides from metallic solutions.

1268 J. Young, Kelly, Renfrewshire, for improvements in the manufacture of carbonic acid.

1269 R. Clews, Dundee, for improvements in weaving the end borders of rugs and mats.

1270 W. M. Brown, Southampton-buildings, for improvements in steam generators. A communication.

1271 J. S. Richard, Southampton-buildings, for improvements applicable to warping or beaming machines, and to other machines in which excessive slackness, breaking, or exhaustion of a thread, other than a weft thread, necessitates the stopping of such machines, and also cases where an expanding comb is required.

1272 J. Ducomet, Paris, for an improved construction of packing cases. A communication.

1273 R. Atkin, Crawford-street, Portman-square, for improvements in the construction of ships and other floating vessels.

1274 E. Russell, Millwall, for improvements in screw caps or covers for the axle-boxes of carriages and other vehicles for common roads.

1275 J. G. Tongue, Southampton-buildings, for improvements in the manufacture of cut pile, Brussels, or Wilton and tapestry carpets, and other pile fabrics. A communication.

1276 J. B. Fenby, Birmingham, for improvements in apparatus for regulating the flow and pressure of fluids.

1277 S. G. Soame, Marsham, Norfolk, for improvements in elevators for raising and stacking hay, corn, straw, and other similar substances.

1278 R. McVey, Jarrow-on-Tyne, for improvements in steam engines.

1279 H. Highton, Putney, for improvements in submarine or other cables for the conveyance of electricity.

1280 E. S. Lenox, New York, U.S., for improved means of concentrating light and in appliances connected therewith.

1281 G. Ayres, New Cross, Kent, for improved means of signalling on board vessels and in appliances connected therewith.

1282 A. Prince, Trafalgar-square, Charing-cross, for improvements applicable to tobacco pipes and cigar tubes. A communication.

1283 C. Woolley and G. H. Woolley, Mark-lane, City, for improvements in the construction of bottles, decanters, and other similar vessels, and means for closing the same.

1284 C. Woolley, Mark-lane, for improvements in the construction of bottles, decanters, and other similar vessels, and in means for closing the same.

1285 E. Pace and J. H. Howard, Bow-common, for improvements in machinery or apparatus for cutting splints.

PATENTS SEALED.

2575 E. P. Baville, for improvements in tool holders.

2583 T. W. Lockyer, for improvements in the manufacture of silk, linen, cotton, and other fabrics, so as to resemble horse-hair cloth.

2906 C. F. Claus, for improvements in the manufacture from blast-furnace slag of blocks suitable for building purposes.

2907 J. Roberts, for improvements in the construction of floating swimming baths and of the approaches to be used in connection therewith.

2908 J. H. Johnson, for improvements in paving and asphalting roads, streets, and footways, and in the composition employed therefor.

2921 S. J. Machen, for improvements in boilers used for the circulation of hot water for heating hot-houses and other similar structures.

2926 A. P. Vassard, for improvements in treating liquid sewage and other ammoniacal liquors.

2930 J. G. Cameron, for improvements in apparatus for steering ships by steam power, partly applicable to the slide valves and valve boxes of steam-engines generally.

2971 T. Briggs, for improvements in waterproof and other fabrics.

2980 J. C. R. Okes, for improvements in working steam-engines and pumps in mines for draining purposes.

3051 R. Wolstenholme, H. Buckley, and R. W. Buckley, for improvements in the mode of manufacturing velvets and velveteens.

3189 C. D. Abel, for improvements in rotary or centrifugal pumps.

3339 A. Tylor, for improvements in apparatus for regulating the working and ventilating of mines, buildings, sewers, and underground workings, and for increasing the certainty, safety, healthiness, economy, and facility of conducting such operations, and for the distributing, regulating, measuring, and purifying of liquids and fluids, such as air, vapour of water, smoke, and water, and in setting out and proportioning liquid and fluid passages and channels for irrigation and other purposes, and in the arrangements connected therewith.

3350 G. Ireland, for improvements in the manufacture of knives and forks.

3493 F. Clinch, for improvements applicable to the feet of horses and other animals.

195 W. Hulse, for improvements in metallic bedsteads, cots, couches, and chairs, and in machinery or apparatus to be employed in the manufacture of the said articles, parts of which improvements are also applicable to the manufacture of metallic railing for other purposes.

363 R. Brough, for improvements in steam-engine governors and speed regulators for machinery.

482 E. T. Truman, for improvements in covering wire or other suitable conductors with insulating materials, and in machinery employed in the covering process.

633 W. Lancaster and J. Bullough, for improvements in machinery for sizing and dressing yarns.

710 G. T. Bousfield, for improvements in sewing machines.

717 W. R. Lake, for improvements in machines for cleaning cotton.

722 W. R. Lake, for improvements in governors for steam-engines.

732 A. Johnson, for improvements in machines for rolling metal.

733 S. H. Hodges, for improvements in machinery for trimming or burnishing the soles or both soles and heels of boots or shoes.

2950 E. V. Neale, for improved methods of governing and arresting the motions of sliding and of hinged or swinging windows, doors, and objects, and of rotating shafts, rods, and objects.

2953 J. Robinson and J. Smith, for improvements in cutting wood into shavings or shreads for the manufacture of paper, and in machinery connected therewith.

2963 J. Shanks, for improvements in and connected with water-closets.

2972 C. Townsend and A. Rollason, for improvements in the treatment of materials and fabrics, rendering such materials and fabrics waterproof and transparent, and also for adapting them to general and surgical purposes.

2994 S. Osborn, for improvements in apparatus for grinding and polishing reaper and mower knives.

3003 E. W. Barnsley and T. Barnsley, for improvements in gutters and down pipes for conducting water from the roofs of buildings and for other like purposes.

3031 J. S. Crabber and W. Mellor, for improvements in machinery or apparatus for rigging or doubling, finishing, and cuttling textile fabrics.

3063 A. MacMillan, for improvements in buttons, and in fastenings for securing buttons, clasps, and such like to garments and other articles, and in tools to be employed for applying the same.

3071 J. Mitchell and J. H. Mitchell, for a new or improved apparatus for utilising the waste heat from steam boiler and other furnaces, thereby economising fuel.

3104 J. Birt, jun., and A. W. Birt, for improvements in life-preserving mattresses for saving life at sea.

3153 J. H. Johnson, for improvements in combined apparatus for the filtration and distribution of water.

3226 J. Crossley, for improvements in kilns for annealing plate glass.

3365 A. Ball, for improvements in invalid beds and couches, and in fittings therefor.

3328 C. Touaillon, for a new or improved process for preventing incrustation in steam boilers.

3378 A. Barrett, for improvements in croquet stands, applicable also to receptacles for implements used in other games.

3509 J. H. Johnson, for improvements in the jaws of machinery or apparatus for breaking stones and other hard substances.

223 A. Ford, for improvements in the mode of treating linseed and other seed and vegetable oils, so as the better to fit them for employment in the arts and manufactures.

269 D. T. Bostel, for improvements in what are known as "dry earth closets" and "urinals."

404 J. H. Johnson, for improvements in the production of alcoholic and other fermented liquors.

439 C. Notara, for a new and improved method and apparatus for separating various kinds and qualities of grain and seed, and for regulating the feed or supply of grain or seed in connection therewith.

465 D. Carter, for improvements in what are known as "dry earth" closets.

520 J. Rice, for improvements in the construction of firegrates, stoves, and furnaces.

592 O. G. Bolitho, for improvements in apparatus for applying railway brakes, also for effecting communication between guards, passengers, and engine-drivers.

669 T. Broughton, for improvements in the construction of foundations of buildings and in apparatus employed therein.

741 F. Cooper, for improvements in finishing velvets and velveteens.

760 W. R. Lake, for improvements in the manufacture of boots and shoes and in apparatus therefor.

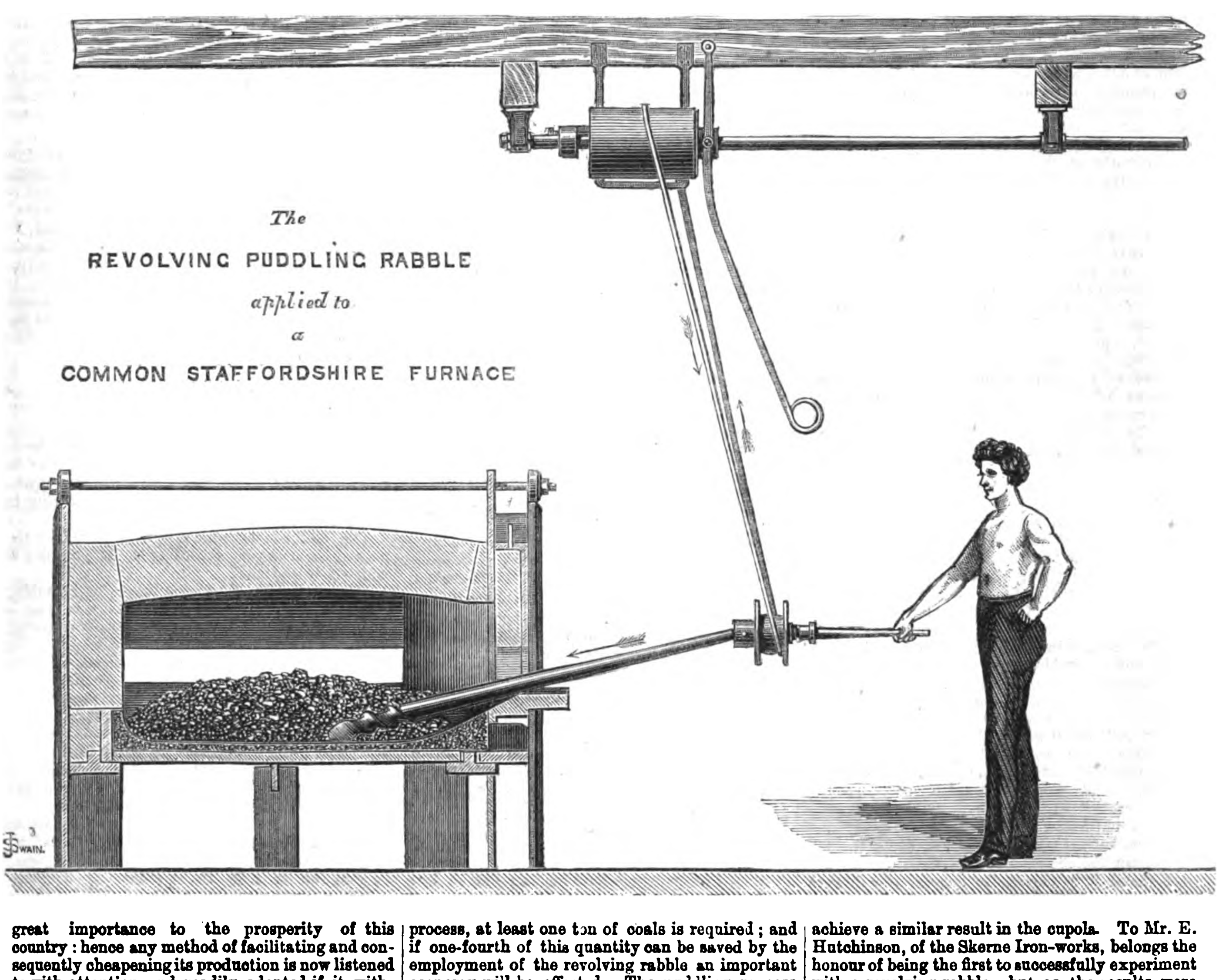
The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, MAY 17, 1872.

ARTICLES.

DORMOY'S REVOLVING RABBLE FOR PUDDLING.

ANYTHING which in the smallest degree affects the production or the manipulation of commercial iron must necessarily be of interest to large numbers of our countrymen, and especially to English Mechanics. The cheap and rapid extraction of that invaluable metal from its ore, if not of the first, is at least of very great importance to the prosperity of this country: hence any method of facilitating and consequently cheapening its production is now listened to with attention, and readily adopted if it withstands the test of practice. As evidence of this we can point to the way in which the Iron and Steel Institute investigated the merit of Danks's mechanical puddler, which we described on p. 579 of our last volume, and to the efforts of other inventors to accomplish equally economical results without rendering it necessary to make so radical a change as the use of Mr. Danks's ingenious apparatus implies. We have already illustrated the result of one of these efforts, which, following in the track of Mr. Danks, seeks to utilise a portion of the ordinary furnace, while adopting the rotary principle of the mechanical puddler (see p. 83 *ante*), and we are now about to describe an appliance which can be used with the ordinary furnace, and which, it is said, whilst increasing the yield of puddled bar and reducing the expenditure of fuel, relieves the workman almost entirely of the heavier portion of his arduous and exhausting labour. This appliance is Dormoy's revolving rabble, a brief account of which, by Mr. F. A. Paget, C.E., will be found in the ENGLISH MECHANIC, p. 35, No. 366. It will be seen from the accompanying illustration that the principle of M. Dormoy's invention consists in the application of steam-power for operating the rabble while the puddler simply guides it amongst the molten metal. The assistance which this simple contrivance affords to the puddler, and its value from an economical point of view to the ironmaster, formed the subject of a paper read before the Society of Arts last week by Mr. Paget. From this we learn that there are more than 7,700 puddling furnaces in Great Britain, representing an invested capital of more than £1,000,000. If we take 6,500 of these as actually in work, each making about 700 tons in the course of the year, the value of the iron produced would amount in round numbers to about £34,000,000. These furnaces require no fewer than 26,000 men, the majority of whom die before reaching 50, whilst the remainder are incapable of the requisite severe labour on attaining that age. For each ton of puddled bar produced by what may yet be termed the present process, at least one ton of coals is required; and if one-fourth of this quantity can be saved by the employment of the revolving rabble an important economy will be effected. The puddling process consists of four stages—viz., melting, boiling, "coming to nature," and balling. In the first, the pig iron, together with a sufficient quantity of oxide of iron, is placed on the previously fettled furnace bed, and as it softens is broken up by the puddler and mixed with the cinder. After about forty minutes the metal reaches the boiling stage, when it has to be violently agitated by the rabble of the puddler, which requires a great exertion of strength, and is, of course, carried on in a "warm" atmosphere, and with the intense glare of the furnace burning the face and eyes. The iron now thickens and becomes of a stiff pasty consistence, "comes to nature." It is worked in this state from side to side of the furnace, and is separated into pieces, after which it is collected into balls and removed to the hammer or the squeezer—one heat, as it is called, being thus completed. The whole operation lasts for about an hour and a half. It will be observed that nearly one-half of the time thus occupied is taken up by the first stage, the ordinary reverberatory furnace not being a very rapid or economical melting apparatus; and the question will doubtless be asked why the metal is not run into the puddling bed direct from the blast furnace. Methods of doing this have been patented and tried more than once; but hitherto they have resulted in failure, owing to the inability of unaided muscular power to puddle out the largely increased quantity of carbon. But as a matter of fact the melting of the pig in the reverberatory furnace, though costly as regards fuel, is a boon to the puddler, for during the thirty or more minutes occupied by this part of the process his work is comparatively of a light nature, and an opportunity is afforded for recovery from the exhausting exertion required during the latter stages of the previous "heat." But with M. Dormoy's rabble, a saving of fuel could doubtless be effected by melting the cast iron in a cupola, for according to a calculation made by Mr. Paget a charge capable of yielding 400lb. of puddled bar requires about 177lb. of coal merely to melt it in the reverberatory furnace, while 50lb. of coke would achieve a similar result in the cupola. To Mr. E. Hutchinson, of the Skerne Iron-works, belongs the honour of being the first to successfully experiment with a revolving rabble; but as the results were never published, and the use of his apparatus was discontinued within a few months, the idea of a revolving rabble and its successful adaptation to the ordinary furnace may fairly be considered as originated by M. Dormoy. It is a sine-quâ-non that any machinery for the purpose of puddling must be not only simple but free from any tendency to get out of order when subjected to the roughest and most careless treatment. The annexed figure will show how far the inventor has succeeded in meeting these requirements. The rabble is a bar $2\frac{1}{2}$in. in diameter and weighing about 80lb.; one end is loosely jointed to a sheave turning on a pin held in the hand of the puddler. This pin is generally covered with gasketting secured in a leather or rubber sheath to prevent any jarring action to the hand of the workman. An ordinary belt, driven by a broad pulley on shafting about six feet above the furnace, rotates the rabble at any desired speed, and while



supporting part of the weight acts as a universal joint and a friction brake. The belt, of course, readily adapts itself to the variety of positions taken by the rabble in different parts of the furnace and to the progressive changes in the metal, diminution of speed being obtained by permitting "slip" through lifting the weight of the rabble off the strap, while any unusual resistance is overcome by keeping the belt tight and so utilising all the power it gives. The tool is run at the high speed of from 300 to 800 revolutions per minute for white pig, and from 800 to 1,000 for gray, which is found to yield the requisite mechanical energy, the end of one form of rabble, which is 4½in. in diameter, having a surface speed of 600ft. a minute when revolving at the rate of 500 revolutions. The tool when too hot is removed by means of a light chain and hook and laid on low trestles, the substitution of a fresh rabble occupying altogether but thirty seconds. The power required has been indicated at from a quarter to a half-horse per hour for each furnace, the draught being greatest towards the end of the heat. This revolving rabble has been used in France, Hungary, and Styria, and the experience of its durability thus gained has shown that the apparatus is not liable to get out of order, the only part at all likely to give way being the belt; which, however, if properly cared for, lasts about four months, while, in the event of its breaking, the puddler can, of course, continue his operations in the ordinary manner. This difficulty is generally met in practice by providing an extra belt, which can be adjusted in a very short time. Independently of the relief this revolving rabble affords the puddler, there are other advantages attached to its use worthy of notice. Thus from the greater command over the melting metal there is less liability of burning, while by means of the power of steam the iron can be worked after it has come to nature, the rabble working like a drill through the tough pasty mass, and facilitating the after operation of kneading under the hammer. The saving in time, and consequently of fuel, is put at 25 per cent., for charges of 800lb. to 1,000lb. of gray iron are worked by the rabble in twenty to thirty minutes, while white pig requires only from ten to fifteen. No pig, however much carburetted, has, it is said, being able to withstand its action, and soft, fibrous iron, fine-grained iron, or steel, can be produced at the will of the puddler.

It is well known that we have vast quantities of pig iron which remains in that state from the want of puddlers to work it; in fact, the production of malleable iron could be increased by more than one-fourth if the requisite number of hands were forthcoming to do the work. It is claimed that by using this rabble the amount of iron now produced in a year would occupy but nine months, while the remaining three could be utilised as a relief for the men, or in producing more iron, as might be found advisable. But it is also claimed that independently of these advantages the employment of the revolving rabble would give a better quality of iron and a less number of ruinous "cobbles" or "wasters," while it would also facilitate the working up of very gray and inferior kinds of pig without any "fined metal," and would diminish the loss by "mill scale" at the rolls. All these advantages would follow its application to the ordinary furnace, but the proper method of using the tool to obtain the greatest results would be to melt the metal in a cupola, to enlarge the furnace, increase the charge, and to have two doors; but this would, of course, cause alteration, which it is the principal purpose of this invention to avoid. The adoption of the revolving rabble involves no alteration whatever in the present furnaces, and it can be fixed in a couple of hours. During the discussion which followed the reading of Mr. Paget's paper, the chairman, Mr. Jones, of Middlesbrough, spoke very favourably of the invention, and pointed out its utility to those ironmasters whose trade did not require the metal in masses so large as those turned out by the Danks furnace. Mr. Jeavons, of the Millwall Ironworks, said that he had practically tested the invention, and would be pleased to show it to any person interested. It is in constant use at his works, and has given great satisfaction. As an instance of the facility with which the puddling process can be carried out by means of M. Dormoy's rabble, we may mention that at a recent trial at Mr. Jeavons's works an elderly gentleman in overcoat and spectacles brought a heavy charge to "nature" in about a quarter of an hour, working the rabble for most of the time with one hand. It may be hoped, therefore, with the filip thus given to invention of late years in this direction, that while our iron manufacture is improved the puddlers will find some relief from their arduous and killing labour.

LESSONS ON CHEMISTRY.*

By SELIMO R. BOTTONE.

(*Late of the Istituto Bellino, Novara, Italy.*)

(*Continued from p. 112.*)

SECTION 7B.—COMPOUNDS OF SULPHUR WITH OXYGEN.

SULPHUR unites with oxygen in eight different proportions: of the resulting compounds only *two* have as yet been obtained in the free, or uncombined, state; the remainder being known only in the state of combination with the elements of water.

A. SULPHUR MONOXIDE.[1] *Symbol*: $S''O''$ (?). *Molecular weight*: 48 (?).

157.—This body has not been isolated. It may be considered as the anhydride of the following compound:—

A2. MONOTHIONOUS ACID.[2] *Symbol*: $H_2'S''O_2''$. *Molecular weight*: 66.

158.—PROPERTIES.—This acid exists as a lemon-yellow fluid, having a peculiar smell, somewhat resembling that of slightly-tainted beef. Its bleaching properties are very marked, and it might be used to great advantage for the whitening of wool, which is so tenacious of its colouring matter. Unlike most of the members of the "thionic" group of sulphur acids, it does not appear to dissolve the so-called insoluble silver compounds, but is instantly decomposed, with the formation of silver sulphide. It is extremely prone to decomposition at temperatures above 32° Fahr., sulphuric acid being formed, and the liquid becoming turbid owing to the deposition of sulphur in a state of extreme division. The results of a few experiments conducted by the author tend to show that besides sulphuric acid and sulphur, water, sulphuretted hydrogen, and oxygen are also evolved during its decomposition. The annexed equation will give an idea of the probable mode in which these changes take place:—

$$\text{Monothionous acid, 6 mol.}\left\{\begin{matrix} H_2 & S & O_2 \\ H_2 & S & O_2 \\ H_2 & S & O_2 \\ H_2 & S & O_2 \\ H_2 & S & O_2 \\ H_2 & S & O_2 \end{matrix}\right\} = \left\{\begin{matrix} \text{2 mol. sulphuric acid} & H_4 & S_2 & O_8 \\ \text{1 mol. sulphur} & & S_2 & \\ \text{2 mol. water} & H_4 & & O_2 \\ \text{1 mol. oxygen} & & & O_2 \\ \text{2 mol. hy. sulphide} & H_4 & S_2 & \end{matrix}\right\}$$

$$H_{12}\,S_6\,O_{12} \qquad\qquad H_{12}\,S_6\,O_{12}$$

The above represents the results of the decomposition *when air is excluded*, but if air be admitted no hydrogen monosulphide appears to be formed. In all probability oxygen is absorbed from the atmosphere, and sulphuric acid formed instead. Sulphur, however, is invariably deposited.

159.—PREPARATION.—By the action of granulated zinc on a concentrated solution of sulphur dioxide, as the following equation illustrates:—

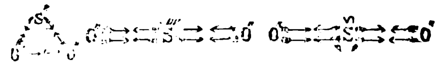
$$Zn + H_2O + 2SO_2 = ZnSO_3 + H_2SO_2$$

B. SULPHUR DIOXIDE. *Synonym*: *Sulphurous anhydride*.[3] *Symbol*: $S''O_2''$. *Molecular weight*: 64.

160.—PROPERTIES.—Pure sulphur dioxide is a transparent colourless gas, possessed of a most pungent and suffocating smell, well known as that of burning sulphur. Its specific gravity is 2·2464 (air 1·000); or, in other words, it is 32 times heavier than an equal volume of hydrogen. It is incombustible, and instantly extinguishes a lighted taper immersed in it. Sulphur dioxide is one of the most easily condensible gases; a temperature of about + 14° Fahr. being sufficient to reduce it to the form of a colourless liquid, at ordinary pressure; the same result may be obtained by subjecting the gas to a pressure of about two atmospheres.[4] The specific gravity of the liquid is 1·45. When this liquid is exposed to a temperature of − 105° Fahr. it freezes to an ice-like mass. If the liquid be allowed to evaporate it does so with such rapidity as to reduce the temperature of bodies in vicinity, to − 76° Fahr. (See paragraph 151.) When perfectly free from water, sulphur dioxide neither bleaches nor reddens blue litmus paper; but the presence of water immediately determines the production of both these effects. For this reason sulphur dioxide is largely used in the arts as a bleaching agent for straw, silk, wool, and other bodies which would be injured by chlorine. It is worthy of remark, however, that the colours bleached by sulphurous anhydride are not *destroyed*, but only *masked*; and may, in most cases, be caused to reappear, by immersing the bleached substance either in boiling water or in a dilute solution of potash or soda. Litmus paper, which has been bleached by sulphurous anhydride, is reddened by immersion in dilute sulphuric acid. Sulphurous anhydride possesses very marked antiseptic properties, and may be used for the preservation of meat, &c. It has been proved, by several well-conducted experiments, that beef, &c., which has been exposed for a few days to the action of this gas may be kept for several months without deterioration or loss of flavour. Sulphur dioxide is also much used as a powerful disinfectant.

Sulphur dioxide is very soluble in water: the amount absorbed varies with the temperature.[5] Thus at 32° Fahr. 1 vol. of water absorbs 68·861 vols. of this gas; at 50° the amount absorbed is only 51·38 vols.; while at 68° only 36·22 vols. are retained. If the water be boiling the gas is not absorbed at all.

161.—Besides its practical importance, sulphur dioxide possesses many points of theoretic interest, for it may be regarded as the basis of most of the oxy-sulphur compounds. It is usual, when speaking of it in this theoretic aspect, to designate it by the name of *sulphuryl*. We will return to this view when treating of the constitution of the oxy-acids of sulphur. According to whether we consider sulphur divalent, quadrivalent, or hexavalent, so may we represent the molecular constitution of this body as being either:—



Divalent Quadrivalent or Hexavalent.

162.—PREPARATION.—Sulphur dioxide may be formed by the direct union of its constituents, aided by heat: hence, when we burn sulphur in air or oxygen, this body is produced.[6]

The methods by which it is prepared for the uses of the arts vary according to the purposes to which it is destined.

When sulphur dioxide is used for bleaching purposes it is generally obtained by melting a quantity of sulphur in an earthenware recipient. The sulphur is then ignited, and the containing vessel placed in a large wooden chest, in which the straw, &c., to be bleached, is suspended. The chest is covered with sacking to prevent the escape of the sulphur dioxide gas produced.

For the preparation of sulphuric acid, sulphur dioxide is often produced by burning iron pyrites in a current of air. The sulphur contained in the iron pyrites combines with the oxygen of the air, producing thereby the body in question.

Sulphur dioxide may also be prepared by acting on carbon with strong sulphuric acid, aided by heat. Sawdust may be substituted for carbon; but in either case the product is contaminated by the presence of carbon dioxide, which is also formed. The following equation serves to illustrate the mode in which the changes take place:—

$$C'''' + 2H_2'S''O_4'' = 2H_2'O'' + C''''O_2'' + 2S''O_2''$$[7]

Should the sulphur dioxide thus produced be required for purposes in which the presence of carbon dioxide would be injurious, this body may be removed by passing the mixed gases through ice-cold water, which dissolves sulphur dioxide freely, while it absorbs very little of the carbon dioxide. By placing the solution thus produced in a retort, and applying heat, the gas is again evolved, and may be collected over *warm* water in the usual mode.

1 Monothionous anhydride. As sulphur forms so many oxygen compounds, it is found convenient to designate some by the Greek name of sulphur—viz., θεῖον, theion.

2 Hydrosulphurous acid.

3 Sulphurous acid. Sulphuryl.

4 The pressure of one atmosphere is roughly estimated at 15lb. to the square inch, hence two atmospheres equal 30lb. to the inch.

5 This is the case with most gases.

6 It would appear from the researches of Williamson, that when the temperature at which combustion takes place is high, sulphur trioxide is formed. It is the opinion of the author that sulphur dioxide is produced in the first instance, and that this body at the high temperature absorbs another atom of oxygen to form the trioxide.

7 As sawdust acts by virtue of the carbon it contains, no note is taken of the other constituents.

Where perfect purity is a desideratum it is found better to decompose the sulphuric acid by means of copper or mercury. The reaction may be expressed by the following equation:—

$$Cu'' + 2H_2'S''O_4'' = Cu''S''O_4'' + 2H_2'O'' + S''O_2''.$$

The gas evolved, after being passed through some desiccating body to free it from moisture, may be collected in the usual mode, *over mercury*; as *water* dissolves it too freely to admit of its use.

B2. SULPHUROUS ACID. *Synonym: Hydrogen sulphite.*[8] *Symbol:* $H_2'S''O_3''$. *Combining weight:* 82.

163.—It is presumed that this body is formed when sulphur dioxide is absorbed by water; for although it has not been found possible to eliminate the excess of water, yet the resulting solution is found to possess all the essential properties of a true acid. The concentrated solution of sulphur dioxide may be, therefore, considered as a solution of sulphurous acid in water; and the mode in which sulphur dioxide acts on water to produce sulphurous acid may be represented as follows:—

$$H_2O + SO_2 = H_2SO_3.$$

Sulphurous acid possesses most of the properties of sulphur dioxide, with the addition of the power of combining with several metals with the elimination of its hydrogen, thus:—

$$H_2SO_3 + M_2 = M_2SO_3 + H_2.$$

It is an active bleaching agent, and absorbs oxygen greedily. Hence it easily reduces (or deoxidises) many metallic oxides, in the following mode:—

$$M_2O + H_2SO_3 = M_2 + H_2SO_4.$$

Here the oxide is reduced to the metallic state, while the sulphurous acid absorbs oxygen, and is converted into sulphuric acid. The same absorption of oxygen takes place when the aqueous solution is exposed to the action of the atmosphere, thus:—

$$O_2 + 2H_2SO_3 = 2H_2SO_4.$$

Exposed to a temperature of about + 40° Fahr., the solution of sulphurous acid yields transparent crystals of a hydrate[9] containing a definite quantity of water. The composition of these crystals is:—

$$H_2SO_3 + 14\,H_2O.$$

As sulphurous acid contains two atoms of replaceable hydrogen it is divalent—that is to say, that to saturate it it requires either two monovalent atoms or one divalent atom.

For this reason the compounds which it is capable of forming with metals may be ranged under three heads—viz.: (1) Those in which both atoms of the hydrogen are replaced by two atoms of a monovalent metal, as illustrated by the annexed formula:—

$$M_2'S''O_3''.$$

(2) Those in which both atoms of hydrogen are replaced by one atom of a bivalent metal:—

$$M''S''O_3''.$$

(3) Those in which only one of the two replaceable atoms of hydrogen are replaced by one atom of a monovalent metal, thus:—

$$\left.\begin{matrix}H'\\M'\end{matrix}\right\}S''O_3''.$$

Compounds belonging to the two first classes are designated *sulphites*; those belonging to the last division are called *hydrogen sulphites*. When acted on by stronger acids all three groups give up their sulphurous acid. In solution the sulphites absorb oxygen readily, being thereby converted into *sulphates*.

C. SULPHUR TRIOXIDE. *Synonym: Sulphuric anhydride.*[10] *Symbol:* $S''O_3''$. *Molecular weight:* 80.

164.—PROPERTIES.—Sulphur trioxide is a white solid, crystallising in fine filamentous prismatic crystals of a silky lustre, much resembling *asbestos* in appearance. The specific gravity of the crystals is 1·9546. These filamentous crystals are very tough and difficult to cut. At a temperature of about 66° Fahr. they melt, and on increasing the heat, boil, when the temperature reaches 114° Fahr., giving off colourless transparent vapours if no moisture be present. In the presence of damp air dense white suffocating fumes arise. An allotropic modification of sulphur trioxide exists, which differs principally from the one just described, insomuch as the crystals are acicular, and the melting point considerably higher—viz., 122° Fahr. Sulphur trioxide does not redden litmus paper, and (unless moisture be present) may be handled with impunity. In the presence of water it acts as a most powerful corrosive agent. Thrown into water sulphuric anhydride combines with it with such violence as to produce great heat, and sometimes light, accompanied by a hissing sound, similar to that produced on quenching red-hot iron. Exposed to the atmosphere, sulphuric anhydride rapidly absorbs moisture, and becomes liquid, or *deliquesces*. The product of the combination of sulphuric anhydride with water is sulphuric acid.

Sulphur trioxide is decomposed when its vapour is passed through a red-hot porcelain or platinum tube, being resolved into two volumes of sulphur dioxide, and one volume of oxygen. Hence sulphur trioxide may be conveniently viewed as an oxide of sulphuryl (see 161), and we can express this decomposition in the following mode:

$$2S''O_2''O'' = 2S''O_2'', + O_2''.$$

165.—PREPARATION.—According to Williamson, sulphur trioxide may be formed by the direct union of its elements, aided by a high temperature. It would appear that by burning sulphur in oxygen at very high temperatures the sulphur dioxide first formed combines with a third atom of oxygen, thus:—

$$SO_2 + O = SO_3.$$

But this method is not the one usually followed. Sulphuric anhydride may be easily prepared by distilling, at a gentle heat, Nordhausen sulphuric acid—a brown liquid which consists essentially of sulphuric anhydride mixed with sulphuric acid; when the sulphuric anhydride passes over, and may be collected in a dry, well-cooled receiver; while the sulphuric acid remains in the retort, as the adjoined equation illustrates:—

$$H_2'S''O_4'', S''O_3'' = H_2'S''O_4'' + S''O_3''.$$

Or common sulphuric acid may be distilled along with phosphoric anhydride when this latter body seizes upon the elements of water contained in the sulphuric acid, liberating the sulphur trioxide, which may be collected as before. The reaction is as follows:—

$$P_2O_5 + H_2SO_4 = 2HPO_3 + SO_3.$$

Another mode of preparing this body is by heating a body called hydrogen sodium sulphate in a glass retort. The composition of this hydrogen sodium sulphate is:—

$$\left.\begin{matrix}Na'\\H'\end{matrix}\right\}\overline{SO_4}''.$$

On being heated, it loses hydrogen and oxygen in the proportions to form water; and a body, resembling in composition Nordhausen sulphuric acid (in which the hydrogen is replaced by sodium), remains behind, as may be gathered from the following equation:—

$$2\left(\left.\begin{matrix}Na'\\H'\end{matrix}\right\}\overline{SO_4}''\right) = Na_2'S''O_4''\,.\,S''O_3'' + H_2O.$$

If this body be further heated, it breaks up into sodium sulphate and sulphur trioxide, thus:—

$$Na_2'\,S''O_4''S''O_3'' = Na_2'S''O_4'' + S''O_3''.$$

[8] Hydric sulphite.

[9] A hydrate is a body containing water. A body is said to be anhydrous when free from water.

[10] Sulphuric acid.

A NEW PHOTOMETER.

FOR making visible to a large audience small variations in temperature, a thermometer containing a saturated solution of iodine in bisulphide of carbon is well suited, on account of the high co-efficient of expansion of that liquid. Comparing the co-efficient of this solution with that of bisulphide of carbon, M. Provenzali found that under the action of light the former exceeded the latter by 0·20, and sometimes even 0·25; whereas, in darkness, the two co-efficients were almost equal; and a thermometer, having a solution of iodine in bisulphide of carbon, rose or fell on passing from darkness to light, or *vice versa*, while a mercury thermometer was stationary.

This phenomenon, he says, is not so extraordinary as it would seem at first sight. The saturated solution referred to is a body with very feeble reflective power, perfectly opaque, and undergoing no chemical change from the action of light. Thus the luminous rays, which are reflected by the mercury, are absorbed by the solution, and transformed into heat, which increases the temperature and volume. Hence thermometers with a solution of iodine in bisulphide of carbon, may be utilised for photometry. The following is the mode adopted: "Two thermometers, one mercury, and the other containing the solution, are placed near each other on a table. The graduation of the mercury thermometer is as usual, except that the scale is divided into fifths of a degree. The graduation of the thermometer with iodine solution is such that the two thermometers agree in their indications in the dark. Under the influence of light, on the other hand, the thermometer with iodine solution rises above the other, in proportion to the intensity of the light.

After the beautiful experiments in which Tyndall separated obscure heat from light by means of opaque solutions of iodine in bisulphide of carbon, there is no reason to think that the obscure rays will have a marked influence on the relative indications of the two thermometers forming the photometer. Nevertheless, in order to know better the diathermancy of the opaque iodine solution, I inclosed two good mercury thermometers in two equal glass tubes; the bulb of one remained uncovered while that of the other was plunged in a saturated solution of iodine in bisulphide of carbon. So long as both were in darkness, and exposed to radiation from obscure sources, they gave the same indications; but when brought into a somewhat strong light, the thermometer with its bulb in the solution rose a little higher than the other, and the difference increased to a degree when the sunlight was admitted into the room. We may, then, believe that the diathermancy of the solution referred to extends to all the obscure rays, and therefore that the obscure rays cannot materially alter the indications of my photometer.

It is necessary here to remark that the two thermometers should be made of the same kind of glass; for I found that a difference in the quality of this altered the relative indications of the thermometer.

Having exposed to the same source of obscure heat three thermometers of the iodine solution, and having bulbs of the same diameter, but made from three different kinds of glass, the apparent variation in the liquid volumes was as the numbers, 1, 1·3, 1·5. These differences are probably due to differences of diathermancy in the glass. Melloni observed that different kinds of glass, though equally transparent, did not absorb and transmit obscure heat in the same degrees. More recently Tyndall, having made a plate of platinum incandescent by strongly concentrating obscure rays with a lens, observed that a piece of window glass placed between the source of heat and the platinum sensibly enfeebled the incandescence, while with glass of a different quality, it was very little enfeebled, and glass that was quite opaque had less enfeebling effect than the window glass. It seems to me that even in meteorological observations, made with the aid of mercury thermometers, the effect of diathermancy in the glass is not to be neglected.

I will now give the results of experiments made with this photometer on solar light, diffuse and direct, in the month of May. In the morning, before sunrise, the two thermometers showed nearly the same degree of temperature; they also did so about half an hour after sunset. At 8 o'clock in the morning, and in a room of the laboratory with open windows, the mean difference of the two thermometers was 0·2°; the greatest difference having been 0·4°, when the sky was perfectly serene, and the smallest 0·1°, when it was entirely covered with clouds. At 11 o'clock the mean difference was 0·3°, the greatest having been 0·5° when the sky was slightly nebulous, and the smallest 0·1°, when it rained heavily. In open air, as was to be expected, I found the differences greater and more variable; thus at 8 o'clock they had varied from 0·3° to 0·7°; and at 11 o'clock from 0·5° to 1°. At the time of the greatest difference the sky showed a number of cumuli strongly illuminated, and at the time of the smallest it was very much darkened by a thick cloud. The mean at 8 o'clock in the open air was 0·5; and at 11 o'clock 0·7°. On carrying the photometer into the open air I observed several times a somewhat curious phenomenon. The two liquids moved in opposite directions, the mercury falling, and the iodine solution rising. The reason of this was, that in the open air the temperature was somewhat lower, while the intensity of the light was greater than within doors.

As regards direct radiation from the sun in open air, the mean difference of the thermometers, when exposed to the sun on serene days, was 5·1° at 8 o'clock and 7·7° at 11 o'clock. This gives us the proportion of 1 to 1·5; and we get nearly the same proportion on comparing the differences 0·5 and 0·7, obtained at the same hours from diffused light in the open air, and the othe differences, 0·2 and 0·3, obtained from diffused light in the laboratory. Thus the intensity of light indicated by the photometer increased from 8 o'clock to 11 o'clock in the proportion of 1 to 1·5, equally within doors and in the open air (the light being diffuse); and in the direct sunlight I have also experimented with phosphorescent light and that of electric discharges, which were only visible in the dark, and on lunar radiation; the photometer shows itself sensitive to all of these.

For lunar rays I experimented in a room which had been made for optical purposes. I placed a bi-convex lens, 247 millimetres in diameter, behind the glass of the window (which faced south), and, at the focus of the lens, the bulb of a thermometer of the iodine solution, with a scale on which it was easy to distinguish the one-hundredth of a degree. It was the 16th day of the lunar month, and between 10 and 12 o'clock in the evening, and many clouds covered the sky, some of them very dense. On the passing of a cloud before the moon the liquid in the thermometer fell, and it rose again when the cloud had passed. The variation of the liquid column under these circumstances reached one-third of a millimetre, corresponding in this thermometer to one-seventy-eighth of a degree C."

BORING AND MORTISING MACHINE.

THE past decade has witnessed the introduction of numerous machines for the rapid working of wood used in the arts of construction and in the various articles of our domestic furniture. What

being adjusted to any required length of mortice. At opposite sides of the machine a table is situated, upon which a leg or other part of a chair or other piece of furniture is placed, and secured thereto by a cramp; the part wherein it is desired to make the mortice being brought in front of the bits, and being pressed against them by means of a screw, an accurately placed mortice is speedily formed, corresponding in width to the diameter of the boring bit and in length to the distance through which it moves. The part of the machine by which the dowel holes are bored consists of revolving bits, carried in brackets situated upon compound slides arranged upon the upper part of the framework, by means of which the bits can be brought into any position to suit the dimensions and nature of the piece of work or to the width of holes required to be bored, the bits being forced or drawn against the wood to be operated upon by hand levers, actuated by the attendant. The patentees prefer to make the machine duplex, so that two similar pieces of work may be operated upon simultaneously. In order to finish the joints of the work after it has been mortised and the dowel holes cut, the back legs and rail are put together by the tenons of the latter being entered into the mortices of the former, and cramped together in a machine for cutting the back joint; this consists of two saws situated upon a transverse hollow shaft, through which a right and left hand screw passes, whereby the saws can be adjusted to any distance apart corresponding to the length of the back rail of the chair, sofa, or other similar piece of work. The back is brought against the saws by a guide plate

in dotted lines the front and back leg of a chair about to be operated upon by the mortising bits B, are carried by brackets bolted to the framing of the machine, and are adjusted to the required height by means of screws and hand wheels, shown in Fig. 1, the screws being kept in position when adjusted by pinching screws. The tables I are situated upon horizontal slides, and by means of the screws and nuts placed under the tables are caused to travel to or from the mortising bits B by the operator turning handles affixed to the rods L (omitted here for want of room), in a right or left hand direction, similar to the manner of operating the slide-rest of a self-acting lathe. The legs or other parts of a chair or other piece of furniture, when placed upon the tables I, are secured thereto by the cramp K, which consists of a horizontal shaft furnished with a feather fitting into a corresponding groove in the eye at the head of the bracket O to allow of the position of the shaft being altered. At the end of each shaft a vertical screw is carried, furnished with a hand wheel, and upon tightening this the piece of furniture placed upon the table under it is firmly held in position, so that the parts wherein it is desired to cut the mortices being brought in front of the bits B, and being pressed against them by means of the screws worked by the handles on the rods L, accurately-situated mortices are speedily formed, corresponding in width to the diameter of the mortising bits B, and in length to the distance through which the bits travel in the race C. The portion of the machine by which the dowel holes are bored consists of revolving bits driven at a high velocity by

FIG. 1

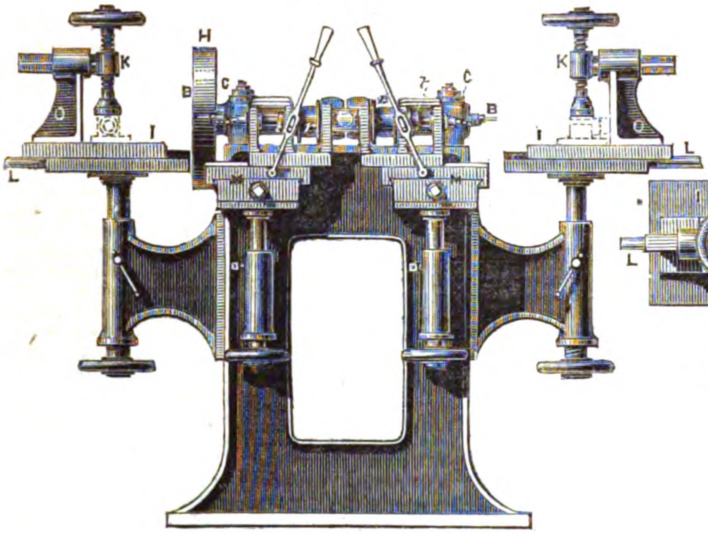
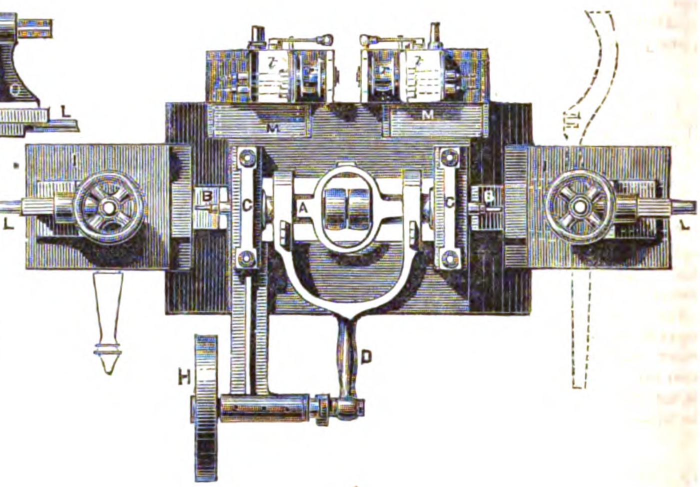


FIG. 2



was formerly manufactured with a great expenditure of labour is now cheaply produced in large numbers by the employment of machines, and although the apparatus has not yet been designed capable of turning out a finished chair or table from the rough log, the various parts are now shaped by machinery, leaving only the fitting together and finishing to the skill of the workman. We this week illustrate one of the most recent of these introductions—a machine for cutting mortices and boring holes in the different parts of chairs, tables, sofas, &c., which is supplemented and accompanied by another of similar construction for shaping the tenons and pins for the counterparts produced by the mortising and dowelling machine. These contrivances form the subject of a patent recently granted to Matthew and John Pollock, of Beith, Ayrshire, and will, we think, be readily understood from the following description, with its accompanying illustrations. By way of introduction, however, the principle of the machine may be described as follows:—The part by which the mortice is cut consists of a revolving shaft fitted with bits, the diameter of which is equal to the width of the mortices desired. This shaft is carried in bearing blocks situated in a race, in which it is caused to reciprocate through a distance equivalent to the length of mortice required by means of a connecting-rod attached to a crank upon a revolving shaft near one end of the machine. This crank is preferably arranged with an adjustable throw, so that the range of the reciprocating spindle, and consequently that of the mortising bits, is capable of

or slide set at right angles to the plane of action of the saws. This latter machine is also applicable to cutting and boring the dowel holes in back stays for chairs, having a compound boring apparatus attached thereto, the action of which is similar to that used for boring the dowel holes in the legs of furniture, the bits being placed at the same distance apart, so that the dowel holes in both legs and back stay correspond; the same saws which cut the joints for the back also cut the ends of the back stay to bring them to the required length.

In the engraving, Fig. 1 represents a front elevation of the mortising and dowel-hole boring machine, and Fig. 2 is a plan. As shown in Fig. 2 the part of the machine used for mortice-cutting is constructed with a revolving shaft A, the extremities of which are fitted with bits B, whose diameter is equal to the width of the mortice desired. This revolving shaft A is rotated at a high velocity by means of pulleys, and it is carried in bearing blocks situated in a race C. The shaft A and bits B are caused to reciprocate in the race C through the required distance by means of a connecting-rod D, attached to a crank on a revolving shaft carried in bearings supported by a bracket bolted to the framing of the machine. The crank is preferably constructed with an adjustable throw, so that the range of the reciprocating shaft A, and the mortising bits B, is capable of being set to any required length of mortice. The revolving shaft to which the crank is attached is driven by a belt passing over the pulley H. The tables I, upon which are shown

means of the pulleys R, the bits being geared
together in pairs or other num rs by means of
spur pinions T, carried in brack upon the hori-
zontal compound slides M, whicl carried and
adjusted, as regards their height by means
of vertical screws passing throug B bolted
to the framing of the machine, a on posi-
tion by pinching screws. The attaides
M are acted upon in one directio this irs
the square heads of which are as a cu
direction at right angles thereto by other po
so that the boring bits can be b German g
position to suit the dimensions ar ones, then
piece of work about to be bore
pressed or drawn against the wood
actuating the hand levers.

The sawing machine which forms the complement to the one illustrated is constructed on the same principle, and with as little difference in the arrangement of details as the nature of its work will permit. It will be observed that all the parts, whether those for carrying the work or those bearing the tools, are adjustable one to the other to suit the difference in size of the various articles to be operated upon.

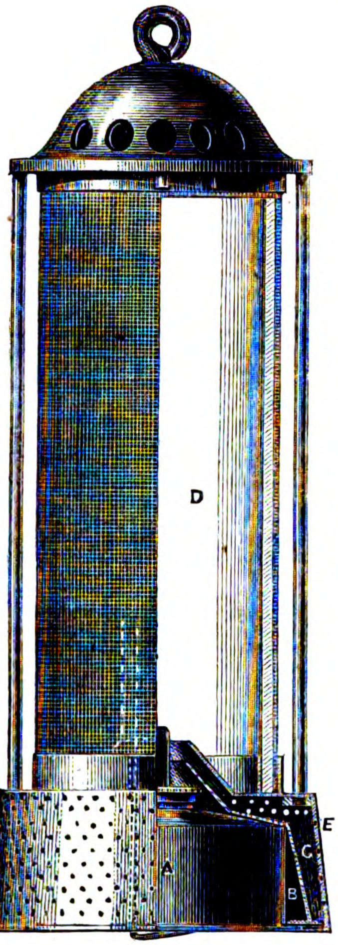
ELECTRO-DEPOSITION OF NICKEL.

THE value of nickel as a preservative coating for metals liable to corrosion or oxidisation is now well known, but, so far as we are aware, little use has hitherto been made of it for the purposes of ornamentation. This arises principally, we believe, from the fact that the colour of electro-deposited nickel does not harmonise with that of gold,—a defect which Mr. Thomas Fearn, of Aston, claims to have removed by employing a deposit formed of iron and nickel, by which the colour is greatly improved, and some useful effects obtained. The process invented and patented by Mr. Fearn consists in the employment of a solution of nickel and iron, by means of which an alloy of these metals is deposited on articles suitably prepared in the usual manner. For this purpose he dissolves twenty-four parts by weight of muriate of ammonia (chloride of ammonium), in 160 parts by weight of water, and saturates the solution with protoxide of nickel, at a temperature of about 120° Fahr. From this solution a good deposit of nickel may be obtained, if desired, with a moderately intense battery power. When the first solution is saturated with nickel the same quantity of a like solution of muriate of ammonia is added; but in order to deposit from this solution the alloy of nickel and iron it is necessary to charge it with iron in addition to the nickel which it contains. This the patentee prefers to do by electricity. He employs an anode of iron, by which an electrical current from a voltaic battery, or other source of electricity, is passed through the solution until the required alloy of nickel and iron is deposited at the cathode. This is ascertained by observing the colour of the deposit. As soon as the required deposit is obtained the solution is ready for use. A film of peroxide of iron forms upon the surface of the solution, but this, it appears, does not interfere with the working of the process. In using the said solution for obtaining a deposit of nickel and iron two anodes are necessary, one of nickel, and the other of iron; so that if the deposited alloy gives any indication of either metal being in excess the anode of that metal is raised either wholly or partially from the solution, and work continued with the other anode until the required deposit is produced. The battery which the inventor prefers is that known as Wollaston's—that is, plates of amalgamated zinc and copper, two or more pairs being employed, but other batteries or sources of electricity may be used. For obtaining quickly thin deposits of the alloy an intense electrical current may be employed, even causing copious evolution of gas from the deposited surface without detriment to the appearance of the deposit, but for giving a strong coating a weaker current is necessary. In depositing an alloy of nickel and iron upon articles of iron or steel it is, of course, necessary to previously coat them with copper or by preference with brass. The coating of alloy upon "parcel" gilt work—that is, articles coated only in parts—is said to be an excellent substitute for the tarnished effect produced in silver-plated articles, commonly called oxydising. For stopping off "parcel" gilt work any suitable varnish mixed with a colouring powder may be used; rouge or Prussian blue answers very well for the purpose, the colour enabling the workman to see better how to apply the varnish. The varnish may be removed from the work after it has been coated with the alloy by means of a hot solution of potash or by oil of turpentine.

Although the above method of preparing the solution of nickel and iron works satisfactorily, and is the best with which the patentee is acquainted, its preparation may be modified in various ways. For example, the solution may be charged with nickel by the use of an anode of nickel instead of dissolving oxide of nickel therein. Or the solution of nickel and iron may be made separately, and afterwards mixed in the required proportions. By thus combining iron with the deposit of nickel a clearer and more agreeable tone of colour in the deposit is obtained, and the nickel contrasts agreeably with gold in ornamental work.

SAFETY-LAMP FOR MINERS.

THE principal feature of the safety-lamp patented by Mr. Plimsoll consists in permitting the ingress of a sufficient quantity of the dangerous gas to cause an explosion which at once puts out the light and warns the miner of his danger, thus preventing all risk of the main body of gas in the mine being fired. The accompanying figure will give an idea of the arrangement of the lamp, and the following is a description of the principles on which it is constructed:—The body of the lamp is made with an internal chamber or passage through which air is supplied to support the flame. This air-chamber communicates with the external atmosphere through wire gauze or a perforated metal plate, such as is usually employed in safety-lamps, and the air chamber surrounds the wick, so that the incoming current of air converges on the flame. Thus, whenever the atmosphere becomes explosive, the air current will be ignited by the flame and will explode within the air-chamber or passage, causing the instant extinction of the light. The explosion is prevented by the wire gauze or perforated metal from communicating flame to the external atmosphere. In the figure, A is the oil receptacle, which is wholly or partly received in a cavity B in the lower part of the casing of the safety-lamp; C is the air-chamber surrounding the lamp. The walls of this chamber are made of plates of sheet brass fitted together concentrically in the manner shown, so as to leave an annular space of about one-ninth of an inch between them in a lamp of the size drawn, and less for a lamp of larger diameter (as the capacity of the chamber or passage must not be increased beyond certain limits), the said plates being soldered at bottom to a flange or ring on the inner plate. The outer plate E is made with a



number of minute perforations through which the entire supply of air required for the combustion of the flame passes. The thickness of this plate depends somewhat upon the size of the perforations, but it must be of such thickness as to prevent the passage of flame through the perforations when the ignition of explosive gases takes place in the chamber C. Perforations one-fortieth of an inch in diameter in a plate one-fifteenth of an inch in thickness will answer the purpose, the object being to prevent the passage of flame without obstructing the admission of air to the lamp. The perforations should be disposed at equal distances apart, and not too close together, so as to leave sufficient metal to cool and destroy the flame resulting from the ignition of explosive gases in chamber C, nor should the perforations be more numerous than is required to admit an adequate supply of air to feed the flame of the lamp. The top of the chamber C is bent into a conical form at the centre around an opening through which the wick tube rises, the opening being of sufficient size to permit the air to pass freely to the flame, and allow for its free escape or expansion when the ignition of explosive gases takes place in chamber C. The top of the inner wall is also similarly bent or made into a conical form at the centre, and has a central aperture for the passage of the wick tube. The upper plate is provided with a gallery to carry the glass chimney D and wire gauze covering, as usually employed in some kinds of safety-lamps, and to this plate the ordinary rods of the framework are also attached, as shown. The glass chimney D is carried up to the top of the lamp, which is provided with the usual protecting top of wire gauze and perforated sheet metal for the exit of the products of combustion. The chimney D is cemented air-tight in its gallery, so that the whole of the air supply must pass through the chamber C to the flame, thereby preventing any accumulation of explosive gases in the upper part of the lamp.

SENSITIVE FLAMES.

SOME experiments on sensitive flames are detailed by Dr. Isaac Norris in the *Journal of the Franklin Institute* for April. The arrangement of Barry for rendering a flame sensitive is well known, and offers the great advantage of using the gas at the ordinary pressure, so that the experiment is arranged in a moment. The size of the pin-hole aperture determines the height of the flame burned above the wire gauze. I have found after many experiments that it is rendered much more sensitive by using a chimney: an ordinary glass one, such as employed with the argand burner, answering perfectly and rendering the flame at the same time much more steady. It may rest on the gauze, which must be placed at the proper height above the burner. The gas should be burned on until it begins to flare, and then lowered a little until it becomes steady. The nearer it is to this point the more delicate the result. Tyndall's caution with regard to obstructions from stop-cocks, &c., is also very important. Wishing to measure the height, I attached a small scale to the chimney, and found, as recorded, that the flame is much more sensitive to some sounds than others. Any sound in which the letter *s* enters seems to affect it particularly. Attaching a telescope to the apparatus, something like the arrangement in a cathetometer, I found that even when the flame appears to the eye perfectly steady, it was continually varying in height—sounds that were quite inaudible to any one near it, evidently producing a marked result. A tall flame, 6in. or 8in. in height, is not as sensitive as one of only 2in. or 3in., and placing the gas in a bag at the same pressure as it issues from the pipe did not alter the result. The whole subject is a very curious one, and I am inclined to think this flame is *the most delicate* yet produced, despite the accounts of the wonderful steatite burner of which Tyndall speaks. A description of Barry's sensitive flame will be found on p. 244, Vol. XIV., and it is to be hoped the present little article may lead to other experiments in the same direction.

PHOTO.-ENGRAVING ON METALS.

WILLIAM A. McGILL and Robert G. Pine, of Memphis, Tenn., have invented a new process for photographing engraving on metals and other substances, which they describe as follows:—We take, as a base of operation, a pure silver surface or an alloy; and, after finely polishing or frosting it, it is subjected to the action of iodine, and a film of the iodide of silver is formed on the plate. We then expose the plate to the action of light in the camera obscura, or under a photographic negative, until a faint image of the object is formed. The plate is then submitted to the action of an electrotype battery (copper solution), when a well-defined image of the object in copper is formed, the cupreous deposit attaching itself only to those parts of the plate which were rendered conductors of electricity by the action of light, while the unexposed parts will remain non-conductors of electricity. The plate is now dried and etching solution poured on it, composed of sulphuric acid saturated with nitrate of potash, or their equivalents. This solution immediately attacks the shadows or exposed portions of silver surface, while the cupreous deposit from the electrotype bath is not affected. After etching the required depth the copper deposit on the plate may be readily removed by *aqua regia*, which will not act on the silver plate, leaving a finely-etched image in the silver plate.

To engrave or etch on steel, gold, copper, and other substances, the surfaces are first coated with pure silver. We then proceed substantially as above explained, with the exception that different acids or combinations of acids are used on the various metals or other substances after the silver plating or surface is etched through, according to the nature of the base to be operated upon; for instance, in etching on gold, after the silver ... etched through with the saturated solution ... sulphuric acid and nitrate of potash, we use ... *regia*, or nitro-muriatic acid, which acts on the ... but leaves the silver intact. The ... specially applicable to the ornamentation ... plate and jewellery.

MICROSCOPICAL CABINETS.

THE principles to be kept in view in constructing and arranging cabinets for microscopical objects are thus stated by Dr. Murie, in a paper read to the Royal Microscopical Society, which is replete with information of value to local societies as to the arrangement of their collections, and will be found suggestive by the advanced histologist. We can only extract a portion:—

As to a choice of the cabinet, so much depends on the intention and tastes of the individual, and the nature of the collection itself, that no rule or recommendation on my part can be given which would meet the conceptions and wishes of every amateur microscopist or professed histologist. I shall discuss the subject, nevertheless, in its broader aspect; that is to say, on such grounds as may be of general interest, or lead others to make suggestions on what at present there is no very definite standard or agreement upon. The dimensions of a cabinet is a matter concerning economy, convenience of space, and the conception the collector intends to fulfil. If the numbers of slides are likely to be or already are very extensive, then large-sized cabinets are in some respects most advantageous. At the same time they are not free from serious drawbacks. Smaller-sized cabinets, while deficient in solidity, roominess, &c., have several points of recommendation, not the least of which is that if made to a uniform size and of a cubical form, they can be piled up one above the other, and so built together as to command all the advantages and none of the drawbacks of an immense single cabinet. I cannot offer a better instance, forcing conviction of the last-mentioned proposition, than by reference to the Botanical Department and Insect Room of the British Museum. There (besides old wall cabinets) they have a set of cubes identical in measurements, each devoted to a group or subsidiary division, numbered and labelled accordingly, and so arranged that to all intents and purposes they represent but one vast cabinet. For study and reference they are uncommonly handy, as they can be brought down to the table, and, in fact, shifted about at pleasure without the slightest injury to contents.

Such is my beau ideal of a microscopic cabinet, compound, yet harmoniously single; adapted to meet the wants of a limited, a moderate, or a numerous series; expansion being in the ratio of increment of slides. But furthermore, as I shall presently mention, the same principle is applicable to very modest microscopical collections; such, indeed, as even the amateur or those of limited means may aspire to. As a closing sentence to this clause, I may even make bold to say that, like other fashions and hobbies, that of cabinets is an infectious one: a handsome piece of furniture is attractive. Would that the zest for a thorough mastery of the contents were as powerful a stimulant.

I do not propose giving a lengthened dissertation and criticism upon every sort of cabinet, but, by allusion to a few, indicate in passing the more desirable features pertaining to economy, easy access, and desirability for classific purposes.

1. As regards space and cheapness, the common boxes with racks, sold by all microscopic object makers, are undoubtedly very handy. They are subject, however, to three great faults. 1. Many specimens, particularly those in fluid, are liable to spoil in them. 2. Reference to individual slides is awkward, from their being tilted in position. 3. Numbers and names cannot easily be read, unless by picking up one and then another, in guess-like fashion. As an example of a considerable collection kept in the ordinary rack-boxes, I may mention Dr. Greville's specimens of Diatomaceæ in the British Museum, of which there are 3,637 in all. His method of numbering and cataloguing, to which Mr. Carruthers kindly called my attention, I shall again make reference to.

2. Dr. Muller, assistant to Professor Hoffmeister, of Heidelberg, a few years ago kindly favoured me with a sight of their Histologico-Educational Collection. They were then adding a series of sections illustrative of medicinal woods. In lieu of an expensive cabinet, they had adopted the following economical arrangement, whereby the slides lay flat and were easily got at. A piece of stout millboard 7¼in. × 9¼in., and covered with coloured paper, had forty-two holes punched out. The holes, drilled at equal distances, ran in parallel lines 1in. apart. Through these an elastic cord was passed, down one hole and up the next; continuing along one line of holes and returning the next. Having reached the farther one from the point of starting, the cord is reversed and brought back hole by hole to the latter, where a knot joins the extremities of the cord. Slides are then introduced beneath the cords, which retain them in place. Each corner of the millboard, above and below, has a wedge-shaped piece glued on to it, and there is a narrow strip introduced in the middle. The trays filled above and below with slides are then piled one over the other on a shelf, or in boxes, open in front, with labels attached to each consecutive group. I mention the inexpensive mode of forming a cabinet rather on curiosity than to recommend it. There is one [illegible] also to be borne in mind—viz., the rangelas[illegible] are shorter than the English quent[illegible]

3. Dr. Carpenter warmly commends a form of book-box as excellently adapted in lieu of an ordinary microscopical cabinet. As he says, a large histological collection can be stowed away in the library shelves, among the other books, and consulted with the greatest ease. My friend, Mr. David Forbes, has a few of such boxes slightly altered from Dr. Carpenter's plan, so as to suit the different shape of slide used by himself. The construction otherwise is similar, so that one description may suffice for both. Each case is about 10¼in. high, 8¼in. long, and 4in. thick in outside measurements. It opens only from behind, and has a fixed shelf across its middle. Trays of light cardboard, to the number of eighteen above and as many below, are piled on the top of each other. A small tack serves as a handle to each tray or *quasi*-drawer. Mr. Forbes uses slides each 1½in. square, so that eight of these occupy a drawer; the number or name, according to circumstances, being towards the knob end of the drawer. Dr. Carpenter's slides are generally those in common use, 3in. × 1in., and these to the same number, eight, lie athwart. Doubtless these book-boxes are neat, and in many instances a very excellent substitute for a large cabinet. The different sets of objects are most readily classified, and the title placed on the back, apportioned to the contents. The great fault, however, lies in the one tray being so placed above the other that to consult those which happen to be below, all the trays above must be taken out. The depth of each tray, besides, does not well admit of labelling, so that, like the rack-boxes, it is a case of trouble in searching for an object. It would be an improvement if each tray slid in on fillets, so that one might be taken out without disturbing the others, and by deepening the face labels could be placed outside. To do this would, however, spoil the compactness, and in part materially cripple their intended utility.

4. Piper's original Portable Horizontal Slide Cabinet, as described by himself,* is composed of any number of flat cardboard trays, divided into six or more compartments, each holding a single slide in a horizontal position. The trays are inclosed in a strong millboard box, the front of which is made to fall down, so as to permit the trays to be readily withdrawn. When closed, an elastic band renders the whole firm and secure. "It may be made of any desired capacity. Specimens are placed on the table capable of receiving from six to 250 slides. The smallest is well adapted to contain a 'half-dozen series' of anatomical or other subjects; and its great strength, combined with lightness, makes it peculiarly available for transmission through the post. Among the advantages which may be derived from the cabinets, I will mention the convenience of displaying, at one view, the entire collection of slides, and the facility thus afforded for the selection of any required specimen, without the troublesome search and difficulty of removal frequently experienced with the old form of box, in which the slides are dropped (out of sight) into perpendicular grooves. It also prevents the possibility of the covers becoming detached by shaking about in transit, which is important when it is to convey a rare or valuable collection. The trays, being all of uniform size, may be transferred from one cabinet to another of larger or smaller dimensions, without necessitating the disturbance of the slides. In addition to its portability, it possesses the merit of cheapness, durability, and neatness of appearance." The advantage of Piper's horizontal cases is marred by the trays resting on each other, and hence is only applicable to a very limited series of objects. The Eulenstein† collection of the British Museum, containing 100 types of diatoms, is contained in a case after Piper's pattern, but larger, and for this purpose it answers very well.

5. Mr. Henry George brought before the notice of this society a few years ago an inexpensive, compact form of store-box, wherein considerable ingenuity was displayed. The merit of his plan of store-box, or, indeed, small portable cabinet, lies in its being composed entirely of tin (japanned or otherwise), therefore of small compass, light, and not liable to warp; in the sides lying flat; and in a simple arrangement whereby the slides are kept in place without chance of overriding each other. Each box is made to hold three or six dozen slides, or by increase of capacity to hold proportionally more. In that which contains seventy-two the outer casing is of oblong figure, 6¼in. long, 3¼in. wide, and about 2¼in. deep. The lid is unhinged, and of ordinary form. The four sides of the box are each incised by a wide, deep semilune, so that the trays can be readily extracted. Each tray is a simple sheet of tin, out of which a large, long, oval piece has been cut, to insure facility in taking up each side. At the two farther extremities the tin is turned on edge, and forms a rest to the tray which lies above it. The opposite sides of the tray have their edges curvilinearly bent in, so that the slides slipping beneath are held firmly in place, alongside of each other. The slides thus lie secure, transversely to the long diameter of the box or tray, six in a row; and when one or more is wanted, by a tilting motion of the finger below the glass through the open space, extraction is easily effected. The defects in this otherwise capital little case apply equally to those of Mr. Piper and the book-boxes—viz., if a specimen is wanted from the bottom row, all above have first to be removed. Again, while the labelling of each slide is readily seen on being raised, yet unless the entire contents are known, every tray has to be gone over before the thing wanted is to be found.

6. I may refer en passant to Mr. Furze's zinc cases, the chief recommendation of which is their being of metal. Thus there is no liability to warp, as is also the case in the material used by Mr. George. These certainly have advantages over wood, which, unless mahogany, and that well seasoned, is so liable to warp, and render drawers stiff and troublesome to open.

7. As a modification of the rack principle, Mr. Sorby (according to my friend Mr. David Forbes) uses a small form of box wherein the slides are ranged in rack, but instead of their lying tilted, each is placed horizontally. A further extension of the same principle, and what are really most excellent capacious store-boxes (or to those who are satisfied with a moderate thing, a compact cabinet), cheap, portable, and each specimen of easy access, will be found in Mr. Norman's adaptation. In a mahogany box, 7in. high, and 4¼in. broad, 150 slides lay in racks horizontally, and by a marginal number are easily got at and referred to. There is a diaphragm across the middle of the box, and another running up the centre longways. This gives four compartments, so many in each. A folding door at each end provides easy access, and, with a handle on the top, the box can be carried about anywhere.

8. Mr. James Smith has described and figured what he terms a microscopical cabinet, wherein the slides are arranged after the mode of some entomological collections. Shaped like a back-hinged book-box, on its being opened back the contained slides are all seen at a glance, being each retained in place by a double elastic band. If I am correctly informed, Professor Hughes Bennett, of Edinburgh, uses a form of box or serial cabinet similar to the above. Other objections might be offered, but that the slides all rest vertically is against its frequent adoption.

9. Lastly, as everything depends upon individual requirements, some wishing a small, others a larger case, it is hard to recommend one form of cabinet that will do for all. Piper's, George's, and Norman's, are each good in their way for small series, but a larger-sized cabinet of square form, with trays coming out separately, is the most preferable article. Mr. Beck sells a cheap plain kind, made of polished deal wood, wherein the trays are cardboard. In this, as in more expensive sorts, every specimen is of easy access. The latter lie flat, the numbers and name facing the observer; and labelling is provided for outside the drawer. A number of such boxes can be piled above one another, and by degrees an extensive cabinet ultimately attained.

It is now universally admitted that objects preserved in a moist medium are retained in a sound state longer and better when laid down flat. This is easily understood, for the finest and firmest cement is not always a safe protection when the slide is tilted edge upwards. In the case of a cabinet with drawers, these are better not too deep; although some drawers of sufficient depth to admit easily the large-sized deep-celled slides are an essential desideratum. Unless in collections devoted to special subjects, deep drawers for the reception of larger objects need not be distributed throughout the cabinet; it is sufficient if they are confined to the lowermost tiers. In this way heavy specimens can be kept together, especially if exceeding in thickness the ordinary drawer's depth. The appropriate position of such objects in the general series can be replaced by a dummy, or blank slide, numbered *seriatim*, and with a reference where its real counterpart is to be found. The latter, meanwhile, also bears its consecutive number in the series. Entire sets of deep drawers having an additional shelf let in from the top I consider objectionable. These may, indeed, come in handy where a cabinet with a set of deep drawers, originally intended for another purpose, is converted into a microscopic receptacle. The microscopic cabinet of our Royal Microscopical Society has been altered in this fashion, and the available area of the double tiers consequently can contain twice the number of specimens they originally did in the deep drawers. It behoves, however, that a sufficient proportion of deep ones be retained.

The compartments of the drawers should admit of the slides lying with the narrow ends, or long diameter, fore and aft. In this way there is no chance of the slides overriding and, when the drawer is suddenly drawn out, injuring each other. In the event of a specimen, not too deep for the drawer, occupying a greater surface than the usual 3in. by 1in., provided it is not over 3in. square, it may readily be placed transversely to the tray or drawer's direction. If it should be above 3in. in diameter, the transverse bar or partition can be cut in such a manner that the slide shall occupy a double interspace. The end of the divided bar will prevent

* "Trans. Micros. Soc. and Journ.," 1867, Vol. xv., 2nd Ser., p. 16

† "Diatomacearum Species Typicæ, Studiis," Th. Eulenstein. Cent I. Stuttgartiæ, 1867.

it moving sidewards. This simple plan, and such like trifling mechanical contrivances, are very useful in preserving unanimity in a series. They keep specimens in their proper classified position, instead of being scattered to a distance.

AGRICULTURAL MANURES.

FROM an interesting paper on the important subject of manures for agricultural purposes, read by Mr. C. D. Hunter, of Blennerhasset, before the Wigton Farmers' Club, we extract the following particulars obtained from practical trials. In commencing his remarks Mr. Hunter drew especial attention to the necessity of a knowledge of agricultural chemistry to the farmer who desires to learn his business thoroughly, and then went on to give an account of his experiments, beginning with the effect of different manures on hay.

On seeds, nitrate of soda applied alone in 1868-71, gave, as the average of four years, 54 stones of hay for every cwt. of manure applied; when used along with superphosphate and muriate of potash it gave 58 stones of hay per cwt. Sulphate of ammonia used alone gave 50 stones of hay per cwt., and in conjunction with mineral manure 48½ stones. Peruvian guano, again, used alone for three years, gave about 8 stones less than sulphate of ammonia for the same period, or equal to 42 stones; and in mixture it gave equal to 80 stones. Nitrate of soda, it will be seen, proved the best nitrogenous manure for hay, and also went farthest when used with a mineral manure. On a clay soil Mr. Hunter had only one experiment. The land was in very poor condition; the unmanured crop weighing only about 10 cwt. per acre. On this poor clay, sulphate of ammonia proved superior, giving, when applied alone, a return of 65 stones per cwt. of manure, and with superphosphate and muriate of potash 95 stones.

Nitrate of soda gave, alone, 89 stones of hay, and in mixture 66 per cwt. The experiments on oats **are more trustworthy, but having been tried on but one soil and under the unusual conditions of three years on the same land, they must not be regarded as entirely applicable to ordinary farming.** From a **want** of reliable no-manure and mineral-manure **plots** for comparison, the figures given may be, as a **whole**, a little too high or too low; but the comparisons between the three manures are quite exact. **Applied** alone, sulphate of ammonia proved superior **for oats**; and, taking its return per cwt. of manure **at 12** stones of corn, Peruvian guano gave 11, and **nitrate** of soda nearly 7 stones. Applied in conjunction **with** mineral manure, nitrate of soda proved **superior; and, taking its return per cwt. as 20 stones, sulphate of ammonia gave 18,** and Peruvian guano **17 stones.** It is rather curious to find nitrate of **soda last** when used alone, and first when in **mixture**; further experiments may but confirm this **fact, but** without further trial, said Mr. Hunter, I **could** not undertake to say which was the best **manure** for oats. One point seems, however, pretty **well** established, viz., that sulphate of ammonia and Peruvian guano proved of nearly equal value in **both** cases. The guano used was the Chincha **Island** of best quality, the supplies of which are now exhausted; but any good guano containing over 6 **or** 8 per cent. of ammonia will prove a good corn **manure.** Barley was also experimented with for **three** years upon the same soil; the same remark **applies** to this as to oats, viz., that the weight, as a **whole**, may be a little too high or otherwise, but **that** the comparisons are just enough. Nitrate of **soda** here takes a decided lead all through, and, **taking** its return per cwt. of manure at 20 stones of **corn**, Peruvian guano gives only 9 stones. Sulphate **of** ammonia was not tried alone, but in mixture **proved** superior to Peruvian guano; thus, nitrate of **soda**, used with mineral manure, gave about 14 stones of corn, sulphate of ammonia 11¼, and Peruvian guano about 7 stones per cwt. of nitrogenous manure. This shows nitrate of soda twice **as** valuable for barley as Peruvian guano, and **slightly** superior to sulphate of ammonia. On potatoes I have experimented very largely, and have, **from** over four hundred trials, a number of very **valuable** facts bearing upon the seed cultivation **and** manuring for this crop. **An average** of six very **reliable** plots gives 161 stones of potatoes as the produce per cwt. of sulphate of ammonia, used in conjunction with superphosphate or nitrate of potash; Peruvian guano, in the three years' trial **against** this gave equal to 99 stones, and nitrate of soda 39 stones. Some other experiments place **nitrate** of soda still lower, and two trials with **Peruvian** guano, used alone, give 84 stones per cwt. **of** manure, but these are not strictly comparable **with** the others, being on different soil each year. **From** the foregoing experiments on nitrogenous **manures**, it is evident that the value of a manure is **affected** by the source of its nitrogen as well as by **its amount**, and that a statement of the raw **materials** used in making the manure is essential **to a** correct estimate of its value. An analysis protects the farmer from adulteration, and a composition may protect him from misapplication; thus, **if** these results hold good on the generality of light **soils in** Cumberland, it is evident that a potato **manure containing** nitrate of soda is much inferior to one containing sulphate of ammonia, though both may analyse the same percentage of nitrogen; 4 per cent. of this being supplied by either 16 per cent. of sulphate of ammonia, or by 26 of nitrate of soda.

Phosphates: Potash.

The phosphates next demand our attention, as being, after nitrogen, the most important of our manurial substances. Bones, guano, and the mineral phosphates are the principal sources of supply. In the raw state the former are, of course, almost valueless; but in the dissolved state, as bone or mineral superphosphate, their value in the field is the same —and soluble phosphates from bone are of no more value than those from coprolites. Superphosphate of any kind applied alone, is, as a rule, wastefully used. Three experiments give it a value of 6½ stones of hay per cwt. of manure so applied, and as the superphosphate costs about 5s. 6d., and the hay is only valued at 3s. 3d., it is evident that this will not pay. Used in conjunction with muriate of potash and nitrogenous manures it did much better, three experiments giving a value of 17 stones per cwt. of superphosphate. It is noteworthy that in the same series of experiments it was applied to 2 plots along with nitrogenous manure, but without muriate of potash, and its value here at once fell to 10 stones of hay. This shows how one manure helps another, and that on soils deficient in potash a good manure wanting in this element is used at a great disadvantage. Plants require many elements for complete growth, and the superabundance of nine can never make up for the absence of a tenth. For all crops, but more especially the root crops, phosphates are invaluable. Potash, from the prominent figure it makes in the ash analyses of all plants, has always held a high place in agricultural science; but till quite recently its price forbade its use in agricultural practice. The discovery of potash deposits in Germany was the first circumstance that brought potash manures into general use. In 1867, when I first experimented with potash, I could purchase at £7 10s. per ton the same article for which I must now pay £12 or £13. Muriate of potash, sulphate of potash, kainit, and crude potash salts are the chief sources of this manure. In 1868-70, I tried the first two on potatoes and clover seeds. Potash salts should not be used alone. Three years' trial of muriate of potash at the rate of 4 cwt. per acre gave it a value of nearly 6 stones of hay per cwt. of manure; two of these years gave it, however, a value of about 8½ stones. Sulphate of potash gave 15 stones; probably its superiority to the muriate is due to the fact that sulphuric acid is more essential to plant life than the muriate. On potatoes its superiority is more doubtful, and probably when used with superphosphate, sulphate of ammonia, and other manures containing much sulphuric acid, its superiority would be less evident; further experiments are, however, required to decide this point—the greater abundance and less cost of the muriate also make it more desirable as a manure. Used along with nitrogenous manures and superphosphate, muriate of potash showed much better results, giving per cwt. of manure 14 stones of hay; this, though not immediately profitable, is so nearly so that in all probability the after effects more than repaid the outlay—and I would recommend that for light land a good grass manure should contain from 10 to 20 per cent. of muriate of potash, equal to from 5 to 10 per cent. of potash. I prefer muriate of potash to kainit or inferior potash salts, because, as a rule, it contains four times more potash. In 1870, I tested kainit against muriate of potash for potatoes, and from the results on four plots of each, the muriate proved itself about five times more valuable. For potatoes potash has shown itself indispensable. In two experiments where it was mixed with lime and salt and applied both alone and with farm-yard manure, it gave the first year per cwt. of muriate, 49 stones of potatoes; the second year, 64; and the third year, 104 stones. With farm-yard manure 1½ cwt. was used, mixed with an equal quantity of salt and 1½ cwt. of lime; alone, nearly double these quantities were used. Applied in conjunction with superphosphate and sulphate of ammonia it gave over two years an average return in four experiments of over 250 stones of potatoes per cwt. of muriate; this was, however, the second and third years on the same soil, and is thus unusually high. It was tried with superphosphate against superphosphate and salt—4 cwt. of each—for three years in three different fields, and gave 55 stones of potatoes per cwt. of muriate; when added alone to superphosphate it gave only 12 stones, and in one experiment, used alone, it gave 43 stones. From these experiments it is evident that neither for hay nor potatoes should potash be used alone. Plant life is in some respects not unlike animal life, and you might as well expect good health in an animal fed on water alone, or on straw alone, as in a plant fed on but one manure. A good potato manure should always contain from 15 to 25 per cent. of muriate of potash, equal to 7 to 12 per cent. of potash. On carrots, after the failure of 1868, I did not again find time to experiment till last season, when the addition of 2 cwt. of muriate of potash to a mixed manure of superphosphate and sulphate of ammonia, raised the produce nearly 8 tons per acre. On turnips, I have but few reliable experiments, but these go to show that a good turnip manure should contain some potash, though less is required than for potatoes. For grain crops I cannot recommend potash; in special cases it may be useful, but for general purposes its presence is unnecessary.

Magnesia.

Magnesia is usually present in the ash of plants to a considerable extent, and has often been recommended for hay and potatoes. In repeated trials I have not found its application attended with much benefit. Eight experiments on potatoes give it the low value of 5lb. of potatoes from 1 cwt. of sulphate of magnesia, that is 6s. worth of manure to produce 2d. worth of potatoes. In these experiments it was used in conjunction with superphosphate, potash, and salt, without any nitrogenous manure; further experiments with nitrogenous manures did not show any better result. On clover seeds, the balance of six experiments with 2 cwt. per acre of sulphate of magnesia, give it a value, per cwt. of 1 stone of hay; it gave the best result—12 stones—when used in conjunction with muriate of potash, common salt, and a little sulphate of ammonia, neither of the first two containing any sulphuric acid; and the poorest result was when added to sulphate of soda and sulphate of ammonia, a mixture containing an abundant supply of sulphuric acid. These facts point to the sulphuric acid of the sulphate of magnesia as the active portion of this manure in these experiments, but neither upon seeds nor potatoes did it pay one-fourth of its cost.

The Application of Salt to the Soil.

Salt is the last manure I shall touch upon. It has been strongly recommended by interested parties, and has doubtless its uses, but as a rule it is more serviceable as a destroyer than as a plant food. Against grub, wireworm, &c., and as a prolonger of vegetation in dry seasons, it is of value, but as a direct manure it more frequently does harm than good. On hay, 4 cwt. per acre applied alone reduced the crop in two experiments, and increased it in two, the balance showing 8lb. of hay per cwt. of salt. This seems a common result throughout all England, as thirteen experiments reported by Dr. Voelcker show only 47lb. of hay for 4 cwt. of salt per acre. The addition of about 2 cwt. of salt to a mixed manure for seeds reduced the produce in seven experiments by more than 2½ cwt. of hay per acre. The balance of testimony is thus against its use as a direct manure for hay. On potatoes, used alone, it seems to have been of service, giving nearly 17 stones of potatoes per cwt. of salt, but when added to a really profitable manure like superphosphate, it almost invariably reduced the crop. It is rather an interesting fact that, though often found in the ash of plants as soda, it is sometimes absent, and for some plants its presence is not necessary to a healthy growth. These are the most salient features of our four years of field experimenting on manures at Blennerhasset. The details of many of the experiments are very interesting, and to put them in a practical form, I will give the composition of several manures, as suggested by the foregoing results:—

Crop.	Nitrate of soda.	Sulphate of Ammonia.	Superphosphate.	Muriate of Potash.	Total per acre.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Hay	1½	—	3½	1	6
Oats	1½	1½	3	—	6
Barley	1½	—	3	—	4½
Potatoes	—	2½	6½	3	12
Turnips	—	1	3	1	5

In the discussion which followed, Mr. Hunter was asked whether, in his opinion, the value of salt in agriculture did not much depend on the proximity of the land to the sea. Probably the salt would be of greater value away from the coast than near to it.

Mr. Hunter said he had heard it said that salt was not quite so useful near the sea coast as inland; but from the thirteen experiments made by Dr. Voelcker, it was shown that he got only 47lb. of hay for 4 cwt. of salt. So that these experiments, in thirteen different parts of England, showed no better results than his experiments with salt at Blennerhasset; which went to prove that it was not of much value. Many plants, indeed, could grow without any soda at all. He had himself never experimented with salt on mangolds, but it was a common saying that mangold "paid well" with salt.

Mr. Hornsby asked if Mr. Hunter had ever tried superphosphates alone, or in addition to farm-yard manure? He had tried nitrate of soda to some extent, with the best results on grass land, his being rather strong land, with a cold bottom.

Mr. Hunter said he had never tried superphosphates along with farm-yard manure. He had tried it alone on grass land and with potatoes. It always gave a heavier crop, but he never found it pay when used alone; he had tried bones and bone dust on grass land, but bone dust did not pay. For three years he tried both, and, curious to say, looking at the results of the whole period, he found that bone dust and guano, and dissolved bones and guano, produced exactly the same result, viz., each something like 15¾ tons of potatoes per acre in three years, or about 5¼ tons each year. He could not recommend bones alone. Dissolved bones, indeed, were a lasting manure, but there was no difference between soluble phosphates of bone and coprolites. It was the insoluble phosphates which were much superior He had tried kainit on potatoes, and also muriate of potash—four plots of each. What they bought for dissolved bones were not dissolved bones, because the makers would not make them, as their reputation would suffer if they sent out the nasty, dirty-looking thing which dissolved bones were. Instead, they sent out a nice preparation, consisting of, perhaps, one-third of bone and two-thirds of coprolites. If they wanted dissolved bones they must make them themselves. Last year he tried dissolved bones—that is, commercial dissolved bones—against superphosphates on turnips, and he got 13 cwt. more from the dissolved coprolites than from the dissolved bones. He did not mean to say that every experiment would be found against them, but this experiment was decidedly against dissolved bones. They were mixed with sulphate of ammonia, muriate of potash, salt, and gypsum, and everything that could give them strength, so that it was a fair trial with the dissolved coprolites.

REMOVING PHOSPHORUS FROM IRON ORES.

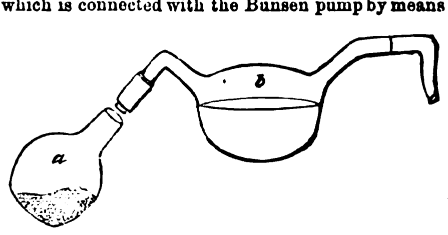
ACCORDING to one of the foreign scientific publications, Mr. Julius Jacobi, director of the smelting works at Kladno, Bohemia, has invented a process of effecting the removal (and subsequent utilisation) of the troublesome phosphorus compounds from iron ores; its efficiency in practice remains still to be tested. The process consists in changing the insoluble basic phosphates, as they exist in the ores, into soluble acid phosphates, and the subsequent removal of the latter by leaching. The ores to be operated on are placed in an appropriate vessel, after being reduced to convenient lumps of moderate size, and a stream of water charged with sulphurous acid is allowed to run upon them, or a stream of the gaseous acid is forced through the mass, and cold water is at the same time turned upon it. After the greater part of the phosphates have passed into the solution, the liquid is drawn off, and fresh water is passed through the mass to wash it thoroughly—this operation being continued as long as phosphoric acid can be detected in the wash water. If much phosphorus exists in the ores, the operation with sulphurous acid must be repeated, until a sufficient degree of purity is reached. The liquid containing the acid phosphates is heated to drive off the sulphurous acid, and the phosphates are again separated, partially by concentration, or by precipitation with lime. This being a valuable fertiliser, is relied upon to cover a large portion of the expense of the operation.

THE DURABILITY OF TEXTILE FABRICS.

WOOL and silk are the most enduring of textile fabrics. The first-named fabric gives evidence of its superiority as an article of clothing, from the fact that it is almost indestructible, and when from long service it is apparently worn out, its durability is once more seen in a new form, as it comes from the mills under the name of shoddy. Nor is this name of reproach entirely just; for are not carpets, druggets, mats, cloths, blankets, and many other articles of domestic use made from it, and does not its continued use attest the fact that for many purposes it can be employed to answer well the place of more expensive goods? The best wools for service are very strong, elastic, and soft to the touch. A variety of low grade wools similar to the Scotch cheviot, when of the right quality, will wear constantly and look well for many months, and in some cases have been known to look almost as well as new at the end of the second year. One peculiarity of this wool is that it takes the dye freely, and retains something of its original lustre until it is worn out. Cotton and flax are liable to a more speedy destruction than other textile products, and may ultimately be reduced to a mere wood fibre. Both of these materials, when made into fabrics, are frequently greatly injured by the process of bleaching, and will stand a very little use, even if their destruction is not greatly accelerated by the further abuse of the washerwomen. Unbleached cotton goods of all descriptions will outwear the bleached, and after a few times washing will look quite as well. Silk fabrics are very enduring, particularly velvet and plush, which often are in use for years, and retain their excellence and beauty until almost worn thread-bare. The manufacturers of France and Germany have beaten their English rivals in the production of cheap and showy silk goods for some years, but it is well known that English silk goods are far more durable than foreign. A textile product is obtained from several ruminating animals in the mountain ranges, known as the Llama, the Paco, the Guanaco, and the Vicugna. The fleeces are very fine, lustrous, and long, and are remarkably free from the attack of moths. The fibre is peculiar, closely resembling the down of the Cashmere goat, and appears to hold an immediate position between wool and hair. In texture it is nearly as fine as silk, besides being very durable.

APPARATUS FOR DETERMINING SPECIFIC GRAVITY.

DR. G. E. MOORE suggests, in the *Journal für Praktische Chemie*, a very ingenious device for determining specific gravity, which, as it may be serviceable to others in similar cases to the one which rendered it necessary, is here produced. The substance operated upon was the black precipitated sulphide of mercury, and as it possesses the unpleasant peculiarity of retaining with great tenacity a coating of air, a complete mixture with water was found to be impossible. The use of the air-pump was also attended with difficulty from the foaming which ensued. To meet the difficulty, the device shown in the accompanying figure was contrived. This consists of the ordinary specific gravity flask *a*, which is connected with the Bunsen pump by means



of the bulbed tube *b*, whose middle part had been widened out into a bulb of equal capacity with the flask, the communications between the bulb tube, which is filled to about three-fourths with water, and the flask being made air-tight by a moist rubber collar. As soon as the manometer of the air-pump indicates the maximum of rarefaction, the apparatus is inclined, whereby the water runs gently from the bulb into the flask, penetrating every pore of the mass without forming a particle of scum.

ON EARTHQUAKES AND VOLCANOES.*

BY AUGUSTUS LE PLONGEON, M.D.

(*Continued from p.* 194.)

3. Whence the Heat Experienced on the Surface and in the Interior of the Globe?

I WILL answer. I told you that I consider the earth as animated, a living being, living out its own life among its brothers and sisters of the immensity, just as any one of us among our fellow-beings. That, as we have our soul, which gives life, activity, and warmth to our bodies, so has the earth its soul, that gives it life, activity, and warmth, that animates all things existing in it or on its surface. I told you that this soul is electro-magnetism.

I do not suppose that any scientific man will dispute me, that electro-magnetism is the agent of the attraction that celestial bodies exert upon each other; and this is the cause of their motions through space. Nor will any one deny that motion causes friction; that in its turn engenders heat and light; that electro-magnetism causes the cohesion of all the molecules whose aggregate composes the universe is a well admitted fact. It is, therefore, the life-sustainer, the soul of the whole creation, of which our reduced planet is but one of the smallest atoms.

I have said that electro-magnetism was the agent that produced the heat of the earth. Let us see if my assertion is sustained by facts; for only through the observation of facts, and a clear unprejudiced mind, can we compare them together and arrive at the knowledge of their causes, and to the causes of these causes that form the catenation of the natural laws, whose understanding and interpretation is science.

1. The earth swims in a medium—a universal fluid that fills all space. Call it by whatever name you please—ether, cosmic fluid, imponderable fluid. This something is obviously matter under a certain form. It has been asserted to be composed of 64 elements that Graham has classified into six series or classes. This something, being matter, offers resistance, and opposes the forward motions of the bodies that pass through it. Of course it opposes the forward motion of the earth in its movement round the sun, and through the immensity where it follows this body in its rotary motion around an unknown centre. This resistance not only causes the diurnal rotation of our planet; its conical movement, which it accomplishes in 25,868 years; its vibratory motion that produces the phenomenon known as tides; but also as the earth forces its way through the universal fluid at the stupendous rate of 30,550 metres per second, besides the 464 metres per second of her diurnal rotary motion, a large amount of continuous friction is produced throughout its whole surface, but particularly at the equator, where the globe is larger. Friction, anywhere and everywhere, creates heat. It is, therefore, impossible to doubt that this is one of the causes that produces heat at the surface of the earth. That heat so generated during countless ages has progressively and steadily permeated its superficial strata, and is preserved in the inferior ones, not exposed to the external causes of refrigeration, like those above, is obvious, and men find it there when they penetrate into them.

I might illustrate my proposition by the example of the cannon ball, that when discharged from the cannon's mouth, is cold, but after having traversed the air at the rate of 500 or 600 metres a minute, is very hot at the time it reaches its destination; but the process of refrigeration begins from the surface toward the centre; and if we split it we find that the interior is yet hot while the external parts are quite cool. What is our reduced planet but a very small cannon ball, that has become heated traversing the cosmic matter, since centuries, at the frightful rate I have just mentioned?

2. The rays of the sun are another cause of the heat of the earth. These rays are not hot, certainly not; the snows that eternally cap the highest mountains prove it. How then can they impart heat if they are cold? Oh! electro-magnetism again is at work there. It is true that the rays of the sun do not convey heat, but they carry light. Light puts in motion the molecules that compose the atmosphere. They rub one against the other: there is friction; friction engenders heat—the atmosphere in its lower strata being more dense, the friction is greater, consequently more heat is evolved and communicated directly to the surface of the earth. It penetrates its lower strata, and there is preserved, as already stated, increasing the intensity of that produced by the first cause.

It is not relevant to prove how the rays of the sun carry light through electro-magnetic agency. The electric lamp of Servin is a good illustration of how electro-magnetism engenders light. The sun, immense reservoir of electro-magnetism, we may consider as the positive coal of Servin's lamp—the earth, another reservoir, but smaller, the negative coal; the light produced is in proportion to the distance of the two poles.

"All bodies," says Mr. Jacobi, of S. Petersburg, "are magnetic in a larger or smaller degree. The earth is a vast magnet, and so are, without a doubt, the other planets, their satellites, and the sun itself."

Then the rays of the sun, acting through, or rather produced by, electro-magnetism, are another cause of terrestrial heat.

3. The internal heat of the earth is also due to the immense chemical operations constantly going on under the agency of electro-magnetism, at no great depths, insignificant even if compared to the supposed crust of the planet.

This, as far as we know, is a vast conglomeration of metallic and mineral matters, which, in order to combine, only need the action of the agent. This agent is electro-magnetism. For, as says the translator of Lyell's Geology: "It would be a great error to believe that the action of electricity is powerful only when noisy and sudden. Its tacit and quiet action throughout nature is far more important. It extends its influence in nearly all combinations. The chemical affinity itself does not seem to be but a variety of electrical attraction. And since the constant reunion and the *quasi*-identity of the electrical and magnetic fluids has been demonstrated; since the phenomena of the magnetic needle, those of the thunder, of the electric fluid in the air, and its dispersion, find an explanation in the action of electro-magnetism, well may we presume that electro-magnetic currents circulate in the interior of the globe; and, indeed, experiments performed on the electro-magnetic properties of metalliferous veins have led to the discovery of marks and vestiges of these currents in the interior of the earth."

We all know that chemical combinations, decompositions, and recombinations take place incessantly in the vast laboratories of the earth. These operations are nothing else but the result of the action of electro-magnetism on the molecules of matter. These are in continual motion. During their travel they evolve heat, in consequence of the perpetual friction they are subjected to. Hence the chemical operations going on in the interior of the planet are another and third cause of its heat; and the life-sustainer, electro-magnetism, the agent.

4. The oxidation of metals is another cause of the heat of the earth.

It is a truth known and demonstrated that currents of electro-magnetism traversing metallic bodies produce oxidation.

The earth, or at any rate that portion explored by man, is a conglomeration of mineral and metallic bodies. These are constantly traversed by electro-magnetic currents. Oxidation then takes place incessantly and produces an augmentation of temperature. Slow, it is true, but constant.

Leaving aside all imaginings, which should never be invocated in the elucidation of scientific questions, as it has unhappily too often been the case in the very one under consideration, I will try to coordinate the truths enunciated, and direct their

* From *Van Nostrand's Magazine.*

light into the darkness that surrounds the mystery of the earth's convulsions, and try to discover the part they play in

4. The Productions of Earthquakes and Volcanoes.

What are volcanoes? Are they the safety-valves which prevent our poor little planet from bursting like a bomb and sending us flying towards the skies, as some pretend?

This question I will answer by another. Who would ever imagine to inquire if the boils, that sometimes, under the influence of certain pathological conditions, appear on the human body, are the safety valves, intended by nature to prevent the explosion of that body?

If there are no central fires: if it is mathematically, scientifically, nay, materially impossible there should be any, what is the use of vents or valves? If the planet is a solid mass, what danger does it run of exploding?

But let us suppose, for an instance, with Buffon, Zimmermann, Humboldt, Cuvier, La Place, Beudant, and many other illustrious defenders of the existence of an internal ocean of fire, whose burning waves sweep, ebb, and flow against the walls of the thin shell on which we live in imminent danger, and examine if the volcanoes can be the vents of that immense furnace.

Our first step will be to ascertain the number of volcanoes and the size of their craters.

Geographers tell us that there are 163, the positions of which are perfectly known: 67 are on continents, 96 on islands; adding this most singular fact, that none of these situated on continents are at a distance exceeding from the sea more than 75 miles in an air line—a peculiarity that I commend to your attention.

Humboldt asserts that they number in all 223—all active; Keith Johnston declares that there are 270—190 on islands, 80 on continents.

Never mind what these authors say about the number of volcanoes; I will grant that there are many more they knew nothing about. Let us be generous and double the number, so as not to be accused of trying to crawl though a small hole. We shall say there are 550 vents or safety-valves, if, by-and-by, volcanoes prove to be such.

Our next step will be to ascertain the size of the chimney or crater of these vents.

Geographers, again, tell us that the crater of Vesuvius, one of the largest known, is 2,000 metres in circumference. Let us continue to be generous, and say that the average opening of all the craters is 3,000 metres in circumference. One thousand in diameter, the 20,000th part of the supposed thickness of the terrestrial crust. That is, admitting that the chimney is of the same size all the way down.

What is a hole of 1,000ft. in diameter compared to the whole surface of the globe? It is not even as much as a hole made on one of the terrestrial spheres in use in our common school with a fine cambric needle.

Now, by way of illustration, and in order to keep all due proportion, let us suppose one of these globes to be one metre in diameter, hollow, made of the most refractory metal—say platinum—the thickness of which, in order to correspond to the thickness assigned to the supposed crust of the earth, would be three millimetres. We shall proceed to bore on the surface 550 small holes with a fine needle. These will represent the volcanoes or safety-valves. After these we shall introduce into it—through an opening left for the purpose, to be afterwards closed and the covering solidly consolidated, so as to present the same amount of resistance as the balance of the surface—two parts of filings, one and a half part of pulverised sulphur, and a sufficient quantity of salted water to make a soft paste. When the chemical decomposition will take place, and the heat so intense as to melt the whole mass into sulphuret of peroxide of iron, the water will have been converted into steam, this again into gases: do you imagine that the 550 little holes or safety-valves will permit a sufficient quantity of steam or gases to escape, and prevent the apparatus from bursting? Will even any steam or gas escape through these little openings?

Any unprejudiced mind will say, no. Then how can the 550 volcanoes that we have supposed to exist on the surface of the earth be considered any longer as the safety-valves of the great liquid heart said by some geologists to occupy the centre of the planet?

Their assertion cannot stand the touchstone of science. And the truth of our denial is the more obvious, if we take into consideration that not one-tenth of the known volcanoes are in activity; and that those which are active do not continually throw out lava; which they would if connected with the central furnace.

From all that I have just said I think I may safely deduce that the volcanoes are not the safety-valves of the earth, but mere local accidents on its surface, just as boils are on the human body.

There is another remarkable fact connected with the existence of volcanoes. It is this. That all volcanoes, without an exception, have for a base, and are situated on, primary formations; showing that the combination of porphyric or granite rocks with the metallic veins found in them is the only one capable of giving birth to volcanoes, through the agency of the electro-magnetic currents that traverse them. It is out of the limits of this article to enter into a nomenclature of all the substances found in the superficial strata of the planet, whose nucleus seems to be formed of granite, syenite, protogine, diorite, pegmatite, and porphyry, crossed in every direction by metallic veins.

It is well known that whenever two or more of these mineralogic and metallic substances are put in contact, and thoroughly wetted with salt water, a chemical decomposition takes place evolving heat, the more extensive the decomposition the greater the amount of heat.

It may even reach incandescence under certain circumstances; such, for instance, as the influence of the sun or other celestial bodies, that, acting one on the other as powerful magnets, engender immense voltaic arches, scattering throughout the boundless fields of creation light and heat.

Then, wherever a large quantity of these substances has accumulated, there will be a large amount of heat developed, which under proper conditions will give birth to a volcano. This is also one of the causes of the multitudinous variations that are observed in the temperature of the divers parts of the earth, even at the same depth.

It is a fact very evident, that if that heat had its source in a central fire that would emit an inconceivable quantity of caloric, the thin crust would be equally heated, even to the top of the highest mountains; seeing that the Guarisconkar, in the Himalaya, said to be with the Illimani and Sorata in Bolivia, the highest peaks of the globe, is only 9,000 metres in height, that is to say, the 1400th part of the earth's diameter.

5.—Are There any Means of Detecting the Places where such Accumulations Exist?

Seems to be the next very natural query that presents itself to the mind.

If you read carefully the history of all the volcanic eruptions; of all the great earthquakes that have laid to the ground the habitations of man, and buried the inhabitants under their ruins, you will find that premonitions have passed unheeded, because there were no inquiring, no scrutinising minds to take note of them, and draw from them the proper inferences. In many instances sulphurous vapours have been seen arising from the ground; strange and mysterious underground noises are heard, inspiring awe and terror alike in men and beasts; mineral waters are seen to be altered; soft waters are seen to become turbid in wells; the level of these waters is changed. Sometimes even the wells become perfectly dry, without any apparent reason. In caves, cellars, excavations, carbonic acid gas is noticed to emanate from the soil; magnets lose their power according to the force of the impending convulsion.

Experience has taught men to recognise in these phenomena the symptoms of a mighty underground work—the signs of some terrible cataclysm near at hand, and the same are observed in the artificial volcano of Emery. Pliny the Junior, in a letter to Tacitus describing the death of his uncle, ascribed it to suffocation, caused by the sulphurous vapours emanating from the ground, and calls them the forerunners of the catastrophe. It is well known that the sulphur mines are invariably found in close proximity to volcanoes—nay, in their very crater.

I have said that on the continents none of the volcanoes are at a distance from the sea exceeding 75 miles in an air line. By some means or other the waters of the sea penetrate into the interior of the earth, since the vapours arising from the lava and the smoke coming out of the craters are the same as would result from the decomposition of salt water, and deposes large quantities of chloride of sodium. It is then that the salt water, coming in contact with the primary materials, causes the chemical decompositions and the generation of sulphurated hydrogen gas.

The sulphurets of potassium or sodium possess the property of decomposing the water at the mean temperature.

I will try to explain.

(*To be Continued.*)

CHIPS.

The United States have about 5,000 telegraph stations, 75,000 miles of line, and over 7,000 employés, and transmit over 11,500,000 messages annually.

It may be laid down as a general principle that a larger proportion of white flowers are fragrant than those of any other colour; yellow come next, then red, and lastly blue; after which, and in the same order, may be reckoned violet, green, orange, brown, and black.

A Berlin lithographer has, it is said, after years of study, succeeded in inventing inimitable paper money. The colour of the paper is the only secret on which the invention rests. The inventor says the colours cannot be chemically analysed; on applying the magnifying glass they can be distinguished from all other colours, and in their quality as colours they cannot be imitated by photography nor any other way.

SCIENTIFIC SOCIETIES.

ROYAL SOCIETY.

The Connection Between Colliery Explosions and the Weather.

AT a recent meeting of the Royal Society a paper was read, the joint production of Mr. R. H. Scott, F.R.S., and Mr. W. Galloway, from which it appears the authors conclude that they have established a connection between meteorological changes and explosions in mines. After briefly detailing the various instances of late years which directed their attention to a study of the subject, from which we gather that out of 525 explosions recorded in 1868, 1869, and 1870, 49 per cent. may be reasonably connected with disturbance of the barometer, 22 per cent. with abnormally high temperature, while 29 per cent. are not traceable to atmospherical agency, the authors go on to say:—It may not be out of place to discuss briefly the manner in which an increased supply of gas or a diminished supply of air, brought about by any of the causes alluded to, leads to a fouling of the ventilating current in its passage through the workings; and also how the comparative purity or foulness of the ventilating current affects the condition of the air in places adjoining its course. The gas flows from the fissures of the coal and stone either into a ventilating current by which it is carried out of the mine, as when it escapes at the face of a long-wall working or bratticed bond, or from the sides of an air-course; or, secondly, it flows into a quiet atmosphere, such as that in goaves and cavities in the roof whence stone has fallen in unbratticed bonds, or in recesses between pack-walls in long-wall workings. In any of these latter cases it diffuses itself into the surrounding air, and an accumulation of a more or less explosive character is generated. As long as the average quantity of air is circulating in the mine, and the quantity of gas which escapes into the workings is not suddenly increased, we may take it for granted that little danger exists, for the districts of the mine in which explosive mixtures are to be met with are clearly defined and well known, so that precautions can be taken to prevent ignition. As soon as these conditions are in any way changed (*i.e.*, if the supply of air be diminished in quantity or deteriorated in quality by an increased escape of gas) explosive mixtures may make their appearance in places where no danger had previously existed.

It may be assumed that a ventilating current consists of pure air when it starts from the end of the in-take air-course on its passage through the workings, and that for every equal space it travels between the in-take and return air-course it receives an equal quantity of gas. Thus, when it arrives at the return air-course it consists of a mixture of air and fire-damp, whose constitution depends on the quantity of air passing through the workings, on the rate at which the gas escapes into it, and on the distance between the in-take and return air-course. It is, therefore, evident that if either the supply of air be diminished or the supply of gas increased, the resulting mixture will be rendered more explosive, not only in the return air-course, but also at every point of the passage between the in-take and return air-course. If, then, from any causes the mixture shall have reached the firing-point when it enters the return air-course, any aggravation of these causes would make the firing point to travel backwards through the workings towards the in-take air-course. In this manner the ventilating current may itself become explosive in some parts of its course. Again, although the ventilating current itself may never become explosive, its gradual fouling may cause explosive mixtures to be generated in certain places, such as unbratticed bonds, recesses between pack-walls, and cavities in the roof in the following manner. All other cases may be more or less directly referred to these.

Figs. 1 and 2 represent sections of the workings. R is the roof F the floor, C is a point where the ventilating current passes in a direction normal to the plane of the paper. In Fig. 1, *a b c* is a cavity in the roof which is filled down to the level *d c* with a mixture of air and gas. Gas may flow into such a cavity from a fissure in the sides, or from any lower part of the seam along the roof and under the edge at *a*. In Fig. 2 *d c b* is an unbratticed bond, receiving gas from the face *b c*, filled with a similar mixture down to *d c*. The space occupied by the foul air is shaded in each case; and *e f* is a plane in that space which is chosen arbitrarily. The plane *d c*, which bounds the lowest part of the accumulation, is level, and here the mixture contains the least proportion of fire-damp; the impurity of the air increases with the height, and the foulest atmosphere is found at *b*, the highest point of the cavity. If any gas flows into the cavity a corresponding volume of the contents of the cavity is displaced and escapes into the ventilating current. Diffusion is also constantly going on; and as the result of this process is to produce below the plane *c d* a mixture lighter than the ventilating current, this mixture rises along the roof and is carried away at C (Fig. 1) *d* (Fig. 2). Gas is therefore constantly being removed from the cavity, partly by displacement, partly by diffusion, and its quantity is exactly equal to that entering the cavity. If now the ventilating current becomes fouled in any of the ways we have described, the space below the plane *c d* will be filled with the same mixture as that in the ventilating current itself. If we suppose that the mixture in the cavity up to a certain level *e f* be less foul, and therefore heavier than that which now forms the ventilating current, the volume of air, &c., in the space *d e f c* will be displaced, and no further escape of gas can take place from either accumulation until the whole of the contents above the line *c d* are more foul than the mixture below *c d*. As soon as this condition is fulfilled, diffusion and displacement will go on. In order, however, that the rate of diffusion may be the same as before, the specific gravity of the whole mass must be reduced, for the square roots of the specific gravities of the mixtures above and below the plane *c d* must bear the same ratio to each other that they did before the current became fouled. This reduction of the specific gravity is, in other words, increased foulness of the air. If, then, the mixture in the space *c b f* was previously near the firing point, it is obvious that any impurity in the ventilating current will cause it to approach nearer to that point, and so eventually an explosive mixture may be generated in a cavity while the ventilating current itself is non-explosive.

It will be seen that by the above process a quantity of fire-damp may be stored up in such a cavity, which can only escape very gradually, after the ventilating current has become purer. It follows, then, that if an explosive mixture has been formed in places and under conditions similar to those described, some time, possibly several days, must elapse after the causes which have led to its formation have disappeared before the contents of such a cavity shall have been rendered innocuous again.

A few words on the subject of the dependence of ventilation on temperature above ground may not be undesirable. When the temperature of the air at the surface is less than that in the mine the phenomenon called natural ventilation ensues. The colder air which descends the downcast shaft is heated nearly to the temperature of the workings on its passage through the air courses and along the working faces, and when it reaches the upcast shaft it has a temperature which is nearly constant if the workings are extensive. The temperature of the workings increases with their depth from the surface; thus, speaking generally, it is 50 deg. at 50 fathoms, 60 deg. at 100, 65 deg. at 150, 70 deg. at 200, and so on. Now, natural ventilation ceases when the temperature at the surface is the same as that in the workings, and, moreover, as the temperature at the surface rises above that point there is an increasing resistance to artificial ventilation. The amount of the force which produces natural ventilation is still further modified by the changes in the hygrometric state of the atmosphere. For instance, if the tension of aqueous vapour in the air is less than that due to the temperature, water will be evaporated in a wet downcast shaft, and the air will not be able to rise in temperature as it descends, and may be actually much colder at the bottom than at the top of the shaft. These considerations will show why shallow mines are much less easily ventilated, and also much more affected by surface temperature, than deep ones. Whatever be the artificial means adopted for producing ventilation at any mine, the quantity of air passing through the workings must vary with every variation of the natural force, unless the artificial power be changed at the same time. It follows, therefore, that if there be no means for ascertaining what is the actual quantity of air supplied to the workings at every instant, a slight decrease, sufficient to bring the colliery into a dangerous state, may take place without being noticed. The first intimation in such a case is the fouling of the currents; the artificial power may then be increased and the crisis passed without accident, but if an explosion takes place there is no trace of its cause discoverable.

Under ordinary circumstances, in the lower parts of small accumulations of explosive mixtures there is a stratum of air containing less gas than is requisite to make it explosive; and when the miner slowly raises his candle into this stratum, shading all the flame excepting the very top with his hand, he is warned by the increasing size of the "cap," the blue flame of the gas seen on the top of the candle flame, that there is an explosive mixture above. When the air in the mine becomes very pure this stratum disappears in many cases; there is no longer a space between the pure air, in which fire-damp cannot be distinguished, and the explosive mixture above, and the gas is then called "sharp," because it ignites without warning when a candle is raised into it.

The authors take exception to Mr. Dobson's argument, in which he concluded that the march of the explosion curve coincides with the march of temperature, with a relative maximum occurring in the autumn, which he attributes to the frequency of serious storms at that time of the year. In order to test this question of periodicity, the authors have collected from the reports of the inspectors of mines all the recorded explosions for the last twenty years. The explosions are only the fatal ones, and include a few accidents due to suffocation by "choke-damp," or carbonic acid gas. They consider that they may fairly count such accidents as due to causes closely related to those which produce explosions of "fire-damp." They plotted the whole of these explosions in two decennial periods for the seventy-three intervals of five days each, and found that the curves hardly showed any agreement with each other, so that no confirmation was obtained for Mr. Dobson's alleged periodicity. The curve for the entire period of twenty years, including 1369 accidents, was also constructed, and all that is worth notice about it is that the number of accidents is somewhat greater in October than in other months. The absolute maximum falls at the end of January, and the absolute minimum in the middle of September.

The gas commonly called "fire-damp," to the mixture of which with atmospheric air the formation of the explosive mixture in coal mines is due, exudes from the coal at a certain pressure, so that the rate of its escape must, to some extent, depend on the pressure of the atmosphere, especially in the shallower mines, where the tension of the gas is not great and the fissures are open. On the other hand, the effect of a given quantity of gas in rendering the air of a mine explosive must depend on the supply of pure air to the workings. It has long been observed that when the barometer, after having stood at a high level for a time, begins to fall more or less rapidly, the accumulations of foul air and gas in the goaves and fissures of a mine emit part of their contents into the ventilating currents which flow past them. It is also well known that as the very existence of these currents depends, in almost every case, on the difference of temperature between two columns of air, those in the downcast and upcast

FIG. 1

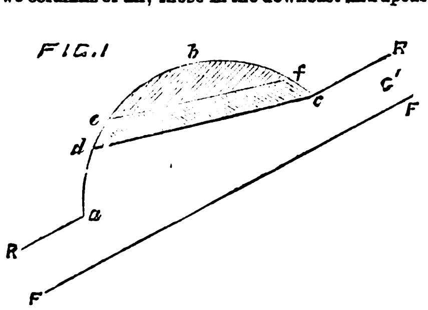
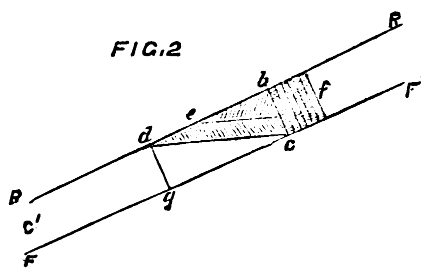


FIG. 2



shaft respectively, any increase in the temperature of the external air, from which the downcast shaft receives its supply, must necessarily render the circulation underground more sluggish. It is, therefore, obvious that the tendency to explosion will be increased when the ordinary causes which lead to the fouling of the air in a mine, such as falls of roofs and leakages in the air-courses, are assisted from without by the meteorological phenomena just mentioned; and several investigators have compiled lists of explosions, in order to compare them with the meteorological observations which have been recorded prior to and at the time of the accidents. One serious disturbing cause, however, interferes with the value of the curves of pressure and temperature plotted from the records of the observatories, arising from the weekly suspension of work in the collieries, and in many instances of ventilation, too, on Sundays. There can be no doubt of the coincidence of certain serious explosions with severe storms; a notable instance of this will be found on the 8th of October, 1870, but the explosions do not happen only at the commencement of a barometrical depression, but occur also two or three days after the barometer has reached its lowest point, and is again rising. The cause of this prolongation of the dangerous period is that when fire-damp issues in greater quantity than usual from cavities and fissures into the workings, and more especially into places where the air is stagnant and already more or less foul by admixture of gas, the volume of the explosive portion of this mixture will increase in consequence of the increased rapidity of diffusion, or, in other words, the explosive boundary will extend itself. This extension of the explosive boundary is gradual, and in some cases a considerable time may elapse before the boundary has reached its extreme limits and begins again to recede. During all this period the mine will be in an abnormally dangerous state. Meanwhile, although the pressure of the atmosphere rises, and a current sets in backwards into the cavities, whence the pure gas has just issued, yet if the entrance to such a cavity be at a lower level than the highest portion of the space occupied by such escaped gas, which rises, owing to its less low density, it is evident that what is driven back into the cavity will be a mixture of gas and air, and that no portion of the gas which lies above the level of the aperture to the cavity can be driven back into it. Accordingly a certain volume of this pure gas remains, diffusing itself freely and fouling the surrounding air.

It is evident from these considerations that in the case of continued unsteadiness of pressure, and repeated violent oscillations of the barometer, we need not expect that each of these reductions of pressure will cause the efflux of a quantity of gas proportionate to the extent of such reduction. If the successive falls of the mercury are of less magnitude than the first, or than any previous one in the series, the quantity of gas given off cannot possibly be as great on each occasion as if that fall had been preceded by a period of high pressure. If, however, any of the latter oscillations be more serious than their predecessors, a certain fresh supply of pure gas will be given off. Hence we see that, as a general rule, we do not find a succession of explosions at a time when the barometer is in a state of continued violent oscillation.

Recurring to what has already been said about temperature, it seems that in cold weather the ventilation of the pits is exceedingly active, many collieries being ventilated easily by natural means without any extraneous agency whatever. In the height of summer, however, it is different; for then the temperature of the air in the downcast shaft is higher, and the ventilation can only be kept up by the help of the furnace. In some cases, then, a sudden rise of temperature may catch the miner unprepared, and where an active current would have remained safe, a sluggish one may become foul, and possibly an explosion may occur. Whether, therefore, the barometer falls or the temperature rises, it is absolutely necessary to keep a most careful watch over the amount of air passing through the workings, in order to prevent the formation of dangerous accumulations of explosive mixtures of air and fire-damp in all mines in which the margin between danger and safety is very small. The one cry, whether we look to security against explosion, or to affording to miners an atmosphere which is respirable without injury to health—is more air.

USEFUL AND SCIENTIFIC NOTES.

Granulated Gold.—Since 1862 Signor Castellani has made experiments in order to recover the lost art of forming patterns in granulated work in gold—that is, patterns composed of globules of gold almost miscroscopic in minuteness, each soldered separately to the surface, and arranged in lines, mottoes, &c. Hitherto this art had baffled all modern skill. Surfaces could be covered with the delicate granulated or powdered work, but patterns such as Greeks and Etruscans could execute were still a desideratum. Now the difficulty has been surmounted, and it is to illustrate this recovery of the ancient process that Signor Castellani exhibits some beautiful specimens of his workmanship at this year's International Exhibition.

The Gyro Pigeon.—A novel application of the principle of the aërial top has lately been effected by Mr. Bussay, of the Museum of Firearms at Peckham. This is the gyro pigeon, which is a plate of thin steel cut into the shape of a pair of elongated oval discs, connected in the centre, and bent at an angle like the blades of a screw propeller. This is spun from a spindle which is rapidly rotated by the action of a coiled spring inclosed in a metallic box, and released by a cord. The gyro pigeon is sprung into the air and is then fired at. It is good practice for the sportsman, as its flight is rather quicker and sometimes more erratic than that of the real bird. We are afraid, however, that it is too much to hope that the "gyro" will take the place of the birds so unmercifully slaughtered at Hurlingham and elsewhere.

American Paper Car Wheels.—In these wheels, which have lately come into use in the United States, the tire is of steel, and when turned up ready for the filling it is made taper inside, so that the inside diameter on the flange is ⅛in. smaller than on the other. The body of the wheel is a paper block made of straw-board cut into circles 30in. in diameter, pasted together with ordinary paste, and consolidated under a hydraulic pressure of about 300 tons. This block, after being slowly dried for nearly two weeks in a dry-house, is turned and fitted in a common pattern lathe. The turning tool is like that used for iron, but the speed is about the same as is used for brass. This block thus turned to fit the tire is, of course, somewhat larger, in order to insure a perfect fit. A hydraulic pressure of about 400 tons is then used to force the block into its place. The tire is heated nearly to the boiling point of water, thus insuring a perfect bearing when cool.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

AFTER "E. L. G."—THE DELUGE!

[4184.]—BEFORE addressing myself to the main object of this letter I must remove an erroneous impression which my own defective mode of expression would appear to have produced in the mind of "E. L. G.," and inform him that I *did* see the book (or the early part of the book) of the Bishop of Natal, when it first appeared; but that I had, as he surmises, utterly forgotten that it contained the expression which I quoted verbatim in my last communication (let. 4040), on page 171.

I think, however, that if "E. L. G." will read Mr. Scrope's book, and the various papers scattered through the *Journal of the Geological Society* on this subject, he will find that there are various indications which go to prove that certain of the volcanoes of Central France have, at all events, not been active since a date in comparison with which, that of his—imaginary—universal deluge is but as yesterday. "Grass or bushes" may have sprung up last year; but ashes, tuff, scoriæ, and lava are the product of a mountain itself; and if we can fix, even approximately, the epoch at which that mountain became quiescent, we most distinctly are entitled to consider all undisturbed volcanic ejections superposed on—or forming—it as coeval with that quiescence.

I fail to follow "E. L. G." in his objection to the validity of Professor Owen's argument, as negativing the possibility of a *universal* Deluge. If "*all* the high hills that were under the whole heaven were covered" it is merely irrelevant to talk about "the present geography," or "Australia joining Asia." And, besides, *what has become of the water?* Doubtless, there have been deluges at divers times and in sundry places, and one of these probably gave rise to the myth among the semi-barbarous Hebrews, of the whole world being drowned. Read all this as a grand old legend, and you may gain much instruction from it. Enunciate it as a scientific description of an actual occurrence, and, I say it advisedly, you play deliberately into the hands of the infidel and the scoffer. I shall not continue this discussion, as it is absolutely painful to me to find a man of the great intellectual ability, wide culture, and extensive information of "E. L. G.," arguing in a way which he would scout, were not (what he imagines to be) theological interests involved in the matter in dispute. I need go no further than his letter 4068 (p. 175) for proof that this is not an unwarranted accusation; and ask any impartial truth-seeker to read Lyell's own most circumstantial and detailed account of his visits to Niagara (both alone and in company with Mr. Hall, the State Geologist of New York); his careful measurements and calculations; and his perfectly candid summing up of the data on which his conclusions are founded; and then say what he thinks of "E. L. G.'s" sentence. "Not Lyell's '30,000 years,' which plenty of *his own* observed facts contradict, but, as any real inquirer will find, only *five* thousand ago." Was "E. L. G." ever at Niagara in his life; and if so, will he favour us with his reasons, *formed on the spot,* for differing with our great English geologist? If not, what is his definition of a "real inquirer"?

Letter 4068 is simply one mass of *assertion* from the beginning to the end. If Mr. Gosse (letter 4097, p. 198) really does value it as highly as he intimates, I can only say that, like the Scotchman, he is "thankfu' for sma' maircies." Does he regard it as a supplement to that valuable addition to our Naval defences, his own "Omphalos," long since in the hands of the butterman?

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

TRANSIT OF THE ZODIACAL CONSTELLATIONS.—THE BARLOW LENS.

[4185.]—IF the object of your correspondent "C. A. S." (query 11765, p. 184) be to obtain a reply which shall facilitate his "star gazing," he could hardly have put a more useless question than that which he has asked; and for this reason: that the "signs of the Zodiac" (owing to the precession of the equinoxes) do not now, in any way, correspond with the *constellations* whence they originally derived their names. For example, the so-called "first point of Aries" is now in the Constellation Pisces; the first point of Taurus in that of Aries, and so on. Assuming, however, "C. A. S." to be familiar with this, and to require the information he seeks for some other purpose, I may tell him that the first point of *the sign* Leo was on the meridian, within a minute or two of midnight, on January 21st; the first point of Virgo at the same time on February 21st; the first point of Libra on March 22nd; the first point of Scorpio on April 22nd; the first point of Sagittarius will be due south about that hour on May 22nd; the first point of Capricornus on June 21st; the first point of Aquarius on July 21st; the first point of Pisces on August 21st; the first point of Aries on September 20th; the first point of Taurus on October 21st; the first point of Gemini on November 20th; and the first point of Cancer on December 20th. Lest, though, after all, "C. A. S." should have put the question which he did to obtain information which might enable him to more readily identify the Zodiacal *constellations*, I further append the days in 1872 upon which the lucida or brightest star of each of those constellations was, or will be, on the meridian at the time which he specifies:—α Geminorum (Castor), then, was on the meridian about midnight on January 12th; α Cancri on February 2nd; α Leonis on February 20th; α Virginis on April 10th; and α Libræ on May 2nd; while α Scorpii will transit at that hour on May 26th; α Sagittarii on July 10th; α Capricorni on July 24th; α Aquarii on August 20th; α Piscium on October 19th; α Arietis on October 20th; and, finally, α Tauri (Aldebaran) on November 27th.

I really must apologise to Mr. S. W. Burnham (query 11712, p. 159) for having overlooked his question last week, until it was too late to reply to it. I may now tell him that a simple concave lens would destroy the achromatism of his telescope, and that the Barlow lens, which he will be compelled to employ, consists of a concave crown and a convex flint lens of focal lengths proportionate to their dispersive powers, the combination obviously acting as a concave. By a very simple formula, which it is unnecessary to repeat here, it may be shown that to *double* the magnifying power of any telescope with a given eyepiece, if the distance of the lens from (*i.e.*, within) the focus of the object-glass be called *d*, then its focal length must be 2 *d*. Mr. Burnham will thus see that he will attain his desired result by placing a negative achromatic lens of 8in. focal length, 4in. within the focus of his object-glass (or 86in from it), his eyepieces fitting into the other or distal end of the adapting-tube.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

A GUN-COTTON ENGINE.

[4186.]—IF "E. J. N." (4106, p. 199), is inclined to try and work out the idea he has, he may be quite sure that there is nothing impracticable about it. It would be quite easy to make such an engine; whether it is worth doing is quite another question, the answer to which depends upon at present unknown facts. I have often said that the construction of a flying machine is dependent, not upon occult problems as to the flight of birds, &c., but simply upon the possession of a powerful engine of light weight (to which aluminium bronze would greatly contribute), and a source of concentrated power or fuel, also of light weight. In fact, we know that if we can press an inclined plane against the air with a certain velocity it will rise and sustain itself, and its progress forwards would then depend upon the angle of inclination. All that is needed is the engine capable of maintaining this pressure practically.

Engines have been devised to be driven by gunpowder, and gun cotton, having greater energy and being more controllable, would probably be better. The quantity might be adjusted to the work readily enough; just as in some instances the governor adjusts the steam valves and quantity of steam admitted for each stroke.

SIGMA.

STRANGE AND RARE MUSICAL INSTRUMENTS, ALIAS QUEER FIDDLES AND PIPES.

[4187.]—I SHOULD be greatly obliged by any assistance in an intended paper on the above subject, which my fellow readers can afford by contributing descriptions—or references to such—of the subjoined wind and stringed instruments of music, stating the means by which their sounds are produced, the quality or timbre and relative power of those sounds, and the compass of each instrument.

CORNO DE BASSETO: (Italian, I believe) A species of clarionette.

MELO DI COW: Said to have been invented by Riffel, probably a kind of harmonicon with metal bars.

OCTO BASS: Possibly a kind of bombardon, or perhaps a very big fiddle.

HARMONICHORDE: Said to have been invented by Kauffmann, probably a species of mechanical keyed fiddle.

CROWLE: Probably a kind of bassoon or bass clarionette.

ADIA PHONON: Invented by Schuster, of Vienna, about 1820; I believe a kind of pianoforte.

SYMPHONION: Said to have been invented by Kauffmann.

CLAVACIN DE AMOUR: Probably a variety of the harpsichord—its peculiarities and why so called.

ANIMO CHORDA: Probably a variety of the Eolian harp.

OBBVALET: Probably a reed instrument of the oboe class.

ALTO BASSO: Possibly a bow instrument of the viol class.

THE HARMONIOUS BLACKSMITH.

CONCRETE MULTIPLICATION.

[4188.]—IT is never worth while to dispute about words, and therefore, in reply to "No. 170," and "M. A." (p. 199), I will readily concede that the form in which "M. A." (and before him "E. L. G.") expresses the idea is better than mine. The idea itself, however, is precisely the same; we may multiply feet by feet (or any other measures of length) and we do thus obtain a result which has an actual existence—*i.e.*, a measure of area expressed in a square unit, whether we say that this is "because there is such a thing as a square foot" with me, or with "E. L. G.," that it is an arithmetical dodge, and with "M. A." that we give a new and arbitrary meaning to the unit, of which the product represents the multiple. So, having thus multiplied feet by feet, and obtained a measure of area in square feet, we again can multiply by feet and obtain a result which has an actual existence—viz., cube feet, a measure of contents. Here we stop, we cannot for a third time multiply by feet, because there is no really existing fact or thing which the product would represent.

What we have, therefore, to consider is not words, but things and facts. We multiply 10ft. by 5ft., and we have a true result, an area equal to 50 square areas of 1ft.; we multiply this by 2ft., and we express in our result an actual fact—viz., our area of 50 square feet with a depth of 2ft.—*i.e.*, 100 cubes of 1ft. Now, this is not concrete multiplication, it is not a true multiplication of feet by feet; it only shows the meaning of the rules in the arithmetics.

If all the arithmetics published, and, furthermore, all the mathematicians living, were to assert that we could multiply 10 pounds by 5 pounds, either weight or money, their assertion would be simply a monstrous fallacy; for what existing fact, or what conceivable idea, is represented by the figures: 10 pounds multiplied by the number 5 means 10 pounds taken 5 times, and all added together producing 50 pounds? But how are you going to take 10 pounds—5 pounds times, and add them?

A schoolboy buys (we will say) 10 marbles for a penny, and having 5 pence, he expends his capital in marbles, and multiplies his stock to 50; but let him have 10 marbles in one pocket, and five in the other, and what possible multiplication can he effect, other than the ordinary process of winning those of his schoolfellows? He may, if he pleases, go to any of the arithmetics which profess to tell him how to do it, and study the first and second books of Euclid for a month, with the advantage of "No. 170's" assistance, and if at the end of the month he succeeds in doing anything with his marbles except shifting both into one pocket, and bringing out a total or product of 15, then, and not till then, will the possibility of concrete multiplication be proved.

Further, if concrete multiplication were a possibility as "an arithmetical dodge," why should there be any more difficulty in multiplying pounds by yards than by pounds. The real explanation is, that concrete numbers are only susceptible of addition and subtraction, and then only as compared with the same concrete object. You cannot add, for instance, a pint of water to a pound of flour, and produce anything which a number compounded of them will represent; as with feet you must use a new unit—paste.

SIGMA.

SOMETHING WRONG WITH JUPITER.

[4189.]—HAD Mr. R. A. Proctor deferred his article, written for *St. Paul's Magazine* about a year ago, on "Something Wrong with Jupiter," he would have had some strong additional evidence to support the title after reading Mr. Ralph Lowdon's letter (4071, p. 176), and might have reasoned on the probability of the "giant planet" becoming one day transparent.

As I have paid attention to the phenomena of Jupiter's satellites for some time past, I regret I was prevented by cloudy weather from witnessing the extraordinary "transit of the shadow of satellite 4" on Jupiter's face on 14th March, 1872, described by Mr. Lowdon with a woodcut, while the satellite itself was at the back of the planet as viewed from us; or, in other words, it was under occultation from 6.46 until 10.56 on that evening, as given in the "Astronomical Notes for March" by "F.R.A.S."

We had lately some correspondence about the "retrogression" of the shadow of satellite 4, and we have now received evidence of it with a vengeance. From the woodcut of the belts of Jupiter, I presume a diagonal prism was used with inverting eyepiece, as the spot (whatever it was) appears on the northern hemisphere. In the description we are carried rapidly to Jupiter and back again. Altogether, the communication is very obscure, and is certainly amusing, if not instructive. I doubt not your contributor "F.R.A.S." little expected when he expressed his belief (let. 4047, p. 171) that we have not had a funnier communication in "our" columns for many a long day than Mr. R. Lowdon's letter (3966, p. 119) on a novel mode of taking the longitude at sea, that he would so soon have his risible faculties again excited.

LINEA.

THE IMPROVED SCALE FOR THE LENGTHS OF PIANO STRINGS IN No. 372.

[4140.]—THIS was drawn showing every string its full length, so that a workman should only have to copy those lengths when making working gauges. Considerations of space induced the reduction of those lengths one-third. Of course, when making his gauges he must add one-half to the lengths shown in the diagram, both above the hammer line and below it, which, with a pair of fine spring dividers he can do without difficulty.

THE HARMONIOUS BLACKSMITH.

WHERE IS THE WATER GONE TO?

[4157.]—VERY often have I speculated whether there may ever be found means of guessing or making some approach to a probable estimate of this important quantity in geology—an approximate figure to, I will not say the *depth*, whether in feet or furlongs, of the general cometary rainfall on the day and hour of our planet's last astronomical catastrophe,—I will not say approximating to the *number* expressing the depth of this added layer of water, but to the *logarithm* of that number,—how many digits the number of feet or yards would probably require—whether, in short, we should rather call the addition one of fathoms, or of poles, or chains, or furlongs, of fresh water. We seem quite without data, either from present traces, or from the Bible, Vedas, or any other tradition or record, for guessing whether furlongs or only a few fathoms would be the nearer measure to assume.

Apart from the work obviously done in scouring the hilly surface into sweep vales, and sweeping into its present deposits the newest "boulder-clay," or rather "drift-gravel"—effects affording no definite measure of the quantity of water unless we knew the exact force, impact of the first dash, and rate of decrease with time, as hour by hour, or minute by minute, the height of unfallen steam atmosphere above diminished; apart from this, the chief fact knowable or to be inferred from the strata is, that there was weight enough of newly-arrived atmosphere to so far equalise the pressure over the whole globe's film (falsely called crust)—so far approach equalising it on highlands and seabeds (which beds, observe, *now* bear scores or even hundreds of times the 6lb. per square inch that the backs of Andes or Himalayas bear)—weight enough so to modify this difference towards equality, as to disturb the whole film's equilibrium, and cause it to take a new form, sea-beds to rise and highlands to sink, by a simultaneous universal earthquake and plutonic movement, or as records (traditional or not) call it, breaking up, of "*all* the [fiery] fountains of the abyss"—whether "fountains of the abyss," or "foundations of the deep," *i.e.*, sea, as some translators say, be the right rendering. Just as now, over thin or tender regions of the film, such as the Caribbean Islands are upon, the mere removal of a tithe or a twelfth of the usual pressure, say 3 or 2½ barometric inches, over the space covered by a cyclone, is difference enough to disturb the crust's equilibrium; so that in scores of cases since Columbus' time, a hurricane has been instantly followed by, or has begun, earthquake shocks, and the last cyclone over St. Thomas set that island rocking for months, after years of quiescence; just so the arrival of the last new atmosphere (one evidently of steam) must have instantly done (all that the traditions or records relate it to have done)—initiated months at least of continental and general plutonic disturbance; but *at first* of a kind just opposite to the usual partial ones, whereby, as Herschel insisted (and as even "Sigma" has heard), plutonic action keeps our lands above water. Instead of weight taken from the land to the sea-bed, and added thus to the depressed scale of the balance, giving the raised scale from time to time a further lift, here the *first* action (whatever might follow) was a contrary one, equalising pressure, and so tending *for a time* toward general levelling of form and general inundation.

Now, if we ask what weight of steam sufficed for this?—an amount equivalent (say) to the air—that is, to 34ft. of water? or to ten present atmospheres, or a hundred? in short, to fathoms of water or furlongs?—I see no conceivable data for an estimate. Even if we knew, or assumed (which I see no sufficient grounds for doing), that the highest antediluvian peaks were at some moment covered, so that not only was every undrowned organism afloat (which, I think, was probably the case for a short time), but even no rock left unsubmerged, even then, what know we of the height of such antediluvian summits, either above the antediluvian or the present sea level? Our present highest ones, all the Himalayas, Andes, Alps, Elie-de-Beaumont, has proved to be the newest, and to date from this last disturbance. The Pyrenees are the highest (now) of all that are known to have had any considerable height *before* it: and *what* height? We know not, whether *double* or *half* their present. We know not, of any two hills 100 miles apart (say Snowdon and Malvern), *which was the higher*, the day before that "six hundredth year of Noah, the second month, the seventeenth day of the month;" though we can be sure both were *hills*, and so higher than the Andes, which then were *not* hills. But even if it were asked, what addition of water would suffice *now*, in a new deluge, to submerge our five-mile Himalaya peaks? we know not whether it would take one mile, or half a mile. For aught that any of us knows, even that "Sigma" knows, a furlong might do it; might have weight enough so to derange and reverse the relations of sea-bed and continent as to bring Dawalagiri's snows under its wave! They and we alike are on a fluid (not solid) globe, a ball of liquid lava with a film (not a *crust*) over it, and, even if we knew all about this, its thickness and structure everywhere, what possible means of ascertaining this weight can "Sigma" conceive but by *experiment?* And without a comet at command, where will he get the one or two trillion tons weight required for the experiment?

That "comets" have "a mass too small" (p. 196, let. 4086) is not only of all things I ever saw alleged in the ENGLISH MECHANIC, but of all myths in any mythology, the boldest venture, the most purely groundless, I ever heard of! "Comets!" Why, of the three or four hundred on record, I challenge him to prove a *single one* too small! Let "Sigma" bring us proof of *any single* comet yet seen having weighed as *little* as (say) a mile layer of water over the earth, 160 atmospheres, or a trillion tons. And comets, remember, have differed in their bulk, the largest and least of *this century* alone, as full a million to one! This variety in bulk, but in appearance as much variety as in *any* 300 things of one name—say a cabinet of 300 minerals! Just *two* very minor ones the spectroscope has been made long enough to examine. And on the strength of this "Sigma" tells you, "*they* (comets) do not contain or consist of water"! Who said they did? *Any* comet "Sigma" chooses to name, I will grant him, if he likes, to have been of rubidium vapour. For aught I know, Encke's is so; or thallium, if he prefers it. But, mind, we cannot allow many to be of like material. Their looks are too various. Moreover, if he likes, there shall never have been more than *one* of steam—none before the last that fell on earth, nor since. What I say geology shows is, that one fell 50 centuries ago (or between 45 and 55), enveloped the earth before falling, and that its material was steam; *that one*,—I know and say nothing of any other's materials.

Now, as "Sigma" asks, "Where is the water gone to?" he might ask the same of any other rainfall. Let me suggest the same respecting some mill tail-water, of which Prof. Ansted writes in his "Visit to the Ionian Isles," 1863, cap. XI., p. 322:—"A curious natural phenomenon occurs, and is taken advantage of, in the neighbourhood of Argostoli. At four points on the coast the sea, at its ordinary level, enters a very narrow creek, or broken rocky channel; and after running somewhat rapidly through this channel and among broken fragments of rock for a short distance, it gradually becomes sucked into the earth and disappears. By conducting the water through an artificial canal for a few yards, and so regulating its course, and forcing all the water that enters to pass in a single stream beneath an undershot wheel, power enough is obtained in two cases to drive a mill. Mills have, in fact, been placed there by an enterprising Englishman, and are constantly at work. The stream, after being utilised, is allowed to take its natural channel, and is lost among the rocks. It is common enough to drive a wheel by a current of water going from the land towards the sea; but it is certainly rare, and, as far as I am aware, peculiar to this locality, to find mills driven by a current of sea water, acting quite independently of the tide, the water constantly and steadily rushing in over the earth's surface, and finally disappearing. . . *Apart* from the facts that the water sucked into the earth is sea water, and that it enters below the sea level, there is *nothing* extraordinary or unusual (!); for numerous instances occur in every limestone country of streams, often of considerable dimensions, entering into open fissures and disappearing. . . . But it is certainly very seldom that we are able to satisfy ourselves of the empty state of the limestone caverns close to the sea and below the sea level, as we can at Argostoli [*satisfy ourselves of their* 'empty state' *by their perpetual receipts!*], and for this reason, if for no other, the phenomena are worthy of particular notice. The general condition of the surface is as follows:—The small harbour of Argostoli is inclosed on both sides by the hard broken limestone rock, so common in the islands. On the east side it rises immediately into hills of moderate elevation; and on the west side, behind the town, there is a plateau, scarcely above the usual level of the water, rising, about two or three hundred yards from the shore, into a low ridge, which, in fact, by its projection into the gulf, makes the harbour." According to his map of the island, p. 378, this "plateau" or peninsula is the only square mile that he represents flat (with no hill shaded), and its area is under a square mile—less than two miles by half a mile—that of the whole island being possibly 300 square miles. "Between the shore line and this low ridge, there is an evident depression of the surface in all that part over which the sea, when it enters, is sucked in. . . . But what, it will be asked, becomes of the waters of the sea thus pouring in continually to fill the cavern?" Let me commend this question to "Sigma." Instead of theoretical "comet's tail" water *once*, here is very practical mill tail-water *every day*, that has ground the Cephalonian's bread corn to the following tune.

Professor Ansted continues (p. 327): "The influx of water, however, is not small. It amounts, as far as I could make out, to *more than half a million of gallons per diem.*, for the two mills together." When "Sigma" has answered that, we will proceed to consider, perhaps, where the cometary water has gone to. . . . . "It will be evident that if sea water finds its way into any large natural cavity, from which it is afterwards evaporated, a deposit of salt must be taking place in this cavity, or in the rocks adjacent and connected with it. Assuming the influx to be at the rate already mentioned, this may be roughly estimated as equivalent to an area of ten or twelve acres of solid matter one foot thick, accumulated each year. It is an interesting question to consider where this deposit of salt is going on, and whether saline springs may not be thus fed. There are no known springs in the island of Cephalonia that present any large quantity of saline matter."

Remember it is not I, but "Sigma," that finds any difficulty about where the comet water of Noah's time has "gone to"? I simply hold it to have obeyed all the same laws as yesterday's shower. But as this does not satisfy "Sigma," probably it will assist him to consider and solve for us first this Cephalonian question, as it is not theoretical. The mills being ascertainably at work for years past (if not to this day), and the corn ground and eaten from them, I return his question as to these millions of tons of sea, "Where is the water (and the salt) gone to?"

E. L. G.

BELL PIANETTE.

[4158.]—MR. S. BOTTONE (reply 11893) says "a paten was taken out for this instrument towards the latter en of the last century." I have carefully looked over the list of musical patents before A.D. 1800, and cannot find it. Query, what was the name of the patentee?

Dr. Cleggat, A.D. 1788, patented—or rather proposed in his patent of that date to make tuning-forks with movable weights for altering their pitches, which familiar method was afterwards employed by Loeschman in the terpodian, patented A.D. 1820; although I have a specimen of that instrument bearing the name of Van Den Burgh and date 1817; and M. Hiles states, in his musical dictionary, it was invented by Buschmann, of Hamburg. Dr. Cleggat also proposed to construct a new instrument (of music) of a proper number of those tuning-forks, or of single prongs or rods of metal fixed on a sounding-board or box. In times of old, I believe all the sounds of stringed musical instruments were "boxed up," or at least supposed to be, and the performer, *à la* Pandora, let the often but too evil sounds out without, like that merciful young (female) person, leaving the hearers any hope of better things. Excepting that the proposed instrument had a sounding-board, I see no difference in principle between it and the terpodian. It can hardly be termed a bell pianette or a rod harpsichord, for Dr. Cleggat does not suggest the employment of either plectra or hammers for vibrating his forks or rods, but that "a celestina stop, made by an endless fillet, may be applied, producing the sounds on (*sic*) these bars as it does on strings." No doubt Dr. Cleggat was familiar with Adam Walker's instrument, the celestina, patented A.D. 1772, also with the application of its mechanism to the harpsichord—viz., the celebrated celestina stop of that instrument, not to mention the lyrichord of Plenius, A.D. 1741. I append a verbatim copy of a broadsheet or handbill containing statements very interesting to all who desire to obtain continuous sounds from the strings of keyed instruments, concerning which I may remark that, excepting in the instances of Hawkins's claviol, R. Mott's sostinente pianoforte, and perhaps the modern tetrachordon piano, we do not seem to have gone much ahead of the musical capabilities of the productions of that clever inventor, always assuming the said handbill to state the truth; but, alas! all statements in advertisements must be taken *cum grano salis*, the said grain of salt being fully understood to be as big as a bushel.

Rutergius Plenius was by no means the first in the field. As early as A.D. 1600 John Heyden produced the clavicin viol; and Kircher, in his "Musurgia Universelle," mentions the possibility of constructing such an instrument. In A.D. 1664 Evelyn relates he saw one with gut strings—a veritable lyrichord—at a meeting of the Royal Society, the bow of which was formed of parchment; and in 1717 Marius constructed a model of a similar instrument (alias mechanical fiddle), which model is, or at least was, in the museum of the Académie des Sciences.

The only thing I can find which seems to resemble the bell pianette was patented by Groll (1812), who proposed to construct a musical instrument of metal bars (bell metal by preference) attached to a sounding-board at one or both ends. Hammers applied to this instrument would have made it a veritable pianoforte, but the inventor does not suggest their use; in fact, he only claims improvements on the class of musical instruments which "afford their tones by friction applied to metallic substances." The said friction he proposes to obtain by the violin bow, the endless web or riband of horsehair or other fibrous material, or by a rosined wheel, *à la* hurdy-gurdy. He, however, also proposes a very important practical improvement—viz., "applying the said friction to a small stem, stud, or protuberance on one or both of the (unisonous) bars."

The earliest musical instrument I remember in which metal bars are struck by hammers is the design of Mr. Goldsworthy Gurney (A.D. 1833), and it is also one of the very simplest, cheapest, and best I have seen. Several patents have since been obtained for modifications of the bell, or rather bar, pianoforte, of which that of Crawford (1862) is one of the most modern. Mr. Crawford, besides hammers, proposed to employ plectra similar to those of the harpsichord for vibrating his elastic bars or springs, probably in imitation of those very pleasing instruments the musical-boxes, some of which yield really powerful sounds, and all of which are rendered considerably louder by being laid on a resonant surface. I find the soundboard of a piano before the strings are put on—or, yet better, the thin belly of an unstrung harpsichord—answers this purpose admirably. It may be a wrinkle well worth knowing—especially to dealers in musical-boxes—that a soundboard (about 30in. long by 20in. wide, only ⅛in. thick, strengthened by three bars ½in. thick, about ¾in. deep at the middle, tapered to one-sixteenth of an inch at their ends) enormously augments the loudness of their sounds. A late friend of mine, who dealt rather largely in those made by Nicol Frère, had a soundboard of the above dimensions constructed to my design, which, being stained mahogany colour and raised on short pillars, had the appearance to his simple customers of a simple show-board standing on his counter. He told me this simple contrivance sold him many musical-boxes; and when I asked him if it was not true that it also "sold" their buyers, he only answered "caveat emptor," which, as he was an Evangelical Churchman who swore by Lord Shaftesbury, was, I suppose, the Christian (practical) rule for "doing your neighbours as they would do you" (if they could).

Should "Valve," or any fellow reader, desire to try his prentice hand on the amateur construction of a bell, or rather a bar, pianoforte—which is far easier and cheaper to make than one with strings, for in the former no framing to resist tension is needed, and no provision of means for retuning required, as it never gets out of tune—I think it would be no more than common prudence to purchase the following patents: Groll (No. 8531), price, with drawing, 4d.; Gurney (No. 6483), price, with drawings, 6d.; and Crawford (No. 1543, A.D. 1862), price, with drawings, 8d. The total sum (1s. 5d.) is not very large, and their perusal would render him familiar with most of the more important things which have been done in this direction. Having suffered "pretty considerable" from the folly of independent investigation and the re-inventing of old things myself, I can appreciate the advantages of starting from the 'vantage ground of the experiences of those who have helped (as the French wit put it) to fill up the many pitfalls in the road to improvement and discovery by falling into them, although I fear they but too often perished on the way. I would also suggest that the intending constructor purchase—I use the word in its strict legal sense of obtaining by any means, and not merely as buying—one of Messrs. Cramer's instruments, which he may obtain on hire at a very small cost. He can then see, or rather hear, how he likes it on further acquaintance, and may—if his conscience does not rebuke him—like a manufacturer, copy all that seems worthy of imitation. I may add if a good treble be desired I would advise him to employ very light hammers, and to drive them with great velocity, for the reasons stated in my recent articles on "Pianoforte Actions," printed in Nos. 367, 368, and 370 of the ENGLISH MECHANIC.

Mr. Bottone says "no dampers are required." I am very sorry to hear this, for, if true, the vibrations of the steel springs or bars which generate its sounds must be addicted to that great evil—laziness, or at least "retiring early to rest." The defects of most pianofortes are manifold, among them the too early cessation of the vibration of their strings is a common one, and this is what renders their tones "short;" but I never yet heard any piano with strings whose tones were so short as not to require dampers, which are necessary in the old harpsichord even when "buff stop" is on. Shortness of tone is to me an utter abomination, and, if not a very great evil in a piano used exclusively for quadrille playing, renders the instrument quite unfit to render properly Mendelssohn's "Lieder ohne Worte" and similar music; in a word, you cannot make such a piano "sing" anyhow.

Verbatim Copy of Broadside (Handbill) in the Chetham Library Relating to the Lyrichord of Plenius, A.D. 1741.

By his Majesty's Royal Letters Patent, granted to Rutgerus Plenius, Harpsichord Maker, for the sole Making, Use, and Benefit of a new invented Musical Instrument called a Lyrichord, which imitates a Violin, Violoncello, and Double Bass; but when play'd full, it resembles a perfect Organ of a most delightful Tone, altho', by catgut strings only, without Pipes. It admits of playing Forte and Piano; as also of swelling any Single Note (or many notes, *ad libitum*), on ye same Key, by ye simple Pressure of ye Fingers: But what is most surprising, and indeed incredible, if not seen (yet plainly demonstrable to everyone), its strings never go out of Tune, as long as ye constituent Instrument remain entire; a Thing which has been so long wisht for and desir'd, and in all Ages, 'till now, by everyone, deem'd impossible to find out. This, therefore, is to inform ye Nobility, Gentry, and others, That ye aforesaid Rutgerus Plenius has now (after Ten years' painful study and Labour, accompany'd with no small Expence) brought ye above-mentioned Instrument to Perfection. And he humbly presumes, that all the Gentlemen and Ladies, who will do themselves ye pleasure, and him ye Honour of seeing and hearing it, will be fully convinced of ye Truth of ye foregoing Assertions; and at ye same Time be agreeably diverted by ye Harmony of ye Instrument, it being esteem'd and approv'd by all that have yet seen it; particularly by ye most eminent Masters of Musick in England, who allow it to be ye most curious Piece of Workmanship, and most wonderful Instrument they have ever seen or heard of. The Price of seeing and hearing it performed on at any Time between ye Hours of Twelve and Four o'clock, is Half a Crown each Person, at ye Inventor's House (ye King's Arms being over ye Door) in south Audley Street, Grosvenor Square; where a good hand is provided for ye Entertainment of ye Audience.

THE HARMONIOUS BLACKSMITH.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4159.]—I IMAGINE that had the first inventors of rifles taken a piece of gas-pipe about the size and length of a gun barrel, and made it red hot for about a foot at one end, then placed an inch or two of that end in water, and looked down the inside of the pipe, we should never have departed from the use of the smooth-bore; for they would have seen the steam thus generated winding its way out spirally, which I take to be the course the gas evolved by the combustion of the powder in a gun does take. It would, therefore, become apparent to them that all that they had to do to obtain the spin for their projectile would be to provide a surface by which the rotary motion in the gas would be received by the projectile.

That surface would be obtained by leaving a projection extending a short way from the circumference to the centre at the butt of the projectile, or, perhaps, more than one projection. I should have tested this theory of mine some two years since, but being a working man I have not the power. Perhaps "Artillery Captain," or some other friend, could say how far I am right. PHILUS WARD.

HOW WE SEE A DISTANT OBJECT.

[4160.]—IN reply to "E. J. D." (let. 4063, p. 174), I would ask what he means by a pencil of rays. Rays from combustion issue and extend in every direction. The Rev. David Blair taught that a pencil of rays is a parcel of them proceeding from a point; but no particle of matter leaves the point and passes to the eye, a mere impulse is given to the ethereal millions of atoms which, from closeness of juxtaposition, almost instantly communicate with every eye in the line of radiation or in any line of reflection thereof; the ray, then, is but transmitted pulsation, and rays from every point of an object acting in every direction compel our acknowledgment that the ultra-microscopic diminutiveness of the ethereal atoms amaze us more with the infinity or smallness than we can be with infinity of extension in stellar space. On the diameter of what we call a "point," it were but guesswork to estimate the number of ethereal atoms that might repose. Reflection of light is but repulsion or rebounding of the infinitesimally small ether-atoms. Now a "pencil of rays" falling or striking on the eye is but a succession of these ether-atoms striking on the eye's outer convex surface, from whence the direction of the impulses converge towards a focus which they reach on the retina or on the optic nerve: the impulses are continuous as long as the combustion that they proceed from continues. Solar combustion is the power which imparts impetus to the ethereal pulsation, and so the distance of the sun is the distance of the power which produces reflection. Glass is porous to the ether-atoms, but mercury seems to reflect nearly them all when pulsating in periods in accord with the interchange of atoms in the gaseous molecules of the sun. We read of three sorts of pencils, cylindrical, divergent, and convergent, and, as Blair has it, they proceed from points. The cylindrical from a flat surface, the divergent from a convex, and the convergent from a concave, just as with the reflected chemical atoms of sound. We read, also (as in Chambers's "Educational Course"—Optics), that a pencil is a parcel of rays proceeding *to* (as well as *from*) a point; thus a concave mirror will converge reflected rays to a very brilliant point, but so immense is the sun that its rays are deemed parallel, the divergency being imperceptible. But the number of pulsations of ether-atoms that fall each second on a square inch of surface are evidently countless millions, and we do not see any object, colour, or shape so much because they reflect rays as because they do not reflect them. Where every ray is reflected, the colour is shadeless white, and we only perceive degrees of distance and shades of colour by non-reflection, some of the ethereal pulsations of larger or smaller amplitude being cut off by the, to them, non-repulsive (or absorbent) nature of the impinged surface. We see objects, therefore, solely by their non-reflection of rays, a red object being one that reflects none of the other rays of the spectrum but the red ones. Pencils of rays, if solar, are parallel, and do not converge till after they strike the convex surface of the eye, and pencils from a point (so far from coming to a focus) must be divergent when they strike the eye, the ether-atoms retaining the impulse transmitted at the surface of the sun, and unless reflected from concave surface, such rays cannot converge before they reach the eye. I cannot understand "E. J. D." when he talks of fresh pencils springing up to suit change of position; the undulatory vibrations are in every direction to and from every point that catches direct sun rays, and it is most absurd to suppose that rays must converge to a point before they enter spectators' eyes. A single pulsation will bestow light lasting the one-eighth of a second on the retina, so that eight ether-waves per second maintain constant light. I see, from where I sit, a placard: it is printed on "white" paper, but whether with red or black ink is hardly plain. I cannot read a word till I put on my concave glasses, and then I make out indistinctly the large letters in the word "Bazaar." Now, why cannot I read every line and letter in the placard? Simply because I am too far off; the ether-atom vibration-rays are too few to reach me unless the diameter of my convex eye were much greater, so as to catch more of the direct pulsations from the placard. I see the shape, size, distance, and colour of the placard; the pulsations from its exterior and interior are adequate for that; but the other pulsations from its interior are too few and too much crossed for me to gain more than a hazy, indistinct picture of the words it bears. No object provides any rays but solar and other fire, and were a very powerful lime or electric light thrown on our placard, I might be able with my concaves to read it all, it would so multiply the ethereal pulsations from each point.

We hear a band of musical instruments, and each of hundreds of hearers can perceive not only the tone of each note from each of all the instruments, but perhaps, also, its first, second, and third overtones, all blending in harmony as one note with numberless overtones, as note succeeds note to suit a well-balanced order of completeness. These pulsations on the drum of the ear are to each note from each instrument and to each of its overtones more or less rapid, or of varying amplitude and number, in accordance with the acuteness (or shrillness), or with the flatness (or baseness) of the sound conveyed. If one note give 256 pulsations in a second, another gives twice, and another three times as many, and so on (see Tyndall "On Sound"); and if all the heart-moving tunes we hear are conveyed by vibrations of the coarser atoms that the chemical laboratory can appreciate, we must cease to consider it impossible that every degree of distance and surface-quality of object in contact with sun rays is shown to us by the intervention and non-intervention of pulsations of what I venture to call the "ultra-microscopic" ethereal atoms (though the recognised chemical atoms may fall under the same name). Rates of speed in the transit of sound, varying to the different notes of music and the varying lengths of musical vibrators, I doubt not, offer us a first clue to the size, distance apart, and number of atoms or molecules in a line of specific length, certainly as to the total amount of interspace that separates them; and the same rule will apply to the otherwise wholly inappreciable atoms of illuming ether, whose closeness brings light to us from the sun in 192,500 seconds of time according to Herschel. If, however, different notes of the spectrum travel like different notes of sound, at very different speeds and amplitudes of oscillation, we need not wonder at speeds of light or of sound varying unless it be with reference to some specific tint or to some specific note.

We should look upon the light-giving vibrations of ether-atoms as moving in masses, rather than only in diverging lines, from each point of reflection, and as subject to cross vibrations in every direction; and as they convey impulse forward about 200,000 miles per second, whilst particles of air convey sound's impulse but about 1,000 feet, and those of glass but 18,000 feet, we should estimate the extreme closeness of the ether-atoms, which carry surrounding atoms wave-like along with them till such are diverted by cross-vibrations, and the motion is so rapid, and the atoms so sufficiently unattached, that crossing does not divert the straight line of motion. In Gutch's "Register," 1859 page 180, I find "Black has small atoms, and absorb light; white large, and reflects it. Reds are of oxyge character, according to Ellis; greens, nitrogen; an violet, hydrogen." An oxygen body combines wit hydrogen and reflects red rays; a hydrogen atmospher cuts off the red, &c., vibrations, and reflects the blue and indigo ones, and a nitrogen air cuts off red and violet, and reflects green or white, orange or blue. As a clue to the nature of any molecular constitution, the rays of sunlight or other light it cuts off is too important to be overlooked. J. BARWICK.

P.S.—Direct sun rays penetrate through porcelain as well as through paper; indirect or reflected rays do not, objects being thus shown as shadow by interception of rays, but no bright tint is seen, reflected pencils seeming to lack adequate force to penetrate through paper or porcelain.

[4161.]—IN reply to the kind letter of "F. R. A. S." (4049, p. 171), I am pleased to get a reply from one who does understand the theory of light, and the best proof that he does so is, that he carefully refrains from touching on the point that I want cleared up. He has omitted to answer the following part of my letter (3974, p. 120): "I cannot conceive how the reflections can be so numerous, and so conveniently arranged, that they flash in right lines from every physical point of the statue to the eyes of the spectators," &c. I said in that letter, "and that in front of them (the multitude) some conspicuous object is elevated." This was to show that a front view was only provided for. The experiment of the lenses only serves to strengthen my position as to the number of rays to be accounted for. I will now add some more points that require to be cleared up. The rays by which vision takes place must leave all parts of the object at different angles, converging to the eye; but if a mirror be placed where the eye was, the rays to it causing reflection proceed from the object to the mirror in right lines parallel to each other; for if they were reflected from the object in converging rays (as they proceed to the eye), the result would be either a confused image or a number of small images; and I am not aware of any power possessed by the mirror, or the eye, to change (as it were, at will) the order in which the rays shall be reflected. Thus, a man standing in front of a mirror resting on the ground, and a little higher than himself (the mirror being perpendicular), will see his eyes by direct rays, I presume, and all his body will be reflected by direct parallel rays; but if he still continues erect, but wishes to see his feet in the mirror, he turns the eyeball downwards, and of course can only see his feet by pencils of rays converging to the eyes. Here, then, we have direct rays for one purpose, and converging rays for the other. The latter, it would seem, must proceed from the phantom image in the mirror, or they must proceed from the observer to the mirror, and be thence reflected to his eyes. Will "F. R. A. S." please to account for this seeming paradox? and if he refers to my letter to Mr. Barwick (4063, p. 174), he will fully understand that I challenge a portion of the theory of light. I hope, therefore, in his next, that he will try and explain the various points I have raised. I feel that we should not take any theory for granted, but carefully analyse it.

Mr. Barwick says, in his letter (3973, p. 120), "A mirror's frame is visible, as 'Bobo' shows, by its shading off or not reflecting all the received rays; it reflects but those that denote its colour." I was under the impression that the prism could analyse light into the three primitive colours and secondary compounds (by some believed to be primitives also); or, in other words, the colours of the rainbow; but I was not aware that the prism or anything else could show the tertiary compounds. I presume, therefore, that olive, &c., must be added to the list. I am at a loss to understand the ether pulsations on the eye: I thought that belonged to the exploded old theory, which stated something about the eye having the power to reflect or direct some subtile ether on a distant object, and by that means see it. He says, "The fading of visibility of distant objects, I take it, is caused by increase of intervening ray-crossings, which obstruct more extensively as distance increases." Well, I should suppose

WHERE IS THE WATER GONE TO?

[4157.]—VERY often have I speculated whether there may ever be found means of guessing or making some approach to a probable estimate of this important quantity in geology—an approximate figure to, I will not say the *depth*, whether in feet or furlongs, of the general cometary rainfall on the day and hour of our planet's last astronomical catastrophe,—I will not say approximating to the *number* expressing the depth of this added layer of water, but to the *logarithm* of that number,—how many digits the number of feet or yards would probably require—whether, in short, we should rather call the addition one of fathoms, or of poles, or chains, or furlongs, of fresh water. We seem quite without data, either from present traces, or from the Bible, Vedas, or any other tradition or record, for guessing whether furlongs or only a few fathoms would be the nearer measure to assume.

Apart from the work obviously done in scouring the hilly surface into sweep vales, and sweeping into its present deposits the newest "boulder-clay," or rather "drift-gravel"—effects affording no definite measure of the quantity of water unless we knew the exact force, impact of the first dash, and rate of decrease with time, as hour by hour, or minute by minute, the height of unfallen steam atmosphere above diminished; apart from this, the chief fact knowable or to be inferred from the strata is, that there was weight enough of newly-arrived atmosphere to so far equalise the pressure over the whole globe's film (falsely called crust)—so far approach equalising it on highlands and seabeds (which beds, observe, *now* bear scores or even hundreds of times the 6lb. per square inch that the backs of Andes or Himalayas bear)—weight enough so to modify this difference towards equality, as to disturb the whole film's equilibrium, and cause it to take a new form, sea-beds to rise and highlands to sink, by a simultaneous universal earthquake and plutonic movement, or as records (traditional or not) call it, breaking up, of "*all* the [fiery] fountains of the abyss"—whether "fountains of the abyss," or "foundations of the deep," *i.e.*, sea, as some translators say, be the right rendering. Just as now, over thin or tender regions of the film, such as the Caribbean Islands are upon, the mere removal of a tithe or a twelfth of the usual pressure, say 3 or 2½ barometric inches, over the space covered by a cyclone, is difference enough to disturb the crust's equilibrium; so that in scores of cases since Columbus' time, a hurricane has been instantly followed by, or has begun, earthquake shocks, and the last cyclone over St. Thomas set that island rocking for months, after years of quiescence; just so the arrival of the last new atmosphere (one evidently of steam) must have instantly done (all that the traditions or records relate it to have done)—initiated months at least of continental and general plutonic disturbance; but *at first* of a kind just opposite to the usual partial ones, whereby, as Herschel insisted (and as even "Sigma" has heard), plutonic action keeps our lands above water. Instead of weight taken from the land to the sea-bed, and added thus to the depressed scale of the balance, giving the raised scale from time to time a further lift, here the *first* action (whatever might follow) was a contrary one, equalising pressure, and so tending *for a time* toward general levelling of form and general inundation.

Now, if we ask what weight of steam sufficed for this?—an amount equivalent (say) to the air—that is, to 34ft. of water? or to ten present atmospheres, or a hundred? in short, to fathoms of water or furlongs?—I see no conceivable data for an estimate. Even if we knew, or assumed (which I see no sufficient grounds for doing), that the highest antediluvian peaks were at some moment covered, so that not only was every undrowned organism afloat (which, I think, was probably the case for a short time), but even no rock left unsubmerged, even then, what know we of the height of such antediluvian summits, either above the antediluvian or the present sea level? Our present highest ones, all the Himalayas, Andes, Alps, Elie-de-Beaumont, has proved to be the newest, and to date from this last disturbance. The Pyrenees are the highest (now) of all that are known to have had any considerable height *before* it: and *what* height? We know not, whether *double* or *half* their present. We know not, of any two hills 100 miles apart (say Snowdon and Malvern), *which was the higher*, the day before that "six hundredth year of Noah, the second month, the seventeenth day of the month;" though we can be sure both were *hills*, and so higher than the Andes, which then were *not* hills. But even if it were asked, what addition of water would suffice *now*, in a new deluge, to submerge our five-mile Himalaya peaks? we know not whether it would take one mile, or half a mile. For aught that any of us knows, even that "Sigma" knows, a furlong might do it; might have weight enough so to derange and reverse the relations of sea-bed and continent as to bring Dawalagiri's snows under its wave! They and we alike are on a fluid (not solid) globe, a ball of liquid lava with a film (not a *crust*) over it, and, even if we knew all about this, its thickness and structure everywhere, what possible means of ascertaining this weight can "Sigma" conceive but by *experiment*? And without a comet at command, where will he get the one or two trillion tons weight required for the experiment?

That "comets" have "a mass too small" (p. 196, let. 4086) is not only of all things I ever saw alleged in the ENGLISH MECHANIC, but of all myths in any mythology, the boldest venture, the most purely groundless, I ever heard of! "Comets!" Why, of the three or four hundred on record, I challenge him to prove a *single one* too small! Let "Sigma" bring us proof of *any single* comet yet seen having weighed as *little* as (say) a mile layer of water over the earth, 160 atmospheres, or a trillion tons. And comets, remember, have differed in their bulk, the largest and least of *this century* alone, as full a million to one! This variety in bulk, but in appearance as much variety as in *any* 300 things of one name—say a cabinet of 300 minerals! Just *two* very minor ones the spectroscope has been made long enough to examine. And on the strength of this "Sigma" tells you, "*they* (comets) do not contain or consist of water"! Who said they did? *Any* comet "Sigma" chooses to name, I will grant him, if he likes, to have been of rubidium vapour. For aught I know, Encke's is so; or thallium, if he prefers it. But, mind, we cannot allow many to be of like material. Their looks are too various. Moreover, if he likes, there shall never have been more than *one* of steam—none before the last that fell on earth, nor since. What I say geology shows is, that one fell 50 centuries ago (or between 45 and 55), enveloped the earth before falling, and that its material was steam; *that one*,—I know and say nothing of any other's materials.

Now, as "Sigma" asks, "Where is the water gone to?" he might ask the same of any other rainfall. Let me suggest the same respecting some mill tail-water, of which Prof. Ansted writes in his "Visit to the Ionian Isles," 1863, cap. XI., p. 322:—"A curious natural phenomenon occurs, and is taken advantage of, in the neighbourhood of Argostoli. At four points on the coast the sea, at its ordinary level, enters a very narrow creek, or broken rocky channel; and after running somewhat rapidly through this channel and among broken fragments of rock for a short distance, it gradually becomes sucked into the earth and disappears. By conducting the water through an artificial canal for a few yards, and so regulating its course, and forcing all the water that enters to pass in a single stream beneath an undershot wheel, power enough is obtained in two cases to drive a mill. Mills have, in fact, been placed there by an enterprising Englishman, and are constantly at work. The stream, after being utilised, is allowed to take its natural channel, and is lost among the rocks. It is common enough to drive a wheel by a current of water going from the land towards the sea; but it is certainly rare, and, as far as I am aware, peculiar to this locality, to find mills driven by a current of sea water, acting quite independently of the tide, the water constantly and steadily rushing in over the earth's surface, and finally disappearing. . . *Apart* from the facts that the water sucked into the earth is sea water, and that it enters below the sea level, there is *nothing* extraordinary or unusual (!); for numerous instances occur in every limestone country of streams, often of considerable dimensions, entering into open fissures and disappearing. . . . But it is certainly very seldom that we are able to satisfy ourselves of the empty state of the limestone caverns close to the sea and below the sea level, as we can at Argostoli [*satisfy ourselves of their* 'empty state' *by their perpetual receipts!*], and for this reason, if for no other, the phenomena are worthy of particular notice. The general condition of the surface is as follows:—The small harbour of Argostoli is inclosed on both sides by the hard broken limestone rock, so common in the islands. On the east side it rises immediately into hills of moderate elevation; and on the west side, behind the town, there is a plateau, scarcely above the usual level of the water, rising, about two or three hundred yards from the shore, into a low ridge, which, in fact, by its projection into the gulf, makes the harbour." According to his map of the island, p. 378, this "plateau" or peninsula is the only square mile that he represents flat (with no hill shaded), and its area is under a square mile—less than two miles by half a mile—that of the whole island being possibly 300 square miles. "Between the shore line and this low ridge, there is an evident depression of the surface in all that part over which the sea, when it enters, is sucked in. . . . But what, it will be asked, becomes of the waters of the sea thus pouring in continually to fill the cavern?" Let me commend this question to "Sigma." Instead of theoretical "comet's tail" water *once*, here is very practical mill tail-water *every day*, that has ground the Cephalonian's bread corn to the following tune.

Professor Ansted continues (p. 327): "The influx of water, however, is not small. It amounts, as far as I could make out, to *more than half a million of gallons per diem.*, for the two mills together." When "Sigma" has answered that, we will proceed to consider, perhaps, where the cometary water has gone to. . . . . "It will be evident that if sea water finds its way into any large natural cavity, from which it is afterwards evaporated, a deposit of salt must be taking place in this cavity, or in the rocks adjacent and connected with it. Assuming the influx to be at the rate already mentioned, this may be roughly estimated as equivalent to an area of ten or twelve acres of solid matter one foot thick, accumulated each year. It is an interesting question to consider where this deposit of salt is going on, and whether saline springs may not be thus fed. There are no known springs in the island of Cephalonia that present any large quantity of saline matter."

Remember it is not I, but "Sigma," that finds any difficulty about where the comet water of Noah's time has "gone to"? I simply hold it to have obeyed all the same laws as yesterday's shower. But as this does not satisfy "Sigma," probably it will assist him to consider and solve for us first this Cephalonian question, as it is not theoretical. The mills being ascertainably at work for years past (if not to this day), and the corn ground and eaten from them, I return his question as to these millions of tons of sea, "Where is the water (and the salt) gone to?"

E. L. G.

BELL PIANETTE.

[4158.]—MR. S. BOTTONE (reply 11893) says "a paten was taken out for this instrument towards the latter en of the last century." I have carefully looked over the list of musical patents before A.D. 1800, and cannot find it. Query, what was the name of the patentee?

Dr. Cleggat, A.D. 1788, patented—or rather proposed in his patent of that date to make tuning-forks with movable weights for altering their pitches, which familiar method was afterwards employed by Loeschman in the terpodian, patented A.D. 1820; although I have a specimen of that instrument bearing the name of Van Den Burgh and date 1817; and M. Hiles states, in his musical dictionary, it was invented by Buschmann, of Hamburg. Dr. Cleggat also proposed to construct a new instrument (of music) of a proper number of these tuning-forks, or of single prongs or rods of metal fixed on a sounding-board or box. In times of old, I believe all the sounds of stringed musical instruments were "boxed up," or at least supposed to be, and the performer, *à la* Pandora, let the often but too evil sounds out without, like that merciful young (female) person, leaving the hearers any hope of better things. Excepting that the proposed instrument had a sounding-board, I see no difference in principle between it and the terpodian. It can hardly be termed a bell pianette or a rod harpsichord, for Dr. Cleggat does not suggest the employment of either plectra or hammers for vibrating his forks or rods, but that "a celestina stop, made by an endless fillet, may be applied, producing the sounds on (*sic*) these bars as it does on strings." No doubt Dr. Cleggat was familiar with Adam Walker's instrument, the celestina, patented A.D. 1772, also with the application of its mechanism to the harpsichord—viz., the celebrated celestina stop of that instrument, not to mention the lyrichord of Plenius, A.D. 1741. I append a verbatim copy of a broadsheet or handbill containing statements very interesting to all who desire to obtain continuous sounds from the strings of keyed instruments, concerning which I may remark that, excepting in the instances of Hawkins's claviol, R. Mott's sostinente pianoforte, and perhaps the modern tetrachordon piano, we do not seem to have gone much ahead of the musical capabilities of the productions of that clever inventor, always assuming the said handbill to state the truth; but, alas! all statements in advertisements must be taken *cum grano salis*, the said grain of salt being fully understood to be as big as a bushel.

Rutergius Plenius was by no means the first in the field. As early as A.D. 1600 John Heyden produced the clavicin viol; and Kircher, in his "Musurgia Universelle," mentions the possibility of constructing such an instrument. In A.D. 1664 Evelyn relates he saw one with gut strings—a veritable lyrichord—at a meeting of the Royal Society, the bow of which was formed of parchment; and in 1717 Marius constructed a model of a similar instrument (alias mechanical fiddle), which model is, or at least was, in the museum of the Académie des Sciences.

The only thing I can find which seems to resemble the bell pianette was patented by Groll (1812), who proposed to construct a musical instrument of metal bars (bell metal by preference) attached to a sounding-board at one or both ends. Hammers applied to this instrument would have made it a veritable pianoforte, but the inventor does not suggest their use; in fact, he only claims improvements on the class of musical instruments which "afford their tones by friction applied to metallic substances." The said friction he proposes to obtain by the violin bow, the endless web or ribbon of horsehair or other fibrous material, or by a rosined wheel, *à la* hurdy-gurdy. He, however, also proposes a very important practical improvement—viz., "applying the said friction to a small stem, stud, or protuberance on one or both of the (unisonous) bars."

The earliest musical instrument I remember in which metal bars are struck by hammers is the design of Mr. Goldsworthy Gurney (A.D. 1833), and it is also one of the very simplest, cheapest, and best I have seen. Several patents have since been obtained for modifications of the bell, or rather bar, pianoforte, of which that of Crawford (1862) is one of the most modern. Mr. Crawford, besides hammers, proposed to employ plectra similar to those of the harpsichord for vibrating his elastic bars or springs, probably in imitation of those very pleasing instruments the musical-boxes, some of which yield really powerful sounds, and all of which are rendered considerably louder by being laid on a resonant surface. I find the soundboard of a piano before the strings are put on—or, yet better, the thin belly of an unstrung harpsichord—answers this purpose admirably. It may be a wrinkle well worth knowing—especially to dealers in musical-boxes—that a soundboard (about 30in. long by 20in. wide, only ⅛in. thick, strengthened by three bars ¾in. thick, about ½in. deep at the middle, tapered to one-sixteenth of an inch at their ends) enormously augments the loudness of their sounds. A late friend of mine, who dealt rather largely in those made by Nicol Frère, had a soundboard of the above dimensions constructed to my design, which, being stained mahogany colour and raised on short pillars, had the appearance to his simple customers of a simple show-board standing on his counter. He told me this simple contrivance sold him many musical-boxes; and when I asked him if it was not true that it also "sold" their buyers, he only answered "caveat emptor," which, as he was an Evangelical Churchman who swore by Lord Shaftesbury, was, I suppose, the Christian (practical) rule for "doing your neighbours as they would do you" (if they could).

Should "Valve," or any fellow reader, desire to try his prentice hand on the amateur construction of a bell, or rather a bar, pianoforte—which is far easier and cheaper to make than one with strings, for in the former no framing to resist tension is needed, and no provision of means for retuning required, as it never gets out of tune—I think it would be no more than common prudence to purchase the following patents: Groll (No. 3531), price, with drawing, 4d.; Gurney (No. 6483), price, with drawings, 6d.; and Crawford (No. 1548, A.D. 1862), price, with drawings, 8d. The total sum (1s. 5d.) is not very large, and their perusal would render him familiar with most of the more important things which have been done in this direction. Having suffered "pretty considerable" from the folly of independent investigation and the re-inventing of old things myself, I can appreciate the advantages of starting from the 'vantage ground of the experiences of those who have helped (as the French wit put it) to fill up the many pitfalls in the road to improvement and discovery by falling into them, although I fear they but too often perished on the way. I would also suggest that the intending constructor purchase—I use the word in its strict legal sense of obtaining by any means, and not merely as buying—one of Messrs. Cramer's instruments, which he may obtain on hire at a very small cost. He can then see, or rather hear, how he likes it on further acquaintance, and may—if his conscience does not rebuke him—like a manufacturer, copy all that seems worthy of imitation. I may add if a good treble be desired I would advise him to employ very light hammers, and to drive them with great velocity, for the reasons stated in my recent articles on "Pianoforte Actions," printed in Nos. 367, 368, and 370 of the ENGLISH MECHANIC.

Mr. Bottone says "no dampers are required." I am very sorry to hear this, for, if true, the vibrations of the steel springs or bars which generate its sounds must be addicted to that great evil—laziness, or at least "retiring early to rest." The defects of most pianofortes are manifold, among them the too early cessation of the vibration of their strings is a common one, and this is what renders their tones "short;" but I never yet heard any piano with strings whose tones were so short as not to require dampers, which are necessary in the old harpsichord even when "buff stop" is on. Shortness of tone is to me an utter abomination, and, if not a very great evil in a piano used exclusively for quadrille playing, renders the instrument quite unfit to render properly Mendelssohn's "Lieder ohne Worte" and similar music; in a word, you cannot make such a piano "sing" anyhow.

Verbatim Copy of Broadside (Handbill) in the Chetham Library Relating to the Lyrichord of Plenius, A.D. 1741.

By his Majesty's Royal Letters Patent, granted to Rutgerus Plenius, Harpsichord Maker, for the sole Making, Use, and Benefit of a new invented Musical Instrument called a Lyrichord, which imitates a Violin, Violoncello, and Double Bass; but when play'd full, it resembles a perfect Organ of a most delightful Tone, altho', by catgut strings only, without Pipes. It admits of playing Forte and Piano; as also of swelling any Single Note (or many notes, *ad libitum*), on y^e same Key, by y^e simple Pressure of y^e Fingers: But what is most surprising, and indeed incredible, if not seen (yet plainly demonstrable to everyone), its strings never go out of Tune, as long as y^e constituent Instrument remain entire; a Thing which has been so long wisht for and desir'd, and in all Ages, 'till now, by everyone, deem'd impossible to find out. This, therefore, is to inform y^e Nobility, Gentry, and others, That y^e aforesaid Rutgerus Plenius has now (after Ten years' painful study and Labour, accompany'd with no small Expence) brought y^e above-mentioned Instrument to Perfection. And he humbly presumes, that all the Gentlemen and Ladies, who will do themselves y^e pleasure, and him y^e Honour of seeing and hearing it, will be fully convinced of y^e Truth of y^e foregoing Assertions; and at y^e same Time be agreeably diverted by y^e Harmony of y^e Instrument, it being esteem'd and approv'd by all that have yet seen it; particularly by y^e most eminent Masters of Musick in England, who allow it to be y^e most curious Piece of Workmanship, and most wonderful Instrument they have ever seen or heard of. The Price of seeing and hearing it performed on at any Time between y^e Hours of Twelve and Four o'clock, is Half a Crown each Person, at y^e Inventor's House (y^e King's Arms being over y^e Door) in south Audley Street, Grosvenor Square; where a good hand is provided for y^e Entertainment of y^e Audience.

THE HARMONIOUS BLACKSMITH.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4159.]—I IMAGINE that had the first inventors of rifles taken a piece of gas-pipe about the size and length of a gun barrel, and made it red hot for about a foot at one end, then placed an inch or two of that end in water, and looked down the inside of the pipe, we should never have departed from the use of the smooth-bore; for they would have seen the steam thus generated winding its way out spirally, which I take to be the course the gas evolved by the combustion of the powder in a gun does take. It would, therefore, become apparent to them that all that they had to do to obtain the spin for their projectile would be to provide a surface by which the rotary motion in the gas would be received by the projectile.

That surface would be obtained by leaving a projection extending a short way from the circumference to the centre at the butt of the projectile, or, perhaps, more than one projection. I should have tested this theory of mine some two years since, but being a working man I have not the power. Perhaps "Artillery Captain," or some other friend, could say how far I am right.

PHILUS WARD.

HOW WE SEE A DISTANT OBJECT.

[4160.]—IN reply to "E. J. D." (let. 4063, p. 174), I would ask what he means by a pencil of rays. Rays from combustion issue and extend in every direction. The Rev. David Blair taught that a pencil of rays is a parcel of them proceeding from a point; but no particle of matter leaves the point and passes to the eye, a mere impulse is given to the ethereal millions of atoms which, from closeness of juxtaposition, almost instantly communicate with every eye in the line of radiation or in any line of reflection thereof; the ray, then, is but transmitted pulsation, and rays from every point of an object acting in every direction compel our acknowledgment that the ultra-microscopic diminutiveness of the ethereal atoms amaze us more with the infinity or smallness than we can be with infinity of extension in stellar space. On the diameter of what we call a "point," it were but guesswork to estimate the number of ethereal atoms that might repose. Reflection of light is but repulsion or rebounding of the infinitesimally small ether-atoms. Now a "pencil of rays" falling or striking on the eye is but a succession of these ether-atoms striking on the eye's outer convex surface, from whence the direction of the impulses converge towards a focus which they reach on the retina or on the optic nerve: the impulses are continuous as long as the combustion that they proceed from continues. Solar combustion is the power which imparts impetus to the ethereal pulsation, and so the distance of the sun is the distance of the power which produces reflection. Glass is porous to the ether-atoms, but mercury seems to reflect nearly them all when pulsating in periods in accord with the interchange of atoms in the gaseous molecules of the sun. We read of three sorts of pencils, cylindrical, divergent, and convergent, and, as Blair has it, they proceed from points. The cylindrical from a flat surface, the divergent from a convex, and the convergent from a concave, just as with the reflected chemical atoms of sound. We read, also (as in Chambers's "Educational Course"—Optics), that a pencil is a parcel of rays proceeding *to* (as well as *from*) a point; thus a concave mirror will converge reflected rays to a very brilliant point, but so immense is the sun that its rays are deemed parallel, the divergency being imperceptible. But the number of pulsations of ether-atoms that fall each second on a square inch of surface are evidently countless millions, and we do not see any object, colour, or shape so much because they reflect rays as because they do not reflect them. Where every ray is reflected, the colour is shadeless white, and we only perceive degrees of distance and shades of colour by non-reflection, some of the ethereal pulsations of larger or smaller amplitude being cut off by the, to them, non-repulsive (or absorbent) nature of the impinged surface. We see objects, therefore, solely by their non-reflection of rays, a red object being one that reflects none of the other rays of the spectrum but the red ones. Pencils of rays, if solar, are parallel, and do not converge till after they strike the convex surface of the eye, and pencils from a point (so far from coming to a focus) must be divergent when they strike the eye, the ether-atoms retaining the impulse transmitted at the surface of the sun, and unless reflected from concave surface, such rays cannot converge before they reach the eye. I cannot understand "E. J. D." when he talks of fresh pencils springing up to suit change of position; the undulatory vibrations are in every direction to and from every point that catches direct sun rays, and it is most absurd to suppose that rays must converge to a point before they enter spectators' eyes. A single pulsation will bestow light lasting the one-eighth of a second on the retina, so that eight ether-waves per second maintain constant light. I see, from where I sit, a placard: it is printed on "white" paper, but whether with red or black ink is hardly plain. I cannot read a word till I put on my concave glasses, and then I make out indistinctly the large letters in the word "Bazaar." Now, why cannot I read every line and letter in the placard? Simply because I am too far off; the ether-atom vibration-rays are too few to reach me unless the diameter of my convex eye were much greater, so as to catch more of the direct pulsations from the placard. I see the shape, size, distance, and colour of the placard; the pulsations from its exterior and interior are adequate for that; but the other pulsations from its interior are too few and too much crossed for me to gain more than a hazy, indistinct picture of the words it bears. No object provides any rays but solar and other fire, and were a very powerful lime or electric light thrown on our placard, I might be able with my concaves to read it all, it would so multiply the ethereal pulsations from each point.

We hear a band of musical instruments, and each of hundreds of hearers can perceive not only the tone of each note from each of all the instruments, but perhaps, also, its first, second, and third overtones, all blending in harmony as one note with numberless overtones, as note succeeds note to suit a well-balanced order of completeness. These pulsations on the drum of the ear are to each note from each instrument and to each of its overtones more or less rapid, or of varying amplitude and number, in accordance with the acuteness (or shrillness), or with the flatness (or baseness) of the sound conveyed. If one note give 256 pulsations in a second, another gives twice, and another three times as many, and so on (see Tyndall "On Sound"); and if all the heart-moving tunes we hear are conveyed by vibrations of the coarser atoms that the chemical laboratory can appreciate, we must cease to consider it impossible that every degree of distance and surface-quality of object in contact with sun rays is shown to us by the intervention and non-intervention of pulsations of what I venture to call the "ultra-microscopic" ethereal atoms (though the recognised chemical atoms may fall under the same name). Rates of speed in the transit of sound, varying to the different notes of music and the varying lengths of musical vibrators, I doubt not, offer us a first clue to the size, distance apart, and number of atoms or molecules in a line of specific length, certainly as to the total amount of interspace that separates them; and the same rule will apply to the otherwise wholly inappreciable atoms of illuming ether, whose closeness brings light to us from the sun in 192,500 seconds of time according to Herschel. If, however, different notes of the spectrum travel like different notes of sound, at very different speeds and amplitudes of oscillation, we need not wonder at speeds of light or of sound varying unless it be with reference to some specific tint or to some specific note.

We should look upon the light-giving vibrations of ether-atoms as moving in masses, rather than only in diverging lines, from each point of reflection, and as subject to cross vibrations in every direction; and as they convey impulse forward about 200,000 miles per second, whilst particles of air convey sound's impulse but about 1,000 feet, and those of glass but 18,000 feet, we should estimate the extreme closeness of the ether-atoms, which carry surrounding atoms wave-like along with them till such are diverted by cross-vibrations, and the motion is so rapid, and the atoms so sufficiently unattached, that crossing does not divert the straight line of motion. In Gutch's "Register," 1859 page 180, I find "Black has small atoms, and absorb light; white large, and reflects it. Reds are of oxyge character, according to Ellis; greens, nitrogen; an violet, hydrogen." An oxygen body combines wit hydrogen and reflects red rays; a hydrogen atmospher cuts off the red, &c., vibrations, and reflects the blue and indigo ones, and a nitrogen air cuts off red and violet, and reflects green or white, orange or blue. As a clue to the nature of any molecular constitution, the rays of sunlight or other light it cuts off is too important to be overlooked.

J. BARWICK.

P.S.—Direct sun rays penetrate through porcelain as well as through paper; indirect or reflected rays do not, objects being thus shown as shadow by interception of rays, but no bright tint is seen, reflected pencils seeming to lack adequate force to penetrate through paper or porcelain.

[4161.]—IN reply to the kind letter of "F. R. A. S." (4049, p. 171), I am pleased to get a reply from one who does understand the theory of light, and the best proof that he does so is, that he carefully refrains from touching on the point that I want cleared up. He has omitted to answer the following part of my letter (3974, p. 120): "I cannot conceive how the reflections can be so numerous, and so conveniently arranged, that they flash in right lines from every physical point of the statue to the eyes of the spectators," &c. I said in that letter, "and that in front of them (the multitude) some conspicuous object is elevated." This was to show that a front view was only provided for. The experiment of the lenses only serves to strengthen my position as to the number of rays to be accounted for. I will now add some more points that require to be cleared up. The rays by which vision takes place must leave all parts of the object at different angles, converging to the eye; but if a mirror be placed where the eye was, the rays to it causing reflection proceed from the object to the mirror in right lines parallel to each other; for if they were reflected from the object in converging rays (as they proceed to the eye), the result would be either a confused image or a number of small images; and I am not aware of any power possessed by the mirror, or the eye, to change (as it were, at will) the order in which the rays shall be reflected. Thus, a man standing in front of a mirror resting on the ground, and a little higher than himself (the mirror being perpendicular), will see his eyes by direct rays, I presume, and all his body will be reflected by direct parallel rays; but if he still continues erect, but wishes to see his feet in the mirror, he turns the eyeball downwards, and of course can only see his feet by pencils of rays converging to the eyes. Here, then, we have direct rays for one purpose, and converging rays for the other. The latter, it would seem, must proceed from the phantom image in the mirror, or they must proceed from the observer to the mirror, and be thence reflected to his eyes. Will "F. R. A. S." please to account for this seeming paradox? and if he refers to my letter to Mr. Barwick (4063, p. 174), he will fully understand that I challenge a portion of the theory of light. I hope, therefore, in his next, that he will try and explain the various points I have raised. I feel that we should not take any theory for granted, but carefully analyse it.

Mr. Barwick says, in his letter (3973, p. 120), "A mirror's frame is visible, as 'Bobo' shows, by its shading off or not reflecting all the received rays; it reflects but those that denote its colour." I was under the impression that the prism could analyse light into the three primitive colours and secondary compounds (by some believed to be primitives also); or, in other words, the colours of the rainbow; but I was not aware that the prism or anything else could show the tertiary compounds. I presume, therefore, that olive, &c., must be added to the list. I am at a loss to understand the ether pulsations on the eye: I thought that belonged to the exploded old theory, which stated something about the eye having the power to reflect or direct some subtile ether on a distant object, and by that means see it. He says, "The fading of visibility of distant objects, I take it, is caused by increase of intervening ray-crossings, which obstruct more extensively as distance increases." Well, I should suppose that the confusion would be more likely to occur near the object, where the multiplicity of rays would be more condensed, and could hardly allow a ray at all to escape outwards; but, with due respect for this theory, I am at a loss to account for the fact that when objects begin to appear indistinct to unaided vision, the use of the telescope again renders them distinct. He further adds, "But also rays diverging," &c. I understood from the theory of light that the rays would converge; but perhaps there is some law I am not acquainted with causing them to diverge; but in this case the telescope, I suppose, has the power of bringing back the wanderers to the proper path. In his second letter (4061, p. 174) he says, "'E. J. D.' should know that the eyes only catch, proportionately to their size, the rays in contact with their surface, which impinge on them, neither more nor less than on every other object in space at an equal distance and equally uninterrupted." Does he mean that a man with a small pair of eyes can see less of the surrounding objects than a man with larger eyes? or does he mean that the rays are reflected in parallel lines, of which the eye can only take in its own breadth? If so, I cannot imagine how we could see more than an inch of an object at a time. I heard that recent computations in Germany, about the retardation of Encke's comet, had settled the question of the ridiculous theory of ether existing in space; and that, in fact, there is no such thing, the retardation of the comet being found due to planetary influence. The remarks about ascertaining the distance of combustion, &c., are too deep for me, and can only be appreciated by astronomers.

In reply to "Bobo's" letter (4062, p. 174), I beg to state that his remarks about contrast, light and shadow, are admirable; and, being an amateur artist, I fully appreciate them; but he forgets that if the black statue was placed in a room hung with black, and the sunlight admitted, the statue would be quite distinct in all its details, without a light background to contrast it; in fact, a light background would render the statue more indistinct, owing to the great preponderance of light reflected. Orange glass stops the chemical rays, and "Bobo" would find that he could not obtain a photographic picture by light transmitted through it. Blackened glass (with soot, for instance) will also stop the heat rays; but, as "Bobo" says, it reflects white light from a black bead. E. J. D.

"T. A." AND REPULSION.

[4162.]—I MUST decline to accept "T. A.'s" invitation (letter 4089) "to give a single instance of the action of a repulsive force in nature." My instance would not convince him, and his objections (judging from former instances) would not weigh with me. So we should argue fruitlessly,—one of the most repulsive things in nature. RICHARD A. PROCTOR.

A STUDENT'S COMPLAINT.

[4163.]—I THINK that "A Desperate Character" has not a sufficient cause to make him desperate. If he had two hours and a half for his paper he had ample time to enable him to pass first-class, if he only knew how to use it, and if he fail it will not be for want of time, but for want of knowledge. The Elementary Chemistry paper (subject X.) contained twelve questions, eight of which only were to be attempted. An ordinary intelligent student who had attended twenty-five times a properly-taught class, or who had gone through a similar course privately, could have answered the requisite number in one hour and a half. If six questions were properly answered a candidate would pass easily. "A Desperate Character" should rail at the local committee in the town in which he was examined, or rather at the local secretary, for he is responsible for almost everything. He can do no good in appealing to the columns of the ENGLISH MECHANIC. It is simply a local question. If the Government rules were obeyed a hundred candidates might begin their papers at five minutes after seven o'clock. As a science teacher of several years standing, I think that two hours and a half is ample time for most of the South Kensington papers.

Bradford, Yorks. J. HARRISON.

[4164.]—"A DESPERATE CHARACTER" (let. 4110) should have noted the facts on the examination paper in explanation of its brevity and shortcomings. A courteously drawn up protest to the Department of Science and Art, if sent before the results of the examination are known, would meet with careful attention, and probably lead to satisfactory results. H. P. H.

TERRESTRIAL GRAVITATION.

[4165.]—THERE is only one word to describe the proof sketched by "F. N." (let. 4115). It is charming. I fully concede that it is a simple proof, not involving the integral calculus. Looking over my papers on the subject, I find that in my search for a simple proof I have over and over again been close on this one. Worse luck that I failed to see it. Yet I need not be ashamed at my failure, since for nearly two centuries the proof was looked for and missed.

The proof involves the theorem that if the attracted particle is the vertex of a cone tangentially inclosing an attracting thin spherical shell, the part of the shell on the particle's side of the circle of tangency exerts the same amount of attraction as the remainder of the shell. This theorem is at once seen to be true, when we take the particle as the vertex of a series of cones of minute vertical angle, as in the proof for case of a particle *within* a spherical or spheroidal shell. I think it must have been this circumstance—the fact, namely, that the method of taking cones with minute vertical angle had already been once applied (in dealing with an external particle), which caused me to overlook the possibility that by applying it a second time the problem could be solved. At least, I find that in my papers I try more than a dozen ways of dividing the two parts of the spherical shell into elements, without once noticing that the centre of the circular section is the proper point to look to.

I do not mention this circumstance by way of excusing my failure, a failure which a host of eminent mathematicians from Maclaurin downwards have equally undergone; but to show what an advantage the integral calculus possesses over the most ingeniously devised geometrical considerations. I would venture to say that the mental effort given to devise a simple proof of this problem, *after* the integral calculus (or disguised integration) had solved it, has surpassed more than a thousandfold that requisite to supply the integral proof. Yet, because there is no certain rule to follow in such cases, that labour has been fruitless until a "happy thought" has shown how the egg is to be set on end. RICHARD A. PROCTOR.

[4166.]—I AM very sorry that my recommendation of the reasoning in Chap. 2, Book III. of Ganot's "Physics" should cause Mr. Proctor to suspect me of a desire to produce the impression of its author being on my side about the attraction of oblate spheroids, as nothing was farther from my intention. It was simply because my idea of obtaining resultants and ascertaining their magnitude seemed followed out in that chapter; not that I imagined myself correct, for here I fear the skiing error is on my side, and not Ganot's or Mr. Proctor's. This, however, all our readers can judge for themselves, as the suspicion has stimulated invention into solving this question by what may be called a method of geometrical integration, easily understood by any intelligent mechanic.

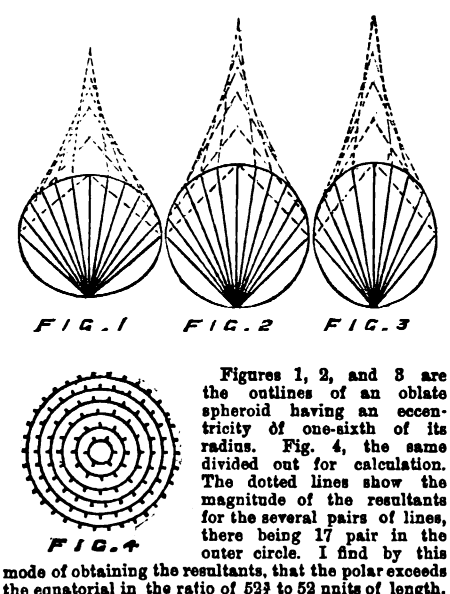


FIG. 1 FIG. 2 FIG. 3

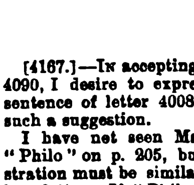


FIG. 4

Figures 1, 2, and 3 are the outlines of an oblate spheroid having an eccentricity of one-sixth of its radius. Fig. 4, the same divided out for calculation. The dotted lines show the magnitude of the resultants for the several pairs of lines, there being 17 pair in the outer circle. I find by this mode of obtaining the resultants, that the polar exceeds the equatorial in the ratio of 52¾ to 52 units of length. Would Mr. Proctor kindly say if this is correct? T. A.

[4167.]—IN accepting Mr. Proctor's apology in letter 4090, I desire to express my regret that the closing sentence of letter 4008 was so worded as to convey such a suggestion.

I have not seen Maclaurin's work mentioned by "Philo" on p. 205, but fancy his geometric demonstration must be similar to the one described in my last letter. If "Philo" examine the diagrams he will perceive that, although the summation of the joint attraction of all the particles in the spheroid is greater in Fig. 1 than in Figs. 2 and 3, yet the force directly exerted is that of a globe one-sixth less radius. To this inequality of attraction is due the fact of liquid matter exerting force in assuming the globular form. T. A.

ELECTRICAL SPARKS.

[4168.]—"PHILO'S" statement (let. 4105) that electrical sparks can be produced in the United States of sufficient force to light the gas by simply walking across the room is perfectly correct, and well known to all intelligent persons in the United States.

In 1855, being then in Troy, New York, my sister called my attention to the fact that she could easily light the gas by simply sliding two or three steps across the carpet. The experiment, although an old one, interested me, and I repeated these experiments with invariable success, when the conditions necessary to such success were fulfilled. These conditions were, that they should take place in winter during a sharp frost, or rather with the ground covered with dry snow. This occurs for at least three months in all the Northern States. The experiment succeeded better where the house was warmed by hot-air stoves, as they generally are at the North. I found that a sliding step gave the best results, two or three of such steps being sufficient to produce a spark three-sixteenths of an inch long, and quite sufficient to light the gas at any burner instantly

Ladies generally could perform these experiments with more success than men; but this was simply from the fact that they had remained longer at home, and consequently their slippers were perfectly dry. In my own case I found that by putting on a perfectly dry pair of slippers, or even boots, I could produce fully as good sparks as the ladies. Ordinary slippers, however, always gave the best effect, a larger rubbing surface being then exposed to friction upon the carpet.

Sparks could be easily given from one person to another, and I have been "shocked" by some young lady with "malice prepense," sliding up to me, and touching my forehead. I have charged a Leyden jar by this means, and, in fact, all static electrical experiments could be produced where the spark of one-eighth to a quarter of an inch sufficed. These results can be obtained during winter in any of the Northern or Western States. I have tried to reproduce them in England and throughout the Continent, but without success—in Russia during the winter of 1864, I observed a few traces of this high electrical or insulating powers of the atmosphere. I did not, however, succeed in lighting the gas, but I found great difficulty in combing my hair with an ordinary indiarubber comb, the hair all raising on an end with constant shower of sparks from teeth of comb; this, however, I found much more disagreeable in the United States than in Russia, as during many winters I had to wet my hair before combing—else impossible to get it to lay straight or even. Without this remedy, or by using oil or pomade on the hair, my hair, which is very thick, would rise up, and would be some minutes before I could get the "porcupine" appearance to disappear.

I have never in England seen these effects, though Professor Wheatstone has already observed them, and read a paper before the Royal Society (two years since) upon the great care necessary in making electrical experiments, as he had found many errors, for which he could not at first account, had been produced simply by the friction of his feet upon the floor. He also observed that in the United States he had been informed by the best scientific authorities that by simply walking across the floor electricity of sufficient tension to light the gas at a burner could be produced. Therefore "Philo's" statement is perfectly true, and I inclose my card, not for publication, but as a guarantee of the good faith of yours TRAVELLER.

[This letter is well authenticated.—ED.]

[4169.]—FRIENDS of mine, on whose truthfulness I feel complete reliance, assure me that they have witnessed electrical phenomena substantially the same as those described (let. 4104, p. 199) as witnessed by friends of "Philo." I am not yet at liberty to publish their names; but if any one is desirous of more precise information I think I could procure it privately.

13, Great George-street. P. H. HOLLAND.

[4170.]—IT is neither right nor wise of "Philo" (let. 4105, p. 199) to force his own misapprehensions and deductions therefrom upon other readers. Why should he persist in asserting that a certain supposed fact which he believes in is "treated as an impossibility by one correspondent at p. 62"? At p. 62 I expressed the "trust that 'Philo' is able to distinguish between the two mental states of not denying yet not believing." It appears I gave credit to "Philo" for more perception than he possesses. I said, "I do *not* deny the possibility of gas being lighted by a spark from the finger, the electricity being unintentionally excited." If that is treating it as an impossibility, as "Philo" is pleased to say, it is time some of us went to school again. I do not believe the event has happened—that is, I wait for evidence; I am accustomed to test facts, even when I witness them myself, and often find that my first impression was mistaken; and does "Philo" suppose I am going to accept the secondhand testimony of one or twenty ladies, young or old, pretty or plain? Why, I have fifty times better evidence that Mr. Home has floated out of window, round the face of a house, and in again, and I actually do not believe that. To speak plainly, I should require any testimony coming from America to be very thoroughly supported. Whether the air there facilitates the production of electricity of high tension I do not know; but that something facilitates the development of enormous falsehoods, intentional or otherwise, we do know very certainly, because the peculiar feature of American wit actually consists in the giving of some vraisemblance to outrageous exaggerations, and that is sure to react upon national character for truthfulness. We electricians of the ENGLISH MECHANIC have not yet forgotten Paine's electro-motor engine.

"Philo" may further be assured that our electrical theories do not fail to correspond with well-authenticated facts; but his facts do not come under that description in the first place, and in the second, no theory that I am acquainted with is opposed to them. We well know that such sparks could be generated under certain conditions: what is doubtful is whether such conditions are ever attained. As to his last word and recommendation, does it not occur to him that misrepresentation of others is not the likeliest mode of drawing out "polite" replies? SIGMA.

"E. L. G." AND PHYSICAL GEOLOGY.

[4171.]—I CANNOT help contrasting "E. L. G.'s" style of argument with the words of Murchison (who was both the friend and opponent of Lyell), that the question between the uniformitarians and the catastrophists was only one of degree, and that by means of fair discussion the truth would at length be eliminated. Why should not "E. L. G." be more eclectic, and select the good grains of uniformitarianism at the same time that he rejects the chaff? Surely none will deny that there is truth in uniformitarianism as well as in the theory of the catastrophists. Let us neither be too "prodigal of violence," nor too "parsimonious of time." The reasonable uniformitarian admits the necessity of occasional catastrophes (not connected with comets, though), while, on his part, the unbiased catastrophist will uphold the necessity of enormously long undisturbed periods to account for the formation of thick and slowly deposited formations like the chalk.

Turning to letter 4068 (p. 175), I find that "E. L. G." there makes three assertions, with none of which I can agree, viz.:—(1) That causes "now in action" can only account for the present condition of one-hundredth part of the globe (putting aside all alluvial and recent deposits); (2) that the form of the remaining part of globe has been determined by deluges; and (3) that the deluges were the result of comet-falls. Now, undulating country has been formed by causes now in action, and it is just the kind of phenomenon that a deluge does not produce. Catastrophal deluges can only account for the condition of a small part of the earth's crust.

To prove the above assertions, let us first consider the beautifully-moulded waterless coombes of the chalk, to which "E. L. G." specially refers. These are due, in the opinion of Murchison, Lyell, and a host of other geologists, to the long continued erosive action of atmospheric influences—such as wind, rain, and frost, which would denude a soft material like chalk, or even oolite, in time, short in comparison to that required to reduce some of the granite mountains of Wales and Scotland to their present weathered condition. These coombes could not have been formed by a deluge which would make a clean sweep, and leave a long trough with sweep sides just as it has done in the Weald and at Woolhope, which are known as valleys of elevation, and are referable to this cause. In these cases the superior strata have been elevated and shattered by a series of seismological convulsions, and the débris then brushed off by a torrent of water. Then, again, small watered "sweep" valleys which are now unfloored mostly began with a floor, the river eating its way down, not all at once, so as to form a canon with steep sides, but gradually, and leaving a series of raised beaches on either side, thus forming a terraced valley. Atmospheric action in many cases has crumbled away these terraces, and formed a gentle slope.

Now for "E. L. G.'s" experiments with mud, fine clay, and sand. These go for nothing, because the materials employed do not resemble those of which the majority of strata are composed. All geologic rocks are more or less consolidated. Try the effect of continual droppings on a piece of soft and unequal sandstone or chalk. The result will be a series of miniature coombes and rounded hills. Now, take another piece of the same material, and chip up a portion of it with a chisel. This represents, though imperfectly, the effect of elevation and earthquakes splitting up the rocks. Now pour on it quickly a jugful of water. The crushed and rent débris is swept clean away, and we have a model Weald left behind.

Lastly, as to the cause of these deluges. They were in all probability partial, and of short duration, doing their work by mere velocity and impetus. Deep seas and other still waters are well known to have no erosive action. The late Sir R. Murchison considered that these deluges were the effects of the sudden upheaval of large tracts of land in mid ocean. Such elevations must have displaced large masses of water which would pour over the then existing continents. OSA.

REVOLVING PUDDLING FURNACES.

[4172.]—IN let. 4064 "G. S.," I regret to see, brands Mr. Danks "as a mere copier of the inventions of Mr. Walker and Mr. Tooth." This must have been written without due consideration, for Mr. Danks's furnace has been carefully tested both in England and America, and the almost unanimous verdict of the trade is that it is a complete success. Surely, then, it must be something more than a mere copy of unsuccessful inventions; if, however, it is not it will share their fate, whatever that may be. If the inventions were alike so would be the results produced; but this is not the case. Mr. Danks has produced a furnace which, in my humble opinion, is destined to supersede all others; and whether his success be attributable to the materials used in fettling, to the mode of applying those materials, to the arrangement of metal plates which secure the fettling in its position, to the contrivances for facilitating the extraction of the puddled ball, to improvements in the construction of the furnace, or to all these points combined, I hope he will ere long reap the reward which all honest men must admit is his due. And let all praise be given to Mr. Walker, Mr. Tooth, and other gentlemen who have endeavoured to ameliorate the condition of the puddler.

I pass over the strictures upon "scientific institutions in England" with the remark that the earnest manner in which the investigations of the present state of mechanical puddling and of the merits of the Danks furnace have been conducted by the Iron and Steel Institute proves that this society, at any rate, is not an "egotistic sham." R. S.

PHOTOGRAPHICAL.

[4173.]—IN the articles on "Photography for the Uninitiated," three solutions are given for sensitising albumenised paper. To No. 1 there may be little objection, but the addition of muriatic acid to any silver solution, as given in No. 2, must be to convert so much of the silver into a chloride, rendering it useless for the purpose for which it was intended. In No. 3 it is mentioned there is a heavy precipitate. What is precipitated? If the author of the articles thinks the uninitiated will find pleasure and profit in purchasing silver to see it precipitated in that manner, I think he will be mistaken. I for one will prefer a plain 60 grain solution, allowing the albumenised paper to convert what is required into a precipitate on the face of it where it is required. I would recommend black enamelled pins for paper.

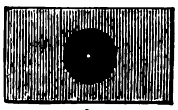
If "R. M. H.," query 11791, will look at page 137 of present Vol. he will find what he asks for. If he succeeds, perhaps he will let his success be known. Several professionals I know have got the length of shadows. If he would like a cheap dry process, which a friend of mine gets on so well with that he can calculate on eleven out of the dozen being good, I will be delighted to give him the details.

Edinburgh. A. C.

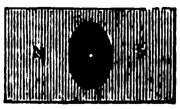
[Please send it.—ED.]

MAGNETISM.

[4174.]—I BEG to say a few words in answer to "Conatus" (query 11761, p. 184). Your correspondent, referring to some lectures on "Magnetism" I have recently been delivering to science students in Liverpool, by the invitation of the Town Council of that town, asks a question relating to some of my experiments. In one of the lectures referred to I showed that the magnetisation of iron or steel causes a molecular change in those bodies, whereby, among other results, the conduction of heat in magnetised iron is swifter in a direction across than along its magnetic axis. Around a central hot rod, wax spread over the iron will be melted in a circle if the iron be unmagnetised (A), but in an ellipse if magnetised (B).



A



B

Further, it was shown that if a cylinder with glass ends be filled with water containing magnetic oxide of iron in suspension, such a medium becomes more transparent along its axis when magnetised by an electric current. These experiments are well known. Your correspondent asks whether the magnetic oxide of iron should not get more transparent across than along its axis. This is not the case, for in magnetisation the particles of iron approximate sideways, and probably place themselves end to end lengthwise, arranging themselves somewhat like soldiers when a scattered field forms its ranks, and closes in. Iron, therefore, slightly lengthens when magnetised, but its total bulk does not alter, as it diminishes proportionally in its cross section.

I hope shortly to find time to publish, in one of the scientific journals, a lecture on the "Molecular Structure of a Magnet," which I delivered last week before the Dublin Royal Society, and where your correspondent will probably find the fuller information he needs. He further speaks of "the conduction of light and heat." I need hardly tell him that there is no such thing known as the conduction of light. Light, as far as we know, is only transmitted in one way—namely, as a wave-like motion of the ether. Heat is chiefly transmitted in two ways—by ethereal undulation like light, and by molecular vibrations like electricity. In the former it is radiant heat, in the latter it is conducted heat. And, further, heat may be carried or convected by causing lighter currents in a liquid or gas. Inasmuch, therefore, as the conduction of heat is totally different from the transmission of light, your correspondent must not expect to discover any phenomenon common to both. In radiant heat he will, however, find in every instance a most perfect analogy to light.

Woodland Grove, Isleworth. W. F. BARRETT.

INCUBATORS.—To "M. O." AND OTHERS INTERESTED.

[4175.]—I WAS glad to see another letter from "M. O." on the above subject, being one in which I take an interest; for I do not see why eggs should not be hatched with certainty and success artificially. In reply to his query, "Whether I have hatched any with the machine I made?" Yes. But if asked whether it is a success—No, as about 90 per cent. of the eggs set are lost on the nineteenth or twentieth day. I have no difficulty in producing full-grown and remarkably fine chickens; certainly remarkable for their size, and fine, strong, and well developed limbs—quite perfect; but when the time comes for the yelk to be drawn up, and, in fact, at the last hour or two before hatching, in my opinion, the chickens die in the shells—frequently after having broken through sufficiently to protrude their bills. The same remarks apply to ducks' eggs. My machine can be set at any temperature, and will remain steady, by the thermometer, and will hatch and bring forth some chickens, which, contrary to the prophesies of the croakers, are strong, healthy, and lively, and eat well. I have been thinking over the matter, and it occurs to me that the drying and evaporating action of the machine heat, leaves the yelk in too thick or glutinous a state for the chicken to draw up into the abdomen. I suggest this for the consideration of others interested, and "M. O." in particular, and shall be glad of opinions upon the subject. Should I be right in my conclusions a question will arise as to the best method of supplying the moisture necessary to effect the best results. It is evident that the hen is not an evaporating machine, but rather inclined in the opposite direction, and that any moisture supplied by her is supplied in a most subtle manner. I am about making some further alterations in my machine, and shall be very glad to exchange results with "M. O." and others practically interested, and working. I think artificial hatching is especially applicable to ducks' eggs, the young from which require no care, and may be turned out next day, and that the matter is sufficiently important as a food question to warrant a little trouble, especially when young ducks a month old are selling for 2s. each in the market of the town in which I live. HATCHER.

THE DELUGE.

[4176.]—THE book of Colonel Greenwood, about which Mr. Gosse inquires in his very flattering but encouraging note (4097, p. 193) was published by Longmans, Green, and Co., the first edition in 1857, the second in 1866, with 237 pp. and some very good coloured maps of the Weald and some French districts. What I intended to praise in the book is independence of thought and fitness to stir up thought in the reader. I must beg to disclaim, if any of my words conveyed such an idea, any acceptance of the Colonel's chief doctrines. In fact, he is a thorough Lyellist in principle, wasting himself in futile attempts on the insoluble problem of accounting for all we see by "causes now in action," though all the while exposing the delusiveness of Lyell's similar attempts. His attack throughout is on Lyell personally, and not at all on what I call "Lyellology." The above false dogma that Lyell (I am told) invented—that, at any rate, made its appearance here in England some thirty to twenty-five years ago—has hardly yet deluded any foreigners, because they generally see that it is utterly disproved by all *known* facts in the heavens or earth (as baseless and as multifariously disproved as ever the Ptolemaic astronomy has been); and yet here—in the very birthplace of geology, the very land whose villages and districts have supplied nearly every name accepted for the world-wide formations throughout the world's schools of science, here it has driven out the true science (except as regards the *older* strata, deep or underground geology) absolutely banished to France and less sophisticated lands all *science* of the later tertiary and human periods, to supersede it by sheer *faith* in the miracle stories of a new *priesthood* that, instead of reasons or arguments, write (like Professor Tyndall in one of his Alpine books) when something is to be swallowed against evidence, of what "*we ought to believe*" Exactly as any Popish Council, or rather provincial or heretic synod of the dark ages, or of Brahmins, laid down their creeds; this new dogmatic *faith* (for such it is, and no science), being just as anti-scientific, reason-scorning, sacerdotal, myth-and-miracle-swallowing, and superstitious, as any form of Popery or Brahminism ever was! Now, of all acceptors of this baseless faith, Colonel Greenwood seems, to judge from his book, the most freethinking, and therefore least likely to swallow it permanently. But his temper towards the perfectly proved fact (as I consider it) of a cometary deluge, in this his last edition, Mr. Gosse may see from this quotation I will make from Chap. III. "Mantell tells us that at Hastings 'a *diluvial valley* intervenes between the white chalk and the west cliff, where the ruins of the castle are situated.' *Diluvial* Beautiful! A valley made by Noah's flood doubtless!" This will show you that if I commend the Colonel's book, it is not for diluvialism, but because its general frankness and breadth of admission of easy and difficult facts alike (very like Darwin's method) enables the reader to see where and wherein its reasoning breaks down, and how completely and solely through this error. In the table of contents all the positions are tersely put, including, with scores of excellent and novel maxims, such plain fallacies as these:—"Rivers may cut deep channels, rain makes wide valleys"! "Aqueous denundation is universal, and is not confined to the lines of torrents and rivers"! "Absurdity of the doctrine of the original incandescent fluidity of the globe"! Readers far inferior to Mr. Gosse may be trusted to see how entirely the book fails to make out the two former, or that there is anything absurd in the latter. As for the second, I maintain, with De Luc (Letters V.) that most vegetation, especially the lower, as moss, grass, heath, bushes, jungles, *totally* protects the ground below from suffering *any* balance of loss, and, in fact, wherever vegetation continues from age to age, it shows the balance (if any) to be on the side of gain, that at least *as much* new soil is added as is carried down and away into gutters, rills, and finally rivers by the rain; all of which has to sink into such ground at first, because the drops, falling only from a few inches above, have not impact to run and wear the surface. Denudation, therefore, by any present known rain, *is* "confined to lines," to the beds of rills and rivers, which it can only lengthen and deepen, never *widen* beyond a fixed small limit (except in those rare flats where a stream shifts its bed from time to time). *Furrowing* is all the effect possible, whether on the hardest or softest, richest ground or bare rock, by any modern rain, or any conceived even 100 times heavier, say, instead of the three inches per hour that is, perhaps, about the maximum of tropical storm fall, a deposit of a foot per minute (or an inch in five seconds). It is doubtful if even that would suffice to denude more than the lines of gutter, into which it would (on any considerable slope) have time to collect without flowing as a sheet on the whole surface, which is what we require to "denude universally." No mere atmospheric rain can or ever could approach aught like general *surface* denudation; and yet every acre (not of modern ground) testifies that such denudation it has had. Moreover, it is easily reckoned that not only the above rate of stormfall, but one *ten times greater*, say, depositing ten feet per minute (supposing you have store of steam enough above to supply it) need neither acquire in the air velocity enough for the drops to hurt or kill animals, nor displace enough of the air to affect their breathing in the least. Of course, the first dash of such a rain would scour to clean rock, all hills, and highlands; the first minute would uproot all timber, even in valleys and flats, would sweep off mankind and their habitations (Job xxii. 16, Matthew xxiv. 39, Luke xvii. 27), and before the sea level had been raised a yard (supposing the land and hills to retain their form rigidly, which however they could not), before, I say, a yard of water had fallen (which it might in one minute), every floatable thing on all continents would be afloat, and either over the old sea, or approaching it with sevenfold railway speed, all ice of both poles, and of all Alpine glaciers, and thousands of square leagues of matted forest timber, rather floating *continents* than the "floating islands" that navigators now see issuing from the Niger or Gambia. But in all this tremendous minute there would be nothing to kill necessarily *every* animal clinging to a tree. Individuals of many species might thus both float and find food on some of these millions of natural rafts of uprooted but still living forest for days or even weeks, till the driftwood landed on some of the newly rising hills that the general plutonic movement would certainly *begin* to upheave into air before *many* days from the first shock; though others, even of such as are now highest, and lowlands and vast portions of our continents might not emerge or reappear for much longer —we have no means of guessing how long. And as Magalhaen was carried, during above half a year, across all the most island-studded part of the Pacific, without once seeing land; so at the time of the Deluge, abundance of land might re-emerge in a few days, and become nearly restocked with most of its former vegetables and many of its former animal species, and yet a human navigator so drift as for months and months to find, like Magalhaen, "all hills that were under the whole heaven covered;" and even, if happening to ground and stick fast on a newly rising cone as solitary as Teneriffe, Pico, or Ararat, might see no other land till his vessel was hoisted above the clouds, whether such hoisting occupied days or months or years. If prevented descending, or afraid to do so, all nature might be teeming over these whole continents through a more sweltering summer (owing to the heat of the condensed steam) than centuries upon centuries had known before, and the renascent vegetable and animal kingdoms be in full swing before the generality of the rocking crust would be settled enough, or the lowland air healthy enough, to make it safe for such human navigators to descend from their lonely box on the cool peak above the clouds (supposing them there provided for).

Colonel Greenwood has, before the above first quoted position, a true one strangely contradicting it. "If valleys," he well says, "were widened by erosion of river banks, their sides would not *slope*, but must be *cliffs* with intervening *table*-land." Quite so, and such is the case on any known *modern*, that is, *undiluviated* land. But then he distinguishes between rain and rivers, which elsewhere he insists are all one action, and for once opposes them, thus—"*Rivers* may cut deep channels, *rain* makes wide valleys." It does no such thing. *Some* rain did so *once*, but no modern rain is capable of this. On the contrary, it collects into hills and rivers, and only acts by them, on their beds. It *furrows* more and more, an effect the very reverse of that of the diluvial *smoothing* rain. The widening and sweep-vale-making effect requires rain too great and rapid to furrow or form torrents. Instead of our *torrential* rain, it requires *diluvial* rain, such as to form a moving *sheet* over the whole of a steep hillside at once. The Colonel evidently met with objectors perceiving this difference, for at the end of Chapter II., he says, "In general the philosophic and the unphilosophic are terribly put out by the powers here claimed for the '*wash of rain*.' Yet when the word '*flood*' is used, they will allow you to wash away articles of any size or description, natural or artificial." A flood, however, is simply the effect of rain, as "*the flood*" was the same. A flood means rain collected in quantity enough to wash, but to do this any *modern* rain must be collected and concentrated greatly. By washing a thing we always imply exposure of the whole surface to water moving with regard to it at once. Modern rain washes the channels it flows in, when collected, but not the mere collecting surface it drops upon. I must, therefore, agree with "the philosophic and unphilosophic," against the Colonel, that "wash of rain," as he uses the phrase, as surface wash apart from wash of rills or torrents, is a thing now unknown. There has been no real washing (whole-surface-washing) rain since what made Mantell's "*diluvial* valley" that so amuses him. No millions of years of any present rains can form any such valley; but a washing rain might do so in less than a day. The motto on his title-page is

Multa renascentur quæ jam cecidere, cadentque
Quæ nunc sunt in honore.

He evidently reckons not Mantell's diluvial valleys among things that "renascentur." Men choose mottoes that occasionally "come home to roost" in unexpected ways. E. L. G.

VERDE ANTICO.—WORKING IN METALS, &c.

[4177.]—"ETHEL" (let. 4088) is mistaken in thinking me one of the gentler sex. Her mistake was, perhaps, caused by my making moan over the state into which filing and finishing metals puts my hands. But I suppose my doing so must be ascribed to early training and prejudice: the remains of the superstition which made Lord Chesterfield and Lord Byron say, "Show me a man's hands and I will tell you whether he is a gentleman or not"—a miserable mistake. Show me his heart, say I, or his head, or both, before I can decide. As to the colour of antique bronzes, I did not mean to say there was no green colour given to bronzes artificially in ancient times. I only meant that it probably was, though verde, not verde antico when freshly manipulated. "Ethel's" own things may be in existence 2,000 or 10,000 years hence, and the verde moderno, which she now laments, be turned into the true antique hue. As to colouring metal before casting that I fear is impossible; any colouring matter would be destroyed by the heat required to melt bronze —unless, indeed, some of the colours used by enamellers, which become green by a heat as intense. Perhaps some of our chemical brethren will tell us. Enamelling, by-the-by, is a thing which "Ethel" might easily add to her metallic pursuits. I used, in a very far-off land, often to see a jeweller friend of mine enamelling pins and things with a mouth blowpipe, and enamel in powder, or rather paste. I believe that enamel powder adheres, when fused, to copper without any preparation, except brightening the copper surface. If "Ethel" has gas where she is, the best blowpipe she can use is the one made of two balls of vulcanised rubber. The first ball, when pressed by the foot, fills the second, and, keeping it full, causes a continuous blast. It costs 15s., and is, I believe, a French contrivance, though I bought mine in London. I have melted with it on charcoal a piece of brass as big as a nut. I don't believe there is any book—in England at least—on working in gold and silver, but there is a *Goldsmiths' Magazine* published monthly, I think, which ought to be useful to "Ethel." Perhaps some of "our" readers will kindly mention the exact title. I once tried one of the spirit blowpipes, and after lighting it the whole inside caught fire and blazed furiously. I put it out at once with the rug, and on taking it back to the man he showed me a hole in the spirit lamp which he assured me was the cause. But having gas and the vulcanised rubber blower I did not again try it. In Ure's "Dictionary" there is a very elaborate table of the various alloys, but I have left mine in London, and shall not get back for months. Will some brother who has access to it kindly answer our fair correspondent's question (p. 560, Vol. XIV.)? PROVEN.

NEW DOUBLE STAR IN VIRGO.

[4178.]—I WOULD call attention to the following double star found two nights since, which appears to be new, so far as I can learn:—

VIRGINIS = L 23106. 12h. 18m. 29s., N 14° 25′: 7, 11½: 110°: 4″.—About 1½° *s.f.* 6 Comæ, and easily found from that star. At the time of the discovery of this pair (and I have not seen it since), it seemed a very delicate and rather difficult object; but as it was in the same quarter of the heavens with a full moon, and the seeing only moderately good, it may, under more favourable circumstances, be quite easy. This is Weisse XII., 197. The spiral nebula, M 99, should, from its place in "Celestial Objects," be about ⅔° *n.* of this pair.

A few days since I forwarded a note in reference to a new double near 17 Hydræ, giving its distance at 1·5″. Later observations indicate that the distance is rather less, if anything, and probably will not exceed 1·25″. I hope to hear from Mr. Knott and Mr. Bird in reference to these matters, and if any of these supposed new pairs have been observed before, I shall be glad to have it stated.

I may repeat, for the encouragement of others having small telescopes, that all the new double stars communicated to the ENGLISH MECHANIC and many others, have been discovered in every instance, and observed only with a 6in. aperture, so that they are all within reach of an instrument of that size, and for many of them a much smaller aperture is sufficient; while with an 8in. or 10in. mirror, all of them, I should expect, would be quite easy objects.

Chicago, April 24. S. W. BURNHAM.

BRIDGE CONNECTING ENGLAND AND FRANCE.

[4179.]—IT appears to me very simple as to the reason why the pump had to work for "three minutes before there was any indication of a vacuum." When the shroud, closed at top and open at bottom, was forced by weights to a depth of 4ft. 7in. of sand and gravel, as well as 1ft. 8in. of water, there would be a very considerable pressure upon the air contained therein, and until the pump had exhausted all this pressure it would not begin to show any tendency to a vacuum. I would imagine that it would be preferable to have an aperture at top, so as to let the air out and water in, until it reached a suitable depth in bottom to commence the the exhaustion. By this means there would not require to be such a quantity of weights to sink it at first.

Liverpool. A.

ATOMICITIES AND ELECTROLYSIS.

[4180.]—THE question which "Eclecticus" (let. 4109, p. 200) has once or twice before raised as to the relationships of the phenomena of electrolysis to the old and new notations is one of interest and importance; like most other natural problems, too, it cannot be decided by studying it only from that point of view. It gave me a great deal of trouble at one time when passing from the old to the new notation, but for me that difficulty has long since vanished. I will not attempt to go into the matter now, as I have it prepared for necessary papers on "Electrolysis," but a few remarks will show, I hope, how it may be explained. As I pointed out in my papers, the electric current appears to support the old equivalent notation; it does so partly because our knowledge of it grew up under that system, and most experiments are on record in it; but the true explanation is that we cannot escape from what are diatomic elements, such as zinc, copper, sulphuric acid, &c., and, therefore, we are bound to get an action represented by H_2 on the atomic notation, and H on the equivalent system, which, therefore, appears (but only appears) to best match the facts.

The principle which clears the difficulty will be found in Section 240 of my papers. "Energy equivalent to 4,673 foot pounds exerted upon a chain, each link of which is a chemical equivalent of matter, weighed in grains, converts that chain into an electric circuit under a tension of one volt at the source of the force . . . It has a further meaning—for applied to the atomic notation it expresses the force transmitted through the centres of attraction or of 'atomicity' by which the molecules are constituted."

We may find here the explanation of several curious facts which have puzzled electricians, and led to the setting up of some imaginary laws of electrolysis. Copper furnishes an example of several such anomalies. It can be deposited either at the anode or cathode, and it can be deposited in the same circuit, in one and two equivalents, a fact I have never had explained by an electrician who held to the equivalent system.

We may form a circuit of three cells—1 containing dilute acid, for what is called the electrolysis of water; 2, cupric chloride; 3, fused cuprous chloride—forming a binary chain of attractions starting from the zinc and sulphuric acid in the battery; the lines below show this:—1, the circuit; 2, the equivalent expression of the products; 3, the atomic expression, remembering that for the same actual quantity the equivalent numbers would be doubled throughout—

1.	$\begin{matrix} H \\ H \end{matrix}{>}SO_4$; $H_2 = O$	$Cu{<}\begin{matrix} Cl \\ Cl \end{matrix}$	$\left\{\begin{matrix} Cu-Cl. \\ \mid \\ Cu-Cl. \end{matrix}\right.$
2.	H O	Cu Cl	Cu_2 Cl.
3.	H_2 O	Cu Cl_2	Cu_2 Cl_2.

Now, all this is quite clear when we adopt its atomic notation, and the idea of the atoms or radicals possessing certain mutual attractions or valencies, or, what is the same thing, class acids or acid radicals as monobasic, bibasic, &c.

Of course, I quite agree with "Eclecticus" in regarding radicals—such as cyanogen, ethyl, &c.—as exactly corresponding to elementary atoms; in fact, this doctrine is a pure "radical" theory. According to my diagrams above, and the atomic notation, one atom of copper exerts its bibasic powers as a radical upon two atoms of chlorine in cupric chloride, while it is capable of uniting with a second atom of copper, so as to form not a molecule but a still unsatisfied radical still uniting to two atoms of chlorine to form cupreous chloride, from which, therefore, the same current deposits two equivalents. Now, until "Eclecticus" can explain this he really must not quarrel with Mr. Davis because platinum is capable of claiming either two or four atoms of chlorine according to the conditions and forces to which it is subjected. SIGMA.

OBSERVING ASTRONOMICAL SOCIETY.—OBSERVATIONS MADE BY THE MEMBERS.

[4181.]—JUPITER.—MR. H. W. Hollis, of Newcastle, Staffordshire, reports that on January 14, 9h., the disc of the planet appeared very sharp, and he counted twenty-two different bands of colour. "Those visible in the equatorial parts of a beautiful delicate pinky brown. I am certain that the belts are visible up to the very edges of the disc, but there is an apparent increase of brightness for a considerable distance round the edge of the planet—probably an effect of contrast—which obliterates the extremities of the belts unless carefully looked for. Several well-marked and beautifully defined irregularities in the belts showed the rotation most clearly, even in half an hour's watching. Jan. 23, 8h. 15m., satellite 1 just entered on disc of Jupiter, and appears as an intensely white spot; 9h. 20m. shadow of 1 on centre of disc black and sharply circular; the satellite itself cannot be seen." Mr. T. W. Backhouse, of Sunderland, observed the transit of satellite 1 on January 14. At 13h. 54m. it "appeared as a faint white spot." On February 3, 6h. 7m., he examined satellite 3 and its shadow when in transit. The satellite itself was, at the time mentioned, nearly half across Jupiter on a darkish belt. "It is much darker than the darkest part of the planet." At 7h. 30m. it was "still very plain, but only the same shade as the darkest part of Jupiter. It was smaller than its shadow, which was very black."

T. CORONÆ BOREALIS.—Mr. T. W. Backhouse says:— "A change has taken place in this star. On its fading the second time it became stationary in brightness about the middle of the year 1867, since which time up to the beginning of this year it continued the same.

but with frequent slight fluctuations, which, however, ceased, so far as I could judge, at the end of 1869. I have suspected fluctuations since 1869, but they were doubtful. On Jan. 14, this year, I looked at the star, and found it about its usual brightness, or perhaps a little fainter, but certainly not fainter than it had been at times previously. I did not look at it again till March 5, when I found it much fainter than I ever saw it before, perhaps half a magnitude less than usual, and it was the same on the following day."

NEBULA IN THE PLEIADES.—Mr. H. W. Hollis has looked for this nebula with his 8in. achromatic, but cannot find it. He says:—" There is something peculiar about all the brighter stars of this group which for months past have appeared to me as if surrounded with nebulous light. Can the nebula have been distributed amongst them ?"

METEORS.—The Rev. S. J. Johnson, of Crediton, witnessed the appearance of "a splendid meteor at 7h. 37m., April 6. Its course was in a straight line downwards from about 15° above the N.W. horizon to about 5°. Colour, white with a greenish tinge. Duration, about 5 sec. Seen against a dark sky this meteor would have equalled, if not exceeded, the brightness of Venus or Jupiter. I was looking for Mercury at the time." On April 19, 11h. 10m., Mr. William F. Denning, of Bristol, saw a brilliant meteor. It passed downwards in the NN.E. sky. It was starlike in appearance, and left no train of light.

MERCURY.—The Rev. S. J. Johnson observed Mercury both with the naked eye and telescope on the evenings of March 25 and April 5. A power of 100 on a small telescope brought out the phase.

W. F. DENNING, Hon. Sec.

EARWIG IN EAR.

[4182.]—ANY insect is immediately killed if its spiracles be filled with oil. A dog of mine was once driven nearly distracted by a flea that had fixed itself so deeply in the dog's ear that neither he nor I could reach it. I gave him immediate relief by dropping a little oil into his ear, which killed the flea. What became of the corpse of the deceased I did not observe. Oil is more easy to use than tobacco smoke, and as effectual. M. R. C. S.

ERRATUM.—In let. 4068, p. 176, line 30, for "probably also the *last*," read "probably also the *east*, of any mountainous tropical island," &c.—E. L. G.

EXTRACTS FROM CORRESPONDENCE.

Communicating Rotary Motion to Ball Fired from Smooth-Bored Gun.—In reply to M. Paris' witty and clever letter (4051) my idea, I fear, seems more likely to cause man's laughter than manslaughter. If it be possible, "with such a ball to shoot round a corner," I must take out a patent and sell it to the Fenians. However, it has done more. "Philanthropist's firework" has recoiled on himself like a boomerang, not to use the stronger language of the poet. However, joking aside, I am obliged to M. Paris for explaining the matter to me; he says, "the rotation might be at any angle to the line of flight." I fear this is the real difficulty, it occurs to a very small extent in rifles of high trajectories at long ranges, as the rotation ceases to be identical with the curvilinear path of the ball.—PHILANTHROPIST.

Experimental Borings for Coal.—An experimental boring in search of coal has been commenced in the centre of the Weald of Kent, but is now postponed till after the meeting of the British Association at Brighton. A desire has been generally expressed that a boring should be made in the Thames Valley to test the hypothesis of Mr. Godwin-Austin and Mr. Prestwich; a considerable sum has already been subscribed for this purpose, and sufficient will probably be provided at the Brighton meeting.

Harbour Scheme for Calais.—Another new scheme for making Calais Harbour available for steamboats of 3,000 or 4,000 tons at all times of the tide has been brought before the authorities. The engineers are Messrs. Liddell and Richardson. Their proposition is to construct a landing and embarking pier about three-quarters of a mile into the water from Calais, and to connect this pier by a subway from the railway station. By going so far out into the Channel they will avoid "silting up," and by making a basin for the steamers at the extreme distance they will be able to land in shelter at any time of tide, wind, or weather. It is estimated that the cost will amount only to about £400,000.

Durability of Framed Timbers.—The durability of the framed timbers of buildings is very considerable. The trusses of the old part of the roof of the Basilica of S. Paul, at Rome, were framed in 816, and were sound and good in 1814, a space of nearly a thousand years. These trusses are of fir. The timber work of the external domes of the Church of S. Mark, at Venice, is more than 840 years old, and is still in a good state. And Alberti observed the gates of cypress to the Church of S. Peter, at Rome, to be whole and sound after being up nearly 600 years. The inner roof of the Chapel of S. Nicholas, King's Lynn, Norfolk, is of oak, and was constructed about 500 years ago. Daviller states, as an instance of the durability of fir, that the large dormitory of the Jacobins' Convent, at Paris, has been executed in fir, and lasted 400 years.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

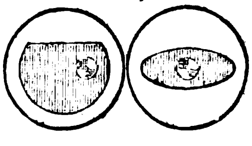
1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10478.]—**Pork Diet.**—I am a believer in the profound wisdom which dictated the old Jewish laws and rules; one of these is the disuse of pig meat. The same regulation prevails in Mahommedan countries, and I have read the assertion that in non-pork-eating lands the disease we call consumption is absolutely unknown! Many medical men object to its use in common; some say that well-cured bacon toasted hanging before the fire may be eaten by delicate people, but not any other description of the animal's flesh. If all pigs were well fed and healthy, there would be but little objection, perhaps, to our using them for food, but there is no animal more liable to disease, and no meat in which such state of disease can be so easily disguised and concealed from the consumer.—A MOTHER.

[10664.]—**Angle of Reflection and Incidence.**—There is a slight error in the diagram on page 205. The line A H should pass through a point in B F, the same distance from F as G is from A, and the line A K through a point the same distance from F as J is from A.—BILLIARDIST.

[11108.] — **Tilt Hammer.** — I have been very carefully examining the drawing of tilt hammer sent by me. (See page 128.) It was carefully studied, and may be made free use of by any of your numerous readers. Two further diagrams will explain all that is needed. No. 1, the eccentric drawn separately; No. 2, a separate action, so that it will be easily perceived. My drawing is correct, and can be made adjustable to any weight or purpose.—JOSEPH WILLIAM FENNELL.

FIG. 1 FIG. 2



[11120.]—**A Question of Sight.**—J. Barwick must really go to the rudiments of the subjects he is attacking, which are to be learnt from school primers. And why does he not try the experiments on shadow and penumbra? He has no right whatever to occupy your space with speculations on points open to experiment, and which he refuses to learn either from nature or books. The shadow of a globe in sunshine extends just as far at all hours of the same day, he might readily find. What does he mean by air "except under special mechanical pressure"? Who has ever experimented on air not under some special pressure? Where can he get uncompressed air? or what is its density? If he could have a steel "needle" reaching to the sun, any pulsation would be communicated in not less but far longer time than light; in fact, according to him, only 17,000 feet per second; 56,000 times slower than light, and would take about two years and a half!—E. L. G.

[11207.]—**Siphon Bottle Caps (U.Q.).**—A greater pressure by making your runner longer, or rather higher, will stop the "drawing into holes;" if this does not do, make the runner bigger. I can't tell about the kind of metal.—ANGLO-AMERICA.

[11209.] — **Making Gold Malleable (U.Q.).**—Perhaps lead was melted in the crucible, which would cause it. A clean crucible is required for gold; melt it again.—ANGLO-AMERICA.

[11223.]—**Stereotyping.**—"A Country Printer" will find the paper process far more economical and convenient than the plaster. He will find all the information he requires on p. 231 of Vol. XIII., and diagrams and description of casting-box on pp. 16 and 36 (Nos. 813, 814, and 323). In answer to his questions the metal may be and is generally "poured over" the mould in the "paper" process; that is, it is poured into the casting-box. A similar proceeding might be successful with plaster moulds, but I think they require rather more pressure than the weight of the small quantity of metal thus used would give. The paper process "injures" the type more than the plaster, but it leaves the forme comparatively clean, whereas the plaster method always entails a large amount of labour in clearing out the small pieces left in the spaces between the words, unless "high spaces" are employed. At times, too, if every crevice is not properly oiled, letters will be filled up, and they are generally damaged (at least) in picking them clean. The cheapest and best metal to use is old type-metal. "A Country Printer" should read the letters I have mentioned, and if he intends to do his own stereotyping adopt the "paper" or papier-mâché process. It is cheaper, easier, and quicker than the plaster; the apparatus is not so expensive, and does not occupy so much room; while, with the exception of woodcuts, the casts are as serviceable for most purposes as those obtained by the plaster method.—SAUL RYMEA.

[11275.]—**Darkening Walnut (U. Q.).**—I have found Stephen's wood stains very useful for darkening oak, mahogany, &c., and I have no doubt that S. Paine will find Stephen's walnut stain answer his purpose. Mix the powder (which can be sent by post), with at least double the quantity of warm water recommended for staining deal. When the stain is dry the work can easily be varnished, French or wax polished in the usual way.—SACRISTAN.

[11275.]—**Darkening Walnut (U.Q.).**—Lime water will darken oak or walnut about $^1/_{10}$in. in depth. The application of steam might drive it in further, but this is only conjecture.—F. G. T.

[11288.]—**Hardening Iron Plates (U.Q.).**—Would not the application of prussiate of potash supply this want?—F. G. T.

[11289.]—**Flexible Oil Painting (U.Q.).**—To make a calico waterproof coat flexible, if the same recipe would answer requirements of this querist, paint the calico or canvas in hot weather in the sun. With every brushful of paint take a rub on a good-sized piece of brown soap, not too dry, so as to take up a moderate quantity of soap each time. It will take a long time to dry, some weeks, and should have free access to sun and wind; but it will turn out perfectly waterproof, and quite flexible.—F. G. T.

[11294.]—**Dividing Metal Disc.**—ERRATUM.—Sixteenth line read: C B, D B, E B, A B respectively.—THETAMU, Horsham.

[11320.]—**Marking Leather for Ornamental Stitching by Machine.**—How will blacklead from a soft dark pencil rubbed well into the back of your pattern answer as a transfer? I always use it for my purposes.—G. W. C. H.

[11359.]—**Casting Brass Solid.**—Put a good tall head on it, and skim clean; if too much copper is used to the spelter, that may account for it; there must never be less than 4oz. to the pound of copper for anything.—ANGLO-AMERICA.

[11385.] — **Crystals in Gas Tar.** — In attempting to correct me "Ethyl" has himself fallen into error. If he will kindly refer to my reply he will see that I stated that naphthaline is used in the preparation of artificial (not real) alizarine. Real alizarine was first prepared synthetically by Messrs. Graebe and Liebermann. From an examination of the substances obtained during the decomposition of alizarine it had been conjectured that it was connected with anthracene, $C_{14}H_{10}$; and the above-mentioned chemists actually obtained anthracene from alizarine by heating it with zinc-dust. The reverse operation was then attempted; and by acting on anthracene with nitric acid, so as to convert it into anthraquinone $C_{14}H_8O_2$, treating the anthraquinone thus produced with concentrated sulphuric acid, which gives rise to disulphoanthraquinic acid, and, lastly, by fusing this with caustic potash, they succeeded in building up the molecule of alizarine, the formula of which is $C_{14}\binom{H_6}{H_2O_2}O_2$. It is also worthy of note that Anderson has prepared alizarine from opianyle; but it is still doubtful whether, when thus prepared, it is exactly similar to that obtained from madder and anthracene. But the artificial alizarine to which I referred in my letter is a body of entirely different composition; its properties are somewhat similar to real alizarine, hence its common name. Schützenberger, who has studied it much, calls it naphthazarine to indicate at once its derivation and its similitude to alizarine. He gives its composition as $C_{10}H_4O_4$. Several other fine colouring matters have been obtained from naphthaline; I need only mention naphthylamine violet, dinitronaphthol, naphthamëine, &c. The reader, who may be desirous of following out this interesting branch of applied organic chemistry, cannot do better than consult "Couleurs à l'Aniline," in Roret's "Encielopédie."—S. BOTTONE.

[11398.]—**Stinging of Bees, Hornets, and Wasps.**—The pain of these poisoned wounds is relieved by either ammonia or tobacco juice, but a writer in the *British Medical Journal* says the very intense pain he suffered from the stings of two bees in his ear was instantly relieved by injecting into the wounds a drop of a solution of carbolic acid 1 to 100, by means of a hypodermic syringe. I never found ammonia relieve instantly, but perhaps it might if injected into, instead of being dropped on to the wound. It would be well for any one who has an opportunity to try the comparative effect of each of these remedies used in the same way. A hypodermic syringe is one with a very fine pipe for injecting medicaments beneath the skin; a fine pointed blowpipe might be used if no better instrument be at hand, but it must be a very fine point to inject into a bee-sting wound, which may not be necessary in common cases.—M. R. C. S.

[11438.]—**Vegetable Marrow Preserve.**—Does your correspondent, "A Young Housekeeper," require a recipe for preserving marrow in imitation of ginger, or simply for a general preserve? If the latter I cannot supply one, but for the former, the following, taken from Francatelli's "Cookery," will no doubt answer. Peel a vegetable marrow and cut into shapes in imitation of preserved green ginger, simmer very gently for a few minutes in syrup prepared as follows:—To 1lb. of loaf sugar add a tablespoonful of Savory and Moore's essence of ginger, the juice of a lemon and half a pint of water; boil three minutes. The syrup should be boiled up twice, adding each time a teaspoonful of essence of ginger.—E. O. J.

[11440.]—**Double Bass and Violin Stain.**—Mr. Davidson will probably furnish "Benson" with the dimensions of a good double bass, and here is a recipe for "stain." Boil a pound of Brazil wood in two quarts of water for about an hour; strain, and add ½oz. of cochineal; boil gently, and it is ready for use, giving a crimson-tinted stain. If a darker colour is preferred, wash with saffron water previously. If a purple is desired, boil a pound of logwood in three quarts of water, add 4oz. of pearlash and 2oz. of indigo in powder.—E. M.

[11442.]—**Old Wives' Science.**—The reference by two of your correspondents to Dr. Brewer's "Guide to Science" for a solution of a scientific question must have amused any of your readers who are acquainted with that work. The specimen quoted from it was characteristic. "Why do the sun's rays shining on a fire tend to quench it or retard its burning?" (Or something to that effect.) Hear the learned reply, so instructive and convincing to the pupils of the young ladies' academies in which the book is used as a scientific "cram." "Because the heating and actinic rays are detrimental to combustion"! That is to say, the sun's rays have such and such an effect because—because they have! What could be more logical and conclusive? The only misfortune is that the fact so ably explained is not a fact at all; as your correspondents, S. Bottone, and "Shu Fly," have clearly demonstrated. Pray don't let us have any more of "Brewer's Guide" in "our" columns.—G. W. K. L.

[11448.]—**Warming Greenhouses.**—My method with my conservatory is to hang a long tarpaulin all along the front and sides of greenhouse in very cold and wintry weather, just taking down, if possible, for a little sun. Valuable plants I remove to my house, and I have a small stove at the end to light in day time, and two or three patent crystal lamps, well suited to the purpose, suspended from roof for night time.—H. B. E.

[11461.]—**Reviving Black Cloth Coats, &c.**—If "A. Despoire" wishes to make a good job in improving an old coat he must first give it a good beating till he has got the dust out. Then he must get the grease out with ammonia, or soap and water and turpentine, and wash the places clean. Fuller's earth is the best for grease. Having got the coat clean, he must brush or sponge it over with a solution, not too strong, of sulphate of iron, till it is well soaked in. Then take a decoction of logwood and galls, and while hot, sponge or brush the coat over with that. Hang it out to dry, and give it a good brushing the right way of the cloth. He must mind the solution of iron is not too strong for the logwood, &c.—E. T. S.

[11482.]—**Algebra.**—Let "A New Subscriber," who finds fault with my solution on p. 180, consider the number 24929, whose internal evidence is, that the four biquadrates which compose it are not fractional, for had any of them been fractional the total would have had a decimal, which must have been even, for it must have terminated in 2, 4, or 0, which is not the fact here; therefore neither of the roots (x, y, z, t) is anything but an integer; moreover, only one of the terms of the analogy can be odd, which can be proved; therefore (n) must be an even number, and (d) must be odd, and both of them integers, and thus 5 and 5 are shown to be the only integral divisors of 25, and thus ($n + 1$) and ($2a + d$) are determined. It may be added the theorist taking advantage of this principle may often avoid a press of calculation. In working equations, where diminution or augment of the root is necessary, a skilful substitution (call it guess) is a vital matter.—THETAMU, Horsham.

[11554.]—**Pedestrian Tour.**—The advice given by "Hedera," at p. 181, is good, but not, I think, quite as complete as desirable. A shooting jacket, if well provided with pockets, will enable a pedestrian to dispense with a knapsack, which to one unused to it is a burden, as is also anything to carry in the hand, except an umbrella to serve as a walking-stick when not needed as a protection from rain, or, as I chiefly use it, from sun. I have a very convenient garment made of an oblong piece of light repellant cloth with a slit cut in the middle, like that of a poncho; it hangs down to my knees behind and just below them in front, and protects me well from a shower. When folded up it is easily carried by a strap over the shoulder, and serves as a cushion to sit on if the grass be damp, as it often is. The shoes I like best are made of No. 3 canvas, with stout but not very thick soles, well supplied with nails, to give secure footing on grass or slippery ground, which is essential to safety and comfort on the mountains. I take care that the shoe soles are cut rather wider than my foot, so that I may walk on the sole and not on the welt. Shoemakers, like other mere practical men, are always wrong, and will make the sole too narrow if we let them. They think the foot should be forced to fit the shoe, not the shoe made to fit the foot. I prefer having too day shirts, one on and one off, to wear day and night alternately, or to change if damp, this saves the necessity of carrying a night-shirt; I need besides only a spare pair of stockings, knitted worsted, soft slippers, pocket-comb, hair and tooth brushes, and a piece of yellow soap. Note, if the stockings are well soaped to keep them pliable, the piece of soap may be left in the portmanteau. All of which can be carried in the pockets of the jacket. A good map, with a telescope, a compass, a purse with some money it, and an amusing book to read when resting, completes the walker's outfit. As "Hedera" advises, the portmanteau should be sent on to where it can be met when wanted. I strongly advise all unpractised pedestrians to avoid the common error of trying to do too much; do not make a toil of a pleasure; you take a tour for health and enjoyment, do not over-tax your strength, or try to walk so far that you cannot properly see and duly appreciate the scenery you pass, simply that you may boast how far you have walked in a day. I find about fifteen miles from the start to the end of the day's walk about enough, not that a healthy man cannot easily walk more, but to allow time and strength without exhaustion, to make diversions by the way, or to push on to another inn if that first reached prove full. It is no great hardship to add, say, five miles to a walk of fifteen, but it is no joke to add it when already dog tired.—PHILO.

[11566.]—**Equisetum.**—I fancy M. Paris must mean the seeds, not pollen, of the equisetum. They make an interesting object with a low power. Each has four kinds of threads or elaters. They appear at the right time as a kind of powder. They should be put on a piece of glass, and while looking though the microscope, gently breathed on for a moment; the threads will then be seen contracting and expanding as they get first damp and then dry. It is curious to watch them and their movements.—E. T. S.

[11572.]—**Compressing Water.**—I will admit that there are leaky joints, but not to the great extent of leaking gallons; if so, it would be impossible to get the pressure required. After a certain strain it would be pumping in and forcing out again, therefore the ram would remain motionless. I should like to ask "C. S." one question: How is it when the pressure is pumped up, the indicator showing three or four thousand tons pressure with what we term weeping joints—*i.e.*, just spotting—the pressure being allowed to remain on for a quarter of an hour—that the indicator never alters? That proves to me it is the compression of water. In reply to "Tubal-Kain's" suggestion, I do not think cast iron has much elasticity, and, depend upon it, the elasticity of the cylinder was inappreciable, or it would allow the water to escape between the ram and the cylinder, also the columns and nuts being so massive, the elasticity would be a mere nothing. Therefore, I think the water does not go in that way; I am also aware that metals are porous to a lesser or greater degree, but I think there is a slight difference between a ball of gold and a cylinder of well hammered steel 8in. thick.—J. WESTWOOD.

[11580.]—**Soda Ash in Boilers.**—No definite quantity can be fixed, as it varies according to the quality of the water. Therefore try a moderate dose first for your 8 horse-power boiler; say 1lb. per day of 24 hours, of strength from 48° to 52°. It is a good plan to dissolve it in the feed-tank, and it is pumped into the boiler without any trouble.—BUSY BEE.

[11589.]—**Dry Steam.**—"A, Liverpool," p. 157, makes an attempt to answer a question which he evidently does not quite comprehend. Superheated or dry steam is not necessarily high pressure steam, although he seems to assume such to be the case. I have seen steam generated in a boiler under a pressure of only 3lb. on the inch, passed through a coil of pipes bent over a furnace, and when issuing into the open air show no appearance whatever of visible or condensed steam. "J. L.," p. 181, thinks that the steam is decomposed into its elements of oxygen and hydrogen; but, were such the case, it would then have become an explosive mixture, which it certainly is, otherwise the flame of paper, timber, &c., which it so readily kindles, would inevitably cause an explosion. I should feel greatly favoured if some one of the talented chemical correspondents of "ours" would give a true solution of this query, which I doubt not they can.—CALORIC.

[11602.]—**Ligurian Bees.**—"G. M.'s" question, p. 131, not having been replied to, I venture to assert that ligurian bees are in every respect far superior to black bees, and that in neighbourhoods where the former are kept in large numbers, the latter cannot get a living. In early spring, when provision is scarce, the ligurians may be seen abroad two hours before the blacks make a move, and when the latter do try their luck, they find that all the sweets have been taken from the few flowers that yield any, and they literally starve. The long tongue of the ligurian enables it to dip much deeper into the nectaries of flowers than it is possible for the black bee to reach, so in scarce times the poor native deserves to be pitied. The long tongue also enables the ligurian to obtain large supplies from flowers that the native never visits, for instance, the red and alsike clover, and enables it to store very much more largely for its master. The queens are very much more prolific, and breed earlier and later than the blacks, the bees are more gentle under treatment than any others, but they are awfully fierce in defending themselves against robber bees, and a little handful will hold their own against large odds of marauders. As to the breeding power of the ligurian, Elisha Gallup, one of the first and most practical of American apiarians, finds 4,000 cubic inches of space not enough for the breeding apartment of a good ligurian queen. My own experience is in that direction, and from a hive containing 2,244in. of space, my first natural swarm issued on Saturday, April 27th, but returned, and on the following Monday came forth again and were safely hived. The same hive sent out a cast on May 8th, which nearly filled a skip which was used to take them, although thousands were lost in the storm of hail and rain which came on before they had alighted. The black bees in my neighbourhood have nearly all perished, in fact, I may say have quite departed, for none exist but those in which their queens have met Italian drones, as may be proved by their worker progeny, but, alas! their drones are all rascally blacks. The mode of introducing Italian queens was fully described by me in No. 333 of the MECHANIC, Aug. 11, 1871, and as it occupies nearly a page, I must refer "G. M." to that number, and am sure he will find the information desired. Now, as to "why Italian swarms are so expensive" I can only give a general answer that the supply is not quite equal to the demand, and point to the difficulty of breeding pure queens, and the necessity for importing them, and when I assure "G. M." and all others whom it may concern, that pure tested queens cost 10 francs each in the Grisons, Italian Switzerland, during the past and present months, perhaps he and they will not think the prices he quotes unreasonable. Italian queens and swarms, too, would be cheap enough and common enough if bee-keepers would take a little trouble and get rid of the black element, but there is the fact that although the Italian drones improve the worker bees of black stocks, the drones of those stocks remain black, and blacken and taint the ligurian blood even at distances of five or six miles from their homes. My answer to "One Interested," referred to above, points out how with one queen a whole apiary may be ligurianised, so that black drones may be exterminated, and a little care and liberality on the part of large bee-masters in seeing that the bees of their little neighbours were Italianised would render the raising of pure queens easy work, and consequently they would soon become cheaper. The best time to insert a ligurian queen is now, before the bees swarm, as the young queens, which will be reared in the hive, will then be all Italians, and the chances are that the drones also will be of that nationality, unless "G. M.'s" bees are more forward than blacks usually are this year. The process of driving is very simple, and is correctly described by "E. D.," p. 158, No. 370, and a very little practice will insure success, and the finding of a queen after driving is only a question of patience (if you know a queen from a hornet), when clad in bee-proof head-gear. Another way in which ligurianising may be performed throughout a whole apiary in one summer is as follows: Suppose the apiary to consist of twenty stocks in straw skips, and one of them (which I will call No. 1) contains a pure Italian queen, and the bee-master has made himself, by practice, an adept at driving or drumming, he will first drive out all the bees he can from the ligurian stock and fumigate the few remaining either with puff-ball, or chloroform, leaving the stupefied bees on their own floor-board. He will then perform in the same manner with the black stock he intends to ligurianise, say No. 10, and will take care to catch and remove the black queen. He will then change places with the hives Nos. 1 and 10, but will always return the bees to their own stance. Thus the Italian brood will be on No. 10 stance for the bees of No. 10 to raise a queen from, which, being of pure breed, will insure a supply of pure drones in future, even supposing she is wicked enough to marry beneath her; and the Italian queen will be at the head of the hive of black brood, and if very ordinary care has been used scarce a bee need have been killed, and the valued Italian queen not even endangered. After the lapse of five or six days the black brood in No. 1 (formerly No. 10) will have become too old to raise into queens, but the Italian queen will have deposited any number of eggs in the hive, and on the seventh day it will be quite safe to go again through the performance, driving out the Italian queen and her motley crew (for her beautiful progeny will have a strong mixture of young niggers), and again exchanging hives with another black stock (say No. 11), after destroying the black queen therein. Then No. 11 will have the stock in which the Italian queen has deposited eggs while on No. 1 stance to raise their queen from, and the Italian queen will in a few days have deposited eggs in No. 11 while on No. 1 stance, and so the whole apiary may be ligurianised, the whole secret of the thing lying in this, that each black stock is successively supplied with pure ligurian eggs from which the black bees must raise their queens. The chief care is required in seeing that no living black bees are left in the hives into which the Italian queen, with her gradually blackened followers, is successively introduced. The only disadvantage attending this system lies in the fact that each stock has to raise a new queen for itself instead of simply having to hatch out a sealed queen cell; but I greatly question if this is not compensated for by the fact that almost every stock having raised queens' cells will cast a first swarm with a young Italian queen at its head as if it had swarmed before; but, of course, the season will have its influence on that matter, and as it will take twenty weeks to operate on the twenty stocks, the time of swarming will be past with some of them. However, by selecting the strongest black stocks successively the swarms will all be headed by young Italian queens; and although some of them may be lost in seeking fertilisation, the majority will do well, and amply repay their owner for his cost, time, and trouble.—C. N. ABBOTT, Hanwell, W.

[11604.]—**A Task for Chemists.**—I must apologise to Mr. Davis for not replying earlier. Having been absent from home, this is my first opportunity. Referring to my reply to query 10510, I find a misprint which altogether alters the sense. I keep press copies of my letters, and find the words I used were "a simple one would be," &c., instead of which it appears as "some simple ones would be," &c., so that my remarks referred to one process including three or more operations, instead of three distinct operations, as it appeared in print. There still remains one omission on my part, which I must now correct, that is that the boiling should be conducted under a pressure of 150lb. per square inch. I note that "Devonshire" says 184lb. pressure, but on this point there is a difference of opinion. I think if Mr. Davis gives thin pieces of wood this boiling, then thoroughly washes out all the resinous and siliceous matters that may still be adhering to the wood, and after that steeps it in the chlorine solution, he will get the wood pliable as desired. This subject is well illustrated in the Exhibition now opened, the various processes adopted for the conversion of wood into par-being shown, and, as I understand (for I have not yet seen it), the machinery used also appears in the Exhibition. I may take this opportunity of suggesting to Mr. Davis that there is here a fine field for original research; and I cannot help thinking that a chemist of such abilities might discover some more expeditious and cheaper process of removing resinous and silicious matters from vegetable fibres. At present it is alkali and steam pressure, and nothing else. Hydrofluoric acid has, I believe, been experimented with, but I have not heard of any useful results.—BUSY BEE.

[11615.]—**Teeth.**—A very simple way of taking tincture of iron and quinine is to suck it through a small glass tube, slightly curved, and flattened at one end to fit the mouth. I believe they are to be obtained from any respectable chemist.—H. C.

[11627.]—**Gilding Strips of Wood.**—W. H. Hey's ineffectual plan (page 146) is not the "golden" rule, which I subjoin as plainly as possible. After the wood has been planed give three or four coats of whiting and size, mixed together to the consistency of paste, rubbing down after each coat while wet with pumice-stone, till you have a smooth and sharp surface, then apply the "body," consisting of gilding clay and chrome yellow mixed with common size, after which give a "clearing coat," consisting of thick common size; it is then ready, when dry, for the oil gold size, which, after applying, gild when sufficiently dry, and size again after gilding. "Ironsides" must get the necessary tools, which can be bought for a mere trifle, consisting of knife, cushion tip, &c., flay for gilding. Common and gold size can be bought ready for use at any compo. shop.—H. B. E.

[11628.]—**Violin.**—In reply to T. R. Willis, the maker he mentions is unknown to me, never having seen any of his instruments. The instrument can be of no particular value, I should say, but it would be impossible to pronounce upon a sum unless one saw the violin in question. The only maker of the name I am acquainted with was a Samuel Collier, who lived in London about 1758, of no particular repute.—P. DAVIDSON, author of "The Violin."

[11632.]—**Debility.**—The answer of "Amateur" on p. 182 is an imposition on your good nature. Its statements about allopathy and homœopathy are so untrue as to show that the "Amateur" is either entirely ignorant of both systems, or worse. Where did he learn that "allopathists think they can cure by the administration of an unlimited number and quantity of drugs and counter-drugs"? Or "homœopathists by the finding of a medicine suitable for each separate malady, and for that only"? Truly each of these theories is "an absurdity;" but they are his own, or he gets them second-hand from some such source as the *Anti-Lancet*. And as to homœopathy having no medicine to relieve constipation, this is also grossly untrue, and a weak invention of the enemy. What is the "altera-tonic system" in praise of which he writes? He does not choose to say, but refers again to the *Anti-Lancet*. If you will get a copy of that work (which is scattered broadcast through the land gratis), and will read it from beginning to end, you will know as much of the matter as you did before. All you will learn is, that every system of treatment is wrong and hurtful except that practised by a certain doctor at Scarborough—which, of course, he does not divulge, though he describes lots of cases of "wonderful cures" he has effected upon "the victims of each of the above systems—that is, of "allopathy, homœopathy, hydropathy, etcætera." (Don't omit the "Amateur's" sweeping "etcætera.")—G. W. K. L.

[11632.]—**Debility.**—Before bringing a charge of quackery, "Saul Rymea" should read the *Anti-Lancet* himself. Perhaps he "would be surprised to learn" how many eminent physicians have agreed with the author's views. I once was as sceptical as he is, but instead of throwing the work aside unread, I gave it a calm impartial investigation, and was convinced of the truth of its arguments, the practical result of which I see in every day's experience. I would also commend to his notice the following, from the *Athenæum*, November 28, 1846. It is a review of a work of Liebig: "From him will be dated those investigations which promise to make medicine a more certain science, if science that can be called which has not yet determined a single main principle of action." "The occult erudition" by which I was convinced may be found in the *Anti-Lancet*, the work of an eminent M.D. and author, whom even the readers of the ENGLISH MECHANIC need not be ashamed to own. But I will give a few extracts: "The artificial arrangement of diseases and their infinite multiplication is much to be deplored, and leads to the administration of countless remedies, with countless intentions. To me such fanciful systems have always appeared utterly repugnant to truth. Indeed, he who considers every affection of the body as a distinct disease resembles the Indian or African native, who regards dew, ice, frost, and snow, as distinct essences, instead of considering them so many different modifications of water, derived simply from the absence of heat." Surely "Saul Rymea" has seen the long train of phials and boxes which follow in the wake of the allopath, so that he need not inquire whence I have derived my peculiar idea of their system. But our author shall again speak: "Seeing that all diseases arise from depression of nervous power, and beholding, moreover, the inutility and danger of the popular practice of medicine, which, not being founded on any fixed principles of science, is purely experimental and conjectural, consisting in administering a multitude of different drugs, and ten thousand times ten thousand different combinations of drugs, and with as many diversified intentions, and, consequently of hurrying multitudes to premature graves, I bent my studies unremittingly for some years towards the attainment of a unity of purpose, or general plan of treating diseases; and the result is the discovery of two most noble medicines, which have already established their power and efficacy in the cure of diseases, beyond all others which have yet been discovered in any age or nation."—AMATEUR.

[11639.]—**Rock Inscriptions.**—I cannot, with "A. D. H.," regard the remarks of "H. E. H." as the least exaggerating the extraordinary neglect of these Sinaitic relics. The few sketches (of 100) by various old travellers under difficulties, collected by Beer in 1840, might mostly be, as he tried to make out, mere names of Christian pilgrims, or even, as another Leipzig professor, Tuch, maintained, of pre-Christian but Nabathean ones! We might almost guess, without any learning, that so famous a desert must contain innumerable such scribblings by visitors of all ages and alphabets; and all accounts agreed that it does so, in Biblical Hebrew, Samaritan, the Egyptian popular (of the Rosetta stone and later), Nabathean, and down to modern Arabic. A few are Greek, including (as Forster thought he made out) that in which poor Cosmas "Indicopleustes" (or the "Wanderer to Ind") asks to be prayed for. He lived about 500 A.D., and left the first extant description of them at any length (according to Dean Stanley), though by no means the first author to name them. As early as B.C. 10, the geographer, Diodorus Siculus, could mention such inscriptions as a characteristic of that country as numerous, "extremely ancient," and "in unknown characters"—which certainly neither Nabathean nor any kind of Hebrew were in his day—the former was a living dialect. Cosmas was told by Jewish guides that those he saw were Hebrew, and stated merely "the departure of such a man, of such a tribe, in such a year, such a month;" and doubtless the majority, especially of the short ones throughout the country, those most easy to sketch, and likely to be brought away, are no more than this. Probably, also, Dean Stanley, in his few days hurried transit, would meet with no others. But would he, or will "A. D. H.," parallel them at all with inscriptions, one of sixty-five lines, another of forty-two, and its first line in characters a foot high? And these moreover, which must necessarily be on rock walls too high to be approachable but by ladders, windlasses, or such appliances peculiar to a numerous population in a "howling wilderness," and "back side of the desert," most remarkable in all historic time for its non-production of human food—much pasture indeed, and even shittim wood, gums, and incense, but so little for man, beyond date-groves few and far between, that even the few herdsmen pasturing there have to carry all their own food. Moreover, these great inscriptions (whereof but one line has been sketched by the Comte d'Antraignes), and all the long ones, or those in the Sinaitic alphabet proper, the only "unknown characters" are, by all accounts, both much larger than the letters of Nabathean, Greek, and other known alphabets, and in a totally distinct and quite peculiar style of execution. Instead of incised letters, that in sandstone would necessarily be chiefly or wholly of straight lines (as even our Roman B, C, D, O, S were made on stone). These are what we should call dotted outline letters, and wholly curved, as if a superintendent had first marked them with a brush of paint or whitewash (on the red sandstone) and then workmen had drilled little deep holes all round the outline, and in some few cases filling the surface of the letter as well, this especially (according to Forster) when particular letters pass, as they often do in a most singular way, into illustrative outlines of the camel, goat, horse, wild ass, ibis, and ostrich, all very correctly and carefully drawn. These evidently are part of, or added force and meaning to the words, whereas the sketches of these same animals accompanying (as they often do) the short pilgrim inscriptions, are quite independent thereof, and mere idle scrawls, no better than boys now chalk on our walls. Again, all the holes thus drilled, we are told, are quite indistinguishable in colour from the weathered rock, whereas incisions now made remain glaringly bright for years, and all the lesser inscriptions give some scale of age by their colour, the Greek and Nabathean even being still perceptibly paler, in that extraordinary climate, than the natural surface. It seems that in 1753 an Irish bishop (Clayton) having heard of these inscriptions, from monks at Cairo, offered large rewards for their transcription—or, as our friend "F.R.A.S." would say (p. 171, let. 4048, par. 4), "offered to bet," in the *Bell's Life* of that day that no one would transcribe any. This seems to have elicited a few of the sketches republished by Beer. But in these photographic days, when no sketching is needed, and the earth might truly more than ever be lightened by any angel "with a little book open in his hand," we have no Bishop Claytons, nor so much as a word of attempts even to re-find either the 42-line or 65-line inscriptions, but, as "H. E. H." says, much otherwise.—E. L. G.

[11661.]—**Photography (Background).**—Wet the canvas you intend for background and wring out well, then tack tightly as possible on to a frame, say 7ft. 6in. by 5ft. When dry, paint over with the following: white lead, 1lb.; driers, 2oz.; black paint, sufficient to give it the desired shade; turpentine, ½pt. Mix thoroughly and allow to stand a day, when the lead will settle down. Pour off turps carefully, which will rid it of the oil; bring to proper consistency by adding fresh turps. Then add 1oz. scraped yellow soap, strain through calico and it is ready for use. The quicker it is brushed over the canvas the better. If done over again it will be improved.—GAMBA.

[11677.]—**Rendering Wood Incombustible.**—I have often wondered that we have no companies for making difficultly combustible timber (as well as rot-proof), by inclosing it in large vessels of boiler-plate, making a vacuum therein, so as to exhaust the sap, and then admitting metallic solutions more fireproofing than alum (as tungstate of soda) to replace the sap. A company had a patent many years ago, and imbued timber thus with sulphate of iron and some lime salt (that decomposed one another and made gypsum within the fibres), in a receiver 40ft. long and 4ft. in diameter, wherein a vacuum was made by condensing steam.—E. L. G.

[11687.]—**Speeding Machinery.**—"A Reader" thanks "Philanthropist," and as he kindly offers to give further information, will be much obliged if he will illustrate by a few examples the rules by which the dimensions of wheels and pulleys are determined for correctly speeding machines.—A READER.

[11694.]—**Green Fly.**—"H. S. C.'s" conservatory must certainly be of extraordinary dimensions for tobacco smoke not to be of any good in exterminating the above and other such-like pests. I have some very large glass-houses, but always smoke with success. "Saul Rymea's" plan for syringing with tobacco water would only answer to a certain extent, not so well, I fear, as the smoke. I imagine sulphur fumes would do better followed by a general clean and paint; but first remove all plants on the slightest approach of sulphur. But autumn is my time for cleaning, not spring.—H. B. E.

[11695.]—**Succession Duty.**—The duty is calculated on the value, according to Government tables, of an annuity equivalent to the net annual income of the property for the life of the successor, thus:—Supposing the net income, after allowing for repairs, insurance, and ground rent, is £70, and the successor to be thirty years of age, the value of the annuity would be £1151 1s. 3d.; if aged forty, £1041 5s.; and if aged fifty, £870 1s. 7d; and the succession duty in this case will be 1 per cent. on such value. I have given the values for these ages to enable your correspondent to estimate within a little the amount he will have to pay for duty.—E. C. J.

[11699.] —**Organ Cleaning.** —The rewiring, cleaning, and tuning of the 24 stopped organ would cost £25, and to alter to equal temperament would cost £5 extra.—S. TAYLOR.

[11704.]—**Rats.**—Melt hog's lard in a bottle, plunged in water, heated to about 150° Fahrenheit; introduce into it ½oz. of phosphorus for every pound of lard, then add a pint of whisky; cork the bottle firmly after its contents have been heated to the above degree, taking it at the same time out of the water till the phosphorus becomes uniformly diffused, forming a milky-looking liquid. This liquid being cooled, will afford a white compound of phosphorus and lard, from which the spirit spontaneously separates, and may be poured off to be used again, for none of it enters into the combination, for it merely serves to comminute the phosphorus, and diffuse it in very fine particles through the lard. This compound on being warmed very gently may be poured out into a mixture of wheat flour and sugar, incorporated therewith, and then flavoured with oil of rhodium. This dough being made into pellets, lay it in rat-holes. By its luminousness in the dark, it attracts the rats, and being agreeable to their noses and palates, it is readily eaten, and proves certainly fatal. This remedy has been tried scores of times, and found to be perfectly effectual.—H. B. E.

[11710.]—**Cleaning Oil Paintings.**—Rub the picture over with a piece of cotton wool, dipped in sweet oil, then rub with dry cotton wool. You must not put too much oil on, nor use too much elbow grease.—H. C.

[11711.]—**Time at our Antipodes.**—I have referred to your Vol. XIII. as recommended by "A Fellow of the Royal Astronomical Society," but, unless I have by accident missed any of the letters, I find they chiefly consist of queries and suggestions rather than of satisfactory explanation. I do not want to know that a day is lost or gained by sailing round the world from east to west, or *vice versâ*, but what the existing difference of time really is. Supposing two telegraphic cables were laid to our antipodes, one by the east, the other by the west, messages sent simultaneously would arrive together, but would they arrive 12 hours earlier or later than the time of dispatch? If a message sent from London on Tuesday 12 o'clock (noon) could be dropped at Calcutta, it would find the time there to be 6 p.m., and therefore continuing its journey eastwards should arrive at the Antipodes 12 p.m. On the other hand, the western message, if dropped at New Orleans, would find the time 6 a.m., and so further westward at the Antipodes still 6 hours earlier, or break of day Tuesday morning. This question has, I have no doubt, been asked scores of times before, and the solution of it a very simple matter to "A Fellow of the Royal Astronomical Society;" but if he would kindly let me know where I can find the matter clearly elucidated, I should feel extremely obliged to him.—T. S.

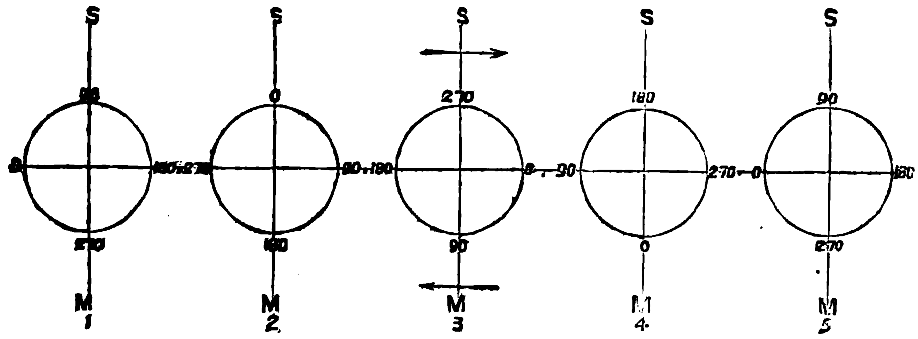
[11711.]—**Time at our Antipodes.**—Can there be at the same moment the commencement of *two* civil days at the meridian of 180° east or west? The earth rotates on its axis from west to east, *i.e.*, considering the sun to be stationary in the heavens, every portion of her surface passes him in this direction. Before noon (say) Tuesday, London, is west of the *upper* solar meridian, or the line on the earth's surface at which the sun culminates; after noon London is east of the same meridian. In the first case our antipodes are east of the *lower* solar meridian, drawing towards midnight of Tuesday in the second they are west of the same meridian, having commenced Wednesday morning at the time of transit. The following diagrams will show that a misapprehension may arise from an erroneous conception of the time westward of the upper solar meridian:—

No. 1.

London ...... 0° astr. time, Monday, May 6, 18 hours.
civil „ Tuesday, May 7, 6 morn.
Antipodes ... 180° astr. „ Tuesday, May 7, 6 hours.
civil „ Tuesday, May 7, 6 even.

No. 2.

London ..... 0° astr. time, Tuesday, May 7, 0 hours.
civil „ Tuesday, May 7, 12 noon.
Antipodes ... 180° astr. „ Tuesday, May 7, 12 hours.
civil „ Tuesday, May 7, 12 night.
Commencement of Wednesday.



No. 3.

London ...... 0° astr. time, Tuesday, May 7, 6 hours.
civil „ Tuesday, May 7, 6 even.
Antipodes ... 180° astr. „ Tuesday, May 7, 18 hours.
civil „ Wed. May 8, 6 morn.

No. 4.

London ...... 0° astr. time, Tuesday, May 7, 12 hours.
civil „ Tuesday, May 7, 12 night.
Commencement of Wednesday.
Antipodes ... 180° astr. time, Wed. May 8, 0 hours.
civil „ Wed. May 8, 12 noon.

No. 5 recommences the series.

—W. R. Birt.

[11718.]—**Composition for Moulding.**—Compo. is made of whiting, size, and glue, which has been stated over and over again in "ours." Will not querists search back vols.?—H. B. E.

[11715.]—**Testing Acetic Acid.**—Though a precipitate from vinegar by barium chloride is almost certain proof of the presence in it of sulphuric acid, it is no proof or even presumption that that acid has been used for adulteration, for it may, and very probably does, exist in the form of a sulphate, naturally existing in the water used in making the vinegar, or, if it be wood vinegar, for diluting pyroligneous acid. To distinguish whether the sulphuric acid, if present at all, exists as free acid, or combined with lime or other base, there should be boiled with a little of the suspected vinegar a few grains more of pure carbonate of lead than it will dissolve, adding a little more vinegar until the acid is in excess; most of the carbonate of lead will be converted into acetate, but if free sulphuric acid be present, sulphate of lead, which is insoluble in acetic acid, will remain. To prove that the white insoluble powder is sulphate, wash it well and suspend it in water, decompose it with a slow stream of sulphuretted hydrogen, filter and test the clear liquid for sulphuric acid with chloride of barium. If a white precipitate falls, which when decomposed with charcoal and a blowpipe flame gives off sulphuretted hydrogen, known by its smell and by blackening lead paper, there can be no doubt that sulphuric acid was present.—Philo.

[11721.]—**Assayers' Duties.**—"G. T. H." must excuse my long delay in giving him the information promised. All ores sold under "private treaty" are sold on an agreed assay, and sometimes on an agreed standard; hence it is not an easy matter to give any general rules applicable to particular cases. However, the account of copper ore sales, published in the *Mining Journal*, contains sufficient data to enable one to ascertain the value of any copper ore offered for sale by public ticketing. Given the produce and price per ton we can easily find the standard for ore of that produce by the simple proportion sum:—As the produce: to the price :: 100 : the standard. The price per ton may be found from the standard and produce in a similar manner:—As 100 : to the produce :: standard : price per ton. The produce may, of course, be determined from the standard and the price.—As the standard : the price :: 100 : the produce. As I have had but little practical experience in valuing ores of copper, I shall not attempt to go further into the subject (having a sincere regard for Montaigne's maxim), but content myself with hoping that "G. T. H." may find something useful in the few hints I have been enabled to give. *Lead Ores, and Lead Ores containing Silver.*—The assay value for lead is determined by "dry assay," with or without fluxes, in an iron crucible, and from the percentage yield thus found, a deduction is made for loss in smelting. This loss increases with the lowness of the produce. In determining the proper deduction to be made, the following table will be found useful:—

Produce of ore per cent.	Loss in units.
82	2
80	3
78	4
76	5
74	6
72	7
70	8
66	10
58	14

The silver in the ore is calculated at 5s. per ounce, and a deduction of (say) 2oz. 10dwts. made for loss in desilverisation. The following example will make the method of valuation clear:—An ore, after making the deduction for loss in smelting, gives 75 per cent. of lead by assay in an iron crucible, the price of common pig lead being (say) £20 per ton. The ore also contains 10oz. 10dwts. silver, to be valued at 5s. per ounce troy:—

Lead in a ton of the ore, 15 cwt. (20s.) per ton	£15
Silver in ditto, minus 2½ oz., = 8 oz. at 5s......	2
	17
Deduct returning charges........................	2
Value of ore per ton..............................	£15

"G. T. H." must, of course, be aware that, as these ores are sold by "public ticketing," the bids must necessarily vary, although they do so only within narrow limits. *Silver Ores.*—These ores are valued on scales devised by buyers and sellers on the basis of the price of standard silver per ounce, and as the other metals (such as gold, copper, and lead) have also to be paid for when existing in notable quantity, valuing these ores is a rather intricate matter, and when we consider the amount of money which might be involved by an error, one on which I would not care to advise through the columns of a magazine like "ours." In the valuing of a rich auriferous silver ore, "G. T. H." might perchance find to his cost that more knowledge is required than could be easily imparted through the columns of the English Mechanic by—Un Irlandais.

[11724.]—**Discharge of Water Over Weirs.**—The quantity of water falling over a weir is proportional to the square root of the cube of the depth measured from the top of the weir to the level of still water in the pond above it. The exact quantity depends somewhat on the form of the weir; but, as far as I understand its construction from the question put, I should think the number 5 would be very nearly the proper co-efficient, and in any case it will not be far from that number either way. If Q represent the quantity in cubic feet per minute, l the length of the weir in feet, = 4 in this case, d the depth of water (measured as above described) in inches, and c a co-efficient proper for the particular construction of the weir. Then $Q = c\sqrt{d^3} \times l$. The depth being, as stated, 2¾in., the quantity in cubic feet per minute is 5 × 4·55 × 4 = 91, and that is 819,000 gallons in 24 hours.—C. S.

[11731.]—**Hair Wash.**—Nothing better have I found, or more refreshing to the head, than equal amounts of glycerine, honey water, and spirit of rosemary. Add soft water to your mind, begin with 10 or 15 times the quantity of water, or even 20, and make a small bottleful at a time. I have used this for years in the morning after washing, and still continue to like it. At some times in the year I think hair is dryer than others, I then use a little so-called lime and glycerine after the other, when required.—F. G. T.

[11731.]—**Hair Wash.**—Your hair wash is generally considered to be excellent. Perhaps you do not prepare it rightly. Reduce half an ounce of camphor and one ounce of borax to fine powder, and dissolve them in one quart of boiling water. When cool, the solution is ready for use. The camphor will form into lumps after being dissolved, but the water will be sufficiently impregnated.—H. C.

[11731.]—**Hair Wash.**—A simple and effectual remedy. Into a pint of water drop a lump of fresh quicklime, about size of a walnut, let it stand all night, then pour the water off clear from deposit, add a quarter of a pint of best vinegar, and wash head. Tried. Perfectly harmless; you need only wet roots of hair.—H. B. E.

[11731.]—**Hair Wash.**—A small tooth comb, taken once through the hair every day, and persevered in, will do more for removing scurf and preventing its return than any hair wash known, whether prepared by hairdresser or "old wives' science." I can recommend it thoroughly, having tried it. It is a good plan, when brushing the hair, to lightly dip the brush into cold water, so as to carry a little moisture to the roots of the hair without wetting the head completely. This is very refreshing. No oil or grease should be used.—Sarah.

[11731.]—**Hair Wash.**—Let "Excelsior" try the Chile or Chili hair wash. Take a large fresh egg, beat up well the white and yelk, rub well into the roots of hair and whiskers (don't laugh), wash with three or four changes of water, and you will find it leaves the head very clean, and hair beautifully soft and glossy, not oily or greasy as one would suppose.—Chambon.

[11733.]—**Cotton Spinning.**—Try and procure "A System of Practical Arithmetic: containing the fundamental rules and their application to mercantile cotton spinning, &c.," by Samuel Young, 1833, published by Cowie and Co., Poultry, London, and in Manchester by W. and W. Clarke, price 4s. 6d., key 5s. This book gives all the computations in cotton spinning. I don't know of any book containing the practical theory. Get some friend to inquire in Manchester or Leeds.—E. J. D.

[11736.]—**Extracting Iodine from Seaweed Ashes.**—The ashes of burnt seaweed (kelp) contain iodine in the state of iodide of sodium. This (iodide of sodium) is mixed with peroxide of manganese and diluted sulphuric acid, and put in a retort and distilled; the iodine passes in the form of a vapour into the receiver, and condenses into lead-coloured crystalline spangles of solid iodine.—T. T. Greg.

[11737.]—**Fairbairn's Ventilating Bucket.**—"Philanthropist" will find a paper by Mr. Fairbairn upon this subject, at page 232 of Part 148, Vol. XII., August, 1849, of the *Civil Engineer and Architect's Journal*.—C. W. M.—[This publication is not now published.—Ed.]

[11738.]—**Cyanide of Potassium.**—Potassium heated in cyanogen gas (a compound of carbon and nitrogen) takes fire and burns in a very beautiful manner, forming cyanide of potassium(KCN). The same substance may be prepared by fusing potassium ferrocyanide with potassium carbonate. It is a white salt deliquescent in air, and exceedingly soluble in water; its solution always has an alkaline reaction, and when exposed to the air exhales the odour of hydrocyanic acid (prussic acid). At high temperatures cyanide of potassium combines with oxygen, forming potassium cyanate. It is decomposed by the feeblest acids, even by the carbonic acid of the air, hydrocyanic acid being liberated. It is a violent poison, and is said by some to be as poisonous as prussic acid. For an antidote an emetic should be taken, and cold water and ice applied to the spine. The other questions I am unable to answer.—E. A. K.

[11739.]—**Economy of Fuel.**—"X. Y. Z." would effect no saving of fuel by increasing the pressure of steam used for heating purposes. As the temperature of steam rises, its latent heat diminishes, so that equal weights of steam thrown into water produce about the same heating effect, although the temperature of the steam in one case may be much higher than in another. This, I believe, is known as Watts' law.—Shylock.

[11741.]—**Boot and Shoe Making.**—First make the sole smooth by scraping; then run the iron round cold. Next, get some ink, and make the soles black, then dry them; now get your heel ball, rub round your sole, and apply the iron hot enough to melt your heel ball, and not too hot to burn the leather; after that rub round with a bit of old cloth.—S. H. L.

[11744.]—**Shorthand.**—I am an oldish practitioner of "Pitman" (getting on for a quarter of a century now since I first used the system as a newspaper reporter), and have also for a number of years used an abbreviated longhand for reporting meetings, trials, &c., to save time and the trouble of transcribing from shorthand notes. With steady practice and lithe fingers it is possible to write very full reports in this way, which are so legible that they can be handed at once to the compositors of a newspaper office to set from. Of course, they must learn the system of abbreviation, but it takes no time to speak of to do this; and the compositors who have done my work were the uneducated (and often stupid) boys who are so plentiful in country newspaper offices. The method is an extension of one which is very commonly in use by reporters—its main feature being to abbreviate to the utmost, and sometimes omit altogether, the frequently recurring particles, prefixes and affixes, which form fully one-third, or more, of ordinary spoken language. In fact, it is founded on the same principle as almost every practical system of shorthand. I have heard, and believe, that some of the best newspaper reporters who ever existed knew nothing of shorthand, but used only abbreviated longhand. I would willingly give a specimen or two, but fear it would entail the expense of a little engraving.—G. W. K. L.

[11744.]—**Shorthand.**—It is generally admitted that Pitman's system is preferable to all others. Those more easily learned are easily forgotten, whereas Pitman's is as readable by the writer himself or by any other Pitmanite ten years after as the day it was written; and there is no living public speaker that ever I heard of whose delivery is so rapid as to baffle a writer in that method.—An Ex-Practiser.

[11744.]—**Shorthand.**—"Wood Sawyer" might write his notes in the ordinary English character, but would very considerably shorten the time by setting down the consonants only, and rejecting the vowels. The articles, conjunctions, &c., that are of such frequent recurrence might be omitted also, as they could be filled in afterwards, or some quickly-written symbol might easily be devised to represent words of that class.—SWAN.

[11749.] — **Cementing Iron in Wood.**— Let "F. S. G." try white lead; I have seen it used for the same purpose.—T. T. GREG.

[11749.]—**Cementing Iron in Wood.**—Make a strong solution of sal-ammoniac in water. Introduce a few drops of this into the hole before putting in your screw. The iron will speedily rust in, and you will find it almost impossible to extract it without breaking the wood.—S. BOTTONE.

[11751.]—**Bugs, Lice, and Parasites.**—Oil of rosemary, or sprigs of ditto, are said to be prophylactic. I know they are useful in warning off mosquitos.—G. W. C. H.

[11751.]—**Bugs, Lice, and Parasites.**—It is a curious fact that there is a sort of "elective affinity" in the proceedings of these pests. Certain of them affect certain persons, in spite of scrupulous cleanliness on the part of the latter, and victimise them fearfully; whilst they either utterly neglect or are innocuous to other persons—either clean or dirty. My duties take me much into public places, and the members of my family are pretty attentive to their church-going; and rarely does either of us come home without a flea—not in the ear, but on the clothes. The worst of it is that the wretch invariably makes his way to the "neckhole" or wrist of myself or my youngest boy, and punishes us horribly. The stings inflicted are nearly as bad as those of a wasp, and so rapidly repeated on every accessible portion of the cuticle that the torture is intolerable; and it soon becomes necessary to rush to a private apartment, strip, and hunt out the persecutor, who has left as a memento of his visit a series of hard white swellings, surrounded by inflamed patches that do not subside for an hour. At the same time, my spouse, eldest son, and daughter, never know when they have one of these parasites about them, unless they see it or feel a slight titillation. But, whilst the F sharps persecute me so fearfully, the B flats and gnats never trouble me at all, although I am occasionally in places where I am sure they abound. Yet, passing by me harmlessly, they vehemently attack and hurt the very persons who are exempt from annoyance by the F sharps aforesaid. Will some learned friend explain what good and wise purpose the tortures I have so often undergone (from no fault of myself or my connections) serve in the order of providence or economy of nature? Why the very persons who from their dirty habits originate and extend the nuisance frequently escape the penalty, which falls so heavily on those who are wholly innocent? As to "prophylatics" the revelation of one which shall be effective, and yet in itself harmless, would indeed be a godsend. There is a plant called "fleabane," from its supposed virtues—but whether preventive or curative, and where it is to be gotten, I do not know. "M. A. B." should try a lump of camphor in a small porous bag, worn next the skin, unless he uses homœopathic medicines for any purpose. If so, avoid the camphor, as it is a powerful antidote to all the medicines except itself.—G. W. K. L.

[11756.]—**Power of Water Wheel.**—You do not state the fall. The modulus of the breast wheel is ·6, that is, it utilises three-fifths of the power applied to it. Your dam contains 40 × 7 × 2 = 560 cubic yards of water, or 560 × 27 = 15,120 cubic feet of water. The power is more at the beginning when the dam is full, as the effective fall is greater. Let me know if it is a breast wheel, or, as I suppose probable, an undershot wheel; and if so, whether the buckets are straight or curved as in Poncelet's wheel; also the height of the fall, and I will send a calculation. If the water ran 4, 6, or 8 hours, the theoretical power would be ½, ⅓, or ¼ of that for 2 hours; however, the practical proportions would be greater, as the buckets of a wheel, if filled full, lose a considerable amount of power by the spilling out of the water before the level of the tail race is reached.—B. A.

[11761.]—**Magnetism.**—For answer to "Conatus" see Professor Barrett's letter.

[11761.]—**Magnetism.**—I fear that your correspondent "Conatus" has not understood the rationale of the experiment he has described. The use of a tube of water with oxide of iron was not to show the increase of transparency of iron when magnetised, but to illustrate by analogy the probable molecular change which a solid bar of iron undergoes when a current of electricity circulates round it. The cause of the increase in the amount of transmitted light was, that under the magnetising influence of the current the particles of oxide arranged themselves longitudinally—that is, parallel to the axis of the tube—and consequently the transverse spaces between the particles were larger than when those particles were indiscriminately mixed together. The arrangement of the particles is precisely analogous to the structure of the so-called Derbyshire egg, which is made of fibrous gypsum, and is much more transparent through its longer than through its shorter axis, because its fibres are parallel to the former.—PI.

[11764.]—**Scrubber for Gasworks.**—The scrubber I am using is composed of iron pipes 3ft. diameter, and 2ft. 6in. long, socketed together, stood upright, and charged with large stones (but I think coke is best, between which the gas passes. I do not think there are any pipes inside except when the scrubber is charged with drain-pipes.—A GASMAN.

[11767.] — **Horsehair.** — Nothing to do with galvanism; simply a consequence of unequal absorption and evaporation of the water. A piece of paper will do the same much more rapidly, but not for so long a time.—S. BOTTONE.

[11768.]—**Cheap Filter.**—Procure the sponge much closer in texture, and about four times as large as the present piece; then compress the new sponge into the hole now occupied by the small piece; this will make the water ooze through instead of pouring.—H. O'B.

[11777.]—**Postage Stamps.**—Sell them for remanufacture into paper. They ought to be worth a penny per pound.—BUSY BEE.

[11777.]—**Postage Stamps.**—I feel due thankfulness and profound gratitude for being the chosen and 'umble instrument permitted to reply to this important question, and have great pleasure in informing "F. A. E." that his postage stamps, although very unpromising material, may be applied to use, provided they resemble the writer and most other blacksmiths in being "werry dry." With great care and attention, the great assistance afforded by a pair of hand bellows and sundry fragments of ligneous materials, I feel quite confident "F. A. E." will be enabled to light his fire with his postage stamps, provided he proceeds *secundum artem*, but (a word to the wise) I may just remark the unpleasant adhesive matter on their backs is a very serious obstacle to ready combustion, and that I am very confident (from long experience in the art) that he will find a large handful of wood shavings, which may be often obtained with facility, for a consideration, at a neighbouring carpenter's shop, far more efficient, and in every way preferable for that important purpose, considered from the domestic stand-point of the feminine satisfaction of "Our Mary Hann."—THE HARMONIOUS BLACKSMITH.

[11784.] — **Restoring Colour to Marble Mantelpiece.**—Clean with diluted muriatic acid, or warm soap and vinegar; afterwards, if you choose, heat a gallon of water, in which dissolve one pound and a half of potash; add a pound of virgin wax, boiling the whole for half an hour, then suffer it to cool, when the wax will float on the surface. Put the wax into a mortar and triturate it with a marble pestle, adding soft water to it until it forms a soft paste, which, laid neatly on your marble mantelpiece, and rubbed, when dry, with a woollen rag, gives a good polish. This, too, is a capital furniture polish.—H. C.

[11784.]—**Restoring the Colour of Marble Mantelpiece.**—Mix up a quantity of the strongest soap-lees with quicklime to the consistence of milk, and lay it on the stone for twenty-four hours; clean it afterwards with soap and water.—G. W. C. H.

[11785.]—**London Blackbeetles.** — Take a common washing-stand jug well glazed, strew the bottom of it with cucumber rind peelings, and place it against the wall: touching it, in fact, so as to enable the beetles to reach the end of the jug, which, if well glazed and cleaned, affords a very treacherous footing, and once in no beetle can get out. They can be destroyed with boiling water at leisure, I have destroyed numbers in this manner.—G. W. C. H.

[11785.]—**London Blackbeetles.**—Let "J. L." try a pot of white phosphorus paste. We tried, when in London, everything, but nothing else appeared to hurt the beetles, a few pots ridding us entirely of these pests. This is not only our own experience, but that of several friends, who found it as effectual as we did. The paste was bought in threepenny pots, but I cannot remember the maker's name.—EMILY.

[11788.]—**Bunions.**—Cold cream applied on a linen rag and bandaged on is often very effectual.—G. W. C. H.

[11788.] — **Bunions.** — The following is recommended:—Bunions may be checked in their early development by binding the joint with adhesive plaster, and keeping it on as long as any uneasiness is felt. The bandaging should be perfect, and it might be well to extend it round the foot. An inflamed bunion should be poulticed, and larger shoes be worn. Iodine 12 grains, lard or spermaceti ointment half an ounce, makes a capital ointment for bunions. It should be rubbed on gently twice or thrice a day.—H. C.

[11789.]—**Effect of Temperature upon Ale.**—"A. N." is evidently unacquainted with the commonest laws of physics, and I would suggest the following answer to him:—The effect of a decreasing temperature on a beer is to render it of a greater specific gravity, and if the cold is sufficient to render the beer of the same density as any of the insoluble matter that was near the bottom of the cask, a portion of this will remain suspended in the beer if it is shaken, or will even rise in the beer of its own will. The water is not the cause of the thickness. If he were to use some of Beane's patent material, this suspended matter would not be there, as the material prevents its being dissolved out into the mash.—AUGUSTUS AVAME.

[11790.]—**Photography.**—If your markings are thick wavy lines of collodion, I have met with the same difficulty myself. After running the surplus collodion off your plate, hold the plate up by one corner in a vertical position, and rock it slowly from side to side, looking through it at the same time, and these wavy markings will gradually disappear, giving a smooth and nearly transparent surface.—PHILANTHROPIST.

[11790.]—**Photography.**—If "Camera" will, after coating his plate with collodion, pour off the surplus and immediately rock the plate to the left (keeping it quite perpendicular), and hold it in that position for a second, and then to the right for the same time, repeating the motion until the collodion is sufficiently set, he will be rid of the lines he speaks of. The reason he has not succeeded is, I think, because he rocks the plate too quickly. With respect to the washings, I find the following plan a very good one: Get two stone jars holding about two gallons each, into which pour the washings alternately day by day: after pouring in throw in about a tablespoonful of salt; every other day pour off the clear liquid from the jar that has been undisturbed the longest. When the jars are about half full of precipitate I begin the evaporation, and save the residue, which finally finds its way into the crucible. I generally use a "positive fixing-bath" twice, and then strengthen by adding a little more hypo. It will keep good in summer about four days, and longer in winter: when bad it will have an unpleasant smell. After the print has laid in the fixing-bath (say) five minutes, hold it up between the eye and near a gas or other light, and if it looks clear the bath is active, but if cloudy it requires strengthening, and the print is not fixed. With respect to the time for exposure in the studio and open air; it all depends upon the aspect and the amount of light "Camera" has in his studio. I have taken views out of doors in less than a second, when I had to expose from five to eight seconds in the studio. Again, I have succeeded in getting a good negative in the studio in three seconds, and with the same chemicals, but a few minutes later have had to give the same time out of doors; this I attribute to the continual change taking place in the light.—C. S. W.

[11797.]—**Preserving Moths and Butterflies.**—Camphor will certainly effect this if the cases be perfectly closed. To arrest decay (or rather insects), inject tobacco smoke by blowing through the bowl of a clay pipe, the stem to be inserted into the case containing the insects. Close the glass and allow the smoke to be well absorbed. This is an effectual remedy.—S. BOTTONE.

[11800.]—**Electrical.**—The processes required by "T. A. D.," are given in No. 359, p. 523 of last vol.; process 4 for electro-motive force, and 2 or 3 for internal resistance. To obtain the result in terms of a certain length of wire of course the measures needed for use in these processes would be simply lengths of that wire.—SIGMA.

[11806.]—**Power Loom Weaving.**—"Lancashire Lad" will find a work written by George White, and published by Simpkin and Marshall, London, or Joseph Thompson and Son, Market-street, Manchester, which will supply the desired information.—WILLIAM ASHPLANT.

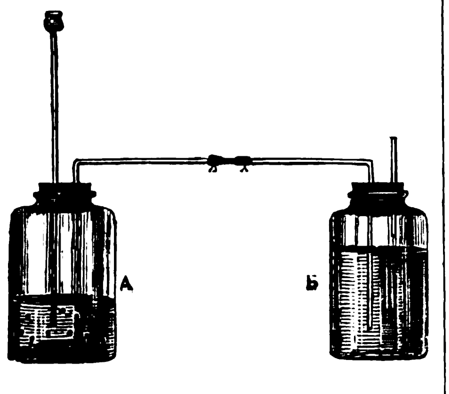
[11809.]—**Cool Air in Hot Climates.**—The plan proposed by "C. H. B." of cooling apartments by the sudden expansion of compressed air is perfectly possible. But I, for one, should never advise any ordinarily constituted mortal to subject himself to the sudden changes of temperature as such cool rooms would involve. I remember that when I first went to reside in Italy sixteen years ago, I thought I was going to be very clever, and carried my impediments into a fine large airy dry and cool cellar, where the daily temperature was about 60°, while in the rooms and out of doors it ranged from 100° to 120°. My peasants warned me that I should have a fever, but wise in my own conceit, I pooh-poohed them. Before the first week was out their prediction was verified, and since then I have taken great care, when in a warm climate, to avoid remaining in cool rooms, and to eschew the use of cold water.—S. BOTTONE.

[11810.]—**Colds in the Head, &c.**—I have much pleasure in recommending "X. Y." the following, as an effectual and speedy remedy for influenza:—Take a pennyworth of carbonate of ammonia and dissolve it in an ordinary wine bottle full of water. I have known a wine glass of this mixture taken three times a day cure a troublesome cold in one day.—WHITAKER.

[11810.]—**Colds in the Head, &c.**—These are not simple colds. Consult a medical man, as there appears to be some organic lesion which might increase.—S. BOTTONE.

[11814.]—**Lathe Queries.**—This is exclusively addressed to "J. K. P.," but having manufactured lathes at a former period, and given the subject some consideration, I would observe that the double cone is very troublesome to make, and only necessary for slide lathes, which, if not perfectly accurate, are worthless. The method which I adopted was to bore the hole for cone in front of headstock slightly taper, and a hole in the back of headstock, say ⅛in. diameter, and perfectly cylindrical, at the one operation. When you have turned the steel collar inside and outside a shade larger than hole, heat the headstock in forge until nearly red hot, slip the hardened collar in quickly, lay a piece of iron upon it, strike tenderly, and cool as quickly as possible. I think Whitworth uses composition metal for his cones. Into the ⅛in. hole in back fit a piece of turned steel, one end with hole in to hold it steady whilst adjusting, the other with taper point and a pinching-nut at each side of headstock.—A., Liverpool.

[11825.]—**Testing Bleaching Powder.**—The quantity of available chlorine in chloride of lime, may be easily ascertained as follows:—Weigh up a given weight of chloride of lime, and place it in a gas bottle. (See Fig. A.) Connect this with a second bottle, B, containing a solution of nitrate of silver. (The quantity of nitrate of silver in this solution must be equal to the amount of chloride of lime to be tested.) Now add gradually dilute sulphuric acid, through the thistle funnel C, as long as gas is given off. At the end of the operation, a heavy white precipitate will be found in the bottle B, consisting of chloride of silver. Filter off the liquid, dry, and weigh the powder. On comparing different samples of chloride, you will find that you will get different weights of this precipitate; and the richer the chloride of lime in available chlorine, the more chloride of silver will you get. Should you desire to know the exact quantity of available



chlorine your bleaching powder contains, you need only make a calculation, remembering that every 143·5 parts of chloride of silver represent 35·5 of chlorine.—S. BOTTONE.

[11826.]—**Tinning and Soldering.**—Having considerable experience in the art of soldering, I have arrived at the following conclusion, which is, as far as I am aware, novel—viz., that if two metals are brought to a certain heat and then a substance applied which will free their surfaces from oxidation, that union will take place, through the partial vacuum produced by the expansion of the air contained amongst the particles of the metals. Now, in order that the joint shall be successfully made, it is necessary that we use a body which will not burn before the metal is hot enough to produce this condition. Therefore, if it is lead or zinc which is to be soldered, scrape the surfaces scrupulously clean and free from grease, and use pounded resin, but, as lead is such a good conductor of heat, many fail from not using a large enough copper bit. To solder steel, iron, brass, copper, tin, or any of their alloys, spirits of salts, with as much zinc as it will dissolve, is all that is required, but, of course, the part to be soldered must be previously filed to a clean surface. How "A. B." proposes to unite by melting wrought iron, which takes such a high degree of heat, with tin, which takes so much less, I don't know, but if he succeeded it would destroy its most valuable property—viz., that of being readily welded. He surely does not suppose that the surface of the steel or iron itself is partially melted in the act of soldering. I have omitted to state that when the spirits of salts has ceased to act upon the excess of zinc I add nearly one-half of water to it to render it fit for use, and I would feel obliged if some of "our" chemists would state whether there is anything of the nature of resin in chloride of zinc, as, after a day's use of it I find that my hands are as difficult to clean as if I had been using resin.—A., Liverpool.

[11827.]—**Sight.**—"W. P." had better go to some oculist at once. If he cannot afford the fee, I should recommend him to go to the Eye Infirmary, Blomfield-street, near Broad-street Station of the North London Railway, between 8 and 10 a.m., where he will, without a letter of recommendation, get the best of advice free of cost, as to the number and kind of spectacles he requires. Invisible spectacles are ordinary convex or concave glasses, with very thin gold, or other wire rims, &c.—SACRISTAN.

[11827.]—**Sight.**—This is a case of myopia. The pin-hole in the card acts as the "stop" in a lens, and enables "W. P." to focus distant objects. Invisible spectacles are "bosh." Go to any respectable optician, state your case, and he will give you a pair of concave glasses that will suit you. Do not begin with glasses which are too concave.—S. BOTTONE.

[11828.]—**Duration of Boiler.**—The life of a boiler depends on the treatment to which it has been subjected, and the kind of water with which it is supplied. A saddle boiler of good material ought to last more than 11 years, but only a practised hand can form any idea of its condition without unsetting it for a thorough overhaul. There is no "insecurity" about a horticultural boiler in the sense of "explosion" unless the pipes are blocked up. The "saddle" is the best boiler for all moderate lengths of piping; the "tubular" for anything more. The "double L," as it is called, is so far an improvement on the saddle that it gives a larger heating surface; but the economy in fuel thus obtained would not, I think, be appreciable except in long lengths of pipe, and in this case nothing has yet beaten the tubular. I am not singular in this opinion; but possibly the coming trials at Birmingham may throw a little light on the subject, if properly carried out.—SAUL RYMEA.

[11831.]—**Thermometer.**—Most likely the air was not completely expelled from the thermometer. A similar case happened once to me, and I got my thermometer in good working order by applying a gentle heat to the bulb.—F. T.

[11835.]—**Arsenic in Wall Papers.**—Scheele's green is a copper arsenite. The presence of arsenic will be easily detected by the Marsh apparatus. Let "G. C. C." scrape off some particles of the paint used for colouring the paper, and mix these particles with the materials required to prepare hydrogen gas—that is, with pure granulated zinc, and pure diluted sulphuric acid. Arseniuretted hydrogen will evolve; on burning the gas, and on putting before the flame a piece of cold porcelain, a kind of gray metallic ring will be deposited.—F. T.

[11839.]—**Plates Chemically Clean.**—You were quite right to say you "fancied" that washing the plates under the tap would grease them. It is sheer fancy. If you wash your plates carefully, either with nitric acid, sulphuric acid, or cyanide of potassium, &c., and rinse them afterwards in abundance of water, drying carefully with a clean diaper washed with soda (not soap), you will have your glasses "chemically clean."—S. BOTTONE.

[11839.] —**Plates Chemically Clean.** — Well rubbing the plates with a piece of felt carpet dipped in a mixture of nitric acid and rotten stone (taking care that it does not get on the clothes or fingers), and then thoroughly washing them under the tap, is much better than a bath of cyanide of potassium. Varnished plates require to be soaked for a short time in a hot solution of common washing soda, to remove the film before using the acid.—WILLIAM.

[11840.]—**Whooping Cough, &c.**—I can't tell "T. C. H." how to make balsam of horehound, but I can tell him that change of air is the very best remedy for whooping-cough. I have found with my own children that even a run down the river to Greenwich and a blow round the Observatory has had a wonderful effect in ameliorating this malady, while a few days in the country has effected a cure. The only medicine advisable (except under competent advice) is some one of those domestic remedies which do no harm if they fail to do good.—SAUL RYMEA.

[11841.]—**Human Relics.**—In the Etruscan Vase Room in the British Museum the oldest human relic is to be seen. This relic is the skeleton of Pharoah Mykerinus. It is decently encased in burial clothes, also surrounded by pieces of the coffin. On one of these fragments is the name of the occupant, which can be deciphered by Egyptologists, affording conclusive evidence that it once contained the body of an Egyptian monarch who reigned more than a century prior to Abraham's time. From the *Gentleman's Magazine*, April, 1866, we find that Herr Dümichen, an explorer of the Egyptian monuments, discovered on the buried walls of the temple of Osiris, Abydos, a large tablet containing the names of the ancient Pharoahs from the time of Mizraim, grandson of Noah, to that of Pharoah Seti I., the father of the well-known Rameses the Great. This tablet shows that Pharoah Mykerinus, whose remains are to be seen in the British Museum, succeeded the builder of the Great Pyramid with only two intervening kings. — HENRY T. MATTHEWS.

[11848.]—**Conic Sections.**—I beg to refer "Rusticus" to any elementary book about conic sections, treated geometrically. He will easily find then the following propositions:—(1) Every section of a cone, by a plane meeting the conic surface on every side—that is, neither a parallel nor a subcontrary section—is an ellipse. (2) If a cone be cut by a plane parallel to another, touching the conic surface, the section is a parabola. (3) Every other section of a cone is a hyperbola. For the demonstration of the above propositions, he will get it as complete and short as possible from Chambers's "Solid and Spherical Geometry."—F. T.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Anglo-America" has answered 11207, 11209; "Sacristan," 11275; "F. G. T.," 11275, 11288, 11289.

11439	Cost of Chamber Sulphuric Acid, p. 80
11441	Dyeing Cotton Thread Jet Black for Polishing, 80
11447	Blundered Coin, 80
11449	Angelet, 80
11452	Rainwater Tanks, 80
11458	Carmine Staining, 80
11463	Working Engines, 80
11477	Lamplough's Pyretic Saline, 80
11494	Utilising Slack, 81
11496	Lotion of Hydro.-Sulphate of Soda, 81
11501	Exhalations and Consumption, 81
11503	Wollaston's Differential Barometer, 81
11509	Adapting Barrel to Pianoforte, 81

Refined nickel is worth three dols. a pound. The ore is found in Pennsylvania and Missouri. The Pennsylvania mines furnish the principal supply at present, and are said to be very profitable.

The best fireproof safe is a hole in the ground, properly lined with brick and cement. If it must be above ground, it must be a double one, with the interval filled with fire-clay and sand; plaster of Paris is much used for this purpose.

QUERIES.

[11857.]—**Gelatine Moulds for Plaster Ornaments.**—Can any of "our" readers inform me how to make the gelatine moulds for casting undercut plaster ornament?—G. W. P.

[11858.]—**Nickel Spoons.**—Will some brother reader kindly give me the mixture of the above, to keep their colour.—ARSENAL WORKMAN.

[11859.]—**Dyeing Raw Cotton.**—Could any of my brother readers inform me the cheapest and quickest way to dye raw cotton black, and, if possible, with one dipping?—F. E.

[11860.]—**Magnetic Machine.**—I beg to inquire further about the magnetic machine for making oxygen, mentioned on p. 49 of this present volume. I have called at Mr. Browning's, No. 111, Minories, and was told there is no such machine. We make our oxygen from the usual mixture of chlorate of potass and black oxide of manganese, and then purify it; then the price is about 1s. per cubic foot. I wish Mr. J. T. Sprague would undertake to devise the required machine, and publish it in detail in the ENGLISH MECHANIC. I have no doubt that many would feel thankful for such information.—A POOR MACHINIST.

[11861.]—**Glove Cleaning.**—I have a pair of valuable American buckskin gloves, in a very dirty greasy state, having worn them across the Atlantic. Will some kind reader oblige by informing me how I can best clean them, without injury to the leather?—CONSTANT READER.

[11862.]—**Charcoal.**—How much charcoal should I get from a ton of tops and edgings of oak and elm? and, if I convert it in a retort, should I get any gas or oil worth saving? I use it for cleaning sewage water, and re-heat it occasionally. Of what use are the gases I drive off?—PRENTICE.

[11863.]—**Barrow-in-Furness.**—No doubt some of "our" readers are residents of Barrow-in-Furness, Lancashire. Having heard some good reports concerning the place, and also having a desire with a companion to get northward (being carpenters and joiners), I should like to know from some brother mechanic, a resident there, what sort of place it is, and if he thought that there would be a chance of getting employment. Should we make our way there? Such a description would perhaps interest other readers besides—AN ENGLISH MECHANIC.

[11864.]—**Rabbit Disease.**—Could one of your correspondents inform me the best way of curing tame rabbits of a disease in the neck? It is something similar to the mange. All the hair comes off from the top part of the neck and back.—JAMES KING.

[11865.]—**Fish.**—Can any of "ours" inform me if there be any foundation for the opinion held by some anglers that fish, such as roach, dace, bream, &c., are attracted by means of oil of aniseed, oil of cloves, rum and honey, when mixed with the bait used. I have been told by enthusiastic amateurs that such is the case, but I never believed in it, trusting rather to fine tackle, clean baits, and my own skill.—PISCATOR.

[11866.]—**Splitting Wood.**—Will some of your correspondents inform me how I can split straight deal in the most expeditious way the following sizes—5in. long, $\frac{5}{8}$in. wide, and $\frac{1}{8}$in. thick? I have been told that matches are stamped out in a peculiar way. Would that process answer, or is there anything better? An enormous quantity wanted, so must be done quick. Perhaps some of your correspondents can inform me where such a machine can be obtained, and the price.—DEAL TIMBER.

[11867.]—**Separating Tar from Wool.**—Will any subscriber kindly inform me the cheapest method of dissolving tar or pitch, and paint, from wool?—Z.

[11868.]—**Ash Timber.**—I have lately purchased some young ash timber, felled this last winter. How must I proceed to keep it in the best condition? Let it be in the open with the bark on, exposed to the weather, and for how long? or saw it into plank? or place it in a shed secure from wet, without sawing it? I may not require to use it for a year or two. What is round ash timber worth per foot (good ash)? How is ash plank sold? I have heard it is sold by the inch.—ASH.

[11869.]—**Zinc v. Coal.**—In Dr. Ferguson's volume on "Electricity," p. 234, it is stated zinc cannot compete with coal as a source of mechanical action—nothing, however, is mentioned as to the means of comparison. Can any reader inform me (1) what data has been obtained on this point? (2) Might the weight consumed per hour of zinc be assumed proportionate, as of coal, to the mechanical action developed?—S. I. G.

[11870.]—**The Sun.**—To MR. RICHARD A. PROCTOR.—Would Mr. Proctor kindly give his reasons for his opinion expressed some time back in the ENGLISH MECHANIC, that the sun is not part of the milky way?—L. J. V. G.

[11871.]—**Deluges.**—Mr. Darwin, in a foot-note in his "Origin of Species," rejects the Adhémar theory on periodical deluges. Would a subscriber, or Mr. Darwin himself, who is very likely a reader of "ours," kindly give the author's reasons?—L. J. V. G.

[11872.]—**Carbonic Acid Gas and the Atmosphere.**—1. How many million tons of carbonic acid does the atmosphere contain? 2. How many million tons of carbonic acid is the atmosphere capable of containing without the animal kingdom being seriously affected by it?—WILLIAM THOMPSON.

[11873.]—**Magic Lanterns.**—Will any correspondent inform me how to japan tin bodies for magic lanterns, to stand the heat without softening or flying off, what sort of japan to use, and where to get it?—A. B.

[11874.]—**Bryant and May's Matches.**—Bryant and May's matches are sold with the warranty that they "ignite *only* when rubbed on the side of the box." I find, however, that many of the matches will light readily on linoleum. Will any kind reader explain to me the chemistry of this?—HIPPARCHUS.

[11875.]—**Spectrum Colours.**—I wish to paint upon a disc of card 18in. diameter, the colours of the spectrum, so that when caused to revolve rapidly it will show pure white. What pigments must I use to obtain pure colours? or could I obtain paper of those coloured? Any advice on the subject will oblige—UTILE DULCI.

[11876.] — **Hydraulic Press.** — Will some kind mechanic help me? I wish to make a model hydraulic press. Any information would be thankfully received by —RICARDO.

[11877.]—**Slide Valve Question.**—Will any reader of "ours" kindly explain how the to-and-fro motion is communicated to the slide-valve (of Cameron's patent steam-pumping engines, manufactured by Tangye Bros.) without the aid of eccentric cranks, &c.? A diagram showing the steam passages in the cylinder, and how the valve is acted upon, will be most kindly received by —HYDRAULICAN.

[11878.]—**Photography.**—Will some kind reader tell me how to retouch negatives, what colours to use, how to varnish the retouched part, and any other particulars? Also why do my landscape negatives flash into view the moment the developer is applied, and afterwards go dull and opaque—when indoor portraits, taken with same camera, come gradually and get more and more distinct.—CAMERA.

[11879.]—**Thermopile.**—How can I make the bars of antimony and bismuth and put them together for a thermopile, to use with radiant heat, &c.? I cannot succeed in doing this because of the brittleness of the bars.—ARTHUR CAXTON LOWE.

[11880.] — **Armature.** — How may I construct a Siemen's armature for a magneto machine? Smiths charge me high for forging the core, and I wish to know how to make one cheaply for a small machine?—ARTHUR CAXTON LOWE.

[11881.]—**Velocipede to be Driven by the Hands.**—Would some reader furnish me with a drawing of a velocipede to be driven by the hands instead of the feet. I have seen several excellent plans, but they will not suit me, as I cannot use my legs. I want one which could be driven up a moderate incline with tolerable ease. Speed is not so much an object as ease; say four miles an hour. I don't mind whether it is a three or four wheeler.—A CRIPPLE.

[11882.]—**Webs of Cranks for Model Engines.** —Will "Jack of All Trades," or some other of our numerous correspondents, be kind enough to inform me how to forge the webs of cranks for model steam-engines? The size I want to make is this: Diameter of shaft ⅜in., throw 1⅛in.—W. B. W.

[11883.] — **Sustaining Weight of Cast-iron Column.**—What weight would a cast-iron column of the following dimensions sustain:—Length 8ft., diameter (outside) at base 7½in., at top 7¼in.—VULCAN.

[11884.]—**Power of Water-wheel.**—Will any one kindly tell me the horse-power of a water-wheel, of which the diameter is 24ft. 5in.; length of bucket, 8ft. 4in.; and fall 19ft.?—R. S.

[11885.]—**Power of Boiler.**—What boiler power would it take to keep at nearly boiling point a tank full of water, measuring 15 × 6 × 4ft.?—R. S.

[11886.]—**A Thick Soled Shoe.**—I am about to make a boot for a person whose leg is so contracted that the foot is considerably risen from the ground, and, in consequence, will want a very thick sole. I wish to know what is the best material for the soles, and also the mode of fastening them to the upper?—WEE PET.

[11887.]—**Hair Dye.**—Nitrate of silver is used in some form of solution as a hair dye. Will any reader inform me how the solution is prepared, the quantity of nitrate and of solvent, and if any other ingredient is included?—GRAY BEARD.

[11888.]—**Astronomical.**—I wish to call the attention of my fellow readers to an article in this month's *Cornhill Magazine*, entitled "A Giant Planet," in which the theory is propounded that Jupiter is at the present time about as hot as red-hot iron. The name of the writer is not given. I should like to hear what our valued friend "F. R. A. S." thinks of this. Can any reader inform me if Sirius is pronounced "Sirius" or "Sirius"? Also is there a planet Vulcan, between Mercury and the Sun?—WHITAKER.

[11889.]—**Hedgehog.**—Will Mr. Pope, who recommends a hedgehog as a destroyer of kitchen beetles, give me a hint about the management? Will he take to a box or basket? and does he require milk?—F. S.

[11890.]—**The Lathe.**—How can I mount a centre knife edge at perfect right angles to the plane of the beam of a delicate balance, the beam of which gets thinner as it approaches towards the ends, that is, the thickness is a gradual slope from centre to ends, so that a square laid on beam will not give the right angle, which it is necessary for the knife edge to have.—C. SMITH.

[11891.] — **Contents of Cistern.**—I should feel obliged by some of the readers of the MECHANIC informing me of some accurate method of ascertaining the number of gallons of water contained in a stone cistern of a shape something like a D.—J. K.

[11892.]—**Steel Combs.**—Will any brother reader kindly inform me how to make steel combs such as those used by weavers? Also what kind of metal the tops of the combs are made of?—DUSTY MILLER.

[11893.]—**B. Sc. of London.**—Will any of "our" readers tell me what is a good book from which to get up the botany for this examination, especially as regards the examples required from British plants? Lindley's books do not seem to meet this quite. Also what is a good book for the zoology, with hints as to the kind of specimens provided in that examination?—J.P.P.

[11894.]—**Lamp for Incubator.**—Will any of your readers be kind enough to tell me what sort of lamp is best for an incubator? I want one that will keep alight 14 hours without touching. Will a double-wick colza oil lamp do this?—OVO.

[11895.]—**Making Templates or Moulds.**—Will some fellow subscriber give me some instructions how to make the templates or moulds for marking out planks for chairs and other furniture in a practical manner?—ANXIOUS.

[11896.]—**Taking Copy of an Engraving or Lithograph.**—Can any fellow reader give me a simple method of taking a rapid impression of an engraving, lithograph, or print?—ANXIOUS.

[11897.]—**Fastening Fret Saw.**—Will some fellow reader tell me how to fasten a fret saw to the end of an arm spring, so as to obtain a perpendicular motion? The spring describes a segment of a circle.—G. W. C. H.

[11898.]—**Tempering Cast Steel Chisels.**—Could any of "our" readers inform me how to temper chisels made of old rasps and files, used for cutting cold iron?—U. V. U.

[11899.]—**Etching on Glass.**—Would some of "our" readers kindly inform me how to propare the hydrofluoric acid in solution for the purpose of writing on glass? I often graduate my ordinary flasks to hold measured quantities, such as 300 c. c., 400 c. c. &c., by exposing the flask to the vapours of hydro-fluoric acid, but I believe that it is much more convenient to use the acid in weak solution, and am anxious to learn the details of the process.—UN IRLANDAIS.

[11900.]—**Electro-Plating.**—Would "Sigma" be so good as to describe for me a battery best suited for the purpose of electro-plating small articles, with other essential pieces of apparatus required? I would also feel obliged by his recommending me some cheap manual on the subject.—UN IRLANDAIS.

[11901.]—**Grip Chuck.**—I want to make a grip chuck how am I to manage the left-hand screw? I have Whitworth's set of four right-handed screws, ½in. largest size. Can I get a set of three taps and dies to one of his pitch, left handed? or had I better get the jaw and screw made by a regular machinist? I had rather do it myself if I can.—F. G. T.

[11902.]—**Chlorine.**—Is chlorine (when evolved from chloride of lime) injurious in a sleeping room?—WM. HAMILTON HEY.

[11903.]—**Quinine.**—(1) What is used to adulterate quinine? (2) How may it be easily detected? (3) Does quinine cause salivation? (4) How is amorphous quinine prepared?—WM. HAMILTON HEY.

[11904.]—**Suitable Spectacles.**—I usually devote the evening to writing, and find that my sight—naturally long-sighted—is rapidly failing, and would be obliged for any information as to the most suitable spectacles to procure.—A., Liverpool.

[11905.]—**Miniature Turbine.**—The following appeared in the *Society of Arts Journal* for March 8, 1871:—"The *Berg und Huettenmaennische Zeitung* describes a small turbine, the diameter of which is only 3in. There are 24 passages of the water, each of which has an area of one-tenth of a square inch. It is driven by a fall of 85ft., the water being led by a small pipe, having a sectional area of half of a square inch. This turbine is used for driving a lathe, in which an iron shaft of 4in. diameter can be turned. The turbine, when not loaded, makes 2,288 revolutions per minute. Can any of our readers furnish fuller particulars, as I think it might prove very useful to many of us?—H. H. MASON.

[11906.]—**Spectroscope.**—Will "F. R. A. S." or Mr. Proctor kindly give me some advice about purchasing a spectroscope? What price one would be most suitable for a beginner? Would it be best to have it fitted to a microscope or not? I shall feel greatly obliged for any information on the subject.—W. H. H.

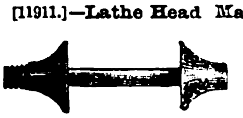
[11907.]—**Hebrew Music.**—Can any one give me any information about Hebrew sacred music. How is it written? Does it at all resemble Gregorian?—KAPPA.

[11908.]—**Drilling Boiler Plates.**—Will some practical boiler maker inform your readers in America, what kind of tools or machines are used for drilling the rivet holes in boiler plates, and state whether it is done before the plates are bent, or after they are fitted or lapped over each other? and whether the holes in each plate are drilled at once, or the one plate drilled first, and the second one from the holes in the first? In this country boiler plates are never drilled, but always punched; and any details about the best practice in England in boiler construction would be of service here, and, perhaps, help to prevent some of the sad accidents unfortunately now so common on this side of the Atlantic.—AMERICAN MECHANIC.

[11909.]—**Loud Whistle.**—Wanted, to know the way to make a very loud-sounding whistle, a regular "ear splitter," to be heard at a distance. Any information thankfully received.—ANGLO-AMERICA.

[11910.]—**The London Encyclopædia.**—Wanted, to know if the London Encyclopædia was ever completed, and, if so, if obtainable? It was begun in 1826, and was to be finished in 8½ years, in 40 parts. I have up to G, 20 parts.—ANGLO-AMERICA.

[11911.]—**Lathe Head Mandril.**—Will "J. K. P." kindly give his opinion on a lathe head mandril, with bearings the shape of the sketch, for an eccentric chuck, or anything else, so as not to have the least shake, the back bearing being a brass bush screwing into head with gas thread, and a nut on inside for a keeper?—ANGLO-AMERICA.



[11912.]—**Chemical.**—Can any contributor inform me of the best book to use in order to acquire a thorough knowledge of the chemical theory in its present complicated form?—ONE WHO IS PUZZLED BY THE LATE ALTERATIONS.

[11913.]—**Fixing Pins in Barrel.**—Will Henry Newman inform me how to fix pins in barrel, for the purpose of playing any tune that may be desired? Also how are the pins tightened?—RICHARD LINTON.

[11914.]—**Expansion Joints in Steam Pipes.**—What is the best kind of expansion joint for 10in. steam pipe, also for 4in. steam pipe? Steam usually 50lb. per square inch, but occasionally let down and shut off.—BUSY BEE.

[11915.]—**Corn Screen.**—I was greatly disappointed to see the correspondence that was carried on by millers a short time ago had been allowed to come to a standstill. I should take it as a great favour if some of my more experienced dusty brothers would give me their opinion as to what they think is the best sort of corn screen to use for general purposes. The number of brushes and what kind, and any other useful information will be thankfully accepted by—A YOUNG TYKE.

[11916.]—**Octave Coupler.**—Will any contributor kindly furnish a drawing or description of octave coupler for organ? or, if such has appeared in the ENGLISH MECHANIC, please give number and volume.—GAMBA.

[11917.]—**Organ Construction.**—Are there any books published on the construction of organs? if so, will any reader please give the name of a cheap and good one?—GAMBA.

[11918.]—**Fumes from Gasworks.**—Will "Sigma" kindly tell me of what the fumes, or "perfumes," which escape from gasworks consist; and what alteration, if any, they undergo in traversing a quarter-mile of air during rainy and dry weather?—SAUL RYMEA.

[11919.]—**Trigonometrical.**—The following theorem occurs in the "London Encyclopædia," article "Trigonometry": "The secant of an arc is equal to the sum of its tangent and the tangent of half its complement." A geometrical solution is given. Will some one give a trigonometrical solution? It will be propounded thus—

$$\text{Sec. A} = \tan. \text{A} + \tan. \frac{90^\circ - \text{A}}{2}.$$

—THETAMU, Horsham.

[11920.]—**From "Jack of All Trades."**—Having had a very protracted bout of ague, from which I was very debilitated, troubles set in thick and fast, which were a cause of great anxiety to me. I caught a violent cold, which ended in a violent attack of erysipelas in the head, and for a fortnight the question was "to be or not to be." Since my partial recovery I have been troubled with a tenderness of the interior of the nostrils, upper part of throat, and the inner ears. One of my eyes seems as if it was seared with a hot iron, which will ultimately end in the loss of sight, there is not the least doubt; and my brain is so affected that if I try to collect my ideas, read, write, or put my considering cap on, I receive a shock in the back of my head as if I had been stunned with a violent blow. At the same time, everything seems to vanish from my sight; in fact, total darkness supervenes for a minute or two. At one time, if I partook of a cup of hot tea or coffee after my daily labour I felt invigorated and equal to a good evening's work, but now, if I partake of a cup of *anything* hot, it debilitates me by producing a huskiness in the throat, and fever, and if cold it produces all the symptoms of a violent cold in the head, and I have been, since I have been able to get about, troubled with a species of fever in my feet. They are painfully tender, as if they had been scalded. Knowing that there are medical subscribers to "ours" that are capable of answering my query, I hope they will answer this candidly, and state whether this is likely to be a permanent affection or wear off in time. It at present leaves me almost a perfect drone, as study or the least excitement or exertion produces the above-mentioned shock to the head, and for the life of me I cannot see or think of what I am seeking.—JACK OF ALL TRADES.

[11921.]—**Curing Sprats.**—Can any of your readers describe a good method of curing sprats in oil, so as to form a substitute for sardines?—WAYNFLETE.

[11922.]—**Sewage Pipes.**—Are iron pipes fit for sewers? and if used as sewers, are they serviceable, or do they quickly corrode when in contact with ordinary town sewage? What difference in price (about) is there between earthenware and iron pipes of equal diameter?—SUGGESTOR.

[11923.]—**Potatoes.**—May I ask "Inquiring Mind" (let. 8888, p. 66) how he can manage to keep the disease from late potatoes by mowing the tops off, seeing that the disease uniformly comes about the beginning of August, when late potatoes are not ripe, neither are the second early; and if potatoes are not allowed to get full-grown they get soft, and are not really good? He is quite right about wide setting and whole potatoes, but he is wrong in wanting to insure large potatoes. They are never so good, or convenient, or nice looking for a gentleman's table, as moderate-sized ones, and he insures a hollow to them. The very best potatoes are always the very small ones, which most people throw to the pigs as good for nothing.—E. T. S.

[11924.]—**To Millers.**—Will some of our miller friends answer the following:—Which is the best size millstone to work as regards power, speed, &c.—a 4ft. 6in., or a 4ft. stone? I shall feel obliged by any of our miller friends answering this or any other items connected between the two sizes of French burr millstones.—M. C.

[11925.]—**Beef Fat.**—Can any of your numerous readers inform me how marrow fat for cooking can be best made out of beef suet, and give it a colour similar to butter? I have tried aunatto, but I think something cheaper for quantities could be got. Also what process will make it soft and seedy like the original marrow?—COMMUNE BONUM.

[11926.]—**Malleable Iron Castings.**—Will any one describe the process through which malleable iron castings are obtained, referring principally to the kind of iron used.—J. T. LITTLE.

[11927.]—**Ants.**—In my kitchen, about the chimney, somewhere, there is a nest of very small brown ants. They have been there some time, and are very troublesome. I should feel very much obliged if any of your numerous readers would inform me how to destroy them. I have tried several things, but have not succeeded in destroying them.—A. N. T.

[11928.]—**Microscope.**—"A Canadian Subscriber" will take it kind of brother subscribers to give him a few hints upon purchasing a first-class microscope. The strength or powers and merits and demerits fully specified, and the names of the different kinds, and, if permitted, the names of makers, with prices.—CANADA

[11929.]—**Chemical.**—Will any one inform me of what iron retorts are lined with for distilling nitric or other acids?—C. M. J.

THE ENGLISH MECHANIC LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£334 13 10
W. R. Birt (3rd donation)	0 10 0
	£335 3 10

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, May 14, and unacknowledged elsewhere:—

Robert Tongue.—Epps and Co.—Thos. Evans.—C. H. Stott.—Wm. Pearson and Co.—John Murphy.—Wm. Tyred.—T. Barnard.—John Abrahams.—J. E. F. Wilson.—J. B. W.—J. H. Heywood.—Col. Staces.—Sigma.—Rev. W. H. Morgan.—"To the Manor Born."—J. H. P.—The Harmonious Blacksmith.—A Paper Maker.—F. C. S.—Roland.—T. J. Ridge.—Whitkirk.—J. S. Wood.—Ebury St.—Samuel Smither.—W. H. Hey.—E. L. G.—The Welsh Shepherd.—Boo.—H. O'B.—A Philanthropist.—J. Barwick.—A Country Tinker.—F. B.—William.—G. R. S.—Nil Sine Labore.—In a Difficulty.—Jas. Renworthy.—S. Brown.—W. H. N.—C. W. M.—A Pupil.—Economy.—Glare.—Hard as Stone.—An Apprentice.—Weather.—S. J. D.—Teachable.—Ashtonian.—J. E. Hale.—Waller.—Boongate.—A. C. S.—Glatton.—Speight.—Ashworth Bros.—W. H. Gaines.—J. Starling.—R. Singleton.—T. P. Barkas.—J. M. Elder.—W. H. Lockwood.—R. A. Proctor.—A Colonist.—J. W. J. Manners.—S. Bottone.—Jannifred.—W. M. S.—A Young Butler.—Sigma.—Lindsey.—R. E.—Artillery Captain.—Optical Bricklayer.—J. W. H.—Barbaros.—W. P. Clarke.—Soper.—Charlie Brown.—W. H.—Nil Desperandum.—One in a Fix.—F. H. Smith.—E. H.—A Sufferer.—W. R.—J. H. S.—Piano.—G. W. C. H.—M. Paris.—Saul Rymes.—Halifax.—W. H.—James Hughes.—B. D. T.—Zoo Andra.—Old Cheeseman.—A Cambridge Graduate.—Spider Wheel.—T. Greenway.—A Welshman.—Mechanician.—A Paper Maker.—W. T.—J. H. T.—Screw Cutter.—W. D. Evans.—J. C. J.—W. D. Roberts.—J. Gilbert.—Master of Arts.—Growing Wiser.—W. H. Hibbert.—The H. B.—Confidential.—American Subscriber.—Obby Oss.—G. R. G.—Henry Jackson.—G. H.—Oyster Eater.—Henry Hall.—Speculator.—W. H. Davis.—Amateur.—E. B. Hurley.—G. F. B.—Watts.—H. B. E.—An Old Subscriber.—F. Greenway.—Learner.—J. T. Maurock.—Wm. John Hay.—Walter Keeble.—Richard Jorman.—W. F. Denning.—Fiddler.—J. Swift.—Capt. Crozier.—A. W. Brewtnall.—Nathaniel Waterall.—Whitley Partners.

Communications which can only appear as advertisements to hand from G. E. G., A Draughtsman, John Robinson, Hamlet, O. J. P., Montre, C. L. A., A New Reader, E. L. J., An Old Subscriber, Achilles, J. H. E., W. Copeland.

GAMBA, Bed of Stone, Screw-cutter, W. B. V., Aspirant, Amateur, A Sufferer, F. S. B., Gloster, W. W., B., Experto Crede, T. H. F., Alfred, and David Williams are referred to indices to back vols.

VENTILATION.—"E. L. G." was mistaken in letter 4087, in saying "Philo" ran away from his challenge. His letter in reply to it was not inserted for want of room and other reasons. "Philo" shows no fear of a fight, whatever his other shortcomings may be.

N. J. G. C.—Write Mr. Browning, 111, Minories.

MORNING.—Because your query was an advertisement.

QUI QUÆRIT.—It meant that we do not receive answers to advertisements and forward them to advertisers. See "Hints to Correspondents," over Replies to Queries.

SUFFIRE.—Query 11454 was answered in due course.

SHADY SIDE OF FIFTY hopes we shall adopt the suggestion of J. Rae, and use a little larger type.

C. E.—See a little book on Dilapidations, by Mr. B. Fletcher; published by E. and F. N. Spon.

VULCAN.—You ask a question and send a drawing that would cover half a page, and would cost about £8 to engrave. Did it occur to you that you were asking too much of our space and our money? Try and put your question without the drawing, or with a small one, and we will insert it.

S. J. STAFFORD.—If a "regular subscriber" you are an irregular reader, as we have said dozens and dozens of times that we do not answer querists by post, neither do we insert queries that only minister to *individual* benefit.

W. ROBERTS (Stonehouse).—You begin your rather long query thus: "Will any of our competent mechanical readers give an opinion on the accompanying sketch, which I presume is so simple," &c., &c. We do not insert illustrated queries on speculative notions to elicit the "opinions" of readers. Why not try the experiment yourself, and then, if you think well, give the ENGLISH MECHANIC the results of your experience?

WEE PET.—Consult in such a case a shoemaker. It will save you trouble and expense.

BED OF STONE.—Query about "lame hen," too trivial.

J. RAWDIN.—See "Hints to Correspondents," No. 6.

H. B. E.—We hope to say something soon about the mechanical inventions at the International Exhibition.

JAS. WADDINGTON.—Please say whether your drawing is a design for a steam tricycle or an illustration of a fact.

H. C. JONES.—It was not "Zoo Andra" who inserted the advertisement you refer to.

ARTHUR BOOTY.—Trübner and Co., Paternoster-row.

S. H. L.—Send.

T. F. S. M. R.—Send description for the benefit of others besides "Modeller." If you want to communicate with him privately, you must advertise.

ONE WILLING TO LEARN.—Pianoforte-tuning is a trade, and can scarcely be taught by a few hints, even to "one possessing a little knowledge of music."

RICHARD HOLDEN.—Have the tooth properly stopped by a dentist.

ANGELO.—You can have any back numbers sent to you at the rate of 5d. each, including postage.

CHICAGO.—The number of the current volume is denoted in the left-hand bottom corner of the first page. See reply to "Angelo."

METEOR.—The proposed monthly record would take too much of our space.

AN OLD PRACTICAL MINER.—We think you hardly touch the side of the question with which we have to deal, viz.—the scientific means available for the prevention of explosions.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MAY 7, 1872.

1286 H. Myerns, Liverpool, for a solution for joining vulcanised indiarubber.

1287 G. Edwards, Park-road-villas, Battersea, for improvements in cabs and other vehicles or carriages.

1288 J. Walker, James-street, Saint Luke's, and A. E. Ragon, Upper Westbourne-terrace, for a new or improved method of constructing public and private buildings, bridges, and other similar structures practically fireproof by the combination of wood and iron in the framing thereof.

1289 L. Cooper, Manchester, for improvements in machinery and apparatus for transporting passengers, goods and other articles. A communication.

1290 H. A. Bonneville, Piccadilly, for a new or improved medical injecting or irrigating apparatus. A communication.

1291 J. Smith, Manchester, for improvements in machinery or apparatus for beetling woven fabrics.

1292 D. Hebson, Liverpool, for improvements in steering gear.

1293 C. Duff, Wandsworth-road, for improvements in the treatment of fibrous substances to be used in the manufacture of pulp for paper, and for conversion into spun and textile fabrics.

1294 T. H. Blamires, Huddersfield, for improvements in machinery for spinning or twisting yarn.

1295 B. A. L. Hautrive, Shrewsbury, for an improved apparatus to facilitate drawing and sketching.

1296 R. Boyle, Glasgow, for improvements in ventilators and smoke extractors.

1297 J. Firth, Sir C. H. Firth, and E. Firth, Heckmondwike, Yorkshire, for improvements in looms for weaving.

1298 Sir J. Whitworth, Manchester, for improvements in gun carriages.

1299 J. Bending, Oxford-street, for improvements in apparatus for producing vapours for medicinal purposes.

1300 J. T. Griffin, Upper Thames-street, London, for improved arrangements of reaping machines to facilitate their transport by road or from place to place. A communication.

1301 W. G. K. Breavington, Regent-street, and T. I. Isaacs, Archer-street, Middlesex, for improvements in reed organs.

1302 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of steel. A communication.

1303 W. S. Fish, Glasgow, for improvements in locking nuts on the bolts used in the fish-joints of rails and other situations, and in means employed therefor. A communication.

1304 W. R. Lake, Southampton-buildings, for improvements in roofing and in apparatus employed in the manufacture of the same. A communication.

1305 H. Hirsch, Craven-street, Strand, for improvements in the form and construction of ships and other vessels.

1306 C. Lund, Fleet-street, for an improved cutting instrument particularly intended for opening tins of preserved food.

1307 L. Bradley, Park-place, Regent's-park, for improvements in the manufacture of cement.

1308 C. H. Southall, Leeds, for improvements in machinery for finishing the bottoms of boots and shoes, and for paring the edges of the soles and heels.

1309 W. W. Box, Crayford, Kent, for improvements in apparatus used in the manufacture of gas.

1310 M. Henry, Fleet-chambers, Fleet-street, for improvements in reeds, sleys, or combs used in the manufacture of textile fabrics. A communication.

1311 W. Jackson, Caroline-street, Pimlico, for improvements in sewing or stitching machines consists of a guard which prevents the under cotton or thread from being caught by the hook, and an improved system for fixing the needle.

1312 F. A. Gatty, Accrington, Lancashire, for improvements in printing and dyeing cotton fabrics.

1313 C. A. de Laskarzewski, Coventry-street, Middlesex, and H. Kehrmann, West Brompton, for improvements in the manufacture of pianofortes.

1314 G. B. Smith, Kennington, for improvements in manger logs or balls.

1315 J. S. Hughes and C. E. Spooner, Carnarvon, for improvements in the means of obtaining motive power for working railways and tramways.

1316 J. Fielding, Liverpool, for improvements in steam and water rotatory engines, applicable also for pumping purposes.

1317 J. Hodgkinson and T. Thornley, Bolton, for improvements applicable to bobbin and fly frames for preparing cotton and other fibrous materials for spinning.

1318 W. H. Percival, Aldershot, for improvements in camp bedsteads.

1319 R. Coddington, Chancery-lane, for improvements in printing presses, partly applicable to other machines. A communication.

1320 W. A. Lyttle, The Grove, Hammersmith, for improvements in the means and apparatus for attaching telegraph wires to insulators, and for protecting such and other insulators from breakage.

1321 W. A. Lyttle, The Grove, Hammersmith, for improvements in the construction of ships and boats.

1322 A. Clark, Rathbone-place, Oxford-street, for improvements in corrugated metal revolving shutters.

1323 H. R. Fanshawe and M. Bird, Southampton-buildings, for improvements in cigars, cheroots, and cigarettes, and in their manufacture, and in the manufacturing apparatus employed.

1324 J. Piddington, Gracechurch-street, City, for improvements in breech-loading fire-arms. A communication.

1325 G. T. Mackley, Shoreditch, for improved apparatus for supplying cotton and other fibrous materials to the shuttles of lock-stitch sewing machines.

1326 E. Craddock, Fowkes'-buildings, City, for improvements in the manufacture of pipe wrenches.

1327 T. Christy, Jun., Fenchurch-street, City, for improvements in the treatment of ammoniacal and other liquor of gas-works, sewage, and other waters containing foreign matters in suspension or solution in order to obtain useful products therefrom. A communication.

1328 H. A. Dufrené, South-street, Finsbury, for improvements in watches. A communication.

1329 J. H. Johnson, Lincoln's Inn-fields, for improvements in apparatus for disengaging ships' boats. A communication.

1330 F. Finlay, Camden-grove, Peckham, for improvements in the further application of asphalte.

1331 A. Smith, Manchester, and E. Kenyon, Hollinwood, Lancashire, for improvements in the manufacture of velvets, velveteens, and other piled fabrics.

1332 W. R. Lake, Southampton-buildings, for improvements in the construction of metallic springs. A communication.

1333 J. Richards, G. Lawrence, and J. W. Lingard, Birmingham, for an improved spring flower or bouquet holder.

1334 W. Darlow, North Woolwich, for improvements in the construction of portable magnets for curative and other purposes.

1335 N. Ager, Grosvenor road, Pimlico, for improved machinery for the manufacture of stock and other bricks and similar bodies from plastic materials.

1336 M. Henry, Fleet-chambers, Fleet-street, for an improved box. A communication.

1337 J. James, Princes-street, Lambeth, for improvements in part of the process of manufacturing cartridge cases and in apparatus therefor.

1338 W. Hammant, Bouverie-street, Fleet-street, for a new or improved method of propelling carriages with or by compressed air.

1339 W. E. Kochs, Manchester, for an improved boiler for generating steam.

1340 S. Vigoureux, St. Denis, France, for an improved means of forming threads and the production of fabrics therefrom.

1341 A. P. Stephens, Brooklyn, U.S., for improvements in vises for machinists and others.

1342 R. B. Stephens, Langrish, Hants, for a new or improved milk-condensing apparatus.

1343 J. Briggs, High Holborn, for a new or improved apparatus, arrangement, or method for giving, receiving, and taking votes by ballot.

1344 W. R. Hodge and R. R. Hodge, Millwall, for improvements in the construction and arrangement of boilers for generating steam and economising fuel.

1345 J. H. Johnson, Lincoln's Inn-fields, for improvements in carding engines. A communication.

1346 D. Bentley and J. B. Jackson, Bury, Lancashire, for improvements in the construction of cylinders or drums for paper-making and other machines.

1347 T. J. Denne and A. Hentschel, Cambridge-road, Mile-end, for improvements in materials for dyeing raw, felted, and woven fabrics, and printing fabrics.

1348 T. J. Denne and A. Hentschel, Cambridge-road, Mile-end, for improvements in materials for finishing and currying leather.

1349 E. T. Hughes, Chancery-lane, for improvements in the manufacture of pianofortes. A communication.

1350 W. M. Brown, Southampton-buildings, for improvements in centrifugal machines. A communication.

1351 A. M. Clark, Chancery-lane, for improvements in rotary engines. A communication.

1352 H. E. Newton, Chancery-lane, for an improved composition to be used for the manufacture of drain pipes and other articles, and as a substitute for artificial stone. A communication.

1353 T. T. Macneill, Warwick-street, Cockspur-street, for improvements in subterranean railway or tramway intercommunication for cities and towns, and in the structures and apparatus employed therefor.

1354 J. Imray, Southampton-buildings, for improvements in interlocking apparatus of railway points and signals.

1355 W. Brookes, Chancery-lane, for improvements in means for communicating motion and pressure to parts of presses, cocks and valves, vices and jacks, which improvements are also applicable in communicating motion and pressure to parts of other apparatus. A communication.

1356 R. M. Marchant, Kirby-street, Hatton-garden, and B. J. Angell, Lubenham, Leicester, for improvements in horse-shoes.

1357 R. W. Marshall, Owlerton, Sheffield, for improvements in the manufacture of bearings.

1358 R. Waygood, Falmouth-road, Surrey, for improvements in the construction and arrangement of steam and other engine governors, and in valves to be used in connection therewith.

1359 G. H. Carter, Eltham, Kent, for improvements in the construction of gas stoves, applicable for heating public and private buildings, pineries, hot-houses, graperies, and such like buildings and purposes.

1360 W. Ellis, South Lambeth, for improvements in or applicable to machinery or apparatus for cutting wood to any required shape, pattern, or design.

1361 W. R. Lake, Southampton-buildings, for improvements in the manufacture of knitted fabrics, and in machinery employed therefor. A communication.

1362 R. Fish, Hornsey, for improvements in the method of and apparatus for revivifying materials used in the purification of gas.

1363 W. Mitchell, Waterford, Manchester, for improvements in the manufacture of felt carpets.

1364 E. Slaughter and A. L. Sacré, Bristol, for improvements in the construction and coupling of locomotive engines.

1365 J. E. Walker, Sunderland, and J. W. Cole, Newcastle-upon-Tyne, for improvements in apparatus for screening coals.

1366 J. Parks, Northwich, Cheshire, for improvements in fixing salt pans and in arranging the furnaces under the same.

1367 F. J. Sweeting, Rotherhithe, for improvements in apparatus for lowering boats from vessels.

1368 J. P. Fison, Cambridge, for an improved lifting and steering gear for double and three furrow ploughs.

1369 P. Couper, Edinburgh, for improvements in motive-power engines.

1370 H. Lomax and J. Lomax, Lancashire, and G. F. Bradbury and T. Chadwick, Oldham, for improvements in sewing machines.

1371 T. Turton, Liverpool, for improvements in spring safety valves.

1372 W. D. Player, Birmingham, for improvements in machinery for the manufacture of buttons.

1373 T. J. Denne and A. Hentschel, Cambridge-road, Mile-end, for preserving meat.

1374 W. L. Wise, Chandos-chambers, Adelphi, for improvements in musical instruments. A communication.

1375 C. [illegible], Compton-street, Brunswick-square, for a new washing fluid for obliterating marks or stains in white linen.

1376 D. G. FitzGerald, Loughboro'-road, North Brixton, and B. C. Molloy, Elm-court, Temple, for improvements in treating compound substances by the agency of electricity, and thereby decomposing them or resolving them into their components.

1377 J. D. Culp, Santa Clara, U.S., for an improved process for drying and curing leaf tobacco raised from Havanna seed, and to be used for the manufacture of cigars, in order to impart to it the colour and flavour of real Havanna tobacco, independent of the soil and climate in which it is raised.

1378 W. R. Lake, Southampton-buildings, for improvements in electric torches for lighting gas. A communication.

1379 R. J. Edwards, Shoreditch, for improvements in the manufacture of sand, emery, and glass papers and cloths, and in the machinery and apparatus employed therein.

1380 B. Hunt, Serle-street, Lincoln's Inn, for improvements in the manufacture by rolling of straight axles for waggons, tenders, locomotives, and other wheeled vehicles. A communication.

1381 B. Hunt, Serle-street, Lincoln's Inn, for improvements in the manufacture of metallic wheels for railways. A communication.

1382 J. H. Johnson, Lincoln's Inn-fields, for improvements in the treatment of corn and other grain, and in the machinery or apparatus employed therein. A communication.

1383 J. H. Johnson, Lincoln's Inn-fields, for improvements in the treatment of coal and in the preparation of artificial fuel. A communication.

1384 B. J. B. Mills, Southampton-buildings, for improvements in apparatus for heating air to a high temperature for use in furnaces and for other purposes. A communication.

PATENTS SEALED.

2955 W. H. Tooth, for improvements in breech-loading small arms.

2976 A. Jaynor and S. F. Smith, for improvements in night signals for naval, military, and other purposes where night signalling is required.

2978 J. Blakey, for improvements in brakes.

2981 H. Denton, for improvements in actuating and constructing the rakes of reaping and mowing machines.

2993 G. Heywood and G. Whewell, for improvements in steam boilers or generators, and in the arrangement of the furnaces and flues thereof.

2999 J. C. Mewburn, for improvements in machines for embroidering.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MAY 24, 1872.

ARTICLES.

AIR AND RAIN.*

UNDER this title Dr. Angus Smith has gathered together and published the results of his investigations into air and rain, and of the experiments made to determine their relative purity or impurity in various parts of the British Isles and on the Continent. As a first step towards establishing a chemical climatology the book will undoubtedly be extensively read; and although a tentative effort to place the analysis of air and rain as affecting the health of the community on a more scientific basis, it must be regarded as the standard text-book of the present time, and in all probability for a long period in the future. Dalton, it is said, considered that chemical experiment could not distinguish the air of Manchester from that of Helvellyn, but the progress made in scientific knowledge since that time has shown that he was mistaken, and that it is not only possible to exhibit a distinction between the air of our manufacturing towns and that of Ben Nevis, but also between the different parts of those towns themselves, and, further, to draw important conclusions from the results thus exhibited. Chemistry, says Dr. Angus, has not hitherto done enough in sanitary inquiries, though it ought to be able to relieve medical men of much of their heavy responsibility, and it is chiefly with this view that he has gathered together the papers and reports written by him, the latter being furnished to the Government in his capacity of Inspector-General of Alkali Works. Besides the two principal gases found in atmospheric air we know that there are others which, though small in quantity, are nevertheless powerful for evil, and in the neighbourhood of towns, and particularly of those which are the seats of special manufactures, ocular demonstration is afforded of the deleterious nature of some of the vapours and gases thrown into the air in unknown quantities and numbers, while others, probably not the least hurtful, escape detection both by the eye and nose. We know also that there are innumerable solid particles, consisting of common salt, sulphate of soda, nitrate of ammonia, and sometimes lime-salts and iron, as well as phosphates, iodides, and, in fact, probably a little of nearly everything at times. Besides all these we have organic substances given off from animals and vegetables, and, finally, living things themselves, capable of propagation wherever they may find suitable conditions and food. It may possibly be true that some of these latter are useful, many inert, but it cannot be doubted that a very large proportion are positively hurtful—conveyers of disease, if not actually the producers.

Numerous observers have experimented on the air and calculated the amount of oxygen it contains, and although formerly results differed, owing probably to defects in the modus operandi, latterly the analyses have come much nearer agreement and to minute accuracy. Gay-Lussac and Humboldt gave the mean as 21·0 volumes per cent. of oxygen; De Saussure, after numerous experiments at Chambeisy, found a mean of 21·0; and Dalton found the air at Manchester to contain from 20·1 to 21·5 per cent. Bunsen, at Heidelberg, however, found an average of several trials to give 20·924; and Regnault, whose results are probably most reliable, from the number of experiments he made in different parts of the world, obtained a mean of 20·949, while 100 specimens of Paris air gave 20·96. Priestley, when oxygen was first recognised, imagined that the amount varied to the extent of 6 per cent., and Scheele is said to have obtained as much as 30 per cent.; but Cavendish, by making a series of 500 analyses, arrived at the conclusion that 20·833 was the mean amount, and later experiments have shown that he was not far out, Graham and Liebig both giving 20·9. Dr. Angus Smith found, from repeated analyses, the following percentage, which we extract from his table as characteristic situations :—

On the N.E. shore and heaths of Scotland	20·999
Outer circle of Manchester (not raining)	20·947
Open places, London, summer	20·950
In a sitting-room, which felt close, but not excessively	20·890
In a small room with petroleum lamp	20 840
Theatre gallery, 10 30 p.m.	20·860
Theatre pit, 11.30 p.m.	20 740
Backs of houses and about closets	20·700
Court of Queen's Bench	20 650
Under shafts of metal mines (average of many)	20·424
When candles go out	18 500
Worst specimen found in a mine	18·270
Difficult to remain in	17·200

The cursory reader who does not stop to examine what these figures really mean will probably exclaim, What difference capable of affecting health can there be in the air of London and that of Scotland—20·999 against 20·950 per cent. of oxygen! It is quite true that a mere deficiency of oxygen to the extent of 49-10,000ths may affect us but little, but that deficiency means something more than a mere absence to that extent of oxygen; it involves a question as to what has taken its place. Even so slight a difference as that between 20·999 and 20·980 is equal to 190 in a million, and if we put impurity into water at this rate it amounts to 13·3 grains in a gallon. This amount, says Dr. Smith, would be considered enormous if it consisted of putrefying matter, or any organic matter usually found in waters. But we drink only a comparatively small quantity of water, and the whole 13 grains would not be swallowed in a day, whereas we take into our lungs from 1,000 to 2,000 gallons of air daily. We must remember, too, that the blood receives the air and such impurities as are not filtered out in its passage, whereas the stomach has powers of disinfection and destruction which render harmless many organic impurities contained in water. But if we take the air found in the pit of the theatre we find that the difference amounts to 2,590 in a million, and the importance of the minute analysis becomes evident. It is rather curious that in the atmosphere of towns more oxygen is found after rain has washed out the carbonic acid than before, some analyses giving more than 21 per cent., the experiment being frequently repeated to guard against what at first was supposed to be an error.

The experiments carried on at Dr. Smith's laboratory in Manchester furnish in a conclusive manner, the proof of the statement enunciated above; for, from a number of trials on air taken from the front of the laboratory and from the back near an ash-pit—in which the means were respectively 20·943 and 20·70—it was found that not only was there a diminution of oxygen in the less pure spot, but that the carbonic acid was not in sufficiently increased proportion to make up for the loss of oxygen. Dr. Smith thinks, therefore, that wherever there is a diminution of oxygen from the standard that is a proof of impurity. "We see putrid matter laid on the ground, and find it disappearing rapidly, and yet we are told that it is not accompanied by loss of oxygen: it is not credible, and the results given show it to be incorrect." Those of our readers who are curious to know the percentage of oxygen found in different parts of London and in various parts of the kingdom and the Continent, must refer to the book; but we may mention that the average of six samples taken on the Metropolitan Railway give, as might be expected, a result as low as that found "about backs of houses and closets"—viz., 20·70—one specimen taken at the open window at 10 a.m. only giving 20·60. We may also mention that the amount of carbonic acid from air at the top of the Monument was considerably in excess of that found at the Duke of York's Column, or at Small Alley, Smithfield.

Not the least interesting of Dr. Smith's experiments were those undertaken to ascertain the amount of impurity in metalliferous mines, the air of which is contaminated by the candles and the breath of the miners, as well as by the gases given off in the explosion of gunpowder. Besides the impurities proceeding from these sources, there are, of course, small quantities of organic substances derived from tallow, tobacco, the human skin, and from putrefaction: it was found impossible to separate these, and in order to obtain a reliable idea of the separate effect of the principal agents, a lead chamber was constructed in which the experimenter could shut himself up from the external air. This chamber contained 170 cubic feet of air when furnished with a table and chair, and occupied by one person. On a day when the temperature was 45°F. no difference in the air breathed was perceptible for 25 minutes, but when drawn from the top by moving an umbrella up and down, it seemed like a soft wind capable of producing a slightly pleasant feeling, being, however, utterly without the property of producing that cheering and exhilarating effect to which we are accustomed in a gentle breeze. The air was moist, and a specimen of it deposited water. After an hour the well-known organic smell noticed in a crowded school-room was perceptible on moving about rapidly; and at the end of the experiment, which lasted 100 minutes, had a very unpleasant flavour and smell, and persons who entered immediately the door was opened, pronounced it very bad. Still, Dr. Smith says he did not feel uncomfortable, although the percentage of oxygen must have been reduced below the average found in the ordinary circumstances of daily life, showing the seductive and insidious character of breathed air. After a stay of 2 hours 20 minutes in the chamber, however, long inspirations became more frequent, and the air was found much less agreeable when breathed at the upper part by standing on a chair; at the end of three hours the amount of oxygen was reduced to 19·61. In an experiment with burning candles it was found that the amount of light was sensibly diminished, and when the candles went out the percentage of oxygen was found to be 18·80*, and of carbonic acid 2·28. On entering the chamber with candles and a spirit lamp the lights were speedily extinguished, and it was found impossible to re-kindle them with matches, the ordinary wooden ones refusing to ignite. Still, it was possible to breathe without difficulty, although a feeling of discomfort was soon experienced. Afterwards gas was lit and burnt brilliantly, but on entering with candles after the gas had gone out they were instantly extinguished. Nevertheless, it was still possible to breathe, although when Dr. Smith stood on a chair he experienced a feeling similar to incipient faintness; "but the senses were not annoyed by anything beyond a feeling of closeness, by no means so unpleasant as a school-room." This is an important fact, as Dr. Smith says, showing almost conclusively that organic matter is the cause of the unpleasantness to the senses on entering a school-room; for there was comparatively little organic matter in the chamber, and the school-room would have more oxygen than the chamber, the percentage found in the latter, after allowing the door to open for three persons to enter, being found to be only 17·45. The conclusion to be drawn from these experiments, therefore, is that the senses are bad and inefficient guides to the wholesomeness of air as regards the amount of oxygen and carbonic acid, save when the former is reduced and the latter increased to such an extent that the lungs seem to refuse to expand, and the whole vital action is threatened with paralysis. This was clearly proved in an experiment, in which a young lady entered the chamber as the candles were giving indications of going out, so that there could not be over 19 per cent. of oxygen nor less than 2·1 of carbonic acid. As no one had been breathing in the chamber there was no organic matter from the human body in the air, and for five minutes the young lady found no difficulty in breathing, and experienced no unpleasant sensation, but at the expiration of that period she became suddenly pale, and had to be assisted out of the chamber. It will thus be seen within what very narrow limits the amount of oxygen necessary for healthy life is confined, and the importance of the figures given in the table above is clearly shown. Rooms badly ventilated which contain less than 20·7 per cent. of oxygen are very unwholesome, and the necessity of taking into consideration the proportions of oxygen and carbonic acid in the sanitary inspection of factories and workshops is abundantly evident from the results obtained by Dr. Smith. We must postpone our remarks on the portion of the work devoted to analyses of rain to a future time; but meanwhile we may say that these "beginnings of a chemical climatology" should be studied by all sanitarians, and their teachings thoroughly grasped by those whose duty it will be to direct legislation on the subject.

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* Air and Rain. By R. ANGUS SMITH, Ph.D., F.R.S., F.C.S. London: Longmans.

* Candles placed in a tin box over water, however, were found to burn till the oxygen was reduced to [illegible] of 15·5 per cent.; but in the lead chamber the candles [illegible] extinguished by the tallow refusing to melt. [illegible] reason miners incline their candles so that th[illegible] may melt the grease.

ELECTRICITY—WHAT IS IT?

By B. Thompson.

I.—Electricity a Form of Motion.

I KNOW, to those tolerably well acquainted with the science of electricity, few arguments would be required to make them believe that electricity is a form of motion as much as heat or light; but since the object of this communication is more especially to show the difference between the motion of electricity and that of heat, light, or sound, I think it advisable to go through the principal arguments for supposing electricity to be motion, as they all bear directly upon the subject which is as follows.

Electricity is a force which resists all direct analysis on account of the difficulty which is experienced in retaining it, and the great restrictions one is under when dealing with it, which are greater and more numerous, I think, than those required in the examination of any of the other physical forces; we can, therefore, only judge of its nature by noting the laws which govern its development and phenomena; these, again, are very numerous and complicated, many of them, however, are identical with the laws governing other branches of physical science, and I think we shall be able to obtain clearer conceptions of the nature of electricity by studying this connection, together with the exceptions, than it appears we are enabled to by direct experiment.

We will first consider in what respects especially it differs from the ordinary physical forces of sound, heat, and light, as the coincidences of the laws regulating these and electricity are very significant, and point to an intimate connection, if not common origin.

Sound, we know, is propagated and made sensible to us by the undulations a vibrating body has imparted to the surrounding air; the molecules of air in immediate contact with the sounding body deliver the pulse they receive to other contiguous molecules, and so the motion is carried on until expended. And, so far as can be ascertained, heat and light are propagated by the same wave-like motion, which, however, does not use the air as a medium, but a (hypothetical) ethereal substance called ether. This is supposed to pervade all space and surround the atoms of all bodies, preventing the atoms themselves touching each other. The rate of vibration in the case of light and heat is, however, immensely greater than that producing sound, as the substance which conducts them is immensely rarer than that which conducts sound.

Apparently, electricity bears most resemblance to the former of these forces in requiring a substance more ponderable than ether to conduct it—as we shall see by after experiment—yet it is more intimately connected with heat than sound; as is shown by the ready and reciprocal transmutation of the one into the other, so that a full explanation must be one founded on a property common to both sound and heat. The most evident common property, and, I think, the one upon which all the other resemblances depend, is, that they are both modes of motion. Therefore, we may with some reason infer that electricity, also, is a mode of motion, and this will appear more evident as we proceed.

It is now generally admitted by philosophers that the dynamical theory of heat is most in accordance with the present state of scientific knowledge; especially since the exhaustive investigations of Professor Tyndall; and the belief, too, is growing fast that all the physical sciences are connected, and require a dynamical theory to account for their behaviour; therefore, it cannot be regarded as presumption on our part to attempt to prove that electricity is a mode of motion, in opposition to the conventional fluid theories, especially when we see the very intimate connection with heat, which we know is a mode of motion.

We will first investigate the phenomena which called forth the remark at the commencement, that electricity apparently requires a substance more ponderable than ether to conduct it. It is impossible for us to conceive of force apart from matter, as it is only manifest to us by its effects in nature, and we are compelled to recognise the existence of a something pervading all space, by which the waves of light from distant stars reach us, and this assumption receives verification from the observed retardation of some planetary bodies from resistance. So electricity requires matter to act upon, otherwise it is not manifest to us, nor does it exist. This leads us to inquire immediately into its relation to the substance which conducts it; the inquiry is attended with difficulty, and we are apt to be misled, for we find that a solid conductor, such as copper, enables electricity to pass freely through it; but we also find that a comparative vacuum, such as that in the vacuum tubes (so called) of Geissler, &c., seems to facilitate the conduction of electricity; in the latter case, we are led to attribute the conduction of electricity to the ether contained in the tubes (absence of air, if you please); but to suppose that the conduction in the case of copper is due to the ether surrounding its atoms is untenable, for as Faraday remarks, "ether exists alike in conducting and non-conducting bodies; it would, therefore, in the case of a conductor, be conducting, and in the case of a non-conductor, non-conducting." So we have every reason to believe that it is the substance of the conductor itself which affects its conducting power for electricity, and not the ether. The following experiments I have selected to still further prove this point.

If a tube—fitted with two platinum wires in its ends, so as to be a very short distance from each other in the tube—be connected with a good air-pump, so that it can be exhausted whilst electricity is passing between the two electrodes; then heated to a dull redness, and the exhaustion continued; in a short time the sparks will cease to pass; the tube may now be sealed, and although there is a very slight distance between the platinum points, the passage of electricity is completely stopped. Indeed, a vacuum sufficient to effect this is not at all difficult to obtain, for if three tubes of the kind described above be filled with chlorine, and the gases of bromine and iodine respectively (three simple substances), and a current of electricity allowed to pass through them, the gases, will combine with the platinum electrodes, from the negative pole of the battery, and in a short time so completely exhaust the tube that electricity will cease to be conducted. Also, if caustic potash can get at the gas in carbonic acid vacuum tubes, it absorbs the carbonic acid (CO_2) by degrees, until electricity will not pass, seeming to show that a substance of a ponderable nature was necessary for the conduction of electricity, for the quantity of ether would certainly be increased by the removal of the air.

Reasoning from the above experiments does it not appear singular that a comparative vacuum should conduct electricity well, when one more perfect will not conduct it at all? but the fact may be we are mistaken in supposing that an attenuated medium conducts (in the sense I am now speaking of conduction) better than a solid conductor, and it will be my next duty to prove that it does not, both by experiment and reason, but that the effect we see is due to the incandescence of the particles of ponderable matter between the electrodes, which, if it be so, implies increased *resistance* rather than conduction, for we know the greater the resistance in a conductor, so long as it will allow a current to pass at all, the greater will be the heat developed in it.

For the determination of this point the aid of the spectroscope is very valuable. If the spectrum of a luminous body is examined by a spectroscope, it is found to contain certain bright bands across it, characteristic of and peculiar to the substance or substances which are incandescent. If we allow the spectrum to pass through the incandescent vapour of any of the elements burning the rays of like refrangibility are absorbed by it, and on now examining the spectrum the lines characteristic of the absorbing vapour are there, but are now dark instead of light. This explanation is, I think, sufficient to enable any one to understand the reasoning founded on it.

Now, if on examining the spectrum of the light we observe in a vacuum tube when a current of electricity passes, we discover the bands are such as would result from the incandescence of the gases or vapours in the tube, and that the lines are bright ones, can we resist the evidence forced upon us that the contents of the tube have been rendered incandescent by the electric current? That the lines are bright and characteristic, and the deductions drawn therefrom justifiable, will, I think, be evident from the following quotations of experiments.

Professor Roscoe, in one of his lectures at the Apothecaries' Hall, gave some experiments with Geissler tubes with which to demonstrate the various characteristic lights emitted by incandescent hydrogen, carbonic acid gas, nitrogen, &c. The nitrogen lines are seen in the spectroscope when the electric spark passes through air, together with those of oxygen and hydrogen, owing to the presence of aqueous vapour.

From the latter experiment, I think, we may form a reasonable and important hypothesis—namely, that when electricity manifests itself to us as light by spark, or otherwise, it is due to incandescent matter, whether it takes place in a vacuum tube or not. This idea is also supported by the fact that electricity passing through air gradually converts some of the oxygen into ozone, an allotropic form of oxygen. Sulphur, selenium, phosphorus, chlorine, bromine, and all the carbon compounds, &c., also give different and characteristic spectra when the electric current passes through them. If the spark takes place through a compound gas or vapour the spectra are those of the elementary constituents of the gas. It seems as if at very intense temperatures chemical combination was impossible, and oxygen, hydrogen, chlorine, and the metals, &c., could exist in a separate state, although mechanically mixed together.

It has also been shown that when the electrodes of a battery are composed of metals, coloured sparks are obtained characteristic of the metals, and by which their presence can always be detected, if not directly from the colour, by means of the spectroscope.

All these facts, I think, give great additional support to the hypothesis before expressed, that it was not the electricity we saw in a vacuum tube or as a spark, but that there had been a transmutation of electricity into light, by its rendering the intermediate substances incandescent.

And it is important for us to notice that the light and heat (the light being a consequence of the heat) produced are *directly* due to the electric current, and not to ordinary combustion, for they are produced in gases and vapours which will not support combustion in the least, or it might be supposed that the current's only function was to heighten the affinities of the elements.

In the above experiments we have the force of electricity producing the motion of heat, which must be the result of some form of motion accompanying the current of electricity, and inseparable from it. We will, however, continue the proof of this motion further, and in another direction.

When electricity is invariably sent through the same pole of an induction apparatus, through the wire of a telegraph, in a very short time the wire is torn or divided into small sections, which destroy its continuity; but when the current is sent alternately through each pole, the conducting wire remains uninjured. As each atom of the wire has its own electricity the same as each atom of the wire has its own heat (motion), it seems to indicate that during the passage of the same kind of electricity the pole of each atom is forced more and more in the same direction, till at last they are not able to return to their normal condition; the coercive force is completely overcome, and a rupture takes place, the more readily if there be any imperfection in the wire.

Faraday was led to believe that the conduction of electricity might be only a consequence of decomposition, for he found that ice would not conduct electricity at all (friction, would, however, overcome the resistance), whatever the power of the battery. Water, however, was readily decomposed by a powerful battery, and this behaviour he found almost universal—that bodies which do not conduct electricity when solid acquire that property when fluid, and are generally decomposed as soon as conduction begins. He also informs us, I think, that there are but two exceptions to this rule—sulphuret of silver and fluoride of lead, and his belief was that electricity was conducted in the same manner in the metals, in lacks, or in gases, but in different degrees.

Looking at the preceding experiments, we shall find that the deductions drawn from them are of universal application in the science of electricity. Thus, when a person completes the circuit of a powerful battery he feels a shock, but only on making and breaking contact, because when the current is circulating continually in one direction, the conducting atoms or molecules lying between the electrodes do not return to their original state, but continue in a polarised one, because the successive polarisations are too rapid to permit of it. So long as there is quiesence no shock is felt; when, however, the current is stopped the return of the polarised molecules to their original state causes a shock equal to that felt when they became polarised, and if the current were to circulate continually in one direction in a human body, analogous results to those noticed in a conductor of metal would occur—*i.e.*, the intermediate matter would suffer slow decomposition. Indeed, induction or medical coils have complete superseded the battery alone as curative agents, because of the evil results from electricity when applied direct from the battery alone. These coils have contact breakers to continually make and break the connection, and as often reverse the current.

I have not been particularly careful in the use of molecule or atom, but may say at this point that it is pretty evident it is the molecules which take the polarised state, as this assumption will enable us the better to understand the action of decomposition when the conductor is a compound, but at present it is a very difficult matter to deal with, as there is no strict electrical distinction of conduction which can be drawn between elementary and compound conductors when solid, although fluidity is not always essential to decomposition.

Turning, however, to the more immediate object of this communication, perhaps the greatest proof of motion in a conductor when a current of electricity is circulating in it is contained in the following:—

When a current of electricity is traversing a wire, so long as it is readily conveyed, there is little heat caused by it, but if the current be increased, the heat is likewise increased, and, therefore, we have the actual and direct transference of one kind of force into another, which certainly cannot be admitted without recognising a great similarity of nature. So, I think, we are bound almost to regard electricity as a modification of the force of heat, and, therefore, a mode of motion, as heat is.

(To be continued.)

CEMENT FROM SEWAGE.

THE new method of disposing of sewage by making it into cement, which has been practically and successfully tested during the last six months at Ealing, a village to the west of London, formed the subject of a paper read at a recent meeting of the Society of Arts by Major-General Scott, the inventor and patentee of the process. From this we gather, although the details have not yet been published, nor the process carried out in the most economical manner, that a cement equal to the best Portland or an excellent hydraulic lime can be made from the ordinary water-borne sewage at a cost which does not exceed that of Portland cement prepared in the usual manner, while the offensive nature of the fecal matter is completely destroyed. The principle of the process consists in mixing with the sewage quantities of lime and clay, the former ingredient combining with the carbonic acid of the fecal matters to form carbonate of lime, which is precipitated with the other solid ingredients in the form of an impalpable powder. The lime and clay are preferably thrown into the main sewer some little distance before reaching the outlet, so as to insure a more complete incorporation of the different matters while at the same time destroying the slimy glutinous character of the sewage "sludge," and keeping the drain clean and free from the festering and putrefying deposit which otherwise tends to choke it. The clay and the lime do not merely facilitate the deposition of solid matter, but, as is well known, they tend to purify the supernatant water. Now, lime and clay are the chief constituents of those limestones, which on calcination yield the best hydraulic limes and cements, and it is claimed for this process that there is a sufficient gain of cement-making material abstracted from the sewage to make the operation profitable, independently of the advantages gained by thus deodorising and defecating the excrementitious matters of towns, which must otherwise be disposed of in a manner more or less unhealthy, and very often at great expense. Hitherto it has been found impossible to clarify liquid sewage at once satisfactorily and profitably. The grosser particles, it is true, are deposited, when it is simply allowed to stand in tanks, but the supernatant water still holds in suspension a very large amount of solid matter which renders it unfit to be turned into any river from which a supply of potable water is drawn. There are chemicals capable of purifying the liquor and precipitating all the solid matter, but the expense attendant on their employment is too great to permit of their use. Of all the chemicals hitherto employed for this purpose ime and clay are the least costly, and now that it is shown that a useful material can be made from the resulting deposit the problem of sewage disposal seems in a fair way to be solved.

The success of the new process depends in no small degree on the fact that the precipitated matter supplies to a considerable extent the fuel necessary for the burning operation. The sewage being allowed to settle in tanks, and the supernatant water drawn off, it is found to be thoroughly deodorised, and may be exposed to the drying action of the air for an indefinite period, without giving rise to any offensive or deleterious vapours. It is then dried on tiles, beneath which the heated gases of the furnace are made to pass, and is then calcined in the ordinary manner. The fecal matters which subside in the settling tanks are found to consist to a large extent of organic compounds, which when dried and distilled, yield large quantities of inflammable gases; and although the proportion of carbon may be small, the hydrogen gives a most intense heat, the sewage thus supplying the greater portion of fuel required to turn it into cement. The experimental kiln at present used by Major-General Scott, is only about 4ft. 6in. in diameter, and 12ft. high, and the working of the process on this small scale requires from three to five bushels of coal per ton of material, yielding a heat sufficient to keep the drying floor red hot, as well as burning the mixture to cement. It cannot well be doubted, therefore, that on a larger scale more economical results would be obtained; but even as at present carried out, a useful article is manufactured and the sewage is disposed of in the least offensive manner yet devised. General Scott does not suppose that his process will entirely relieve the inhabitants of a small place like Ealing from a sewer-rate, but it will reduce the expense lower than any system yet proposed, save the plan of utilising it upon land, which is not always that *summum bonum* which its advocates would have us believe. It was urged in the discussion that followed the reading of the paper, that cement might become a drug in the market, if the sewage of towns was extensively utilised in this manner; but even supposing this to be the result, the expense of carrying on the process would not exceed that of the present costly and wasteful system, while the sewage would be disposed of in a far more satisfactory manner than that at present in use for getting rid of the refuse of the metropolis. As a matter of fact, however, the value of Portland cement has been considerably augmented of late years. Experiments have proved that it is a most serviceable material when employed as concrete for building purposes, and we look for a much more extended utilisation of its valuable properties in time to come. Anything, therefore, that will cheapen its production, even if that result is attained by making it a drug in the market at the expense of the rates, must be hailed with satisfaction, for from the evidence of Mr. Hawksley, Dr. Odling, Dr. Frankland, Dr. Voelcker, and Professor Abel, the sewage is most effectually deodorised, and while the solid ingredients—those most difficult to deal with—are utilised, the liquid portion can still be employed for irrigation. The general opinion of those best capable of judging, was in favour of the new process, as a means of getting rid of an intolerable nuisance, the only objection being the large quantity of cement produced—estimated by Dr. Letheby at a ton per day for every 10,000 persons. The plan is, of course, only applicable to towns where a system of sewerage is in existence or in course of construction.

KEROSENE AS A CURE FOR RHEUMATISM.

ALL the way from New Zealand comes the intelligence that the administration of kerosene has had a most decided and marked effect in the cure of chronic rheumatism. Mr. W. G. Kemp, L.R.C.P. and M.R.C.S., of Wellington, N.Z., sends to the *British Medical Journal* an account of six cases of rheumatism, in which kerosene appears to have acted almost as a specific. The dose is a teaspoonful in a wine-glassful of water every other night. It produces no unpleasant symptoms, no loss of appetite, and has no effect upon the bowels or kidneys. Mr. Kemp says:—"Although kerosene cannot be called a specific for rheumatism, I think that the cases cited are quite sufficient to induce medical men to give it a fair trial. I am unable to find any unpleasant symptom caused by taking kerosene. The great objections with many people to taking it, are the unpleasant taste and smell. Some have taken it in water or milk; but I have lately heard a patient say he could take it best with salt; a pinch of salt being put into the mouth and allowed to dissolve, and the oil then swallowed, mixed with about its bulk of water. I am not aware of the remedy having ever been used internally; but I trust some medical men will be found who will give it a trial and record the results of their cases. Externally, it is of great use in cases of burns, whether severe or slight; it seems to relieve pain more than any other application, especially if resorted to as soon as the injury is received. I have known cases of severe burn to heal up rapidly under its use alone."

LESSONS ON CHEMISTRY.*

BY SELIMO R. BOTTONE.

(Late of the Istituto Bellino, Novara, Italy.)

(Continued from p. 215.)

c2. SULPHURIC ACID. *Synonym: Hydrogen Sulphate.*† *Symbol:* $H_2'S''O_4''$. *Combining weight:* 98.

166.—PROPERTIES.—Pure sulphuric acid is a transparent, colourless, oily liquid, of a specific gravity of 1·854 at 32° Fahr. It is extremely corrosive, owing to its powerful attraction for water. For this reason it chars and decomposes most animal and vegetable substances (which may be looked upon as compounds of carbon and water), by abstracting their water and leaving their carbon. Such is its action upon sugar, wood, paper, &c. Taking the case of sugar as an illustration, the following equation will give an idea of the reaction:—

$$\underbrace{C_{12}H_{22}O_{11}}_{\text{Sugar.}} + \underbrace{11H_2SO_4}_{\text{Concentrated sulphuric acid.}} = \underbrace{11H_2SO_4H_2O}_{\text{Dilute sulphuric acid.}} + \underbrace{C_{12}}_{\text{Carbon.}}$$

In practice the elimination of water from the organic substance is seldom found to be so complete as that represented by the above equation; and owing to the heat generated during the action, part of the unaltered sulphuric acid is decomposed by the carbon produced, and a quantity of sulphur dioxide is consequently evolved.

Sulphuric acid boils at about 638° Fahr. When boiled, a small quantity of sulphur trioxide is evolved, and a liquid remains behind which contains only 98·5 per cent. of the pure acid. At this strength the acid may be boiled without being farther decomposed, its boiling point being then constant at 620° Fahr., and its specific gravity 1·846. A temperature of 15° Fahr. causes sulphuric acid to freeze to an ice-like mass. When mixed with water sulphuric acid gives rise to the evolution of great heat, the degree depending on the relative quantities of acid and water employed. For instance, with 4 parts of sulphuric acid to 1 of water, the temperature produced is 300° Fahr. N.B.—We would impress on the reader that on mixing sulphuric acid with water it is prudent *to pour the acid into the water*, for if the opposite mode of procedure be adopted, the contents of the vessel are sometimes ejected, such is the violence with which combination takes place.

Great cold is produced on mixing one part of sulphuric acid with four parts of snow, and this apparent paradox is owing to the fact that as sulphuric acid on mixing with snow reduces it to the liquid form, so the heat necessary to transform snow into water is abstracted from the surrounding bodies, *id est*, cold is the result.

167.—Sulphuric acid possesses in the highest degree the typical properties of the class of bodies known under the name of *acids*, hence it may not be amiss here to enumerate them.

Sulphuric acid is endowed with an extremely sour taste, so sour that 1 part of acid will give a distinct taste to 1,000 parts of water, hence it is often used to adulterate vinegar. It reddens litmus paper strongly, and can combine with nearly all metals and metallic oxides, with the production of a series of bodies called sulphates. When it acts on metals these generally replace and expel the hydrogen contained in the acid, thus:—

$$M'' + H_2'S''O_4'' = M''S''O_4'' + H_2'.$$

If a metallic oxide be used, a similar expulsion and replacement of hydrogen takes place, but the oxygen of the metallic oxide combines with this hydrogen to form water, as may be seen by the following equation:—

$$M''O'' + H_2'S''O_4'' = M''S''O_4'' + H_2'O''.$$

† Hydric sulphate.

168.—The generic name for compounds resulting from the combinations of metals with acids is *salts*. A salt may therefore be defined as being "an acid in which part or all the replaceable hydrogen has been substituted by a metal or body playing the part of a metal."

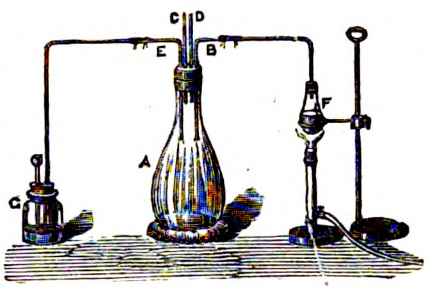
Salts may be divided into two grand classes—viz., 1. Those in which all the replaceable hydrogen of the acid has been replaced by the metal: these are said to be "neutral" or "normal" salts. *Potassium sulphate*, $K_2'S''O_4''$, will serve for an example of this class. 2. Those in which *only part* of the replaceable hydrogen is removed and substituted by a metal: such are called "acid salts," and *hydrogen potassium sulphate*, $\left.\begin{matrix}K'\\H'\end{matrix}\right\} S''O_4''$ may be taken as the type.

169.—Bodies which are thus capable of uniting with acids, whether they be metallic oxides or the oxides of bodies resembling metals, go by the general name of *bases*. The terms "acid," "base," and "salt," are by no means very accurate, or capable of very exact definition; but they are very convenient to point out the general properties of three large classes of bodies, hence they are often employed by the chemist.

of commercial importance, the preparation of sulphuric acid is of the highest interest and import to the scientific and practical chemist. We shall, therefore, enter somewhat into details, beginning by the experimental mode of preparing it, and after having traced the causes on which its production depends, terminate by noticing the several appliances employed in its manufacture on the large scale to bring these various causes into operation.

173.—We have seen (165) that when sulphur

FIG. 18



This nitric oxide absorbs oxygen readily from the atmosphere, being thereby converted into a higher oxide of nitrogen, known as nitrogen tetroxide. The mode in which this takes place is illustrated by the following equation:—

$$N_2'''O_2'' + O_2'' = N_2'''O_4''.$$

The sulphur dioxide issuing from the generator F meets with the nitrogen tetroxide formed by the action of the nitric oxide evolved from the bottle G on the atmospheric air in the flask. Though not able to absorb oxygen directly from the air, sulphur dioxide, by virtue of its deoxidising power, is able to take half the oxygen from the nitrogen tetroxide, thus:—

$$N_2O_4 + 2SO_2 = N_2O_2 + 2SO_3.$$

But the nitric oxide thus reproduced cannot exist *as such* in the presence of atmospheric air; it immediately absorbs oxygen from the air, and is reconverted into the tetroxide. Thus it acts as a *carrier* of oxygen between the atmosphere and the sulphur dioxide, which is therefore rapidly converted into sulphuric anhydride, and this body in contact with water gives rise to sulphuric acid.

Though other bodies, which part readily with their oxygen, might certainly be substituted for

FIG. 19

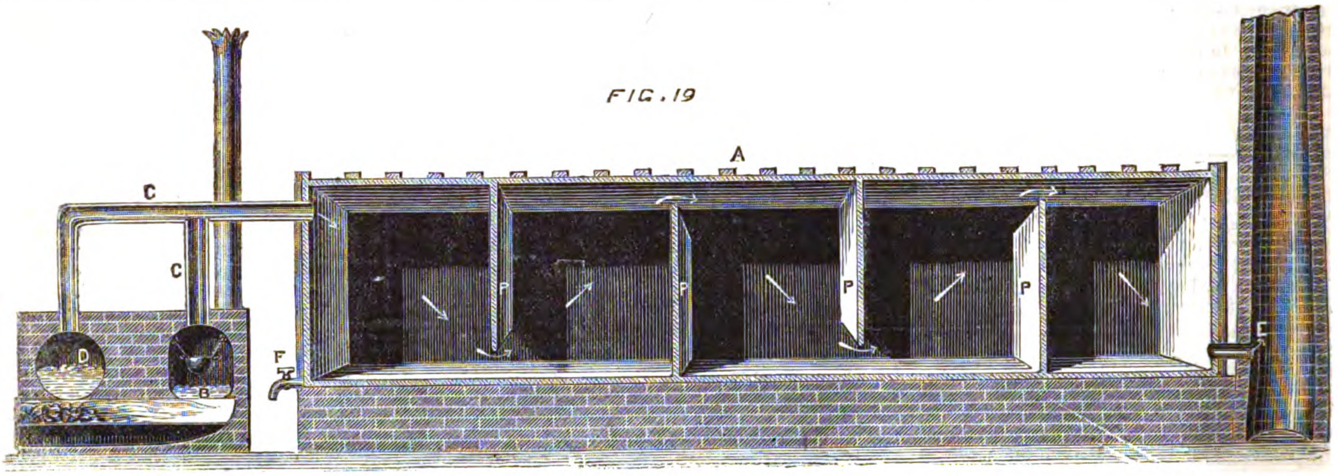


FIG. 20

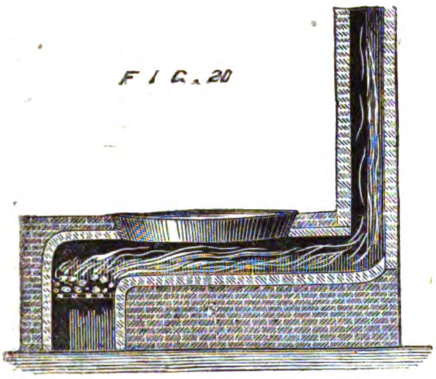


FIG. 21

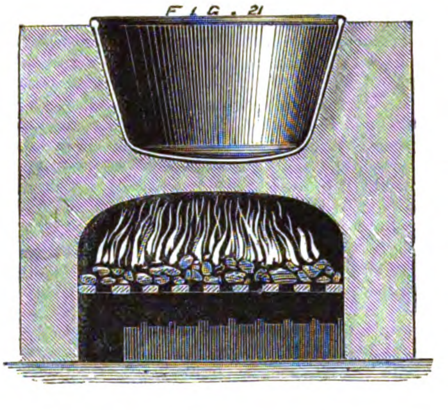
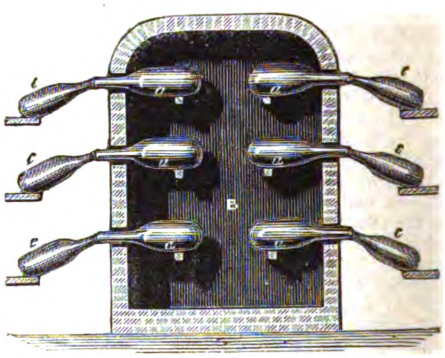


FIG. 22



170.—Sulphuric acid is one of the most useful chemical products employed in the manufactures and arts. Owing to its superior affinity for bases it is in daily use for the liberation of other weaker acids from their salts, hence its employment in the preparation of hydrochloric, nitric, acetic acids, &c. In dyeing, bleaching, and the manufacture of soda, sulphuric acid plays an important part, and a very useful application has been made of its effects on paper (when slightly diluted), in the preparation of *parchment paper*. Of the multifarious manufactures to which Great Britain owes her commercial prosperity, few could exist without the employment of sulphuric acid, hence enormous quantities are annually produced here, and very considerable imports of the Nordhausen acid (from the Harz Mountains, Germany) are also made.

171.—STATE IN NATURE.—Sulphuric acid is sometimes met with in certain volcanic springs. In the mineral kingdom it is largely found, in combination with various metals, in the form of *sulphates*. Sulphates are also found in the animal and vegetable kingdoms.

172.—PREPARATION.—Whether we regard it from a theoretical point of view, or from a point

is burned at high temperatures, in air or oxygen, sulphur trioxide is produced; we also have learnt that sulphur trioxide in presence of water gives rise to sulphuric acid (see 164). It might, therefore, appear that this would be a good method of preparing this body, but in practice the heat required is found to be so great, and the product so small, as to render it impracticable. But though we cannot conveniently cause sulphur to unite with the required amount of oxygen at one operation, yet by taking advantage of the attraction which sulphur dioxide has for oxygen, and its power of abstracting it from bodies containing it, we can do so in two operations, which may be made to take place simultaneously.

Let A, Fig. 18, be a glass flask, closed with a cork carrying four glass tubes, B, C, D, E. A small quantity of water is to be placed in this flask. The tube B is made to communicate with an apparatus from which sulphur dioxide is being evolved, while the tube E is connected with a bottle G, from whence a compound of nitrogen and oxygen, called *nitric oxide*, is issuing.

Nitric oxide may be considered as consisting of two atoms of nitrogen united to two atoms oxygen, as the following formula indicates:—

$$N_2'''O_2''.$$

nitric oxide as oxidising agents, none have as yet been found which possess at once the power of successively absorbing and parting with the absorbed oxygen in the manner above described.

This property enables a relatively small amount of nitric oxide to convert a large quantity of sulphur dioxide into sulphuric acid. The presence of water is absolutely necessary for the conversion of the sulphur trioxide produced into sulphuric acid, and should the supply be limited, a white crystalline compound, in which the elements of water contained in sulphuric acid are replaced by nitrogen tetroxide, is produced. This body, however, is immediately converted into sulphuric acid and nitrous anhydride when placed in contact with water. The water contained in the flask A becomes therefore gradually charged with sulphuric acid. The use of the two tubes, C and D, is to admit atmospheric air without incurring loss of the gases evolved from the two generators, F and G.

174.—In the above experiment, nitric acid, consisting of HNO_3, may be substituted for nitric oxide, for it is speedily reduced by successive steps to that state, as may be seen by the following equations:—

Nitric acid.		Sulphur dioxide.		Sulphuric acid.		Nitrogen tetroxide.
$2HNO_3$	$+$	SO_2	$=$	H_2SO_4	$+$	N_2O_4

But on meeting with a fresh supply of sulphur dioxide, nitrogen tetroxide is immediately converted into nitric oxide, thus:—

$$N_2O_4 + 2SO_2 = 2SO_3 + N_2O_2.$$

Consequently, whether we inject nitric acid or nitric oxide, the contents of the flask A are soon the same—viz., sulphur dioxide, nitrogen dioxide (nitric oxide), and atmospheric air. The round of interchanges is continuous, for as fast as the nitric oxide absorbs oxygen from the air to become tetroxide, it yields it to the sulphurous anhydride constantly supplied, which is thereby converted into sulphur trioxide, and dissolved by the water with the production of sulphuric acid.

175.—Figs. 19, 20, and 21, may serve to elucidate the means employed on the large scale to bring about these various results. A, Fig. 19, represents a large leaden chamber, divided into several communicating compartments by means of the partitions, *p, p, p, p*. Sulphur dioxide is produced in the furnace B, either by burning iron pyrites or sulphur. Directly over the space in which this burning is going on is placed a stone box or cast-iron crucible, containing materials for the production of nitric acid. Sulphurous anhydride, along with nitric acid vapour, passes from the furnace into the leaden chamber, through the short wide conduit C. Steam, from a boiler at D, is also thrown into the chamber, the floor of which is covered to the depth of a few inches with water.

A moderate current in the direction of the arrows is insured by the chimney E, which also serves to carry off the spent gases, &c. During its passage through the chamber this mixture of nitric acid, steam, and sulphur dioxide, is converted into sulphuric acid, as explained in paragraphs 173 and 174, and collects in the water on the floor of the chamber. When this has attained a certain strength, with a specific gravity of about 1·6, it is drawn off by means of the leaden pipe F. This dilute sulphuric acid is placed in large shallow leaden tanks, seen in section at Fig. 20, where it is evaporated to get rid of the excess of water. It cannot be concentrated in these tanks beyond a specific gravity of 1·72, as at that point it begins to act on and corrode the lead. At this point it is known in commerce under the name of "brown oil of vitriol." It is further concentrated by being cautiously evaporated in glass or platinum vessels (see Fig. 21) till it acquires a specific gravity of 1·854. It is then allowed to cool, and when cold drawn off by means of siphons, and stored in carboys. This is known as "double oil of vitriol."

Whatever be the exact composition of the nitrogen oxide employed to effect the oxidation of the sulphur dioxide, whether it be injected into the leaden chamber as nitric acid HNO_3, as nitrogen trioxide N_2O_3, or finally as nitrogen tetroxide N_2O_4, it is speedily deoxidised to the state of nitric oxide (N_2O_2), when the "carrying" effect begins, and the operation can proceed continuously without requiring any farther supply of nitrous compounds than that which is needed to make good the waste which takes place through the chimney E. The formation of the white crystalline body mentioned at 173 is a sign that the supply of aqueous vapour is insufficient. Binitro sulphuric anhydride, or De La Prevostaye's crystals, as this body is called, is composed of sulphur, oxygen, and nitrogen, linked together probably, as expressed by the following formula:—

$$N_2O_2 . SO_4 . SO_3.*$$

176.—As thus produced, sulphuric acid or oil of vitriol is a heavy, oily, slightly brownish liquid. This colouration is owing to the presence of charred organic matter. This commercial acid contains many impurities, which must be removed if the acid be required for analytic or other delicate processes. The usual impurities are lead, arsenic, iron, &c., and these may be removed by diluting the acid with its own weight of water, passing a current of hydrogen sulphide through it, and after repose decanting the clear liquid. This treatment removes the metals under the form of sulphides. By cautious evaporation in a platinum or glass vessel the acid may be once more brought to its highest strength, while any volatile impurities, such as nitric acid, &c., are simultaneously got rid of.

177.—Sulphuric acid unites with water to form two definite hydrates. One, having the composition of $H_2SO_4 + H_2O$, may be obtained in rhombic crystals by cooling a mixture of 86 parts pure acid and 24 of water down to 44° Fahr. Another hydrate, $H_2SO_4 + 2H_2O$, has also been obtained.

178.—When sulphuric acid is exposed to very high temperatures it is resolved into water, oxygen, and sulphur dioxide, thus:—

$$H_2SO_4 = H_2O + O + SO_2.$$

(See paragraph 86.)

178.—When certain metallic sulphates are well dried, to expel their water of crystallisation, and then placed in an earthen retort, the application of a bright red heat causes the evolution of a mixture of sulphuric acid and sulphuric anhydride, known in commerce as Nordhausen sulphuric acid. The composition of this acid may be represented as being—

$$H_2SO_4SO_3 = H_2S_2O_7.$$

The process followed in the Harz Mountains for the production of this body is the following:—Dried iron sulphate, having the composition of $Fe''S''O_4'' + H_2'O''$, is placed in a series of earthen vessels of the form represented in Fig. 22 (*a, a, a, a, a, a*), which are ranged in three tiers in a peculiarly-constructed furnace B. Wood is the fuel employed. When sufficient heat has been applied dense white fumes of the body in question begin to appear. This is the signal for attaching the receivers (*c, c, c, c, c, c*), made of the same material and shape as the retorts, only a trifle smaller. The acid condenses in these receivers, and is found in commerce under the name of "fuming" or "Nordhausen" acid. It is a viscid light brown liquid, having a specific gravity of 1·896. At 0° it solidifies, forming colourless transparent crystals. It fumes strongly in the air. Its principal uses are in the preparation of sulphur trioxide and the solution of indigo for dyeing purposes. The effect of heat on iron sulphate may be understood by the aid of the following diagram:—

2 molecules of iron sulphate	=	H_4	F_2	S_2	O_{10}
Yield by heat:—					
1 molecule of fuming acid	=	H_2		S_2	O_7
1 molecule of iron peroxide	=		Fe_2		O_3
1 molecule of hydrogen	=	H_2			
		H_4	F_2	S_2	O_{10}

179.—The following table, compiled by Dr. Ure, gives the amount of real acid, H_2SO_4, contained in oil of vitriols of different specific gravities:—

180.—Table showing the amount of sulphuric acid contained in oil of vitriols of different specific gravities, at 60° Fahr.:—

Specific gravity of fluid.	Amount of H_2SO_4 per cent	Specific gravity of fluid.	Amount of H_2SO_4 per cent	Specific gravity of fluid.	Amount of H_2SO_4 per cent
1·8485	100	1·5503	66	1·2334	32
1·8460	98	1·5280	64	1·2184	30
1·8410	96	1·5066	62	1·2032	28
1·8336	94	1·4860	60	1·1876	26
1·8233	92	1·4660	58	1·1706	24
1·8115	90	1·4460	56	1·1549	22
1·7962	88	1·4265	54	1·1410	20
1·7774	86	1·4073	52	1·1246	18
1·7570	84	1·3884	50	1·1090	16
1·7360	82	1·3697	48	1·0953	14
1·7120	80	1·3530	46	1·0809	12
1·6870	78	1·3345	44	1·0682	10
1·6636	76	1·3165	42	1·0544	8
1·6415	74	1·2999	40	1·0405	6
1·6204	72	1·2826	38	1·0268	4
1·5975	70	1·2654	36	1·0140	2
1·5760	68	1·2490	34		

ADJUSTABLE SPANNERS AND WRENCHES.

THE improvements in the construction of adjustable spanners, wrenches, &c., recently patented by Mr. James Hosking, of Stratford, which we illustrate in the annexed engraving, are worthy of a short notice, as spanners constructed on this plan may probably be found handy by many amateur mechanics. Fig. 1 illustrates the application of the improvement to an ordinary spanner, with a sectional view of the same. In this case a fixed head on a shank of the usual length has a rectangular mouth similar to the ordinary tool, but deeper in proportion to its width between the jaws. This aperture is made sufficiently wide to take in the largest sized nut or other body the spanner is intended to operate upon, and is filled up with a number of plates or tongues T of any required thickness, such thickness being regulated so as to agree with the different sizes of nuts for which the spanner is to be used. These tongues are centred on a pin, so that they may all be turned back or out of that part of the mouth which operates on the nut into the recess at the back of the pin, so as to rest on the web F, which prevents them falling through, as shown in the section, Fig. 1. Thus, if all the tongues are turned back into the recess the mouth of the spanner will be at its largest, and may be reduced as required to take in smaller sized nuts by turning one or more of the tongues into the mouth. It will be seen that when the tongues are turned into the mouth to reduce its width, they are prevented from falling through by their corners coming in contact with the edge of the web F.

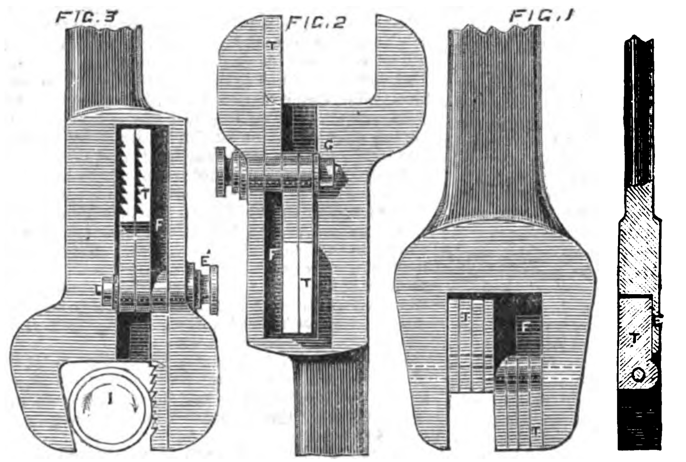


Fig. 2 shows a modified form, in which it will be observed that the mouth of the spanner is not wholly filled up with the tongues, but it is so arranged that when the whole of the tongues are turned into the mouth it will be of a size to take in and act upon the smallest sized nut it is intended for, other sized nuts being operated upon by turning one or more of the tongues back or out of the mouth. It will also be observed that in this design the pin on which the said tongues turn terminates in a screw which takes into a nut G let into a recess in one of the sides of the reserve recess F. Thus, by turning the pin by means of the thumb-stud, the nut G will be drawn against the tongues, tightening them together, and against the side of the reserve recess, and preventing them falling out, even if the spanner be turned over, thus enabling it to be used either side uppermost. The washer H is inserted to reduce friction.

Fig. 3 is a wrench, specially designed for grasping round surfaces, such as those of pipes, bars, or studs; it will also grasp oval, rectangular, or other surfaces. The action of this wrench is as follows:—I is a pipe that it is required to turn in the direction indicated by the arrow. After the

* Some chemists, while admitting that the above formula represents correctly the number of atoms of each element contained in the molecule of this compound, suppose the *arrangement* of these atoms to be different, and prefer giving the formula as being:—

$$\left\{\begin{matrix} SO_2\,(NO_2) \\ O \\ SO_2\,(NO_2) \end{matrix}\right\}$$

It would appear, however, that the constitution of this body varies, according to whether water is present in small quantity or totally absent. In the latter case the composition given above is probably the correct one; but if water be present, an intermediate body is formed, the composition of which is $SO_2\left\{\begin{matrix} NO_2 \\ HO \end{matrix}\right.$, or what amounts to the same, $\left.\begin{matrix} NO \\ H \end{matrix}\right\} SO_4$.

tongues have been turned back into the reserve recess, F, the mouth of the wrench is placed upon or over the pipe, allowing the smooth inclined surface to rest upon it, and then after turning as many of the tongues into the mouth as there is room for, the pipe will be jammed by drawing back the wrench, and can be turned as desired.

REPORT OF THE COMMITTEE ON THE PATENT LAWS.

THE Report of the Select Committee appointed to inquire into the laws and practice, and the effect, of grants of letters patent for inventions, was issued on Wednesday week. The committee contend that the law and its administration are defective, and they recommend the following alterations of the laws:—

That protection be not granted to any invention, except on the report of a competent person that certain conditions are fulfilled, those conditions being that protection for a limited period, and dating back to the time at which it is applied for, should only be granted for an invention on its nature, and particular points of novelty, being clearly described in a provisional specification, and upon the report of a competent authority that such invention, so far as can be ascertained by such authority, is new, and is a manufacture within the meaning of the law.

That no warrants for sealing letters patent be issued until the following conditions are fulfilled:—That letters patent ought not to be granted for any invention so protected until the provisional specification has been open to inspection, nor until a complete specification has been deposited, fully describing the means of carrying it into effect, and such complete specification has been found by the same authority to accord in all essential particulars with the description of the invention in the provisional specification.

That in the case of several concurrent applications for a patent of the same invention, the patent be granted to the first applicant, unless it be shown that he is not the first inventor.

That all trials of patent causes should be before a judge, with the assistance of skilled advisers (who may be Commissioners of Patents), and, as a rule, without a jury, but with power for the court to order a jury for the ascertainment of facts in exceptional cases requiring the same.

That the commissioners be reinforced by the appointment of competent persons of legal, scientific, and technical experience, whose time is not occupied with other engagements to such an extent as to prevent their giving full attention to such administration.

That the commissioners should make rules, relegating to some of their body, together with competent assistants, amongst other duties, that of ascertaining as to every invention for which a patent is sought to be obtained, whether it is properly the subject matter of a patent; whether its nature, and the particular points of novelty, have been clearly described in a provisional specification; and whether, so far as can be ascertained by them, it is a new invention; and, as to the complete specification, whether it fully describes the means of carrying the invention into effect, and accords in all essential particulars with the description thereof in the provisional specification.

That all letters patent should contain the following conditions not hitherto usually inserted therein, viz.:— That the manufacture be carried into effective operation within a reasonable time within the United Kingdom by the patentee or his licensees so as to supply the demand therefor on reasonable terms, and that licenses be granted by him to competent persons on fair conditions, such conditions, as well as the fact of competency, to be determined in the event of disagreement by the commissioners, due regard being had in such determination to the exigencies of foreign competition.

That besides the assistance afforded to intending patentees by the examination of their specifications, and by the reference library of the Patent Office, more satisfactory indices and abridgements of specifications be provided, and more particularly that the practice of accepting, without control or revision, the abridgements prepared by the patentees themselves be abandoned.

That the court or judges having discretion in patent litigation should avail themselves of the assistance of the commissioners for the better definition and limitation of the matters in dispute in respect of particulars of breaches and of objections respectively.

That in all future appointments of officers concerned in the administration of the patent law, remuneration by fees should (as it has been in the recent appointment of her Majesty's Solicitor-General) be discontinued.

The committee are of opinion that there should be an assimilation in the law and practice in regard to inventions amongst the various civilised countries of the world, and that her Majesty's Government be requested to inquire of foreign and colonial Governments how far they are ready to concur in international arrangements in relation thereto.

A GIANT PLANET.*

[From the *Cornhill Magazine*.]

THE planet Jupiter has been selected even by astronomers of repute as an abode of pleasantness, a sort of paradise among the planet-worlds. There exists, we are told, in that distant world, a perennial spring—"A striking display of the beneficence of the Creator," says Admiral Smyth; "for the Jovian year contains twelve mundane years; and if there were a proportionate length of winter, that cold season would be three of the earthly years in length and tend to the destruction of vegetable life."

Even those who have denied that Jupiter can be the abode of life, and have formed altogether unfavourable ideas of his condition, have pictured him, nevertheless, as the scene of continual calm, though the calm is, according to their view, the calm of gloom and desolation. They recognise in Jupiter an eternal winter rather than a perpetual spring. Whewell, for example, in that once famous work "The Plurality of Worlds," maintained that if living creatures exist at all in Jupiter, they must be wretched gelatinous monsters, languidly floating about in icy seas. According to him Jupiter is but a great globe of ice and water, with perhaps a cindery nucleus—a glacial planet, with no more vitality in it than an iceberg.

But when we begin to examine the records of observers, and to consider them with due reference to the vast proportions of the planet, we recognise the fact that whatever may be Jupiter's unfitness to be the abode of life, it is not of an excess of stillness that his inhabitants (if he have any) can justly make complaint. Setting aside the enormous activity of which the mere existence of the belts affords evidence, and even regarding such phenomena as the formation of a disappearance of a new belt in two or three hours as merely indicative of heavy rainfalls or of the condensation of large masses of invisible aqueous vapour into clouds—there have been signs on more occasions than one of Jovian hurricanes blowing persistently for several weeks together at a rate compared with which the velocity of our fiercest tornadoes seems utterly insignificant. During the year 1860, a rift in one of the Jovian cloud belts behaved in such a way as to demonstrate the startling fact that a hurricane was raging over an extent of Jovian territory equalling the whole surface of our earth, at a rate of fully 150 miles per hour. It is not too much to say that a hurricane of like velocity on our earth would destroy every building in the territory over which it raged, would uproot the mightiest forest trees, and would cause, in fact, universal desolation. At sea no ship that man ever made could withstand the fury of such a storm for a single minute. And yet this tremendous Jovian hurricane continued to rage with unabated fury for at least six weeks, or for fully one hundred Jovian days.

But during the last two or three years a change of so remarkable a nature has passed over Jupiter as to imply the existence of forces even more energetic than those at work in producing atmospheric changes.

In the autumn of 1870, Mr. Browning (the eminent optician and observer) called the attention of astronomers to the fact that the great equatorial zone, usually, as we have said, of a creamy white colour, had assumed a decidedly orange tint. At the same time it had become much less uniform in outline, and sundry peculiarities in its appearance could be recognised, which have been severally compared to port-holes, pipe-bowls and stems, oval mouldings, and other objects of an unocelestial nature. Without entering into descriptions which could only be rendered intelligible by means of a series of elaborate illustrations, let it suffice to say that the bright edges of the belts bordering on this ruddy equatorial zone seemed to be frayed and torn like the edges of storm clouds, and that the knots and projections thus formed often extended so far upon the great orange zone, from both sides, as almost to break it up into separate parts.

Now, without inquiring into the particular form of action to which these remarkable changes were due, we can see at once that they implied processes of extreme energy. For, every one of the projections and knots, the seeming frayed edges of narrow cloud-streaks, had, in reality, an extent exceeding the largest of our terrestrial countries. Yet their aspect—and, indeed, the whole aspect of the ruddy belt, whose extent far exceeded the whole surface of our earth—changed obviously from night to night.

Strangely enough, these interesting observations, though they were presently confirmed by several well-known students of the heavens, did not attract that full attention from the senior astronomers of the day which they appeared to merit. Several, indeed, of our leading astronomers were disposed to deny that anything unusual was in progress, though none asserted definitely that they based this opinion on a careful re-examination of the planet's face. But quite recently one of the most eminent of our modern observers—Mr. Lassell, lately president of the Royal Astronomical Society—(having been led to observe the planet by the fact that certain phenomena of interest in connection with the satellite system are now in progress), found his attention attracted by the marvellous beauty of the colours presented by Jupiter's belts. After describing the appearances he had intended to observe in the first instance, he proceeds. "But this was not the phenomenon which struck me most in this rare and exquisite view of Jupiter. I must acknowledge that I have hitherto been inclined to think that there might be some exaggeration in the coloured views I have lately seen of the planet; but this property of the disc, in the view I am describing, was so unmistakable that my scepticism is at last beginning to yield." Nor will this statement be thought to express more than the truth, when we add that in the picture accompanying his paper, Mr. Lassell presented the equatorial zone as brown-orange, and three neighbouring dark zones as purple; one of the intermediate light belts being pictured as of a light olive-green.

Let us compare these observations made in our brumous latitudes with those effected by Father Secchi with the fine equatorial of the Roman Observatory. "During the fine evenings of this month," he wrote last February, "Jupiter has presented a wonderful aspect. The equatorial band, of a very pronounced rose colour, was strewn with a large number of yellowish clouds. Above and below this band, there were many very fine zones, with others strongly marked and narrow, which resembled stretched threads. The blue and yellow colours formed a remarkable contrast with the red zone, a contrast doubtless increased by a little illusion. The surface of the planet is actually so different from that which I have formerly seen, that there is room for the study of the planet's meteorology."

It appears to us that when these remarkable changes are considered in combination with the circumstance that on *à priori* grounds we should expect the sun to have very little influence on the condition of the planet's atmosphere, the idea cannot but be suggested that the chief source of all this energy resides in the planet itself. The idea may seem startling at a first view, but when once entertained, many arguments will be found to present themselves in its favour.

For instance, it does not seem to have been noticed heretofore, as a very remarkable circumstance, if the Jovian belts are sun-raised, that they pass round to the nocturnal half of Jupiter and reappear again, with the same general features as before, and this often for weeks at a stretch. Even that remarkable feature whose changes led to the conclusion that mighty hurricanes were in progress, yet changed continuously and regularly during the Jovian nights as well as during the Jovian days, for one hundred such days in succession. This is perfectly intelligible if the seat of disturbance is in the planet itself, but it is perfectly inexplicable (as it seems to us) if the sun occasions all these meteorological changes in Jupiter, as he occasions all the changes which take place in our earth's atmosphere. The alternation of day and night, which is one of the most potent of all the circumstances affecting the earth's meteorological condition, appears to have no effect whatever on the condition of Jupiter's atmosphere!

Now, as respects the alternation of summer and winter, we can form no satisfactory opinion in Jupiter's case, because he has no seasons worth mentioning. For instance, in latitudes on Jupiter corresponding to our own, the difference between extreme winter and extreme summer corresponds to the difference between the warmth on March 12 and March 28, or between the warmth on September 15 and on September 31. Yet we are not without evidence as to seasonal meteorological effects in the case of the sun's outer family of planets. Saturn, a belted planet like Jupiter, and in all other respects resembling him so far as telescopic study can be trusted, has seasons even more markedly contrasted than those on our own earth. We see now one pole now another bowed towards us, and his equatorial zone is curved now downwards now upwards, so as to form two half ovals (at these opposite seasons), which, taken together, would make an ellipse about half as broad as it is long. As no less than fourteen years and a half separate the Saturnian summer and winter, we might fairly expect that the sun's action would have time to exert itself. In particular, we might fairly expect the great equatorial zone to be displaced; for our terrestrial zone of calms or "doldrums" travels north and south of the equator as the sun shifts northwards and southwards of the celestial equator, accomplishing in this way a range of no less than 3,000 miles. But the Saturnian equatorial zone is

* In a leading article (Saturday, May 4) the *Spectator* remarks that readers of Mr. Proctor's "Other Worlds" will entertain little question that the above essay on Jupiter is from his pen. The arguments in the essay are, indeed, for the most part new, relating as they do to recent observations; but the theory in support of which they are advanced, is that which Mr. Proctor advocated in the first edition of "Other Worlds." It may be added that in the second edition of that work, other arguments not mentioned in the first, or in the above article, are adduced in support of Mr. Proctor's theory. In particular, a remarkable phenomenon observed simultaneously by three astronomers (Smyth, Maclear, and Pearson)—viz., the appearance of a satellite outside Jupiter's disc ten minutes after its transit had commenced, finds an explanation if we accept the theory advocated in the above article.

not displaced at all during the long Saturnian year. It remains always persistently equatorial! Nothing could be more easy than the detection of its change of place if it followed the sun; yet no observer has ever suspected the slightest degree of systematic change corresponding with the changes of the Saturnian seasons. Or, rather, it is absolutely certain that no such change takes place.

It appears, then, that night and day, and summer and winter, are alike without influence on the Jovian and Saturnian cloud zones. Can it reasonably be questioned that, this being the case, we must look for the origin of the cloud zones in these planets themselves, and not in the solar orb, whose action must needs be largely influenced by the alternation of night and day and of the seasons?

But further, we find that a circumstance which had seemed perplexing when we compared the Jovian belts with terrestrial trade-wind zones, finds an explanation at once when we regard the belts as due to some form of action exerted by the planet itself. For let us suppose that streams of vapour are poured upwards to vast heights and with great velocity from the true surface of the planet. Then such streams starting from the surface with the rotational movement there prevailing, would be carried to regions where (owing to increase of distance from the centre) the movement due to the planet's rotation would be greater. They would thus be caught by the more swiftly-moving upper air and carried forwards, the *modus operandi* being the reverse of that observed when an engine leaves a trail of condensed steam behind it; or, rather, it may be compared to what would take place if a steam-engine were moving in the same direction as the wind but less swiftly, so that steam-clouds would be carried in front instead of behind.

Now, heat is the only form of force which could account for the formation of the enormous masses of cloud suspended in the atmosphere of Jupiter. And it seems difficult to conceive that the clouds could be maintained at a great height above the real surface of the planet unless that surface were intensely hot—as hot, perhaps, as red-hot iron. If we supposed this to be the case we should find at once an explanation of the ruddy aspect of the dark belts. Nor would the change of the great equatorial belt from white to red imply more than that, owing to some unknown cause, clouds had not formed during the last two years over the planet's equatorial zone, or, having formed, had been dispersed in some way. We need not even imagine a complete dispersion, since the best telescopes—and notably Mr. Buckingham's fine 21in. refractor—have shown always a multitude of minute cloud-like objects over the ruddy equatorial zone.

But the idea of a red-hot planet, or of a planet partially red-hot, will appear at a first view too bizarre to be entertained even for a moment. We have been so accustomed to regard Jupiter and Saturn as other worlds, that the mind is disposed to reject the conception that they can be so intensely heated as to be utterly unfit to be the abode of living creatures.

This unwillingness to accept startling ideas is not o be altogether reprehended, since it prevents the mind from forming rash and baseless speculations. Yet we must not suffer this mental habitude, excellent though it may be in its proper place, to interfere with the admission of conclusions which seem based on trustworthy evidence. Let us, then, inquire whether the startling hypothesis to which we have been led by the study of observed facts may not be found to be in agreement with other facts not yet considered.

It will be obvious that if the real globe of Jupiter is thus intensely heated, a portion of the planet's light must be inherent. Therefore, we might expect that the planet would shine somewhat more brightly than a globe of equal size and similarly placed, shining merely by reflecting the sun's light. Now, two series of good observations have been made upon the luminosity of Jupiter. One was made by the late Professor Bond, of America, the other by Dr. Zöllner, of Germany. According to the former, Jupiter shines more brightly than he would if he reflected the whole of the light falling upon him! According to the latter, and more trustworthy series, Jupiter does not, indeed, shine quite so brightly as Professor Bond supposed, but the planet yet shines *three times* as brightly as a globe of equal size would shine, if similarly placed, but constituted like Mars, and *four times* as brightly as such a globe would shine if constituted like our moon. Jupiter shines, in fact, very nearly as brightly as though he were constituted like one of our terrestrial clouds!

This result is highly significant. If Jupiter showed no belts, and shone with a pure white colour, we could explain it at once by simply regarding Jupiter as wholly cloud-covered or snow-covered (for snow and cloud shine with nearly equal lustre when similarly illuminated). But the great dark belts which occupy so large a proportion of the planet's disc altogether negative this supposition. We seem compelled to believe that some considerable portion of the planet's lustre is inherent.

Let us, however, proceed carefully here. We have to inquire first how far Zöllner's results can be trusted, and secondly, whether they are corroborated by any independent evidence. Now Zöllner carefully estimated the weight of his observations,—we may say he jealously estimated their weight, for it must be remembered that he was in no way interested in securing a greater or less result, while he was greatly interested in so stating the value of his results that those who might succeed him in the inquiry should not detect any serious error in his estimate. But his opinion of the probable degree of error in his observations was such as scarcely to affect to an appreciable extent the statements we have made above. Taking Zöllner's lowest estimate of Jupiter's brightness, that statement remains appreciably correct.

And next as to corroborative evidence.

It happens that we have a very delicate means of measuring the degree of Jupiter's luminosity, as compared with that of other orbs similarly placed, for his satellites pass across his face, and nothing can be easier than to observe whether they appear darker or brighter than his surface.

It was an observation such as this which Mr. Lassell had made on the night when he noticed the ruddiness of Jupiter's great medial belt. By a singular chance Father Secchi made a similar observation during *his* researches, and the reader will see, when we have quoted the narratives of both these observers, that the comparative darkness of all four satellites will have been established. "The fourth satellite," says Lassell, "has begun again for a season to cross the planet's disc, and I have looked out for opportunities of observing its passages, and was favoured on the night of the 30th December last by witnessing a part of its passage under circumstances more than usually propitious. On its first entrance it was scarcely to be distinguished from the edge, not appearing at all as the others do, as a round bright spot. As it advanced it grew gradually manifestly darker than the surface of the planet, and by the time it had advanced a fourth of the way across it had become a very dark, if not a *black*, spot—so dark, indeed, that if I had looked at Jupiter without knowing anything of the positions of his satellites, I should have said that a *shadow* (of a satellite) was passing. I remember having seen the like phenomenon many years ago; but my impression is that I had never seen the disc of the satellite so near to absolute blackness before. Of course, it is only by contrast that it can possibly so appear; and we have in this fact a striking proof of the exceeding brilliancy of the surface of the planet. In the same way the solar spots, if not surrounded by the marvellous splendour of the sun's surface, would doubtless appear as brilliant objects."

Next let us hear Secchi's account. "On the evening of February 3rd," he says, "I observed the transit of the third satellite and that of its shadow. The satellite seemed almost black when it was upon the middle of the planet's disc, and notably smaller than its shadow, which was visible at the same time; one would have estimated it at only one-half. In approaching the edge the satellite disappeared, and reappeared soon after, close by the edge, but as a bright point. This fact is not a new one for the other satellites, but for the third it is unique. This result shows also the great difference of luminosity at the centre and near the edge of the planet, a difference already confirmed by photography."

It is hardly necessary to point out how strikingly these facts illustrate and confirm Dr. Zöllner's observations. But they also supply fresh evidence of a very interesting nature.

Although a part of the difference dwelt on in Secchi's closing words may be ascribed to the oblique incidence of the light near the planet's edge, yet it does not appear to us that the whole difference can be thus explained. A difference so great that a satellite appears as a bright point close by the planet's edge, and almost black near the middle of the disc, suggests that the light near the edge is not reinforced by the inherent luminosity of our theory, that luminosity adding only to the brightness of the central parts of the disc. We would not insist too strongly on this inference, because the darkening due to oblique incidence is, under certain circumstances, very obvious to direct observation. But it seems to us that a portion of the difference should be referred to the inherent luminosity of the central parts of the disc. This being admitted, it would follow that the real solid globe of the planet is much smaller than the globe measured by astronomers; and that, therefore, instead of that amazingly small density which is so perplexing a feature of the planet's physical condition, Jupiter's globe may have a density equalling or exceeding that of the earth.

And after all, let us remember that the theory that Jupiter is an intensely heated globe—a theory to which we have been led by the consideration of many observed facts, and which in its turn suggests very satisfactory explanations of other observed facts — would merely show that, as Jupiter and Saturn hold an intermediate position between the sun and the minor planets in respect of size, so those giant orbs hold a corresponding position in respect of inherent heat. Roughly speaking, the earth is 8,000 miles, the sun 840,000 miles, in diameter, and Jupiter, with his diameter of 82,000 miles, comes midway between these orbs. Now, the sun is at a white heat, and the earth gives out only what is called obscure heat; and if Jupiter's globe is at a red heat, he again comes midway between the sun and the earth.

We should be led by the theory here maintained to regard the major planets which travel outside the zone of asteroids as in a sense secondary suns. So viewed, they could not be regarded as orbs fit for the support of living creatures. Yet, as each of them is the centre of a scheme of dependent worlds, of dimensions large enough to supply room for many millions of living creatures, we should not merely find a raison d'être for the outer planets, but we should be far better able to explain their purpose in the scheme of creation than on any theory hitherto put forward respecting them. Jupiter as an abode of life is a source of wonder and perplexity, and his satellites seem scarcely to serve any useful purpose. He appears as a bleak and desolate dwelling-place, and they together supply him with scarcely a twentieth part of the light which we receive from our moon at full. But regarding Jupiter as a miniature sun, not indeed possessing any large degree of inherent lustre, but emitting a considerable quantity of heat, we recognise in him the fitting ruler of a scheme of subordinate orbs, whose inhabitants would require the heat which he affords to eke out the small supply which they receive directly from the sun. The Saturnian system, again, is no longer mysterious when thus viewed. The strange problem presented by the rings, which actually conceal the sun from immense regions of the planet for years together in the very heart of the winter of these regions, is satisfactorily solved when the Saturnian satellites are regarded as the abodes of life, and Saturn himself as the source of a considerable proportion of their heat-supply. We do not say that, in thus exhibiting the Jovian and Saturnian systems in a manner which accords with our ideas respecting the laws of life in the universe, we have given irrefragable testimony in favour of our theory. That theory must stand or fall according to the evidence in its favour or against it. But so long as men believe that there is design in the scheme of the universe, they will be readier to accept conclusions which exhibit at once the major planets and their satellites as occupying an intelligible position in that scheme, than views which leave the satellites unaccounted for, and present the giant planets themselves as very questionable abodes for any known orders of living creatures.

THE PREPARATION OF TELEGRAPH POLES.

WHEN the telegraph system was transferred to the Government, arrangements were made with various contractors for providing the trees necessary for supplying the demand of the prospective increase of telegraph communication. In the north of Ireland the preparation of the trees which are to serve as telegraph poles is under the superintendence of a Government official, and a large staff of workmen are engaged in the process. The manufactory, as it may be termed, is situated in the middle of an extensive field, and consists, in the first place, of a quadrangular structure; four strong poles, some 60ft. in height, forming the angular points. Within 6ft. of the top is a platform, on which are two or three vats, each capable of containing 200 gallons. In the bottom portion of this structure are pumps for the purpose of forcing a liquid, chemically prepared, into the vessels above. The principal ingredient, besides water, is sulphate of copper. From these vessels two systems of tubing are carried downwards to the ground, and continued along the surface forward to a distance of a couple of hundred yards, in a direction at right angles to the front of the rectangular structure already mentioned. Raised at a slight elevation from the ground, and placed at right angles to these tubes, lie the trees to be operated upon, with their thicker ends inwards; at intervals of 12in. or 15in. in this horizontal tubing is placed a series of taps, each connected by a short indiarubber tube to the end of a tree, to which it is secured by means of cramps and screws, and rendered water-tight by a sort of nozzle. By means of cocks at the upper end of the horizontal piping the solution in the vats is permitted to descend. The pressure exerted from above forces it into the pipes through the indiarubber tubing and into the trees, traversing them in the direction of their fibre. In a short time the sap and a portion of the chemical solution are seen to ooze slowly from the smaller end of the tree, when it falls into a sort of wooden gutter, inclined at such an angle as causes it to run back to a cistern near to where it had been originally prepared. After undergoing some filtration here it is placed along with the yet unused liquid, and again performs the circuit of the vats above and trees below. The time necessary for the complete saturation of the trees varies from ten days to three weeks, according to their quality and age. In this way an application of the principles of hydrodynamics, combined with what is little more than a mechanical chemical knowledge, enables the manufacturer to provide poles for telegraphic purposes which will resist the action of the atmosphere for at least five times as long as the telegraph poles formerly in use.

SAND-PAPERING MACHINE.

WE this week illustrate a machine designed for facilitating the sand-papering of flat surfaces, which has been recently patented by Mr. Joseph Barker, of Chicago. It consists in principle of a horizontal wheel, formed with a series of blocks on which the glass-paper is secured, these blocks being supported on the arms or spokes and rim of a wheel in such a manner that the underside or working face of the wheel is furnished with what the inventor terms "tangent furrows," the object of which is to remove the dust by permitting a current of air to pass through the furrows. The arrangement will be readily understood from the illustration, in which Fig. 1 is a plan and Fig. 2 a longitudinal section. The upper surface of the wheel is shown in Fig. 1, and consists of a centre, through which the air-holes P are formed, of a series of arms or spokes *g* connected to the rim K. It is also provided with bars or levers L, the inner ends of which are attached to the centre, and the outer ends are secured to the rim K by set screws. The blocks N, on which the sand-paper is secured, are made to fit between the spokes *g*, the centre, and the rim K, and are clamped in position by the levers L, by means of the set screws at their outer ends. The rim K and the spokes *g* are provided with bevelled flanges corresponding to the shape of the under side of the blocks, by which means the lower surface of the blocks is kept below the under surface of the rim, the spokes, and the centre of the wheel, as shown in Figs. 2, 3, and 4, the latter, also, showing the formation of the furrows for the removal of the dust. Sand-paper (*f*, Figs. 3 and 4) of the requisite shape being laid on the blocks N, covering the face and the bevelled edges, the blocks are then placed in the wheel and clamped down by the levers or bars L, which are secured by the set screws to the rim K, the sand-paper being thus firmly held between the bevelled flanges of the spokes *g* and the rim K and the corresponding edges of the blocks. The surface of the sand-paper thus projects below the framework of the wheel, leaving the furrows formed by the spokes *g* in connection with the air-holes P in the centre, so that when the wheel is in motion a current of air passes through and carries away the dust, while the glass-paper, not being fastened to the blocks, is readily removed when worn out, though it is claimed that it lasts much longer than is usual under the arrangements in use at present.

The method of carrying the wood to be finished under the wheel will be understood on reference to Fig. 2, where B is a table provided with rollers R, J J being two rollers supported above the two end lower ones. The work W to be sand-papered is fed in as shown, and is supported on the rollers, R, which have bearings in blocks so mounted on rubber as to yield to a slight difference in thickness of the stuff to be finished. To accommodate greater differences the table B is made to slide on inclined planes *a a*, so that when either of the hand wheels T is turned, the distance between the rollers R and the sand-paper wheel can be regulated to suit the thickness of the articles to be operated on. For this purpose the table is connected by a rod to a block working on the screw *c*. A hopper is provided underneath at E to receive the dust. A in Figs. 1 and 2 shows the position of standards for supporting cross-beams through which the vertical shaft of the wheel passes to the driving pulley, as shown in Fig. 2. The machine appears to be an improvement on the ordinary discs used for sand-papering, and the principle on which it is constructed may possibly be found available for other purposes.

FIG. 1

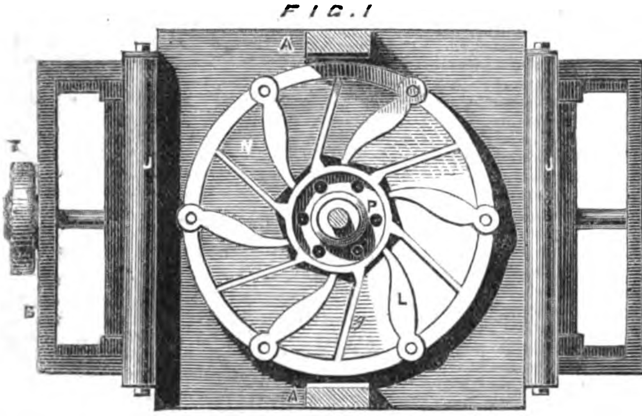


FIG. 2

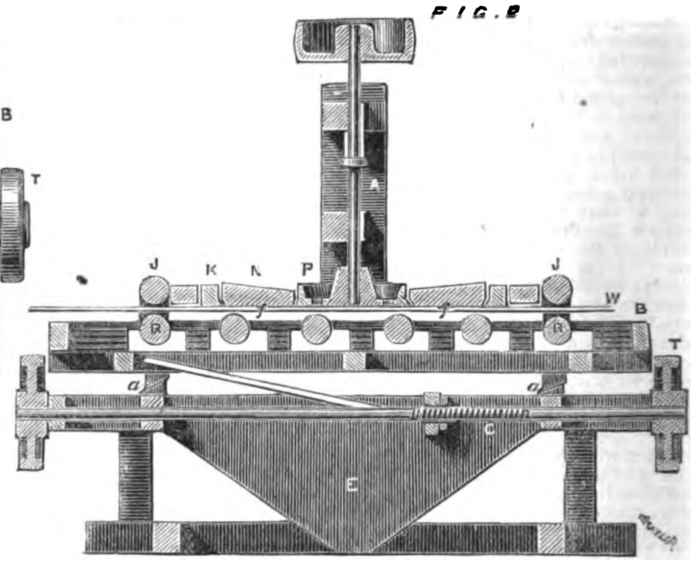


FIG. 3

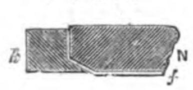


FIG. 4

PHOTOGRAPHY FOR THE UNINITIATED*.

(*Continued from p.* 191.)

THE albumen paper, having fully dried after silvering, has now to be fumed with ammonia. This operation should be conducted in a room distant from that in which you may be performing the negative-making process, otherwise, the fumes may raise "old scratch" with that part of your operations. In handling the liq. ammon. conc., care should be exercised, as its great strength will, if too freely inhaled, give you much physical inconvenience and suffering, even should it not dangerously affect you. The bottle should always be kept very tightly stoppered, and in a cool place. The stopper, when removed should be pointed away from you, as the force gained by the confined gas often ejects it with great violence; a disregard of this precaution has led to most serious injuries. So much for my lecture. Now let's fume the paper.

Provide a box, some old case, or large old trunk; if the last stand on end so that the lid or cover may be easily opened and closed; on each side, a few inches from top, nail a narrow strip of wood, so that upon such you can easily lay other strips of wood, stretching across the trunk or box, to which the dried sensitised albumen paper can be fastened by a pin in one corner. When you have so fixed these strips of wood, with paper fastened thereto, pour into a saucer or flat dish an ounce or two of the ammonia, and close the door. The dish should be placed upon the bottom of the trunk or box, and at least 6in. (better twelve) below the lower corners of the paper. The paper must be allowed to hang in the fumes of ammonia for about ten minutes, and must be well opened to allow free contact with all portions of the silvered surface. Upon opening the door, first remove the dish, being careful not to inhale the fumes too freely.

The paper is now ready for printing, which operation, as you know, simply consists in placing its silvered side next to the film side of the negative, and exposing, while so held, to the action of light. No general rule can be given as to how long to allow this action of light to continue. This is alone to be governed by the quality of the light and the character of the negative. Most generally the best prints are those made from what are known as thin or weak negatives, full of detail, and which are printed either in diffused light, or shielded (if printed in the sun) by tissue paper. After all your paper has been printed, you have the various operations of toning, fixing, washing, &c., to which we will now proceed.

Before toning, you will need to wash the prints for about half an hour in at least three changes of water, or until the milkiness produced by the free nitrate of silver is no longer noticeable. This water should be saved by throwing into a tub, where it, with many other of the washings of your various processes, can be treated with salt, and the resulting chloride of silver utilised. While our prints are washing, the toning-bath can be made.

I do not intend to give you but one formula; it is a good one, in my hands quite good enough:—Water, 32 fluid ounces; chloride of gold, $\frac{1}{4}$ grain to ounce; acetate of soda, 64 grains; sal. soda solution, enough to make the bath just alkaline.

If you use the ordinary gold, which you will find with the dealers, it may be that more will be required than $\frac{1}{4}$ of a grain to each ounce of water. It is often very poor, as photographers are not unlike other people: they too often buy that which is lowest in first cost, not considering that the highest priced is most often the best and most carefully manufactured. The bottles of gold referred to are supposed to contain, I believe, 15 grains, which is, probably, somewhere about half gold and half salt. Procure a bottle, in which measure 60 fluid drachms of water ($7\frac{1}{2}$ fluid ounces), remove the cork from a 15-grain bottle of gold, and put gold, bottle, and all, into the water; you now have a solution of gold of $\frac{1}{4}$ of a grain of gold to each fluid drachm. Eight fluid drachms (1oz.) of this would then be the proportion to add to your 32oz. of water intended for the toning bath.

One grain of gold is enough for each sheet of paper to be toned, so that if you know how many sheets of paper you have printed, you can always estimate how much toning solution you should make up. It is important that the amount of gold should be in proportions given; if more is used, the prints tone faster; if too much is used, the action is likely to be irregular; if much less, the operation is tedious; if too little, the prints lack richness, and lose rapidly in the subsequent fixing operation. The sal. soda solution can be made and kept for use of about 5 grains of sal. soda to an ounce of water. This must be added to the bath cautiously, and carefully tested with litmus paper upon each addition; if too much is added, the prints are flat, dull, wanting in vigeur; if too little, the action of the bath is irregular and slow. This bath solution should stand fully half an hour before use, and should be of about 80° to 90° Fahrenheit. But few prints should be placed in it at one time, so that you can closely watch the changes, and from ir, when toned to your liking, at once remove them to a dish of clean water.

No rule for toning can be given, for each print depends much for its tone upon the quality of the negative; some may be pushed to a rich purple red; others never would reach that point, but would become flat, and be over-toned; therefore I will not attempt to direct in a matter in which experience alone can teach. I willl only say that it is better to be on the side of under-toning than to push so far as to over-tone.

After careful washing in several changes of water, proceed to fix in a bath of soda as follows:—Water, 8oz.; hyposulphite of soda, 1oz. In this be careful not to place so many that they become matted together, and keep them moving, so that the solvent action of the soda may have an opportunity to perform its part. Ten to fifteen minutes will be required to properly "fix" your prints, after which place them in water, which should be changed at least a dozen times, and in which they should all night, and be treated with two or three more changes in the morning before you hang them up to dry. If possible, a stream of water should pass through them; with this the washing can be well done in three or four hours.

In either of the operations of toning, fixing, or washing, care must be taken to prevent the matti[ng]

* From the American *Photographic Times.*

together of the prints, otherwise the chemical changes of toning and fixing will be irregularly conducted, the results of which will be miserable work. The final washing is also of the greatest importance, for upon it largely depends the permanence of your prints.

With a few general remarks I will close this letter. In the summer, reduce strength of silvering solution, or float a shorter time. A freshly albumenised paper requires less time for silvering than old and hard dried paper, and is, consequently, more liable to render the solution cloudy. Paper a long time albumenised is often repellent to the solution of silver, such as standing out upon it when hung up to drain like the moisture on a window-pane. This can be remedied by rubbing over the face of the paper with a pad of cotton, to absorb the oily surface, before silvering.

A print, before "fixing" in hypo., presents, when held to a strong light, a mottled appearance in its white parts or high-lights. When properly "fixed" and examined as before, this mottling has gone, and only the even grains of the paper is seen. I have thought at times that the addition of about five per cent. of alcohol to the hypo. solution was of benefit; yet am scarcely prepared to assert that it is of any material value.

We have now passed hastily over the whole subject of negative making by the "wet" process, and the production of prints from the same. I have aimed to write plainly, and have tried to avoid confusion by giving but few formulæ. If I have been at all successful in making a somewhat intricate science more plain than it was before, or in giving any hints of value, my purpose has been accomplished.

In practising our beautiful art, allow me to advise you never to be too hasty in making changes in formulæ which work well in your hands; they are generally less to blame for any poor work you may make than you are. Brains, patience, cleanliness, and system, with almost any of the thousands of formulæ published, will give good work. In formulæ there is but little practical difference. In the men who work them the difference is greater than any words of mine can express.

AN IMPROVED BLOWPIPE.

THE following description of a simple method of constructing a useful form of blowpipe is given by Messrs. Arnim, Junge, and Mitzopulos, of Freiburg:—All workers with the blowpipe are well aware how much the work is facilitated by a good blowing apparatus. In qualitative operations it can be dispensed with, but there are certain assays, such as concentrating cupelations for poor silver ores, which cannot be carried on without a blower, save with great exertion. For this reason, nearly every one who has quantitative assays to make provides himself with a blowing apparatus. The ordinary blowing apparatus consists of three parts, the caoutchouc bellows, the regulator, and the stand for the nozzle. The part which most easily gets out of repair is the caoutchouc regulator, for the operator, looking at his assay, often does not perceive that the regulator is too much stretched by the blast; the consequence is that the regulator often bursts. When we recollect that such regulators are not to be had everywhere, and that a reserve stock is often useless, from the caoutchouc getting hard, it becomes important to find a substitute which will give as regular a blast, and can be made of a more lasting material. The regulator designed by the inventors gives a perfectly constant blast, which can be used either for the oxidising or the reducing flame, and after numerous trials it is found to be in no way inferior to the caoutchouc regulator; at the same time it is so simple that it can be constructed with great ease and in a very short time. The arrangement is as follows:—A common wide-mouthed bottle is carefully fitted with a caoutchouc cork bored with two holes, into each of which passes a piece of glass tube bent at a right angle. On to one of these tubes is slipped the caoutchouc tube coming from an ordinary caoutchouc bellows, whilst the other is put in communication with the blowpipe nozzle by means of four pieces of caoutchouc tubing joined by three pieces of glass tube, drawn to a fine point at each end. This forms the main peculiarity of the arrangement. When air is forced into the bottle by the blower in jerks, it finds a difficulty in escaping as fast as it comes in, on account of the six fine openings in the glass tubes that it has to pass through on its way from the bottle to the nozzle, and it thus acquires a certain pressure in the bottle and flows out towards the nozzle as a regular blast. The bottle may be about 6in. high by 3¼in. wide, with a neck 1¼in. diameter; but of course the dimensions are of no great importance. On the whole, a somewhat large bottle is better than a small one. The pieces of glass tubing we use are 2in. long by ¼in. in diameter. The apparatus will be stronger if instead of a glass bottle a tin cylinder is used, about 4in. high by 2in. diameter, with two tin tubes opening into its top. Small metal cylinders, with a fine hole at each end, may be used instead of the little glass tubes. A blowing apparatus constructed in this manner will deliver a perfectly regular blast, and will be of practical interest to those who are thinking of working in places where it is difficult or impossible to repair the ordinary instruments.

ON CERTAIN PHENOMENA ASSOCIATED WITH A HYDROGEN FLAME.*

PHENOMENA of much interest, and possibly of future usefulness, are associated with the combustion of ordinary hydrogen.

1. To study these phenomena free from disturbing causes three things should be attended to, although the effects to be described can be obtained without any special precaution. (1) The gas must be stored and purified in the ordinary way—namely, by passing into a gas-holder through a solution of potash, and then through a solution of perchloride of mercury or nitrate of silver. (2) From the holder the gas must be led through red or black indiarubber tubing to a platinum, or better, a steatite jet. (3) And then the gas should be burnt in a perfectly dark room, and amid calm and dustless air.

2. In this way the flame gives a faint reddish brown colour, invisible in bright daylight. Issuing from a narrow jet in a dark room, a stream of luminosity, more than six times the length of the flame, is seen to stretch upward from the burning hydrogen. This weird appearance is probably caused by the swifter flow of the particles of gas in the centre of the tube. The central particles as they shoot upward are protected awhile by their neighbours; metaphorically, they are hindered from entering the fiery ordeal which dooms them finally to a watery grave. Dr. Tyndall has shown that the radiation from burning hydrogen is hugely ultra-red, and moreover, that it has not the quality of the radiation from an elementary body like hydrogen, but practically is found to be the radiation from molecules of incandescent steam. So that, except at its base, a hydrogen flame is a hollow stream of glowing water raised to a prodigious heat.

3. Bringing the flame into contact with solid bodies, in many cases phosphorescent effects are produced. Thus, allowing the flame to play for a moment on sand-paper and then promptly extinguishing the gas, a vivid green phosphorescence remains for some seconds. The appearance is a beautiful one, as a luminous and perfect section of the hollow flame is depicted. Similar phosphorescence is produced by the flame on white writing paper, or on marble, or chalk, or granite, or gypsum, &c. But no such effect is produced by coal gas, or olefiant or marsh gas. It is evidently a question of temperature, as oxygen driven through coal gas shows the phosphorescence well.

4. Far exceeding in generality the effect just noticed is a really magnificent blue image of the flame that starts up on almost every substance with which the flame is brought into contact. I have already drawn attention to this effect in the *Philosophical Magazine* for November, 1865, and the same effect has more recently formed the subject of a memoir, presented through M. Wurtz, of the Paris Academy of Sciences, the author of that paper evidently being unaware that the subject had already been investigated by myself.

The appearance is as follows:—When the hydrogen flame is brought either vertically or sideways, say, upon a white plate or a block of marble, there instantly appears a deep blue and glowing impression of the exact size and shape of the hollow flame. The moment the gas is extinguished, or the flame removed to the slightest distance from the solid, the effect as instantly ceases. If the flame be brought successively to the same spot on the solid, the effect grows fainter and finally vanishes, but instantly reappears upon an adjoining portion.

Other combustible gases, such as carbonic oxide, or marsh gas, or olefiant, or coal gas, do not yield this effect, nor does any lamp flame, luminous or otherwise; nor is it obtained in the oxidising flame of an ordinary blow-pipe; but it is imperfectly produced in the reducing flame when coal-gas is used; it is not seen when oxygen is driven through coal-gas, unless the latter be in excess; and it is poorer and vanishes more quickly with the oxyhydrogen flame than with hydrogen alone. This blue luminosity is, therefore, not a question of heat, but some property depending either on (*a*) the chemical nature of hydrogen, or on (*b*) the physical effect of its radiation. At first I thought it was the latter, and that it was a new form of fluorescence, so closely did it resemble those phenomena. But after a week's incessant experimenting, the true cause was hunted down and found to be dependent on the former effect (*a*), and in every case ultimately due to the presence of sulphur. A chemically-clean body, or a freshly-broken surface, did not show the blue coloration; but after exposure for a short time to the air of London, the substance invariably yielded the blueness; this, however, was not the case when the clean surface was covered by a shade, or exposed to the air of the open country. The combustion of coal-gas and coal fires yields sulphate of ammonia, a body often deposited in acicular crystals in the glass tubes in a laboratory. Sulphate of ammonia is decomposed by a hydrogen flame, and when that salt is brought into contact with burning hydrogen, it permanently yields the blue colorescence. Hence this body is probably the main source of the blueness seen whenever a hydrogen flame comes into contact with glass tubes or a dirty surface. This effect must repeatedly have been seen by every one who has experimented on singing flames.

When the blueness, as is so often the case, is seen tinging the flame itself, without contact with any body, the sulphur is derived either from the vulcanised tubing, the dust of which is taken up by the passing gas; or, if the hydrogen be burnt from the bottle generating it, the blueness is due to the decomposition of the sulphuric acid spray, as will be shown further on.

As a chemical re-agent for detecting sulphur, the delicacy of a hydrogen flame is extraordinary. This fact was estimated as follows:—Pure precipitated silica yields no blueness with the flame; 500 grains of silica were intimately mingled with one grain of milk of sulphur. Less than a one-hundredth of a grain of this mixture was thrown on the surface of pure water or placed upon chemically clean platinum foil. The water is best, but in either case the blue colour (absent before) now shot forth on bringing the hydrogen flame down. Tried again and again with fresh portions, the effect was very evident, but quickly vanished. The sulphur in a similar portion of the mixture could not be detected chemically by nitro-prusside of sodium. The wonderful sensitiveness of the flame may be still better seen in another way. Immediately after washing, the fingers show no colour when brought for a moment into the flame, but if a white indiarubber tube be touched ever so lightly, the fingers not only show a vivid blueness, but for some time any clean object touched by them, such as platinum foil, shows traces of sulphur by the appearance of the blue coloration with the flame. A block of melting ice continually weeps itself free from dust, and thus presents an excellent surface upon which to try the foregoing experiment. Or a plate of platinum, after heating to redness, may be written over with a stick of sulphur. If kept covered, the invisible letters may long after be traced out by sweeping the hydrogen flame over the surface of the platinum.

Examined through a prism, the blueness derived from any source shows blue and green bands, similar to the spectrum of sulphur, but I have noticed also a red band. This mode of obtaining a sulphur spectrum suggests further inquiry. White marble smeared over with a bit of sulphur, or with vulcanised rubber tubing, is a convenient source for obtaining the effect at pleasure.

Some sulphates and sulphides show the blueness with the flame, and are evidently decomposed by the hydrogen. Thus sulphate of soda gives no blue appearance, whilst sulphate of ammonia, or alum, does.

Various liquids were tried in contact with the flame. Sulphuric acid was very notable. Here a magnificent blue effect was observed. For persistence and brilliancy of the colour, this experiment leaves nothing to be desired; the spectrum is very fine. If the liquid is in a glass dish when the flame is brought vertically down, the blueness lights up the glass in a lovely manner.*

6. But the presence of sulphur is by no means the only body that a hydrogen flame reveals. The least trace of phosphorus is detected by the production of a vivid green light. It is striking to notice the wonderful sub-division of matter in these experiments, and how an immeasurable trace of an element can evoke pronounced and apparently disproportionate effects.

Might not this ready detection of minute quantities of sulphur and phosphorus be of use in the manufacture of iron? and might not hydrogen introduced into the molten metal be employed for the removal of these great enemies of the iron worker? I speak ignorantly.

7. Among the range of substances I have tried, tin was found to yield the most conspicuous effect, after the bodies named. A fine scarlet colour is almost instantly produced when the hydrogen-flame is brought into contact with tin or any alloy of tin. Tin is somewhat volatile, and its spectrum is rich in red rays. The tin must be clean; or the sulphur blue, which is much brighter, will mask the effect. A charming experiment may be made by partially scraping a soiled surface of tin; the blue and the scarlet colours mingle, and a lovely purple is the result. When a trace of phosphorus is present there may be obtained a green belt encircling a rich blue, then a purple zone, and finally a glowing scarlet at the root of the flame. These colours, it must be remembered, are not imparted to the flame, but reside on the surface of the body which the flame touches. And where the combustion of the hydrogen is complete, as in the upper part of the flame, or in the luminous stream referred to (2), these effects are not produced: they are best developed at the root of the flame.

* By W. F. BARRETT, F.C.S., Head Science Master at the London International College, &c.

* With all liquids, but best with mercury, a fine musical note can be obtained by causing the jet to dip just below the surface of the liquid.

8. Passing from liquids and solids, I next tried gases in contact with the flame of hydrogen. Many gases imparted a colour to the flame, but here the effect was different to that previously noticed. The whole flame was tinged with the colour imparted to it. A mere trace of hydrochloric acid gas imparts a reddish brown to the flame; ammonia gas gives a yellow, and burns freely. It is striking to note the combustion of ammonia gas rising from an unstopped bottle that contains the usual solution and which is placed below the flame.

But carbonic acid gas yields the most striking result in contact with the flame. A pale lilac tinge is instantly produced by a stream of this gas. This, I imagine, is due to the decomposition of the carbonic acid by the hydrogen, and the production and combustion of carbonic oxide. For it is at the lower part of the flame that the effect is most marked. One per cent. of pure carbonic acid admitted to a jar of air can be detected on holding the jar over the flame. The breath, of course, shows the effect most strikingly.

9. Here then is an eminently practical method of noting the presence of vitiated air in rooms or public buildings. A continuous hydrogen apparatus might be employed with a wash bulb attached. The flame might be burnt from a brass burner or lava jet, placed within a blackened tin cylinder. Opposite the flame a hole might be pierced in the cylinder, and closed by a lens for better viewing the flame within. As soon as the atmosphere in a room becomes unpleasantly vitiated the flame would indicate the fact by its changed colour. A similar apparatus might likewise be employed by miners: in metal mines as a warning against impure air, and in coal mines as a detector of fire-damp. In this latter case the ends of the cylinder could be covered with wire gauze. To this practical aspect of the question I am now giving such little leisure as I possess.

The results thus briefly described demonstrate—

1. That a hydrogen flame exhibits some physical peculiarities, and produces phosphorescence on many substances with which it comes in contact.

2. That the blueness so often seen in a hydrogen flame is due to the presence of sulphur, derived either from the vulcanised rubber tubing, or from atmospheric dust, or from the decomposition of the sulphuric acid spray from the generator.

3. That a flame of hydrogen forms an exceedingly delicate re-agent for the detection of sulphur or phosphorus, and possibly also of tin.

4. That many sulphates, and also carbonic acid are apparently decomposed by a hydrogen flame.

5. That a hydrogen flame is further a test for the presence of some gases, notably carbonic acid.

6. That these results are capable of practical application.

THE STAR DEPTHS.

MR. RICHARD A. PROCTOR, Honorary Secretary of the Royal Astronomical Society, gave the fifth and last of his course of lectures on the above subject on Saturday, May 11. That day being the anniversary of Sir John Herschel's death, Mr. Proctor paid a tribute to the memory of the great astronomer before entering on the subject of his lecture. He passed then in review the various theories which have been advanced in explanation of the phenomena of the sidereal universe by the ancients, by Corpernicus, Kepler, Wright, Kant, Lambert, the Herschels, and the elder Struve. In discussing the work of Sir W. Herschel, the lecturer pointed out that that astronomer's observations extended over a very long period, and that in the course of that period Herschel's ideas respecting the constitution of the universe underwent certain well-marked changes. The theory which he had advocated in 1785, a travestie of which appears in our text-books of astronomy, was definitively abandoned in 1802, and the principle on which it had been based was as clearly abandoned in 1811. The views which Herschel had entertained respecting the nebulæ were in like manner modified, it being impossible that any terms could be clearer than those in which he announced his change of opinion. Yet again, in 1817, he adopted a totally new principle for gauging the profundities of space. Notwithstanding these circumstances, the views belonging to the different periods of Herschel's observing career are as carelessly intermixed in our books of astronomy as though they had all been expressed in one and the same paper. The lecturer proceeded to sketch his own views, and the principle on which his researches had proceeded, which was simply this, to make all the relations he discussed—whether referring to the distribution of the stars or of the nebulæ, to the stellar proper motions, or to whatever else they related—*palpable to the eye* by the selection of suitable modes of charting or picturing them. He announced in passing his firm conviction that his theory of star-drift would be placed beyond dispute by the spectroscopic labours of Dr. Huggins. The lecture closed with a summary of the wonders presented to our contemplation by the star depths.

HINTS ON PAINTING.*—VI.

(*Continued from p. 168.*)

Scrolls.

THIS work requires the good taste and perfect outline of a draughtsman. But an insight into this art may be gained by copying the work of others, by processes described in these papers. When a copy has been made on the copying-paper, take a piece of stout wrapping-paper, and laying it on a smooth board, place the copy over it, and fasten all down to the board with a few tacks or pins; then with a pin prick the outlines with small holes through the copy and wrapping-paper. Having done this, lift all from the board, and by placing the wrapping-paper copy on the panel, and dusting on fine whiting with a pounce-bag, you will transfer the copy to the panel. Next proceed to fill in the outlines with gold size; lay on the gold, and then clean all off nicely for shading. This is done with asphaltum, but a very fine effect can be made by glazing some parts with carmine or blue. Copy the shading of the original as near as possible; put in the lights or white fine lines, and with a little practice and the use of pattern, you will soon gain a knowledge of scrolling sufficient to enable you to perform ordinary work. Scrolling in colours can be learned in the same way, but it is a more difficult art, as it requires good taste in the application of colours—harmony of colours being the greatest desideratum in good scrolling.

Stenciling.

Stenciling is an art by which the painter can execute ornamental work quickly, and when thoroughly understood it will often be called into requisition in the waggon paint shop. The articles required in making a stencil are a sheet of well-sized writing paper, a lead pencil, and a sharp pen-knife. Fold the paper, allowing the edge of the fold to form the centre of the pattern; then draw any design you wish, leaving bars to hold the parts together, then lay the paper upon a piece of glass and cut out the figure with the penknife. The tool used for this work is a camel's-hair brush or pencil, with air not over ½in. long, bound with quill and wire on a round wooden handle. The small sizes are preferable. The colour may be mixed in Japan and turpentine, as for striping, but colour mixed with vinegar and sugar will be found best. The paint must be quite thick, and a small quantity only must be taken on the brush, and then well rubbed out on a dry place before applying it to the work. Laying the stencil on the panel as desired, hold it down firmly, and rub over with the brush carefully until the cut portions of the figure are well coated. Then lift off the stencil and the work is completed.

To Transfer Ornaments for Carriages, Waggons, &c.

This beautiful art is now practised by many painters, who are either in a hurry with their work, or for economy's sake. Pictures expressly designed for carriages are now sold at the leading periodical stores, and the amateur painter is enabled thereby to finish a job of carriage painting in fine style. These pictures may be stuck on, and the dampened paper carefully removed, leaving the picture intact upon the panel, requiring no touching with the pencil. The proper way to put on decalcomainie pictures is to varnish the picture carefully with the prepared varnish (which can be obtained with the pictures), with an ornamenting pencil, being sure not to get the varnish on the white paper. In a few minutes the picture will be ready to lay on the panel, and the paper can be removed by wetting it, as already described; and when thoroughly dry it should be varnished like an oil painting. Be particular to purchase none of these transfer pictures, except those covered with gold leaf on the back, for they will show plainly on any coloured surface, while the plain pictures are used only on white or light grounds.

The following items will be found of interest.

To keep striping pencils in good shape and ever ready for use, grease them with tallow from a candle, and spread the hair straight on a piece of glass, keeping the same in a box made for the purpose, so that they may be preserved from dust. Why do striping pencils curl up or "crinkle" when used in white (keg-lead) colour? Because the acid with which the lead is made acts on the hair, heating and contracting the fibre. To straighten them when thus crooked, I draw the pencil across or between a warm iron and the finger. Dry white lead mixed in varnish and turpentine is preferable for striping, but tube colours are best.

When it is desirable to glaze a job with carmine, why do you advise the workman to get up a colouring varnish surface, while some painters are in the habit of putting on glazing the same as if it were colouring varnish? Because I have then a chance to rub the job smooth, which I could not do so well over the glazing. Besides, the glazing being mixed with flowing varnish, will flow level and free from clouds, if put on a smooth surface.

* From the "Carriage Painter's Manual." By F. B. GARDNER. New York: S. R. Wells.

Paper Cups for Striping Colours.

Although I do not recommend the use of paper cups for holding striping colours, I am aware that many prefer them, as they are easily disposed of when no longer desired for use. The economical painter would have small tin cups to use for striping colours, as the paper cups cause a waste of sandpaper.

Bronze Paint for Iron.

Ivory black one ounce, chrome yellow one ounce, chrome green two pounds; mix with raw linseed oil, adding a little Japan to dry it, and you have a very nice bronze green. If desired, gold bronze may be put on the prominent parts, as on the tips or edges of an iron railing, when the paint is not quite dry, using a piece of velvet or plush with which to rub on the bronze.

To Paint Magic-Lantern Slides.

Transparent colours only are used for this work, such as lakes, sap-green, ultramarine, verdigris, gamboge, asphaltum, &c., mixed in oil and tempered with light-coloured varnish (white Damar). Draw on paper the design desired, and stick it to the glass with water or gum; then with a fine pencil put the outlines on the opposite side of the glass with the proper colours; then fill up and shade with black or Vandyke brown, as you find best.

Lettering on Glass.

Sign painting on glass is one of the beautiful branches of our art, and as there are but few who can make a good job, I will endeavour to explain the method which has always been found to answer the purpose admirably. The glass should first be thoroughly cleaned and dried, then lay out the lines for the letters with soap, a piece of hard scented soap being the best, then proceed to paint the letters on the *right* side of the glass with lampblack mixed with oil; this is to form a guide for the work; then, on the inside, lay on a thin coat of size—made with the white of an egg and water, or isinglass dissolved in water—with a camel's-hair brush, covering over the whole line of letters. Then lay on the gold leaf with a tip, until every part of the letters is covered well. Allow the leaf to remain until the size is dry, and you will find that the letters on the front side can be easily seen and traced. This is done with quick drying black, to which is added a little varnish. Paint over every part of the letter directly on the gold and allow it to dry; then wipe off with soap and water the lampblack letters from the front side, and with clean cold water and a soft sponge, wash the superfluous gold leaf and size from the back, and you will have a perfect gold letter on the glass.

Proceed now to shade the letters, which may be done in colours to suit the taste of the painter. Always shade to the edge of the gold, for by that means you have only *one* edge to make straight. The shade may be left rough on its extreme edge, and when dry a neat straight edge can be obtained by merely scraping with a knife.

Ornamental Designs on Glass.

In making scrolls, eagles, &c, on glass, some painters put on the outlines and shades first, and then lay the gold leaf over all. Another good way is to scratch the shades into the gold leaf after it is dry, and put the colours on the back of the gold. Silver leaf may be used in the same manner as gold, but it will not wear as well. A very pretty letter may be made by incorporating silver with gold. Take paper and cut any fancy design to fit the parts of the letter, stick it on to the size before laying the leaf, and then lay the leaf, allowing it to dry, and wash off as before; then with a penknife raise the paper figure, and the exact shape or form of the figure will be found cut out of the gold letter. Clean off nicely, apply more size, and lay silver leaf to cover the vacant spots. Wash off when dry, and a very handsome ornamented letter will be the result. Colours may be used instead of silver, if desired, or a silver letter, edged or "cut up" with gold, will look well.

The Metal Industry.—The following, according to Mr. Hunt, are some of the quantities and values of metals obtained from the ores raised in the United Kingdom during 1870:—Pig iron, 5,963,515 tons, of the value of £14,908,787; tin, 10,200, £1,299,505; copper, 7,175, 551,309; lead, 73,420, £1,452,715; zinc, 3,936, 74,096; silver, 784,562, 195,140; gold, 191oz., £750; other metals estimated, £3,500.

Granite Glass.—The *Baltic Journal* reports that there exists near several cities of Finland a kind of granite, called there cupakivi, of which the composition is this:—Silica, 74 per cent.; feldspar, 12; oxide of iron, 8; lime, 1; alkalies, with traces of magnesia, 9. This being evidently a good compound to make glass, the first experiment was consequently made by melting 500 parts granite, and 200 limestone, and a white glass was obtained. The second experiment was made with 500 granite, 150 lime, and 75 of soda. This glass was more fusible, and at the same time harder. Both kinds were blown without difficult at a bright red heat, while a dark glass was made by the addition of 70 parts of sulphate of lime or potash, and 7 parts of carbon.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

AT the monthly meeting of this Society, held on Friday, May 10th, the President, Professor Cayley, in the chair, several interesting papers were read, one of the most important of which, by Colonel Tennant, was on

The late Solar Eclipse.

In introducing the paper, the Colonel remarked that of the six photographs obtained during totality, the first three were very good, and from the appearances depicted, he felt quite satisfied that the corona is a solar phenomenon. This opinion is based on the *persistency of the rifts* during the progress of the dark moon over the bright sun, which, by the shutting out of the solar light, enables us so to view the coronal appendage as to determine if its essential features preserve their relative positions, now that we are becoming acquainted with them. This the Colonel succeeded in doing: he found that as the moon passed onwards the corona appeared to be unaltered; each rift, as seen last December, was certainly connected with a visible prominence. As a general result of the observations, it was stated that a connection between the corona and its rifts with the solar prominences was well made out; the corona did not extend more than a radius of the sun from the surface.

Another very important result of the observations made in connection with the Indian Government, was the *reversal of the dark lines* seen by Captain Herschel—*i.e.*, the ordinary dark lines in the solar spectrum were at the moment of totality seen as bright lines, and not only so, but these bright lines existed in enormous quantities; the impression, if we understood Colonel Tennant correctly, made by them on Captain Herschel's mind, was that they were successive in their appearance, but with such rapidity did they present themselves that it was next to impossible to note their sequence. The conclusion drawn from their number and brightness appears to have been that the lowest stratum of the corona in contact with the sun consisted of a mass of vapour in which the bright lines originated. The narrow and lower bright portion of the corona, which was seen by several observers on the occasion of the eclipse of 1870, was not seen by Colonel Tennant in 1871.

Mr. Brett stated, in reference to the narrow bright rim next the sun which he saw in 1870, that it did not extend more than two minutes' of arc from the dark limb of the moon.

Dr. De La Rue bore testimony to the excellence and value of Colonel Tennant's photographs, and observed that they furnished conclusive evidence that the corona is a true appendage of the sun. As in 1860 his own photographs had decided the question of the prominences, so in 1871 Colonel Tennant's photographs had decided that of the corona by showing that during the passage of the moon over the sun no change in the coronal features had occurred.

Captain Noble, in alluding to the thanks that the Fellows present would unanimously award to Colonel Tennant for the very valuable information communicated in his paper, took occasion to remark that the Colonel had embraced the earliest opportunity after his arrival in England to dispel the ignorance of the details of the eclipse which characterised the meetings of the society that had intervened between its occurrence and the present. Having stated that he joined heartily in thanking Colonel Tennant, he wished to direct particular attention to the fact that on the occasion of the eclipse of 1870 the coronal matter extended outwards over each prominence, the rifts appearing in those portions of the corona in the lower stratum of which prominences did not exist. In 1871 the rifts are described as occupying precisely the localities in which in 1870 the greater extension of the coronal matter was found.

Dr. De La Rue suggested that the appearance of the rifts in the late eclipse might be explained on the supposition that the light of the photosphere being so much more intense than that of the prominences the corona would not appear so bright behind them.

Mr. Ranyard called attention to certain features in Colonel Tennant's photographs, the positions of which were symmetrically related to the sun's poles.

In reply to a question by Dr. Huggins, Colonel Tennant stated that the corona exhibited strong radial polarisation.

Mr. Ranyard read a paper on the value of the stereoscope as applied to the examination of eclipse photographs, in which he pointed out that the appearance of relief depended upon the direction in which the light fell on the photograph, as well as on the objects, and exhibited photographs of a cut tumbler taken with the open part downwards, and also with the same part uppermost. In the photographs the relief was reversed, the appearance of the tumbler in its ordinary position being as usually seen, while in the photograph with the mouth downwards the raised portions appeared as depressed. He also called attention to the fact that drawings viewed through a lens presented the appearance of relief. From these circumstances he argued that in judging of the appearances of objects in three dimensions care should be exercised as to the presence of light and shade in the originals, otherwise an erroneous estimate might result from the combination of photographs in the stereoscope, and suggested that for the determination of the positions of important features micrometric measurements should be employed.

Dr. De La Rue, as we understood him to say, was not aware with whom the notion of three dimensions, as shown in the stereoscope, originated, but he was quite clear as to the stereoscopic combination of photographs in furnishing information relative to the disposition of objects in a picture.

An Improved Altazimuth.

Mr. Brett exhibited and explained the construction of an altazimuth mounting for a reflector, possessing portability combined with facility of manipulation, the essential principle being that of a tripod with a movable apex. The instrument, when not in use, presents the appearance of a neat mahogany box, which forms one leg of the tripod the other two, folding within the box, can be so arranged externally that the box itself, carrying the reflector, eyepieces, &c., may take any position as to altitude. The two legs, constructed upon the principle of steadying rods, are furnished with adjusting screws having a play of about eighteen inches. By the aid of these screws a slow motion either in altitude or azimuth is effected. The instrument, having been constructed with a view to portability, was stated to weigh about 40lb., and could easily be carried from place to place. For temporary purposes it was described as fairly steady. The compactness of the arrangements was very striking.

Vlacq's Tables of Logarithms.

Mr. Lee Glaisher read a paper on the errors in Vlacq's tables of logarithms, in which he drew attention to the circumstance that Vlacq's are the only tables that extend throughout the series of numbers to *ten* figures. The author entered somewhat extensively into the history of these tables as containing the completion of the seventy chiliads left uncompleted by Briggs; that in many instances the errors of Vlacq had been transmitted through later editions; that the English and Continental editions were printed from the same types, and contained the same identical errors, of which about 700 had been ascertained and published. Mr. Glaisher referred to a copy of Vlacq in the library of the Royal Observatory, Greenwich, in which the errors detected at the time of Maskelyne are corrected. About one-half of these errors are considered as unimportant.

Satellites of Jupiter and Saturn.

Mr. Proctor read a paper on the densities of the satellites of Jupiter, which he considered to be greater than given in our text-books, and urged upon the Fellows of the Society the importance of examining for themselves the statements they met with in print. He also communicated a note on the discovery of the second satellite of Saturn, reckoning from the primary, by Sir William Herschel, with the 40ft. telescope. The object of the communication was to correct an erroneous statement which Mr. Proctor had met with.

A few further papers having been read, and others announced, the society adjourned at a late hour.

INSTITUTION OF CIVIL ENGINEERS.

Explosive Agents applied to Industrial Purposes.

AT the last ordinary meeting of the session, a paper was read on this subject by Mr. F. A. Abel, F.R.S.

The nature and properties of gunpowder, and its special advantages and defects as an explosive agent for industrial purposes, were first briefly reviewed. The application of chlorate of potash to the production of mixtures more violent than gunpowder was discussed, their general susceptibility to explosion by friction or blows was pointed out, and some comparatively safe compounds of this class, such as Horsley's powder and a substance called tutonite, were specially noticed. The salts of an organic acid, called picric acid, now produced in large quantities by the action of nitric acid on the well-known antiseptic carbolic acid, were described as endowed with explosive properties, and as furnishing very powerful agents when mixed with chlorate of potash or saltpetre. Of these the "poudre picrate," or mixture of picrate of potash and chlorate of potash, was the most violent, but was far too dangerous, on account of the readiness with which it exploded by friction, to permit of its technical application. A mixture of picrate of ammonia and saltpetre, designated "picric powder" by the author, was described as certainly not more dangerous to manufacture and to use than gunpowder; considerable quantities had been produced with the ordinary appliances of gunpowder-works, and the material had received safe and successful employment as a violently explosive charge for shells.

Numerous other products of the action of nitric acid upon organic substances, endowed with explosive properties, were stated to exist, but only two of them—nitro-glycerine and gun-cotton—had hitherto received practical application, and these two constituted, at the present time, the chief rivals of gunpowder in many of its most important uses. Attempts were made to apply gun-cotton immediately after its discovery in 1846, and long before its properties were understood; but nitro-glycerine, which was discovered in 1847, had continued a chemical curiosity for sixteen years, its manufacture and application having been developed during the last nine years.

The early history of gun-cotton was briefly referred to, and it was shown that, even in the first days of its production and application, important results were arrived at, though the too hasty attempts to utilise it led to its speedy abandonment, as a highly dangerous material, by all but the Austrians. The improvements effected by Baron von Lenk in the application, as well as in the manufacture, of gun-cotton, which first became public in 1863, led to a resumption of the employment of this agent in England, and to its careful study by a special Government Committee and others. The advantages of the Austrian gun-cotton, as a mining, quarrying, and engineering agent were pointed out, as also the considerable improvements in point of power, economy, safety, and convenience in use, in facility and uniformity of production, which had been effected by the reduction of gun-cotton fibre to a finely divided condition, and its subsequent conversion into highly compressed homogeneous masses. The rigidity of the charges of gun-cotton, and their consequent occasional tendency to become jammed in irregularly-shaped blast holes were, however, shown to be occasional sources of accident; and the necessity for strongly confining gun-cotton, in order to develop its full explosive force, was a defect which existed until recently, and had, for a time, rendered the material decidedly inferior to nitro-glycerine.

An account was next given of the successful manner in which Mr. Alfred Nobel had developed the practical application of nitro glycerine. His discovery that the explosion of this liquid could be brought about through the agency of a detonation, and its successful manufacture, combined to furnish the industrial world with the most powerful explosive agent hitherto susceptible of application, and which agent, from its high specific gravity and insolubility in water, presented the special advantage that it could be used in positions whence water could not be excluded. The poisonous nature of the substance constituted an objectionable quality, and some uncertainty occasionally attended its employment, but its principal defects arose from the fact of its being a liquid, and from the comparatively high temperature at which it froze. The majority of the numerous fearful accidents which had occurred during the transport and landing of nitro-glycerine appeared to be caused by the accidental leakage of the liquid from receptacles in which it was confined. The liability of such leakages to escape observation, and to lead to accidental explosions which would be transmitted to the confined nitro-glycerine, and the reckless manner in which the frozen nitro-glycerine had been frequently dealt with, in consequence of its apparently inert condition, had been fruitful sources of disaster, which had rendered the liquid, in its pure condition, a very unsafe material for employment as a mining agent. But Mr. Nobel has succeeded in applying nitro-glycerine in a simple manner, by which its defects, arising out of the liquid nature of the material, were remedied. He mixed nitro-glycerine with a porous and finely divided silicious earth, and thus obtained a solid but plastic preparation, which could be conveniently handled and converted into charges of suitable dimensions, susceptible of application like any other solid explosive agent, and capable o detonation quite as readily as the pure nitro-glycerine. This mixture, called dynamite, and of which one or two varieties were prepared by Nobel, was stated to be one of the safest, most convenient, and most powerful blasting and mining agents. As now manufactured, in the form of compressed charges, it retained as much as seventy-five per cent. of nitro-glycerine, without exhibiting any tendency to a separation of the liquid during transport and storage.

Several other nitro-glycerine preparations of more recent production were referred to, all of which might be regarded as modifications of dynamite. In some of them, such as Horsley's mining powder, dualine and glyoxiline, solid explosive compounds or mixtures were employed instead of porous silica, as the absorbents of nitro-glycerine; in others, as in lithofracteur, the silicious earth and nitro-glycerine contained in dynamite were in part replaced by semi-explosive substances—for example, by gunpowder constituents. None of these newer preparations contained so high a proportion of nitro-glycerine as dynamite, and although some of them, such as lithofracteur, might vie with it in regard to safety, it was scarcely possible that the substitution of other explosive substances for a proportion of nitro-glycerine in the mixture could result in the production of an equally powerful explosive agent.

When it was found, by recent experiments, that gun-cotton, in the compressed form, could be exploded by detonation like nitro-glycerine and its preparations, that substance proved to be quite analogous to them in its behaviour, though the pure nitro-glycerine still remained somewhat the strongest explosive agent. The suddenness of the explosion developed by detonation permitted of the application of compressed gun-cotton and nitro-glycerine preparations to purposes of destruction without any confinement, and thus operations could be expeditiously and effectually carried out with comparatively small quantities of these materials, which could only be accomplished by exorbitantly large charges of gunpowder. The rapid demolition of military works, bridges, &c., the breaking-up of boulders, large masses of rock, guns, or castings or forgings, were quoted as operations of this class.

The author pointed out some of the causes of the great difficulty experienced in arriving at anything approaching a precise estimate of the relative power and effect of different explosive agents. Taking dynamite as the type of the practically useful nitro-glycerine preparations, and as certainly one of the strongest, experience had shown it and compressed gun-cotton to be about on an equality in point of power, and to exhibit, in their most advantageous applications, a strength which was estimated at six times that of powder. The plastic nature of dynamite and its power of resisting penetration by moisture, gave it advantages over compressed gun-cotton, as it could be used in wet blast-holes, and as very irregular holes, or holes terminating in fissures, could be more conveniently and heavily charged with it than with gun-cotton. On the other hand, the readiness with which dynamite froze and its inertness unless thawed, or fired by special arrangements, and the unpleasant effects experienced occasionally by those using it, were inconveniences not shared by gun-cotton. The advantages presented by these materials, in their general application as blasting agents, were shown to consist chiefly in saving of time and labour, especially in tunnelling or in blasting in hard rock. They were also susceptible of advantageous employment as auxiliaries to gunpowder, in the rapid removal of large masses of rock, or of submerged wrecks; the violent explosive agent being first used to produce extensive rending and shattering effects, and the superior displacing effect of powder being afterwards brought to bear. It was pointed out that gunpowder could not be satisfactorily replaced by these violent explosive agents in some kinds of work, where its comparatively gradual action was a specially valuable feature.

In conclusion, after referring to some recent interesting experiments of Dr. Sprengel, on the application of readily oxidisable and other powerfully oxidising liquids in the production of violently detonating mixtures, the author showed that, even in the application of gunpowder to industrial purposes, some decided advance had lately been made, for its violent explosion could be developed, like that of all other explosive mixtures and compounds, through the agency of a detonation, whereby its action might be considerably intensified, and its application to some important classes of work—*e. g.*, submarine operations, greatly facilitated.

Koumiss.—Dr. Townsend, of Cork, writes to the *British Medical Journal* that koumiss was used by his father many years since in the treatment of phthisis. The following is the manner in which he prepared it, and it answered well:—Take one quart of new milk, one noggin of good thick milk or fresh butter-milk, and three or four lumps of white sugar. Mix all together from jug to jug till the sugar is quite dissolved. Put it in a warm place to stand for ten hours. It will then be quite thick. Pour it again from jug to jug till it is smooth. Bottle it in soda-water bottles; let it remain in a warm place for thirty-six hours (twenty-four in summer). Use the best velvet corks; tie them down; shake the bottle well for five or six minutes before it is opened. It will have whey at the bottom when fit for use. It is to be made every day, and taken in quantities. Its fermentation is the test of its excellence.

Ashworth's Fine Pointed Flattened-Wire Cards.—Messrs. Ashworth Bros., of Manchester, have introduced some improvements in wire cards for carding cotton, wool, worsted, silk, &c., consisting in the manufacture of the teeth or staples out of a wire which has been flattened by passing through hardened steel rollers. The wire thus produced is similar in shape to an ordinary comb tooth, having two broad flat sides, and two narrow round sides. The breadth of the teeth in the direction of the working of the cards gives more than the strength gained by the use of round wire, and thus renders possible the production of cards equal to their work, with a less weight of metal, though with the same number of points as round cards. The cards have now been at work for twelve months in a number of mills, and are very well spoken of. A special "steel" card used extensively in covering lickerin rollers should be separately noticed. It is cut, pointed, and does not require grinding. It works quite clean, and therefore needs no stripping or even brushing. The advantage of an even and regular ..d is thus insured.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 81, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"T. A." AND GRAVITATION.

[4183.]—"T. A.'s" method (let. 4166) is altogether unsound. It is based on two assumptions (tacitly made)—viz., first, that the length of a line drawn from the attracted particle in any direction through the spheroid represents the attraction exerted by the portion of the spheroid lying in that direction; and, secondly, that the lines thus drawn diverge (in "T. A.'s" construction) uniformly from the attracted particle—that is to say, that an equal number of them would fall on equal portions of any spherical surface having the particle at its centre. The second assumption is undoubtedly erroneous; as to the first, "T. A." should have substantiated it before proceeding with his proof.

It is impossible that there can be any simple proof for the attraction of a *spheroid* on an external particle, simply because the integral calculus has demonstrated that the expression for that attraction is not simple.

"T. A.'s" explanation of his reference to Ganot is quite sufficient to show that my apology was called for.

RICHARD A. PROCTOR.

THE SUN.

[4184.]—IT would not be easy for me to answer the question of "L. J. V. G." (query 11870) within compass of a letter, as the considerations which have led me to the conclusion that the sun does not belong to the stream of stars forming the Milky Way are based on researches which have occupied me during the last seven or eight years. I am compelled, in this instance, to refer to my published works, "Other Worlds" (2nd edition, p. 256, *et seq.*), "The Sun" (2nd edition, p. 464, *et seq.*); and, for an account of the researches themselves, the "Essays on Astronomy" (p. 240, *et seq.*), and appendix. It will, I fear, seem unsatisfactory thus to refer to books of my own; yet it must be remembered that if my views could be fully or properly exhibited in a letter I should probably not have cared to write books concerning them.

RICHARD A. PROCTOR.

PIANO CONSTRUCTION—To MR. SCHUCHT AND OTHERS.

[4185.]—"THE HARMONIOUS BLACKSMITH," with that modesty which is his normal characteristic, respectfully declines the honour (?) of being an inventor (?) of perpetual motion; also of being the designer of mechanism which—in the mechanical sense—gains power. Sooth to say, both are simply mechanical impossibilities, and their conceptions only exist in the absence of knowledge of mechanical laws. All machines being but transmitters, not generators, of force.

Mr. Schucht says "'The Harmonious Blacksmith' is trying to show the possibility of imparting to the hammer—in the treble of a piano—a greater power than we usually can get." Now this may be quite true, or "the thing which is not," for it all depends on our definition of the word power. If power and velocity be identical, yes; but if they don't mean exactly the same thing (and I have yet to learn they do), why then, no.

If I ever said anything from which it can fairly be inferred I expected my own, or any other man's, "mechanick" could give out a greater mechanical force than that which impelled it, I can only say, with the parrot (wiser than any "Harmonious Blacksmith," who had experience of the evil consequences of garrulity, "The Harmonious Blacksmith's" greatest fault), "Sorry I spoke" to so little purpose; but I guess I am rather "too old in the tooth" to have been guilty of uttering any such nonsense. What I did say (or intended to say) was, that from the change of its position, the hammer of a piano with an upright action has more and more of its weight supported on its centre as it rises, and (as a necessary consequence) less and less force becomes needed to continue its motion (supposing the velocity of that motion to be uniform), as it approaches the strings. This notorious fact may be ascertained experimentally by taking out the dampers, and finding the different weights required to balance the hammer of a common cottage action in various positions between the lowest and highest.

It is notorious that a continually diminishing resistance to the finger during the key's descent is neither desirable nor pleasant, but that, on the contrary, a perfectly uniform or even moderately increasing resistance produces the most pleasant touch—a fact well known to most makers of grand pianofortes, who purposely delay the contact of the key with the damper lever until the former has descended about half its path, for the purpose of diminishing resistance to the finger at the commencement of the key's motion. In imitation of their practice I designed the actions figured in No. 368, in both of which the resistance to the finger will be found slightly to increase as the key descends.

I might have effected this by other means; for instance, by a spring which, as its resistance increases when it becomes more bent, its reaction necessarily also becomes greater as the key descends. I might also have employed a lever carrying a weight, a contrivance employed in certain ancient machines for weighing bread, &c., which I remember in the—alas, long past—days of mine youth. In these machines the weight recedes from its support as its rises, so, of course, it requires a greater force to balance it the further it rises. Something like this in connection with the key would have compensated for the diminishing resistance caused by more and more of the hammer's weight becoming supported on its centre during its rise, but I thought it far preferable to effect the same result by imparting greater velocity to the hammer, and I did this by positing the sticker hinge (or butt shoulder) in relation to its centre, so that the arm of the lever which lifts the hammer—in other words, the distance from the vertical plane of that shoulder, or of the sticker hinge, to the vertical plane of the hammer centre—became less as the hammer rose. (See Fig. 2 and the description thereof in No. 868.) My reason for preferring to increase hammer's velocity I subjoin.

I presume neither Mr. Schucht nor any other man will deny that *cæteris paribus* the loudness of the sounds produced when the strings of a piano are struck is in proportion to the force of the blow. Also that that force will, *cæteris paribus*, be in proportion to the hammer's velocity. Now, had I adopted either of the former methods of improving the touch, the hammer's velocity—and consequently the force of the blow struck by it—would have remained unaltered: on the contrary, by adopting the method I did, which increased the hammer's velocity from three to six-fold, at the instant it struck the strings (N.B.—So far as regards the production of sound, its velocity during any other portion of its path is quite uninfluential), need I add the force of the blow was increased in proportion to the increase of the hammer's velocity? and although I am far from asserting the sound became six times louder, its power was very considerably augmented. That the sound should not respectively have become three or six times louder—so far as I am able to estimate the relative intensities of sound—need not very much surprise us, for the proportions between the force of the blow and the mass of material—strings and belly—by which the blow was resisted were considerably altered: in a word, *cæteris paribus* was not maintained, and to restore, or rather to approximate to, those original proportions, it became needful to increase either the length, the thickness, or the number of unisonous strings the hammer struck. All these methods were tried, as I before stated, and from the experience gained during those trials I opine the very best thing to do—supposing our object to be the production of a pianoforte capable of yielding the most powerful sounds of the best possible quality, without regard to its original cost or the expense of occasionally, but not very frequently, retuning it—would be to employ all three of these methods; but as regards increasing the lengths of the strings I fear we can hardly do so with safety, beyond those shown in the diagram and specification in No. 372, until the employment of wire of greater tenacity than can now be obtained, unless it be drawn extra hard to special order becomes general.

With regard to the positions of the dampers I may just remark that, *cæteris paribus*, they act quickest when at the middles of strings. Of course, it would be inconvenient, although far from impossible, to place them there; doing so would not be worth its cost, for if made pretty long (say, from one-twentieth to one-fifteenth the string's length) and soft, they act efficiently when properly pressed against the string at any convenient portion of its length, especially if their soft faces be grooved so that they embrace the string for about two-fifths of its circumference. If you desire to damp "werry dead" indeed, double dampers are the right thing. By double dampers I don't mean what the late Mr. Mott called by that title, but dampers before and behind the strings, which when opened allow them to vibrate, but when shut clip the strings like a pair of hollow-bitted forge tongs clip round rod iron, which the "Harmonious Blacksmith" avers is a very efficient clip indeed, but it is unnecessary; again, as their French hosts—who are now mercifully permitted to have the privilege (?) of feeding and entertaining a good many of Mr. Schucht's countrymen—would say "Le jeu ne vaut pas la chandelle."

THE HARMONIOUS BLACKSMITH.

MUCH EXPERIENCE IN FEW WORDS.

[4186.]—A CORRESPONDENT, who is a competent observer, has sent me the following pithy letter:—"A vessel of ink and water is better for solar observations than an oblique silvered glass; but your first surface prism for ever!"

J. B.

AN IMPROVED BEEHIVE.

[4187.]—BEING a constant reader of the ENGLISH MECHANIC, and of late having seen several articles on "Bees and Beekeeping," I thought a few words and sketch of an improved hive might interest a few of your readers. I have myself been a loser of these very interesting labourers in considerable numbers for want of a well-constructed hive, both in workmanship and principle, and after many trials with plain straw hives, those on the Neighbour system, as well as those on the Woodbury principle, both with bars and frames; but this last winter has convinced me that a hive constructed after the inclosed sketch is more practical, simple, and better than any of them.

The hive consists of a long box, most representing a cupboard. The extreme dimensions inside are: Height, 29½in.; width, 9½in.; depth 11½in. The body is of 1in. thick pine, with ¼in. thick crossing the grain again inside, and fastened by means of nails every three or four inches of the whole surface, thus making the sides and door 1¼in. thick. The bottom, or floor, is formed of two pieces, 1in. thick, with a space of 1in. between, which is stuffed with hay or other open material, as shown, and closed by a piece fitting in between the bottom boards. The top or roof of the hive is formed by a 1in. thick board; between this and the gable-roof boards, which are 1¼in. thick, the space is filled in with hay, as shown. The gable-roof is made weather-tight by means of painted canvas; the rest of the hive is painted dark ochre, and the whole varnished. The door is formed the same as the sides, and extends from top to bottom of the hive in one piece, and fits neatly into the recesses formed by the 1in. and ¼in. thicknesses. This completes the exterior of the hive.

It will be observed that the interior is divided, as it were, in three compartments; in reality, Nos. 2 and 3 are one compartment, so high that two frames can hang one above the other, with five-sixteenths of an inch space between them for the bees to travel through. The top room (No. 1), or super-room, is separated from the stock-room by means of a board ⅜in. thick, formed of three breadths, which slide easily from back to front of the hive in the recesses (*b*) at each side. The total breadth of these three boards should be five-sixteenths of an inch less than the total depth of the hive inside from back to front. In one of these boards should be bored a hole 1½in. in diameter to allow for a feeding-bottle to be placed over it, as shown in the sketch, the bottle being supported on a turned wooden base, as shown. The same hole can be used for setting a glass over in summer for honey taking; at other times a prop or cork can be inserted, through which a hot wire or needle has been passed several times; the prop then serves as a gentle ventilator. The objects gained by having this partition board in three pieces are that the position of the one with the hole in it can be changed to suit the requirements of the inmates at the different seasons for feeding; also, that when it is wished to take honey in the frames the one board is pushed in first close to the front, the other two are then put in, but kept close up to the door at the back; thus there will be left an opening of five-sixteenths of an inch between the second and third board, which will allow the bees to pass through and fill the frames, the queen never venturing to pass through such a small opening, thus we secure clear honey in these frames. When wishing to take one or all the frames out I merely press the two front boards gently and slowly back against the other, thus closing all communication between the super and stock-room; then, by removing the window (*c*) of the super-room, the confined bees can escape, and we can take the frames out with freedom. All the frames are of equal size, and can be used either in the super or stock-room. They are of the following dimensions: 9in. high, 8¾in. wide, and fifteen-sixteenths of an inch broad, outside measure. They are made of deal strips, fifteen-sixteenths of an inch broad by three-sixteenths of an inch thick, being joined at each corner by means of fine sprigs driven into ⅜in. square distance pieces. Each of these distance pieces project ¼in. at each side of the frames, and serve to hold the frames at a regular distance from each other—that is, ½in., so that the bees have clear access over the whole combs at each side. The top pieces of frames project ⅜in. over the sides that form a support on each side to fit in the recesses (*b*) that are worked out of the ¼in. lining at the sides of the hive. The recesses or grooves are made in the form shown, so that the bees can at all times have access to destroy moths or other intruders that may have entered the hive, as it is of the highest importance to avoid having any opening where the moths can lay their eggs, or other intruders hide, and where the bees cannot come at them to destroy them for this purpose there is left a space of ⅛in. at each side of the hive between the outside of the frames and side of the hive.

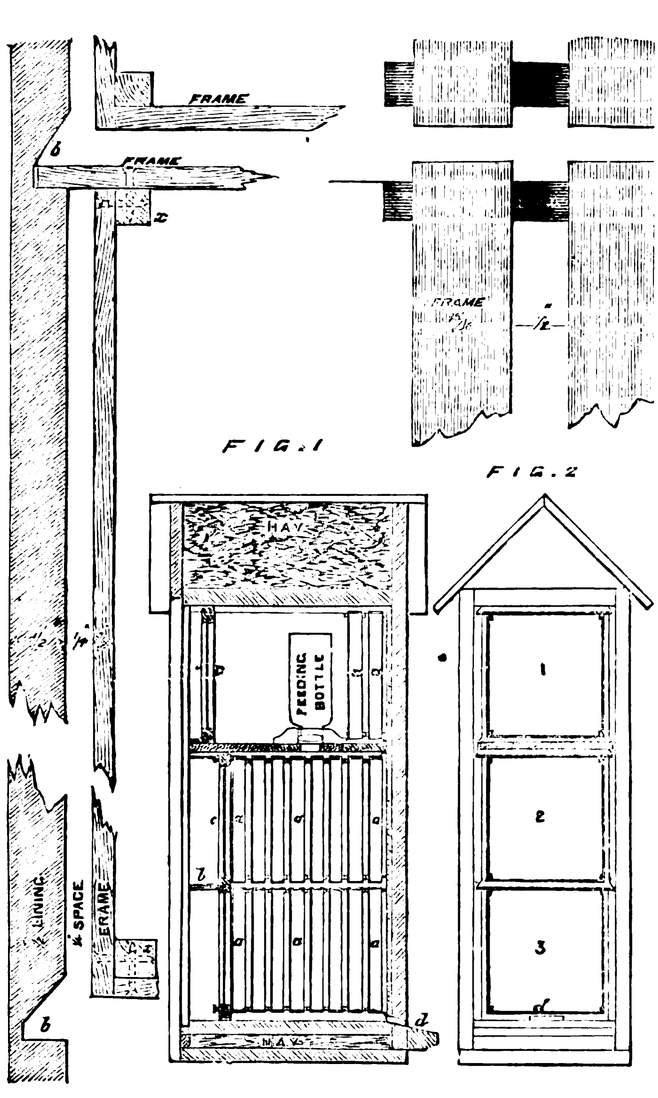


FIG. 1 FIG. 2

From the sketch it will be seen that there are sixteen frames in the stock-room; this is the full number intended, and in the super there can be eight frames. It will also be observed that there are two windows (*c*)—one for the super and the other for the stock-room. These windows fit nicely, and slide from back to front of the hive. By this means we can always limit the space for the bees' requirements. For instance, on having a swarm, six frames can be put in the stock-room (three under and three over); the window is then slid in close up to these frames. On our next examination, if we see that they have begun to fill the frames nearest the window, we immediately take the window out and place two more frames (one top and one bottom), pressing the window up as before, and so on progressively until the sixteen frames are inserted, when the hive will then be in good condition, and well populated. The same control can be exercised over the working space in the super. Inside the window of the stock-room a small thermometer is fastened to the window, by which means the temperature can at all times be observed. On looking at the sketch it will be noticed that when the full number of frames are in the stock-room, and the window close up to them, there is a space between the door and the window. This, in winter, after the frames have been seen to and found all in order and the window replaced, is well filled with some dry material, such as cotton waste, hay, or whatever may be found most convenient and warm.

After one has satisfied himself that there is no occasion to feed by means of the bottle or honey in the super, the bottle and frames should be taken out and the space well packed with a dry and, if possible, absorbing material that has been previously dried carefully in an oven, to destroy all eggs or larvæ that may come to life by the warmth from the hive. After thus packing, the window can be replaced, after opening a small sliding ventilator fitted into the frame of the window at the top, the ventilator being a plate, pierced with small holes, inside the frame. The door can then be carefully closed and fastened, and the little colony left safe and warm for their winter's rest, until a warm day in the early spring allows of their being examined, and they give a healthy buzz as sign of thanksgiving for their careful preservation during the cold winter. I may here state that on opening the super-room in the spring the packing material will be found quite wet or damp, and covered with a dew, thus showing that all this moisture otherwise must have remained in the stock-room, to the little colony's danger and discomfort.

The advantages of this hive are: Always being able to see all going on inside; able to take any frame out in a few minutes; able to feed at all times without enticing robbers from other hives; being able to obtain honey easily by three modes—viz., in a glass or in a beautiful square piece of comb, by merely passing a knife all round inside a frame, when the square comb is left on the plate as easily as a brick from a mould; or, if wished, by means of machine the frames containing the combs full of honey can be taken out, and in a few minutes the empty combs can be returned to the super to be again filled, thus saving the bees time and trouble of building fresh combs, as by use of machine half a dozen frames can be beautifully emptied, and the empty combs returned to the super to be filled again, the whole not occupying more than as many minutes of time.

In hives of this description there are no screws to take out or set in, and the bees are not annoyed by the roof of their dwelling being taken off every time one wishes to examine or see to their welfare. I reserve until another time a short description of a honey-taking machine, should any of your readers wish to make and try one, as I assure them they work admirably. I may add that such a hive costs me, complete in all respects for working, at the rate of English money, £1 2s.

REFERENCES TO DRAWING.—Fig. 1, side elevation in section; Fig. 2, back view with door removed. *a*, frames for combs; *b*, recesses for frames to slide in; *c*, windows to slide in and out; *d*, entrance; 1, super-room for honey in frames or glass and for feeding by bottle (Crosse and Blackwell pickle bottle); 2 and 3, stock-rooms; *x*, distance pieces.

Myborg, Denmark. BEEKEEPER.

CURIOUS CASE OF DOUBLE REFRACTION.

[4188.]—MANY years ago, observing to a philosopher how curious it was that Iceland spar should possess the property of giving a double image, he replied that the wonder rather was to find what had not this property. I had lately an illustration of this doubly-refracting power in the ordinary glass of a window. About 50ft. outside of my window a small iron ball is attached to an iron rod. When the background of the sky is not too bright, I clearly discern through the window glass a shadowy ball, like a photographic ghost, which I prove to be a secondary image by changing the position of my eye and angle of visual perception. The shadowy image moves, as it would do if a prism of Iceland spar were slowly rotated. I cannot see this secondary image on looking at the eaves of a house or the bare branch of a tree. At first I referred it to polarisation. Perhaps both have something to do with the phenomenon. THOMAS BUCHANAN.

DR. CARPENTER AND PERSPECTIVE.

[4189.]—THERE is such a conventional rule as "Cervus" mentions (let. 4118, p. 200), for limiting the horizontal angular range of pictures containing architecture; but it need not apply to their vertical extent, which need not be nearly so limited, as will appear the moment the reason of the rule is understood. No picture can possibly represent a scene with *real* accuracy when viewed from any other point than *one*, the "point of sight," the same at which the lens would be placed for viewing it as a "peep-show," or what was lately dignified as "cosmorama." But pictures to hang on walls for ornament (as the vast majority always must) are necessarily viewed with the eye constantly moved away from their true "point of sight," more or less; and if the angular range of scene represented do not exceed 60°, the eye can so allow, by habit, for the error of the foreshortened plane picture, as still to understand, and not find it distorted. But beyond 60° this correction is hardly in the eye's power, so that, when much removed from the point of sight, it will find the picture distorted in the perspective of its corners or extreme parts; though *at the point of sight* (let me remind "Cervus" and M. Paris), perspective is perspective, and absolutely true, however far extended, so that a picture to be viewed only cosmoramically, or from the right point, has no limit, but may be 100 times as wide or high as it is distant, and represent any amount of horizon possible, even 170° or 179°, with no distortion. Now, as the eye, in a room or gallery, moves away from the point of sight *horizontally*, but hardly at all *vertically*, only so much as arises from our unequal statures, "Cervus" will see why much closer limitation has to be observed in any picture's horizontal range than its vertical. The latter may be freely carried even beyond 45°, both above and below the horizon, while the former should never exceed 30° each way from the centre.

M. Paris says "all objects diminish as their distance from the eye increases," but forgets that the marks on his picture are no exception to this! If the top and bottom of his *representation* of a tower are at distances from the eye as two to one, and the top and bottom of the *real* tower are at distances in the same ratio, must not the top and bottom widths, if equal in one, the tower, be equal also in the representation? He sticks, like the Chinese before they had photographs to measure, to the metaphysical heresy against perspective, that the representation of outlines is to be matter of judgment instead of pure science; something subjective, physiological or psychic, instead of objective; but with more than Chinese obstinacy, he sticks to this after photographs have given tangible proof that the mathematical perspective (which is what I suppose he means by "Laputan") was always the sole right one!

If by "moving" the eye or the camera he means *locomotion* of them, of course there must be none, but if by "moving" he only means *turning*, the eye may always turn to any extent, in viewing the same picture (or panorama). The camera, however, if forming its images on a plane (as it usually does) may not turn at all, without altering the picture's forms, because the *plane of projection* is altered. If it threw the picture on a spherical watch-glass (as the eye on its spherical retina), then it might turn to any extent on the centre of sphericity, just as the eye does. The picture, though falling on different parts of the glass would always be identical. E. L. G.

[4190.]—IF M. Paris had read my letter (3944, p. 39, so as to understand it, before he wrote his replies (let. 3971, p. 119, and let. 4111, p. 200) he might have seen that his question about a long wall is answered; and that if he wants to delineate his wall of infinite length his canvas must be of infinite length also. If he has understood my letter and thinks that my definition of the reason for parallel perspective is wrong, he might as well explain where the error is. A sketch, also, of some simple subject, such as a row of houses, according to his ideas of perspective, would be interesting.

I am as sure as M. Paris is to the contrary that parallel perspective is the only true one; that pictures are something to go by, because they are not conventionally arranged, but are drawn as they are actually seen; that moving the eyes is not the same as moving the camera, because when the camera is moved the plane of delineation is moved also; and that "E. L. G." will not say anything so foolish as M. Paris supposes.

Ten minutes' drawing practice on a window, as suggested in my letter (p. 39), would teach M. Paris more of the true principles of perspective than reading or writing any number of letters on the subject, and he would also see that he has totally misunderstood the matter which was to be demonstrated. No one says that the summit of a tower, viewed from the ground, does not look narrower than the base, the question to which Dr. Carpenter gives one answer and I another is, why a tower with parallel sides, which appears to the eye tapering, should (or should not, if M. Paris likes) be drawn parallel? B. D. T.

SPINNING-TOP.—PERSPECTIVE.

[4191.]—THREE letters (4180, 4181, 4182, page 204) have drawn my attention to an earlier one (4040, page 151). "Philo" is right. A top has keen known to spin longer in a partial vacuum than in the atmosphere. As to "A." and M. Paris, they revive old fallacies about the gyroscope, of which the common spinning-top is but a variety; but may console themselves that they are in good company, since the Astronomer Royal for Scotland said that in the case of the gyroscope we must look to the action of gravity acting horizontally, or words to that effect. It is strange how often mistakes reappear, although corrected. At page 411 of your issue for January 7, 1870, your correspondents will find a figure and description of apparatus which demonstrates that "the effect of gravity is not nullified"—that the "force of gravity is not overcome."

The late Arthur Parsey published a book about twenty years ago, to endeavour to establish a system of perspective in accordance with Dr. Carpenter's unfortunate blunder, and a very curious book it was. The difficulty some people have about the point in question arises from their erroneously supposing that in a picture or drawing objects must be as the eye sees them. Now, the image in the eye is not identical with the objects, for it makes the more distant ones smaller than the nearer ones: it also corresponds to a spheroidal section of the rays from the objects. A drawing or picture is a contrivance (generally, although not necessarily, on a vertical plane) for producing in the eye the same image that the actual objects would do, which it could not do were it precisely the same as that image. It is geometrically demonstrable that parallel vertical lines in the object must be represented by parallel vertical lines in the picture, when the plane of the latter is vertical. But for all that, the picture will appear quite right to the eye, for the widths between the lines of the actual objects will appear to vary in a manner depending on the angles between the vertical lines and imaginary lines from the several points to the eye, and the widths between the lines of the drawing will appear to vary in precisely the same way. Thus the top of a tower in the picture must appear as much further from the eye than the bottom as the top of the actual tower seems further than the bottom.

Glasgow. E. H.

ECONOMY OF SMALL BIRDS.

[4192.]—I BEG to thank "Animals' Friend" (let. 4126, p. 208) for his defence of small birds. I am a gardener in a small way, and do all I can to prevent birds being driven away, being convinced that though they do some mischief, they prevent far more being done. Some years ago, when visiting a large establishment for the growth of grapes for sale, I noticed many birds flying about the houses, and was told by the owner that he had quite satisfied himself that though the birds did eat a good many grapes, they took no more than they were fairly entitled to, for they prevented a great many more being eaten and spoiled; he would not on any account have them excluded, even during the fruit season, while during the greater part of the year, their services as insect eaters are of unmixed benefit, and as to a few grapes they were welcome. The labourer is worthy of his hire. PHILO.

"E. L. G.'s" COMET.

[4193.]—ONE thing is certain. Whether there was a universal deluge 5,000 years ago or no, there is a deluge of words now. Four columns of "E. L. G."! However, there are some good grains of wheat among the large amount of chaff, and I hope our friend will not object if others add a little chaff also.

Lest we should get altogether swept away from any known position, let me lay down some fixed bearings. "E. L. G." is committed to two distinct propositions, not singly, but united, and it is the union of the two which caused this discussion; at all events that has brought me into it. These propositions are:—

1. That some 5,000 years ago there was a universal deluge which covered the whole then existing earth, necessarily destroying all its inhabitants except those specially preserved.

2. That this deluge was caused by contact with a comet.

The first of these propositions is difficult to debate without getting into a morass of theological squabbles, upon which I should firmly refuse to enter if "our" Editor were foolish enough to let me. But I heartily indorse the truly wise sentiment of "F. R. A. S.," p. 223; it *is* "playing deliberately into the hands of the infidel and the scoffer," when those who consider themselves the advocates of religion insist upon coupling together religion and statements set forth as facts which are not facts, and which can be disproved. That the early fathers of mankind were subjected to a great destruction by a deluge or flood is a fact testified to by most of our early records. That this deluge was a universal one covering the whole earth is the apparent verbal meaning of the account given in our sacred records. But those records are the history of a family and nation; they give a cosmogony and early history, but they do *not* give them on their own account. They are the grandest poem in the world, but they are but an episode; they are simply an incidental introduction to the history of the Jewish family and race, and all the rest of the world, and its history is ignored except where it is essential to that special history; even when touched upon in consequence of this, it is always dealt with in perfect accordance, not with late scientific discoveries, but with the ideas of the people to whom the narrative was addressed, and who regarded the earth as consisting of just the lands they were acquainted with, as a plane surface, the centre and object of the universe, to which the sun and moon were subordinate, and in relation to which the stars were utterly insignificant, ranging these bodies purely in the order of their apparent utility. To people with these ideas, a flood which covered the land their fathers were living in (probably a fertile river district) would be fitly described as covering the whole earth. But if because such words are used we must be bound to extend that idea to the whole globe such as we know it, we must also be bound to accept literally the similarly connected ideas of the sun and moon standing still, and the creation in six literal days, as to both of which, explanations similar to that which I have given are now universally admitted.

Turning now to "E. L. G.'s" remarks (for it would be a great stretch of courtesy to call them arguments), they are found to consist of such phrases as these: "Very often have I speculated whether there may ever be found means of guessing;" "The arrival of the last atmosphere (evidently one of steam) must have;" "If we ask what weight of steam sufficed, I see no conceivable data for an estimate;" &c., *da capo*, as the musicians put it.

Happily "E. L. G." in his letter (4176, p. 229) has furnished a few excellent words which, reversing their application, convey admirably the sentiments his doctrines excite: "They generally see that it is utterly disproved by all *known* facts in the heaven and the earth (as baseless and as multifariously disproved as ever the Ptolemaic astronomy has been);" "A new priesthood that instead of reason or argument, write when something is to be swallowed against evidence, of what *we ought to believe*;" "Exactly as any Popish Council, &c., laid down their creeds, this dogmatic *faith* (for such it is, and no science) being just as anti-scientific myth and miracle-swallowing," &c. It is not necessary to give in full the usual string of epithets in which "E. L. G." so delights.

Now, as to the first point, was there a universal deluge? Any single fact inconsistent with such an occurrence disproves it, despite of any quantity of facts or arguments which may be consistent with it. Such a fact is that distribution of life to which I referred (p. 196), for it is impossible that in the short space of 5,000 years, the whole of the marsupial races should have found their way to the great island of New Holland, and disappeared from all the rest of the earth; ergo, New Holland was *not* flooded, its inhabitants were *not* destroyed, and, corollary therefrom, the deluge was *not* universal.

It may be "obvious" to "E. L. G." that all surface undulations were caused by a flood, but to other minds it is equally obvious that these undulations are due to other causes. But the second paragraph of letter 4157, p. 226, is one of the richest things I have seen for some time past. We are to accept on "E. L. G.'s" pure dictum that the earth is covered with a film (falsely called crust). Of course, "E. L. G." has measured its thickness, and is prepared to show the error of those mathematicians who show that this crust or film is some 800 miles thick at least. The one evidence he appears to present is a connection between cyclones and earthquakes at St. Thomas's, as to which far too little is yet known for any one but "E. L. G." to dogmatise about. But the fun of the matter is, that if "E.L.G.'s" facts and doctrines are true, they disprove his theory of the deluge. A mass of water falling over the whole surface would certainly do exactly the reverse of what he states; all that fell on the sea would increase the liquid pressure on its bed; all that fell on the land would run off into the sea, and increase that pressure; so that the result, on his own theory, would be such a compression of the film under the sea as would force the land up higher and higher, instead of raising the sea bed. This would be further aided by that rapid denudation, and, therefore, diminished land pressure depicted p. 230, because although "E. L. G." speaks of the action occurring before the water could run off, that could only maintain a temporary equilibrium—not increased pressure on the land, as the "10 feet per minute" on the area of the land would be balanced by the same 10ft. per minute on the sea; but as soon as it began to run off it would add to the sea pressure, not its own weight only, but that of the land it swept away also.

But how is it possible to argue seriously with a man who coolly obliterates the Andes and the Himalayas at his pleasure?

Now, as to the second proposition, the comet as cause of the supposed deluge. I have never yet weighed a comet for two reasons. 1. My balance, being for chemical analysis, will weigh only small masses up to 1,000 grains. 2. I do not know how to get a comet into the pan. But astronomers suppose they have some means of weighing the heavenly bodies, and in reply to "E. L. G.'s" challenge to prove a *single one* too small, I quote from Roscoe's "Spectrum Analysis." "The mass of the comet, I believe, is, astronomically speaking, inappreciable. We do not know whether there is as much matter in this comet as would fill this room, or as much as would fill one's hat, and this amount of matter is spread over an enormous space." This may not be proof; but assertion against assertion, if I am to choose between Roscoe or Huggins and "E. L. G.," I have no hesitation as to where the preference is due.

Now, as to the great question, where is the water gone to? Probably, "E. L. G." thinks that by puzzling others with a small problem of this sort he may evade the great difficulty. But, unfortunately for him, the difficulty he proposes is a very slight one. I know nothing of the matter beyond the extract he furnishes, showing the disappearance of a quantity of water from the sea into a limestone cavern. Probably a visit to the spot and a careful survey would explain the matter at once. I will, however, suggest a very likely explanation. We know that in many seas (and particularly we know it of the Mediterranean) there are very strong undercurrents. Such a current sweeping along a shore perforated with an opening leading to the particular cavern in question would produce a strong eduction current, or suction sufficient to draw out the water entering the cavern, probably on the other side of the island. The account shows, apparently, that the fall of the water is very slight, for the mills are stated to be driven by an undershot wheel. I could furnish several other probable explanations, but it is needless.

"E. L. G." holds that the water of the deluge obeyed the same laws as yesterday's shower, but this is absurd. Yesterday's shower fell, and returns to the sea to be again raised in vapour; here is circulation of a fixed quantity. Our problem is to dispose of a sudden and vastly excessive quantity, taken, at the least, very much in excess of the power of the air to absorb as it does yesterday's shower; for we know that the whole weight of the atmosphere is only equal to about 34 feet depth of water over the earth's surface, and the water contained in that atmosphere is only a small fraction of the total weight.

"E. L. G." has undertaken a hopeless task: a believer in the universal deluge, by faith in the record of it, has a perfect right to assume a miraculous production and a miraculous removal of the water: that is consistent, and I know of no possible reply. But one who treats it as a scientific fact, to be accounted for by natural causes, whether providentially controlled for the purpose or no, is bound to show that the causes he relies on explain his doctrine. If he invents a comet to bring the water, he must invent some way of getting rid of the water when its work was done. That task can surely prove no difficulty to a man who can order in a ready-made steam comet when he requires it. This is all "E. L. G." has done, for he most certainly has not given one particle of evidence that "geology shows that one fell 50 centuries ago, enveloped the earth before falling, and that its material was steam." SIGMA.

INLAND NAVIGATION.

[4194.]—I AM much obliged to "Jack Tar" for his great concern on my behalf, but very much surprised that he should gather from my simple letter that I was going to be fool enough as to venture to attempt crossing the Channel in my canoe. The words I used were simply that I was desirous for information about the waters in England or in Ireland; but lest any one else may go wrong, I want particulars the waters, rivers, canals, &c., of the counties of Armagh, Monaghan, and Fermanagh (more especially in the province of Ulster), which come on the way to join the Shannon.

I may say I have carefully read all Mr. Macgregor's books relating to his various voyages. I intend to confine myself to river and lake or canal navigation—with the exception of our own river here, the Mersey.

When asking for particulars of outfit, I had hoped some of our readers would have described the shape, material, and number of their sails; the sizes and weights of their various spars; the make of painter; whether they used an anchor or boat-hook, or carried wheels to make portages, or trusted solely to the chance of friendly assistance, or dragged their craft over land. Such particulars as these will be gratefully received by AFLOAT.

[If "Afloat" had referred to the *number* of the query or reply he would stand a better chance of getting the information he is in search of.—ED.]

GOVERNMENT AND AMATEUR SCIENCE.—I.

[4195.]—AT a late meeting of the Royal Astronomical Society, Colonel Strange advocated very strongly the importance of establishing physical observatories for prosecuting original research, more particularly with regard to what he termed the "physics of astronomy," and urged that as it was out of the power of individuals to carry on those long-continued observations that are necessary to elucidate questions which have been raised in the present advanced state of science, national establishments should be founded for the purpose of conducting such observations.

In the present age of amateur activity it may not be unimportant thoroughly to canvass this proposition, and if, Mr. Editor, you will grant me the necessary space I shall be happy to lay before the readers of the ENGLISH MECHANIC my views of science, as it exists under Government patronage and support, and as pursued by enthusiastic and energetic amateurs.

With the remarks of the Astronomer Royal relative to the connection of an object of secular interest with a Government establishment I most fully concur. We are all, more or less, taxpayers, and we have an interest in the disbursement of public money for scientific purposes. This disbursement may at present be considered under the two heads of "Astronomy" and "Meteorology." During the existence of the Royal Observatory, from its foundation to the present time, I think we must all agree with Colonel Strange that in connection with navigation it has done its work nobly and well; it may, nevertheless, not be out of place to ask if during this interval it has fully executed *all* the work devolving upon it? If I mistake not, the distinguished astronomer who at present presides over the establishment found in the archives of the observatory certain *unreduced* observations of the moon, which in that state were unfit for use. These by the aid of a grant of money, have since been reduced, and rendered capable of being employed in one of the most important astronomical investigations, "The Lunar Theory."

This allusion to the lunar theory leads me to notice the five principal divisions of this part of astronomy. 1. The raw material, consisting of the observations as made with the necessary instruments, and recorded in the books of the observatory. 2. Of the prepared material or the reduced observations in a fit state for the use of the theorist. 3. The theory itself brought to its present state by the labours of gifted minds, aided by mathematics of a high order. 4. The construction of tables in accordance with the theory. 5. The application of these tables in the computation of our national ephemeris, the *Nautical Almanac*. In looking at these five divisions we find three that are the work of the Government, and could not be accomplished without its aid. The unbroken series of lunar observations made at the Royal Observatory is one of the scientific glories of England. Nowhere in the whole world is an observatory spoken more highly of in connection with the moon than the Royal Observatory at Greenwich. Although the accumulation of unreduced observations during an anterior period of the history of the observatory has been referred to, such is not the case under the present able management. All observations are now reduced and duly published. The two departments, observing and reducing, are most efficiently carried on, and represent astronomy as supported by the Government.

The work of building up and perfecting the lunar theory is altogether separate from that above described, and may be regarded as a high order of amateur effort. While Governments have contributed to furnish theorists with materials, it is only by such minds as those of Newton, Clairault, Euler, Mayer, Lalande, La Place, Hansen, Delaunay, Cayley, and others that a theory so important in its bearings on the well-being of mankind could be brought into its present state. It was said by the Astronomer Royal, at the meeting of the Royal Astronomical Society, that the observations of the moon so sedulously pursued at the Royal Observatory were not undertaken for the elucidation of the lunar theory, but for the determination of the longitude. Now these two objects are indissolubly bound up in one great enterprise, an enterprise in which a succession of master minds have engaged; an enterprise that has had a two-fold effect upon society, for it has developed and disciplined minds of the highest order, and it has contributed in an accelerating ratio to the spread of commerce and civilisation. Without the theory the determination of the longitude would still be an unsolved problem, and without the important incentives for discovering the longitude, the theory might not have been developed to the extent to which it is at present.

Of all the branches of astronomy, the lunar theory has been the most extensively employed, but to render it as efficient as possible it must be cast in a mould, it must assume a shape by virtue of which its results can immediately be turned to a practical account; in a word, tables must be computed which can be used in determining the position of the moon for any given time; accordingly, several of the astronomers who have engaged in investigations of the lunar theory have constructed lunar tables. It is at this stage that Government aid is again indispensable. For the mariner to compute from the lunar tables the position of the moon before he could from his "lunar" find his longitude, would be a work which few, if any, could accomplish, but by supplementing the observational work of the Royal Observatory with the results of computations embodied in the *Nautical Almanac*, as suggested by Nevil Maskelyne and continued since his time, the mariner goes to sea with the requisite means for finding his longitude furnished him by science.

I have in this letter endeavoured to direct attention to the important assistance which our Government has rendered to a portion of astronomy that has been of incalculable benefit to navigation in the departments of observing and reducing observations, and in the computation of data by which the mariner determines his longitude. The higher branch of this valuable work appears to have been beyond the reach of a Government establishment. The improvement of the lunar theory has not been worked out within the walls of the Royal Observatory, nor have the tables been constructed therein. Men unconnected with it have accomplished the higher objects—that of producing tables of the moon as accurate as existing data will permit. In my next letter I propose to notice more especially the labours of amateur astronomers.

W. R. BIRT.

LUNAR OBJECTS FOR OBSERVATION IN JUNE, 1872.

[4196.]—JUNE 8, Brom., Agarum, Hahn, Berosus, Condorcet (*a*). June 9, *Wrottesley*, a crater adjoining Petavius on the east, Snellius Stevinus. June 10, Mare Nectaris, the ridges on the western part. June 11, Mare Serenitatis, the ridges on the western part (*b*). June 12, Linné and craters west of it. June 13, *Piazzi Smyth, Rumker* (*c*), *Bond* (*d*). June 14, Abenezra, Azophi, Agrippa, Godin. June 15, *Teneriffe Mountains* (*e*), Archimedes, *Newton* (*f*), (Schr.). June 16, Delisle, Diophantus. June 17, La Place, Maupertius, Condamine. June 18, Hesiodus (*g*), Cichus, Wurzelbauer.

(*a*) There are two conspicuous craters (not in Webb) S. and SS.W. of Condorcet. They were well seen on March 23, 1871.

(*b*) With longitude of terminator at 60° north latitude, varying from 20° to 12° west, and from 24° to 12° also west on the equator, the ridges of the Mare Serenitatis may be studied to advantage.

(*c*) Piazzi Smyth and Rumker are two small but conspicuous craters between Archimedes and Plato.

(*d*) A group of fine formations exists on the north of the Mare Frigoris, in the neighbourhood of Barrow and Timæus. The fine lozenge-shaped formation between Timæus and Barrow has been named "Bond," in commemoration of the discoverer of the obscure ring of Saturn.

(*e*) The group of mountains on the Mare Imbrium south of Plato has been named "The Teneriffe Mountains," to commemorate "An Astronomer's Experiments."

(*f*) The ancient crater about as large as, and south of, Plato, described as "Newton" by Schröter. It is best seen just after sunrise.

(*g*) The cleft from Hesiodus to Capuanus is a fine study. It has lately been traced throughout its length by Mr. Knobel.

Possessors of the first sheet of my catalogue of "Lunar Objects," including Area I A β, are requested to add the following, which were observed on May 15, between 8 and 10 hours Greenwich mean time:—

I A β 38 An isolated mountain between Agrippa and I A β 9, shown by Schröter in T LXII., Fig. 2. and by Lohrmann in both Map and Section I.

I A β 39 A peak on the S.E. border of Agrippa, shown by Lohrmann only in his map and Section I.

I A β 40 A cleft extending from I A β 41 to I A β 31. It terminates at the northern part of the mountain I A β 31, is a bright conspicuous object, and forks about the middle of its course. It is not shown by Lohrmann, but is well given by Beer and Mädler in the new edition of the large map as *a mountain ridge*, forking as above described. Its character may be better determined under an earlier illumination than on the 15th of May. It is about double the width of the Higginus cleft, and brighter. It is perceptible on De La Rue's photogram of Feb. 22, 1858.

I A β 41 A small mountain N.E. of I A β 5. It is shown in Fig. 2 of my Notes and Illustrations to the Catalogue.

W. R. BIRT.

HOW THE TONES OF A VIOLIN MAY BE INCREASED.

[4197.—To state anything new concerning the violin is usually a difficult matter, and I suppose one may experiment for years before arriving at any new fact worth mentioning. In previous numbers of "ours" the construction of the violin has been freely handled, and the relation of string to bridge, and thence to the breast, commented upon. Savart went further, and compared breast with back, showing (I think) that they must be dissimilar in kind of wood, and in thickness or density. We may infer, then, that to make the parts of a violin the same or alike is a mistake. I thought at first (and do now in part believe) that the pressure of the strings on the bridge interfered with the vibrations of the breast, for by raising the strings on a piece of wood 1¼in. high, previously removing the nut, sensibly improved the tone; but alas! not when the bow was used near the bridge, but only near the nut, and, again, the tone was not the true violin tone. It will always be difficult to maintain the present tone and increase its power without a roughness or reediness as a consequence. So I have come to the conclusion that we may not change the rules already established, but must endeavour to carry them out further, if possible, and I beg to place before our readers the following fact for their consideration. It is known that the back of a violin is hard, and forms the sound reflector; now, if a piece of hard wood—mahogany, for instance—is placed against a violin, the tone is very much enlarged. The best way is to lay the instrument down on its back, on another sounding-board, made 14in. wide, 28in. broad, and 1in. thick, the grain of the wood running across. The inference is this: cannot a second back be made to fit the violin? Very easy, is it? But no pressure must be used in the fixing, or the tone is lost, a simple contact is only allowable. A piece may be cut so as to cover the back, and held under the chin with the violin in the usual position, and that would do very well if you could keep it there. Another sounding-post will not act; I wish it would, for then we might have a series of soundboards *ad libitum*. Some of our fiddlers may see their way through this difficulty, if so we shall be glad to know. Probably if the backs of violins were made thicker it might improve the tone, but not much, and it might act just the other way. I have communicated this very small piece of information in the hope that as the trial can be easily made, some of our friends will report on the same.

FIDDLER.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4198.]—"PHILANTHROPIST" is quite correct in what he states is the object of rifling a gun (let. 4100, p. 198); but when he says the composition holes might point backwards, so as to be ignited by the fire of the gun, he shows a want of practical acquaintance with artillery work. In shells for smooth-bore guns, the projectile is fitted into a wooden bottom, and the fuze points forward, towards the muzzle, and is ignited by the flash lapping all round. All muzzle-loading shells have their fuses ignited in this way. Breech-loading shells have their fuses ignited by a fulminating composition, which is fired by the shock of the explosion, owing to there being no windage.

I have seen many contrivances for rotating projectiles fired from smooth-bores, but however plausible in theory, they have all utterly failed in practice.

If "Philanthropist's" gun had to be used to fire over the heads of infantry, I should very much object to being the "infantry."

ARTILLERY CAPTAIN.

HOW TO USE A BOOK WITHOUT HANDS.

[4199.]—THAT your readers may see how gratefully the consideration of your correspondents, and the special kindness and ingenuity of "M. O." have been appreciated by the railway men, I inclose extract from the *Manchester Courier*, and shall be glad if you can insert it, and accept our best thanks.

"HOW TO READ A BOOK WITHOUT HANDS.—This question was opened a few weeks back in the ENGLISH MECHANIC, on behalf of an engine-driver who lost both arms on the Lancashire and Yorkshire line about a year ago, and who was so successfully treated in the Manchester Infirmary. After many ingenious suggestions, the question has at last been solved by Mr. Morehen, of 18, Banner-street, St. Luke's, London. This gentleman has taken a most kindly interest in the case, and last week sent his invention to Mr. Inspector Davis, Victoria Station, free of all charges. After the usual porters' church service last Sunday, this neat little desk was examined and tested by the unfortunate engineer, John Shaw, and his sympathising comrades. The table is fitted with wire folders attached to pedals which turn up twelve pages in succession, the sloping book-rest being easily adapted to the thickness of the volume or magazine used, held in its place by elastic bands. The mechanism is compactly covered in between the knees, and not liable to get out of order. It is altogether a very creditable and efficient contrivance, and cannot fail to prove a valuable relief where such an affliction to a man of healthy mental power renders it necessary."

T. M. W.

ELECTRICAL BELLS ANTICIPATED.

[4200.]—GIBBON, in his "History of the Decline and Fall of the Roman Empire," relates that "below the citadel stood a palace. The statues of all the provinces were arranged in order, each with a small bell suspended from its neck, and such was the contrivance of art or magic, that if the province rebelled against Rome, the statue turned round to that quarter of the heavens, the bell rang, the prophet of the capitol reported the prodigy, and the Senate was admonished of the impending danger." If this account is not a fanciful exaggeration, no modern city is so well provided with telegraphic apparatus as was the Rome described by Gibbon. It was not, it is true, like our post-office telegraph, available to every one according to tariff; but then the warning signal was of imperial importance, and was at once reported to the proper officer of department. Perhaps our discoveries are but recovered reminiscences of the forgotten past.

THOMAS BUCHANAN.

NEW FORM OF VIOLIN—VIOLA AND VIOLONCELLO COMBINED.

[4201.]—I should be greatly obliged by the frank expression of the opinions of "F.R.A.S.," "Suffolk Amateur," and my friend "Fiddler" (who is not only what his signature imports, but also an experienced amateur constructor of fiddles large and small) on the above design for a fiddle which—unless they think it mere fiddle-de-dee—would, I think, be a very effective instrument for solo performance, especially if extreme rapidity of execution be not attempted.

Its compass extends from CC to E, which includes that of the cello, the tenor, and the ordinary violin. The four shortest strings are of the same lengths as those on the latter instrument; but I would suggest that instead of making the tenor C string the usual length, that it be made—as I have shown it in the drawing—2ft. long, and the string which sounds C C—the lowest open note of the violoncello—the same length, both being covered strings, and the latter loaded pretty heavily, so that its tension may equal that of the same string on the cello. Of course, if preferred, the tenor C string might be the same length as it is on the viola, but if made 2ft. long, the tone will, I think, be found to be more powerful and of finer quality. A further advantage being that when the performer has learned to "stop" in tune one 2ft. string (that of the cello), he has only to "mind his stops" that are alongside on the tenor C string, and he will be correct to a "comma." I mean a musical comma, not a printer's.

Possibly, some fiddler may be inclined to inquire "Cui bono?" and say we are able to produce all the sounds this "funny fiddle" can by playing on the tenor and bass. Quite true; and, let me add, it is not intended to supersede those instruments in the orchestra, but for solo performance, especially of chamber music. No doubt, it is considerably larger than an ordinary fiddle, and therefore less portable, but its case—not necessarily a poor case—would not be nearly so large as that of a bass viol, if the stick on which it rests during performance be taken out of its socket. I think this instrument, whose compass extends from the lowest note in the bass voice to above the highest soprano, would be especially suitable for performing, in the absence of the singer, the vocal parts of any composition, if accompanied by the piano or harpsichord, even when those parts are for two voices, for the stops lie well together. Of course, duets wholly in harmonics *à la* Paganini are not to be thought of on the two long C strings; but—excepting that the four fiddle strings are a trifle farther from the hand, and therefore, somewhat more difficult to reach—there is nothing to prevent the young aspirant from attempting, not to say succeeding in, Paganini's favourite feat.

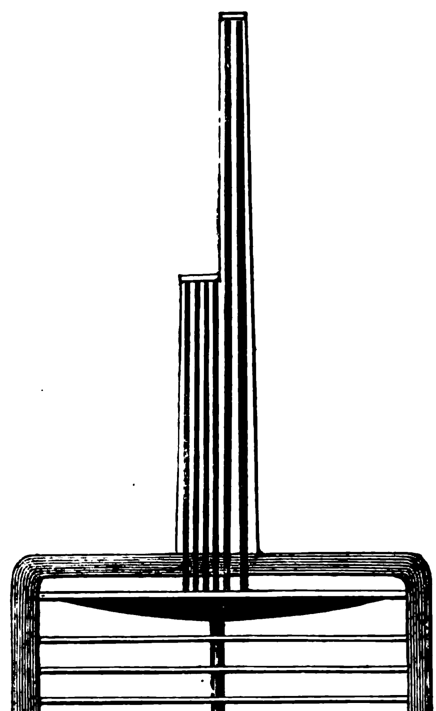
In the ordinary violin its strings are connected with its soundboard or breast only by pressing on its bridge and causing the latter to press on the soundboard with exactly the same force the strings press it. This is, no doubt, very objectionable, but a necessity, so long as no other means for forming their connection can be employed. The down-bearing of the bridge must necessarily impede the vibrations of the soundboard, which can hardly rise so far, while supporting and being held down by that pressure, as it would do were it connected with its strings in a similar manner to that in which the connection of those parts is effected in the pianoforte or harpsichord. Probably no one sees this evil more clearly than the writer does, and this is by no means the first time he has pointed it out; but, bad as it is in the fiddle, it must needs be worse in the harp, whose soundboard has to sustain not merely, perhaps, ten per cent., but the whole tensile force of the strings. Now, admitting these facts, it must seem rather inconsistent that he should propose to make a fiddle whose strings are to be connected with its soundboard exactly like those of a harp; but "circumstances alter cases," yea, even the case of a fiddle.

Had I designed to employ only one soundboard I should have been open to the reproach of choosing the very worst known method of exciting its vibrations; but experience has taught me that a load, intolerable for one, becomes easy when divided into seven parts, and placed on seven backs, or even on seven bellies. On referring to the drawing, it will be seen the said bellies—or rather soundboards (there can be no need to belly them, so we will belay all that)—might say with Mr. Richard Attenborough and the rest of the "Uncles" of that family, "We are Seven;" by the way, somebody said the same thing before that clever taker of pledges uttered it. Now, supposing a string to be strained with a force equal to 21lb., it must, to a considerable extent, mute any soundboard to which one end of it is attached *à la* harp; but when attached to seven such soundboards, it is obvious it can only pull each one of them with a force equal to one-seventh of 21lb. (*i.e.*, with a force equal to only 3lb.), and that it cannot mute any one of them to any very injurious extent; so in practice we may reasonably expect our seven soundboards to be a sort of Ajax' sevenfold shield to defend us from those ugly black melancholy men or things yclept "mutes."

I have assumed it would not be necessary, nor even desirable, to arch the seven soundboards, but if preferred it may be done, in which case it would seem preferable their concave surfaces should be towards the strings, so that the force of tension may tend to flatten them. Arching a soundboard seems only necessary to resist a force which tends to render it concave or convex. Down-bearing has the former tendency, so we make our pianoforte soundboards convex towards their strings; but as the strings in this funny fiddle must, like those of a harp, tend to induce convexity of the surface, which is towards them, I suggest making that surface slightly concave, so that when the strain comes on it, it may become—I fear my friend "Fiddler" will say, like the writer—quite a flat.

I think it will be found needful to glue a piece of hard wood, about ¼in. thick, (say) 4½in. long, by 1in. wide, on the under face of the first soundboard to which the strings are to be attached to prevent it from splitting. I have drawn a series of soundposts or struts, which, in practice, should just fit the spaces between each soundboard, but not be long enough to force them asunder. A screw bolt made of about No. 20 steel wire (screwed and nutted at both ends), passing through all these soundposts, will effectually clamp their ends, and the surfaces of all the soundboards together, so that they must vibrate simultaneously. There is no necessity to take the trouble to bore a hole in each soundpost for the bolt; a groove descending to the centre of each, formed by a saw, is easier to make and preferable, because it affords the means of extracting any one or all the soundposts. I have drawn one bar on the first soundboard. Of course, bars may be glued on every one, if preferred; but this is a mere matter of detail, which I do not think a necessity, although I prefer it to be done.

It would obviously be impossible for any man, whose dimensions did not equal those of Goliath or the Anakim, to "chin" such a fiddle as this, so I have provided a socket to receive a leg on which it can be supported during performance. I should much prefer being able to chin it, but can't, and after all, it may not be necessary for good performance. I have heard



very tolerable violin playing by executants who held their fiddles upright; and that very clever fiddler, Mackney, elicits a really fine quality of tone when he plays on his fiddle behind his back or above his head. Nay, I once saw him take one end of his bow between his teeth, resting its other end on the floor, and rub his fiddle up and down the bow; by no means the easiest method of performance, yet his tone was firm and full. Doubtless it would have been yet better had he held his fiddle properly; and, considering the difficulties of really good violin playing, are, what our Yankee cousins call "pretty considerable," I cannot conscientiously recommend the youthful aspirant to follow Mackney's example, unless, indeed, like him, they are well paid for doing the trick, for that which gets money must be the correct thing; but to shoulder their arms, I mean their fiddles, manfully, and scrape away to their hearts' content. (N.B.—The "content" of the auditors of their industrious practice is not necessarily included in this programme.)

I have not attempted to draw the head or scroll of this fiddle, because those parts are so very familiar that it would be a waste of labour to engrave them; besides, I did not like to trust myself delineate heads either of lions or humans. I fear my attempts at the human face divine might have been mistaken for caricature, in which so serious a person as "The Harmonious Blacksmith," of course, never indulges. I did indeed make the attempt, but instead of the head of Apollo Belvedere, only produced what resembled an ugly specimen of one of those grotesque grinning gargoyles we sometimes see in churches (placed there, no doubt, as aids to *serious* devotion), so I decapitated the original sketch of what was—with the aforesaid gargoyle—a very funny fiddle indeed. I might, indeed, have drawn a simple scroll, but I am not so good at scrolls as at scrawls, as you, Mr. Editor, must well know to your sorrow.

A friend to whom I showed this design said it must fail because you cannot make several soundboards to vibrate synchronously. If I cannot, of course it must fail, but I am very confident I can, having already done it in the piano, nay, it is done daily in the violin itself, for are not the vibrations of its breast and back—connected, as they practically are, to a very great extent, by its soundpost—synchronous? When you want to make things move together, you have only to couple them just as man and wife are, who invariably do "move together," or as a policeman is coupled with the thief by handcuffs, or the carriages of a train on the railway by chains and screws, or the discs of a chain pump by its chain on which they are affixed. Not only do the latter, like the bobby and the man supposed to have "prigged wot isent hisen," and having been "cotched" is being taken to "prisen"—move together, but they move—*i.e.*, lift the inelastic aqueous fluid between each of them together, the seven buckets lifting seven times as much as one can. May I not, therefore, conclude that having succeeded in making my many soundboards move together in both directions, they will move the elastic fluid (air) between them alternately to and fro, and thereby cause those aërial waves we perceive as sound; also that, as the magnitude of those waves must be in proportion to the area of the surfaces which create them, seven soundboards, each having a superficies of 600in., will move seven times as much air as one can do. It is seven air pumps to one, long odds in favour of the brethren who can say, with Mr. Attenborough, "We are seven."

A hint to would-be constructors—possibly the timbre might be finer if the first soundboard be made a trifle thicker than the others—but we must be careful not to make the combination too rigid, or the strings will not move it far enough to produce very loud sounds. As the best degree of rigidity can only be ascertained experimentally, it might be preferable to put one or two light belly-bars on each soundboard, because the depth, and consequent rigidity of each, could be accurately adjusted by a fine rasp until the best effects are obtained. The Harmonious Blacksmith.

ON THE FLY-WHEEL.

[4202.]—The formula $V^2 = 2gh$ gives the velocity of a falling body in terms of the height; hence, if we know the weight of a moving body, we can determine the quantity of work in it by considering the height from which it would have to fall to acquire its present velocity—thus, $h = \frac{V^2}{2g}$; but $g = 32{\cdot}1$ nearly, so we may write $h = \frac{V^2}{64}$. Let V_1 be the greatest velocity of the fly-wheel, and V_2 its velocity in feet per second; on passing the dead-points we have (h_1 and h_2 being the values of h corresponding to these velocities) $h_1 = \frac{V_1^2}{64}$, $h_2 = \frac{V_2^2}{64}$; therefore $h_1 - h_2 = \frac{V_1^2 - V_2^2}{64}$, and if M be the mass of the fly-wheel, and W its weight, $W = Mg$. The work given out towards passing the dead-points is $W(h_1 - h_2) = W\frac{V_1^2 - V^2}{64} = W\frac{(V_1 - V_2)}{64}(V_1 + V_2)$. We see, thus, that for a given weight of fly-wheel (that is, W being constant), if applied to a swiftly-moving engine, $V_1 + V_2$ is large, and therefore $V_1 - V_2$ small—that is, the motion is pretty uniform. In a slowly-moving engine of the same power, the value of $V_1 + V_2$ is smaller, and therefore $V_1 - V_2$ is greater, or the speed is not so uniform, since $W(h_1 - h_2)$ = work given out towards passing the dead-points $= \frac{W}{64}(V_1 + V_2)(V_1 - V_2)$, h_1 and h_2 of course vary in value with V_1 and V_2. It has occurred to me that, if the fly-wheel could be so constructed as to become smaller in diameter at the dead-points, or by weights actuated by springs have its radius of gyration decreased, the motion would be more uniform. In the former case the circumference would require to be in segments, I know the idea is rather crude, but perhaps it might be improved on. Philanthropist.

"E. L. G." AND THE GEOLOGICAL QUESTION.

[4203.]—The following letter appeared in *Nature* this week, singularly apropos of the geological discussion now going on in the English Mechanic. Its bearing on the geological question will, no doubt, soon be confirmed or disproved:—"Geologists state that the volcanoes of Auvergne have not been in action in historic times (see Lyell, Jukes, and Geikie). I find, however, that the Rogation days were appointed by Mamercus, Bishop of Vienne, about A.D., 460, for the purpose of chanting litanies to stay the volcanic eruption which was then devastating his diocese (see Robertson's 'History of Christian Church,' and Proctor on 'Book of Common Prayer.'—(Signed) W. J. Green." I find that it was Mamertus, Archbishop of Vienne, who restored certain fasts, which had fallen into disuse in his diocese: he held a Synod for this purpose in 474. However, I can find no mention of volcanic eruptions; *vide* Gregor. Turon, lib. 2; ado in Chron. Baron. Annal. These references may possibly throw some light on the matter, but I have not the books at hand.

Though not prepared to go with "E. L. G." entirely, I take this opportunity of thanking him for his very suggestive letters. H. C. Key.

GOSSE'S "OMPHALOS."

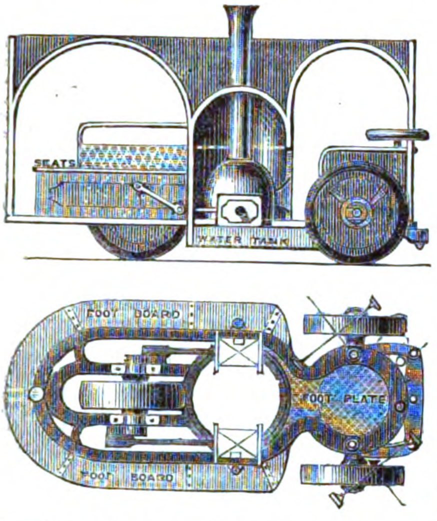
[4204.]—IT is reluctantly that I condescend to notice the gratuitous ungentlemanliness of the last sentence of letter 4134 (p. 223). It requires no abnormal talent or learning to be impertinently saucy, especially under the hiding of a pseudonym; but will "A Fellow of the Royal Astronomical Society" essay to *answer* my "Omphalos"? It assumes to be severely logical. Many have sneered at it (an easy process!); but I have not yet met with a single adversary who, accepting my postulates, has convicted me of a *non sequitur*. If "F. R. A. S." likes to bend himself to the effort, he will find that the work has not "long since been in the hands of the butterman," but is still on sale at Mr. Van Voorst's. P. H. GOSSE.

THIS YEAR'S INTERNATIONAL EXHIBITION.

[4205.]—I FULLY believe that you will favour me with a little corner of your journal, in reference to the present International Exhibition. In the first place, it is a matter of surprise to me how it is that the Exhibition is closed at six o'clock on each evening. Now that the long days have commenced, I think it would be doing the public a good service to allow it to be open until eight o'clock during the height of the summer, if not later even, to give many persons an opportunity of visiting it who are unable to do so in he earlier part of the day. Again, I would recommend that the charge for admission on all Saturdays during the season should be reduced to sixpence—at any rate (say) after two o'clock—thus enabling many of the working classes, to whom a shilling would be an object, to visit the palace of wonders on their Saturday half-holiday. NATHANIEL WATERALL.

YORKSHIRE STEAM TRICYCLE.

[4206.]—IN answer to letter 2900, p. 171, Vol. XIV., I herewith send you drawings of a steam tricycle, for family use, pleasure, or hire; for traction, sawing,



thrashing, grinding, pumping, or forcing water; as a fire engine, for which it is well adapted, for it can be drawn by horses very readily when steam is not up. When wanted to saw, thrash, or pump, the front or steering wheels will only require chocking, and the hind part raising a little from the ground, for the driving belt to be put on the driving-wheel, which is covered with indiarubber tire of a suitable thickness and breadth for weight and power required. The steering wheels have only one-fourth of the radius of those on the old system, when moved from centre of axle; consequently they are much easier to guide or move into or out of lock, and not so liable to upset; the wheels on the old system are one foot further to move back and forward, to be put in the same lock as the others, and the bearings on the ground are 5in., or more, nearer to the centre line of carriage, which is a great disadvantage. There is not that tendency to slip with one driving wheel as there is when two are fixed on each end of crank shaft, with a great deal of unnecessary friction, wear, and tear, when moving out of a direct line. The exhaust steam to be conveyed betwixt the boiler and the jacket that surrounds the whole of the boiler, whereby the steam will be greatly expanded before it comes in contact with the smoke, &c., just above the steam dome. The chimney is in one piece, with the jacket, and I think it will have a tendency to decrease the noise of the exhaust steam, which is a great intimidation to horses on the road. JAMES WADDINGTON.

ORNAMENTAL TURNING.—XI.

[4207.]—THE subjoined sketch of an ornamental table pillar will show by what means one portion of the work can be ornamented, although the pillar on the whole would be unwieldy. The top portion has a pin at each end, tapped or screwed with the ordinary wood screw-box, as heretofore described. The usual size for this class of work is 1¼in. tap and box. To those who have no tap or box a plain pin can be turned, and when ready to be fixed, glued. The bottom pin is turned about 3½in. in length, for the purpose of passing through the bale A into the block B, a hole is bored previously and tapped. The advantage of a screwed pin is that the table and pillar can be packed into a small compass. C the mitre cut in the block for fixing the claw. A great quantity of the London furniture is manufactured in this manner for the purpose of shipment. Some manufacturers use iron screws, in some respects same as the common bed screw, with the exception of the ends, which are jagged and driven into the end of the wood, a small hole having previously been bored. A nut is fixed in the other part of the wood, a hole a trifle larger than the screw bored, and both parts screwed together, and afterwards turned in the lathe. The general term applied to such is portable furniture. In all operations with a screw box, care should be used, as an inexperienced person can very easily spoil a box or a tap in a moment. Hard wood, such as ebony or rosewood, or even boxwood, should not be used; but if an article of the above woods are required, a hole should be bored in the article, and a beech pin inserted. Care should be also taken that the pin to be tapped should fit the lid of the box. The amateur will find a circle marked upon the box the size of the centre-bit required to bore a hole for the purpose of tapping a female thread. The tap should be entered carefully, at the same time pressing somewhat hard upon the handle, and turning the tap gently round to the right. When entered about one-third, unscrew, and re-enter the tap again until the head of the tap enters the hole. The prices of taps and boxes will be about the following:—⅝in., 3s. 6d.; 1in., 4s. 6d.; 1¼in., 5s. 6d.; and larger sizes in proportion. It is a tool no amateur turner should be without. SAMUEL SMITHER.

[4208.]—A CORRESPONDENT (let. 4099, p. 198), signing himself "Smithereens," pens a sentence that almost takes away my breath—"No one can cut soft wood with a tool set in a radial line." I do not remember ever stating that it could. Had he taken the trouble to look carefully at the sketch, he would have perceived a thumb-screw for the double purpose of tightening the cutter, and fixing at what angle was required. It is a well-known fact that according to the nature of the wood to be turned so the angle of the iron. It is not a fact (*i.e.*, practical) that the iron must be set at a tangent to the circumference of the wood to be operated upon, or to the circumference of the rod. If very soft wood, the iron may be fixed at an angle of 30°, or even 35°; if very hard wood, such as ebony, box, or *lignum vitæ*, the rod may be cut, and cut cleaner with the iron perfectly vertical. The circumference has nothing at all to do with it, it is the nature of the wood to be operated upon. Regarding the assertion that one cutter will only cut a certain sized rod, our friend is in error again. Several sizes can be made with the same tool. The only alteration is the insertion of a loose collar with a slot for the cutter. I made several collars of cast iron, turned smooth, and fixed in with two screws in the face. If a quantity is required, of course a superior iron chuck is preferable; but as the question was asked how to make the rod, I deemed it was not required for a permanent affair. SAMUEL SMITHER.

GOLAIL OR INDIAN PELLET-BOW.

[4209.]—THIS bow is in very common use among residents in East India, many of whom attain to great dexterity in its use. It forms a capital weapon against squirrels and such small game, and perhaps some readers of the ENGLISH MECHANIC would like to know something of its construction. It is generally formed of a good piece of split bamboo, but can, of course, be made as any English bow; it is stringed with two strings instead of one. At a short distance from the top fastenings the strings are separated by a short stick about two inches long, notched at the ends, placed between them as in the drawing, and in the middle, between the two strings, is fastened a piece of cloth or soft leather, in which to place the pellet. The bow is held in the left hand, the pellet, or marble of hard burnt clay, between two fingers of the right hand. The bow is then fired, a peculiar twist of the left hand being given at the same time to prevent the pellet striking the thumb of the left hand—which is very often the case until "practice makes perfect." The peculiar twist is hard to explain in writing, but after a few attempts to avoid hitting one's fingers will soon be apparent to the tryer. The bow is generally about 5ft. high. A A, the two strings; B, piece of wood separating strings; C, cloth holder for pellets. G. W. C. H.

CLAVICLE, HUMERUS, AND NEW CRANIUM.

[4210.]—THE fossil figured No. 1 has long been somewhat enigmatical among our coal-measure specimens, and it is only recently that the balance of evidence seems to point in favour of its being a clavicle of a tolerably abundant coal-measure fish, the generic name of which is *Ctenodus*. Of the Ctenodi there are several species, and the fishes vary in length from a few inches to four or five feet, some of the bones, resembling that figured, are upwards of four inches long, and that now represented, which is of natural size, is considerably below the average dimensions of those found.

Fig. 2 represents a humerus or femur of natural dimensions; it differs considerably from those that were illustrated in your issue No. 296, Nov. 25, 1870, p. 224, letter 816, and probably belongs to one of the ambulatory reptilia or labyrinthodontia, the remains of which are so comparatively abundant in our northern coal shales. The specimen was found isolated, and it is impossible, therefore, to identify it as belonging to any special reptilian form with which we are at present acquainted.

Fig. 3 is an outline sketch of an inner or lower aspect of a cranium of what appears to be a new batrachoid form of coal-measure vertebrate. The coal-measure Batrachian it most nearly resembles is that known as *Batrachiderpeton lineatum*, but it differs from that Batrachian in so many particulars that it cannot for an instant be referred to it.

According to the illustration of the inner aspect of the cranium of Batrachiderpeton, given in the Transactions of the Tyneside Naturalists' Field Club, Vol. IV., part 1, plate iv., Fig. 1, the head of Batrachiderpeton resembles that of the new reptile head in outline; that is to say, its length and breadth are about equal, but in that respect only does it resemble our new fossil cranium. The premaxilla of Batrachiderpeton is crowded with small conical teeth, while the premaxilla of the new specimen has not any small conical teeth, but their position is occupied by a small ridged pecten-like plate, which differs from any dental apparatus I have yet discovered or examined. The vomer of Batrachiderpeton is covered with small rounded elevations or teeth, and each side of the vomer is flanked with a row of eight teeth nearly as large as are those on the premaxilla. The vomer of the new Bratachian is toothless, and with the exception of the maxilla there are no indications of conical teeth on the under surface of the cranium. The maxilla of Batrachiderpeton, so far as the figure of it gives any information, is adontoid, and in that respect it differs from that of

FIG. 1

FIG. 2

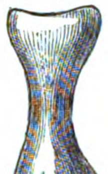


FIG. 3

our new Batrachian, inasmuch as between the points marked *a* and *a*, a distance of 1¾in., there are distinctly visible 34 maxillary teeth. The teeth are arranged at nearly equidistant intervals; they are small, glistening, and slightly striated. Those that are broken transversely show in their transverse sections large pulp cavities which are filled with the white lime-like material which is found in the teeth and bone cavities of larger reptiles and fishes. The cranium is fractured diagonally, as represented by the figure, and the posterior portion of the specimen is entirely removed. A small portion of the outer surface of the cranium is exposed, and it presents the reticulated appearance which usually characterises the surfaces of the bones of the labyrinthodonts and reptiles of the coal period. I am indebted to Messrs. Simm and Taylor for the opportunity of examining and describing these interesting specimens.

Newcastle-on-Tyne. T. P. BARKAS, F.G.S.

ONE PROOF OF THE DELUGE.

[4211.]—IT is a trite remark that the amusements of men of great mental power are generally, whether by contrast or otherwise, childish. I am, therefore, not surprised to find that our instructive and parenthetical correspondent "E. L. G." should be found amusing himself with endeavouring to get the birds and beasties, not to mention the insect millions, into his Noah's Ark. I am afraid, however, that he has not in all his long defence of that tide which led to so much misfortune enabled us to answer these questions: Granting the water, whither did it go to when no longer required to correct mankind? in what manner did it, being universal, rush along so as to "round" our hills, and also our ancient earthworks, our barrows and railway cuttings? and, lastly, supposing the water from the comet to be distilled, or at least fresh, how is it that we still enjoy oysters, and that sharks enjoy us? For, as to the last question, I would remind "E. L. G.," who knows all things, that the monsoon rains in India destroy millions of sea-fish at the river mouths. We might also ask how it was that the force capable of rounding the hills left vegetation unharmed, unless

"E. L. G." believes our coal-fields to be "Diluvii Testes," which belief he seems perfectly capable of holding. It is soothing in this scientific age to find one man not uneducated who clings to the romantic tales of our young days. M. Paris.

THE DELUGE.

[4212.]—"E. L. G." is, no doubt, one of our cleverest contributors, and one from whom we have all, at some time or other, derived considerable benefit; but what on earth has possessed him lately to become such a regular Don Quixote, at one time breaking a lance against decimals, at another, accounting for a mythic deluge by a mythic comet? It strikes me that "E. L. G." is one of those people who first desire a theory, and then look for facts to support it, and to such, "trifles light as air are confirmation strong as proof from Holy Writ." I had intended to ask "E. L. G." a few questions, but I see "Sigma" (letter 4086) has in some degree anticipated me. Like "Sigma," I want to know what has become of the water, and am desirous also to learn what proof is there that comets are composed of water at all, or that they contain any considerable quantity of that fluid? Loose reasoning is a waste of the editor's time; it is also a waste of the reader's, and of valuable space, and I believe it is principally owing to a habit of so, to say, not "taking the bull by the horns," that all three are often wasted. In order that I may not so offend, I shall not attempt to answer "E. L. G.'s" *flooring* proof of the deluge, but content myself by asking him to prove to me that a comet could cause the deluge.

Un Irlandais.

ELECTRIC SPARKS.

[4213.]—Letters 4168 and 4169 furnish some reasonable grounds for believing that the phenomena under debate do occur in some places and conditions of air; they also show how information is drawn out by discussions, and even by erroneous statements. But they do not at all affect the commencement of the discussion itself, because the generation of these sparks was a mere incidental portion of the subject, which was in some way developed into the main point. The real question was not whether quarter-inch sparks could be generated of tension enough to light gas (it being, of course, well known that friction of the feet on carpets will always produce some electric tension), but whether electric sparks were generated having a tension of some miles, whether such sparks were transmitted through the air, so causing the spread of extensive fires, rather than that such spread was due to mere fiery sparks mechanically carried by the air.

Sigma.

[4214.]—"Sigma" has been perfectly right in not accepting a scientific fact without its being duly authenticated, but he is wrong in sneering at the testimony of Americans. He says "We electricians of the English Mechanic have not yet forgotten Paine's electro-motor engine." To this I can only reply that I hope "Sigma" does not entirely ignore all American scientific authorities, nor that as an electrician he does not forget that at present Professor Morse's telegraph instrument is almost universally used in England.

The question of electrical sparks being easily produced in the United States is now too old and too well authenticated to bear a fresh discussion. I inclose a page from the "Year-Book of Facts" (1859) which if you will kindly publish will convince many of your readers, and perhaps, even "Sigma" of the truth of "Philo's" assertion:—

ELECTRICAL PHENOMENA IN NEW YORK AND OHIO.

There has been read to the American Association at Baltimore, a paper "On some Electrical Phenomena witnessed in houses in the cities of New York and Cleveland, Ohio," by Professor St. John. (See also the paper read to the British Association in 1857, by Prof. Loomis, "Year-Book of Facts," 1859, p. 147.)

By the invitation of Professor Loomis, of the New York University (says Professor St. John), I accompanied him on the evening of the 12th of February, 1858, to witness some experiments on electricity, exhibited in a house in Fourteenth-street, in the city of New York. The rooms in which the experiments were performed had upon the floors thick velvet carpets, and the usual furniture of elegant houses; they are warmed by furnaces, and are kept at a nearly uniform temperature of 70° Fahr. The experiments were performed by the gentleman and lady of the house, and Professor Loomis, who had put on dry slippers. After walking rapidly through the parlours with a shuffling motion, very bright electrical sparks were exhibited when the hand was presented to the chandeliers or other good conductors communicating with the ground. Gas was ignited at one of the burners by a spark from a key in the hand of the lady, and sulphuric ether inflamed by the spark passing from her finger to the liquid which I held in a metallic cup in electrical connection with the earth. The spark was made to pass between two small insulated brass balls, with a view to measure its length. The greatest length attained was ¼in. The spark exhibited a beautiful appearance in a darkened room when the fingers were brought near to the wall-paper, dispersing itself through the space of a foot or more over the gilded ornaments of the paper. On the evening of the 5th of March, the coldest day of the season, the experiments were repeated in the same rooms, when a sensible increase of electrical intensity was discerned. The gas and ether were inflamed by Professor Loomis holding a brass ball in his hand, and the length of the spark attained was a little more than ¼in.

These phenomena were similar to such as I often witnessed during the winters of 1854-5 at the Cleveland Female Seminary, located in the south-east quarter of the city of Cleveland, Ohio. The building is three stories high, of brick, with a sandstone basement, and is warmed by three furnaces supplied with the ordinary bituminous coal of south-eastern Ohio, the fires declining, but not becoming extinct during the night. The temperature of the rooms varied considerably, sometimes rising above 80°, but rarely falling below 60° even during the night. The rooms in which the electrical manifestations were conspicuous were the parlours on the first floor above the basement. The floors of these rooms were covered with substantial Brussels carpets. The seasons when they attracted especial attention were periods of severely cold weather—the thermometer on one occasion indicating 23° below zero; the electrical excitement diminished in mild weather, and ceased entirely when it rained. The carpets on the halls and other rooms were thinner fabrics than Brussels carpeting, or composed partly of cotton or linen, and upon these the electrical phenomena were barely discernible. In the parlours, electricity was manifested during dry cold weather at all hours of the day, but much more strikingly in the evening, after the young ladies had spent an hour in recreation and dancing. On such occasions the intensity of the spark was such as readily inflamed ether and pulverised resin, and measured repeatedly one-half inch, passing between insulated balls to the furnace register, which was in good electrical communication with the earth. All persons remaining in the rooms were enabled to communicate sparks to conductors, but the longest sparks were given by two boys of the ages of nine and eleven years, after running and sliding upon the carpets; this we attributed to the friction evolved by their unconstrained freedom of motion. These boys wore dry slippers, were clad in woollen, one of them wearing flannel next to his person, and the other cotton; the latter, who was of more vigorous constitution and active habits, giving the more vivid spark. A difference of electrical accumulation was also discernible among the young ladies, which we were inclined to ascribe to diversities in their dress, silk, woollen, cotton—the silk and woollen appearing more favourable to success. In one instance the different degrees of moisture upon the skin seemed to affect the amount of electricity communicated. These phenomena attracted the attention of all the inmates and visitors of the seminary; many persons expressing surprise, and some consternation, on receiving a shock, as they entered the room and took the hand presented to welcome them, preceded by a vivid spark. The passage of the spark over glass by bits of tinfoil disposed in letters, and in the "spiral tube," together with the usual experiments on electric light, were repeatedly exhibited as a source of amusement. Traveller.

COMPETITIVE EXAMINATIONS.

[4215.]—To raise the discussion (see letters 4110, 4163, and 4164) out of localism altogether and place it upon a broad footing, I will, with permission, cull one or two facts from the report of a deputation to Mr. Forster on this "Science Question":—

"There has," said Mr. Busbridge, "been a marked decrease in the number of students in practical, plane, and solid geometry, and in building construction. In subject I. in—

1869	1870	1871
1,308 passed	680 passed	763 passed
1,217 failed	2,679 failed	1,010 failed
2,525 total	3,359 total	1,773 total
Above 50 per cent. passed	Above 20 per cent. passed	Decrease of about 50 per cent.

In Building Construction—

974 passed	395 passed	516 passed
1,025 failed	2,235 failed	393 failed
2,000 total	2,630 total	909 total
About 50 percent. passed	About 15 per cent. passed	Decreased to about ⅓ of number."

Has the above nought to do with us mechanics? Who were these science classes and examinations established for if not for us who have not had the advantage of a good school education? Is this an incentive for us to push onwards? I know the answer. Reward should not be your aim, but the gaining of knowledge. Just so, but how about our teachers—poor, hard-working men—men who do their duty well—who not only give us a minimum of twenty-five lessons, but fifty, or sixty, or more, and then we fail. Our teacher's fault. How is it that he is so successful with another class of scholars? Further, Mr. Russell said, "The one point he wished to direct Mr. Forster's attention to was the standard of examinations, its capricious changes, and singular uncertainty. . . . Teachers made no complaint of a high standard, but they considered themselves unfairly treated when questions of too difficult a character were set, and when the answers were judged by a much higher standard than that which the official syllabus indicated as essential for a pass."

I have before me certain examination papers set this year, and I know that in the majority of cases a student cannot pass the elementary stage with twenty-five or thirty lessons, unless he comes with some previous knowledge. Take as an example—Stage 1: Mathematics. Given twenty pupils who know the first four arithmetical rules and no more; drum fractions, decimals, practice, proportion, interest, stocks, square and cube root, the metric system, &c., algebra up to quadratics, and "Euclid," Book I., into their heads in thirty lessons, and I'll honour you. Similarly, take a class in "Theoretical Mechanics," assuming again they know little or nothing of mathematics, and after twenty-five lessons what do they know? I fancy "Steam" is easier. Again, take the "Practical Plane and Solid Geometry," and how do the students fare? I might go on, but the above is sufficient. Little is said about the above statistics. I leave your readers to ponder well over them, and judge whether the examinations are as easy as Mr. Harrison would have us believe.—For the last time,

A Desperate Character.

THE ALCOHOL QUESTION.

[4216.]—"Saul Rymea" (let. 4098, p. 198) accuses me of a "leap in the dark" in differing from Dr. Richardson. I did not intend to differ from him so much as to adduce another reason. As for assuming that alcohol too suddenly carbonises and hydrogenises the blood, I did not expect any scientific person could doubt it. C_2H_6O is ethyl alcohol (spirits of wine), boiling point 78·4° C.; and what else, I ask, can cause any action so sudden on the nerves and brain and heart as the rapid carbonising and hydrogenising of the blood? Has "Saul Rymea" read Odling's "Lectures on Animal Chemistry"? I suppose the precise formula of muscle and brain remains unknown; but Dr. Odling gives the ratio of carbon atoms to nitrogen atoms as very near 4 to 1. "In the most minute fragment of muscle, then, for every single atomic proportion of nitrogen there are four atomic proportions of carbon" (4 carbon to 1 nitrogen). Say there are 8 carbon to 2 nitrogen. All muscular exertion depends on muscular metamorphosis by oxidation. "A free supply of thoroughly oxygenated arterial blood is essential for complete well-developed muscular action. . . . . The volume of oxygen which has circulated through a contracting muscle is less than one-fourth of that contained in blood which has traversed the same muscle at rest; while there is a corresponding (not equal) increase in the volume of its carbonic acid. . . . . The irritability of muscular fibre out of the body is arrested by its removal from oxygen, and again manifested on its re-exposure thereto;" and, other things being equal, "the amount of urea, $CN_2H_3(HO)$, excreted by the kidneys, and of carbonic acid, $(CO)''H_2O_2$, excreted by the lungs, is proportionate to the muscular activity of the individual." Thus muscular action depends on muscular oxidation. "If we take the two proportions of nitrogen existing in muscle, and add to them the one proportion of carbon necessary to form urea, we shall have seven proportions of carbon left for conversion into carbonic acid, thus:—

$$7 \text{ carbon to } \begin{cases} 1 \text{ carbon,} \\ 2 \text{ nitrogen."} \end{cases}$$

Thus the complete oxidation of muscle results in the appearance of one-eighth of its carbon as urea, and of seven-eighths of its carbon as carbonic acid.

Now we find in alcohol no nitrogen to replace the nitrogen oxidised into urea (CN_2H_4O); but we have carbon and hydrogen which pass off by oxidation at the lungs, demanding the pulsation of the heart. I think the rapid effect—quickened circulation, &c.—produced by alcohol is sufficient proof of rapid absorption of it into the system, and as it lacks nitrogen it is inadequate to replace muscular tissue or any other part of the human frame but fat: it may contribute to fat and to the development of heat or rapid vibration of atoms and molecules. At the blood vessels in the lungs, oxygen at the outsides draws through them carbon and hydrogen to which it unites, whilst more oxygen fills up the place in the blood vacated by the carbon and hydrogen, and what is it that causes this interchange but near-enough presence of the interchangeable and adequate heat (the hammering by atoms) to vibrate the atoms to re-coalescence? Solar heat vapourises the water of the Atlantic, and transmits it in cloud and rain to all parts of the earth; so does heat effect transfer of atoms from molecule to molecule to maintain the equilibrium of aptitude, and accomplish the purposes of creation. And, I ask, may not the action of the heart be hastened by a more rapid absorption of carbon and hydrogen in the blood, at once producing greater heat and being more abundantly presented for oxidation? The heart may be the pump, but heat is the power that works it. Is not, then, alcohol a stimulant of the heart's action? Oxidation thins or refines the blood and causes it to flow more briskly.

The forces that maintain the circulation are (1), the propulsive action (*vis a tergo*); (2) the contraction and elastic reaction of the coats and arteries; (3) the activity of the nutritive and secretory processes attracting blood to the capillaries (*vis a fronte*); and (4) in the case of the returning or venous current—general muscular contraction (combined with the valves in the veins which prevent reflux), and the tendency to vacuum in the chest formed by its expansion during inspiration. Now the heart *does* receive monition; it has a force in front and a force in rear. On an average, we may suppose the whole quantity of a person's blood is 28lb., and that in the ventricles 2oz., and the pulsations are 75 per minute; thus, 150oz. of blood passes through the heart every minute, and the whole 28lb. passes through in less than 3 minutes. I quote these averages from Gutch's "Register," 1859. Now respiration requires pulsation to present more carbon to oxidise, and in 24 hours one person produces 10·666 cubic feet of CH_2O_3 by respiration (removing a like bulk of oxygen from the atmosphere), contributing about 125lb. of carbon annually towards increase of vegetation by absorption through foliage when oxygen is again set free for respiration. As for the heart having no sense, is it not sufficienfly connected by nerves with the brain and other centres? I deem blood is carbonised and hydrogenised too rapidly or suddenly when it is too largely swallowed in a liquid state without any admixture of nitrogen which is needful to replace the tissues decomposed and carried off during all muscular if not other action; the temperature and proximity of carbon and oxygen in the lungs, must, I think, before all the displaced carbon has its vacated place re-occupied by another element oxygen, pump the blood forward by rarefaction from two causes, the one the departure of carbon, the other the wave motion forward propelled by the newly entered oxygen, whilst valves admit of no retrograde motion. Does "Saul Rymea" suppose that alcohol runs through a person without change, or that it all passes off through the lungs as aqueous vapour? Does he wish proof that alcohol in the stomach, or blood, is split into carbon, hydrogen, and oxygen? All heat, from whatever burning source, is but solar heat, stored up, it may have been for ages, in the coaled timber of a pre-historic age; but solar combustion arranged the atoms where they are. The plant absorbs solar energy in pulling apart carbon, hydrogen, and oxygen; the animal disperses solar energy by recombining the oxygen and carbo-hydrate, in the pulling apart of which that energy had been absorbed or rendered latent; the sun's force is hoarded by the plant; it is dissipated by the animal, though in a more penetrative sense force, like matter, is indestructible. Nature may employ every practicable outlet to throw off a smothering over supply of alcohol, but all the energy from it is derived by the conversion of it into some portion of tissue, and, at least ultimately, into CH_2O_3 in the lungs.

But the force derived from hydrogen is greater than that from carbon, and there is three times the volumer quantity of it in alcohol, but the weights are C_{12}, H_3, C_8. Assuming muscle-formula is $C_{12}H_{10}N_2O_4$, and subtracting all the oxygen and nitrogen with the necessary hydrogen, in forms of water and ammonia, so as leave a residue of $C_{12}H_2 \times O$, then 269 grammes of muscle would leave 144 grammes of carbon and 2 grammes of hydrogen for oxidation, which should furnish 517,280 kilogrammetres of motion, thus:—

	Grammes.		Kilogrammetres.		Kilogrammetres.
Carbon	144	×	3,392	=	488,448
Hydrogen	2	×	14,416	=	28,832
					517,280

Hence, 1 gramme of muscle should furnish $517{,}280 \div 269 = 1923$ kilogrammetres of motion, force sufficient to lift 1923 kilogrammetres to the height of 1 metre, but imperfect data renders this but approximative. Have we not in alcohol, then, an adequate spur to circulation without the paralysation of any check-nerve to the heart? Deficient nitrogen must arrest molecular change in a very short time, so as to much lower the temperature of the frame, unless extra oxidation at the lungs suffice to maintain it. As to "Saul Rymea's" heart beating on seeing a mad bull rush at him, I am not prepared to prove, and have not attempted it, that that proves no nervous paralysis of resisting muscles. I merely suggest what, to my state of information, seems an adequate and likelier cause, and that is a spasmodic effort of nature demanding swift oxidation to do the greatest possible amount of work in the shortest possible period, and to be more a spur than any paralysis; nevertheless, may they not go together and maximumise resultant energy?

It is easy to say the brain regulates the heart's action, but what regulates the action of the brain? As a physical agent it requires more than carbon and hydrogen to long maintain its operation; and like every other part of the frame would soon collapse into cold rigidity did not the vibratory impulse of combustion, of atomic clashing or interchange, promote or maintain its elasticity. I ask, may not, cannot, or are not, obstructive molecules formed, when no nitrogen is presented when required, that may in capillary vessels obstruct the true vital order of atomic recombinations, which combinations I have faintly shown in the muscle-transformation attending on all vital activity? Some one well versed in physiology may explain. J. BARWICK.

TIDAL POWER.

[4217.]—I THINK that tidal power might be employed for dredging, a vessel being moored at the bows, and fitted with an undershot-wheel, preferably of Poncelet's pattern, with curved floats. The advantage of having the vessel moored at one end is that reversing-gear would not be needed. Some suppose that the undershot-wheel does the most work when moving at very nearly one-third the velocity of the stream; others think that a velocity of about one-half that of the stream gives the greatest efficiency. Chambers, in his "Natural Philosophy," takes the former view of the case. Suppose the tide flows with a velocity of 6ft. per second, and that the velocity of the wheels is 2ft. per second, therefore the relative velocity of the tide compared to the wheels is 4ft. per second. From the formula $V^2 = g\,h$, or $h = \frac{V^2}{2g} = \frac{V^2}{64} = \frac{(4)^2}{64} = \frac{1}{4}$, since a cubic foot of water weighs 62½lb., we get a pressure of about 16lb. on each square foot of the immersed float; but the wheels, moving at 2ft. per second, or 120ft. per minute, gives $16 \times 120 = 1920$ units of work done per minute for each square foot of the immersed float. If each float measured 10ft. broad by 4ft. deep, the work done on the two wheels $= 10 \times 4 \times 2 \times 1920 = 80 \times 1920 = 153200$ units per minute, or nearly five horse-power. Allowing for the modulus of Poncelet's wheels, we get about three horse-power effective. The practical difficulty, however, in dealing with tidal and wave power is first to get hold of the power, which, in the latter case, is not easy; and, secondly, to utilise it. It should be remembered that steam-power is (say) fifty times cheaper than manual labour, and electro-magnetic power rather cheaper, in most instances, than manual power. Thus it will be readily seen that in endeavouring to utilise tidal power for any particular purpose we must not forget the class of power it is intended to supersede. We seem to want a good method of accumulating power. I should like some practical calculations as to the units of work accumulated by compressing air. Would some of your correspondents kindly oblige me in this? Stretching indiarubber, as tidal power, &c., might be rendered useful in accumulating force. Probably more work can be done in employing it to turn wheels than in simply raising a floating body, as in the former case a great quantity of water successively moves the wheel; in the latter case a mass of several hundreds of tons is raised ten feet or more every high tide, or twice in 24¾ hours (say). And, since a horse-power is $33{,}000 \times 60$, nearly 2,000,000 units of work in an hour, or about 900 tons raised a foot high in an hour, the power obtained by lifting vessels is not so much as might at first sight be supposed; besides, in utilising slow motion, the machinery requires to be very strong. Six feet per second is a very strong tide, being upwards of four miles per hour. The power to be obtained by the tides varies as the cube of their velocities.

PHILANTHROPIST.

TO THE BANJOISTS.

[4218.]—I SEND a sketch of a banjo, with an accompaniment of my own invention, which I have had in use for some time, and it accords very nicely with the voice, or with a "nigger" troupe. Fig. 6 is banjo, with bottom upwards; 1, spiral spring with knocker joined to the stem of banjo that goes through the hoop; 2, a loop that the catgut goes through for pulling the

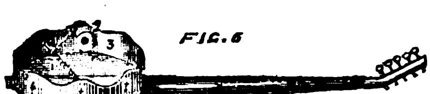


FIG. 6

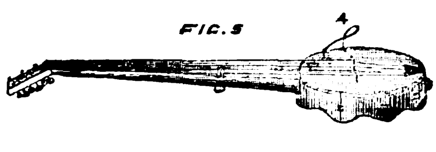


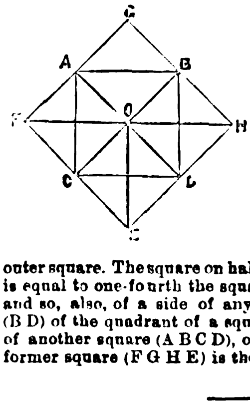
FIG. 5

striker; 3, a bell fastened in inside of hoop to strike on (a clock bell will do). Remember, the bell must be fastened freely to make it sound well. Fig. 5, banjo with face upwards, showing the end of the catgut with loop for putting on the finger 4. Remember, the loop of catgut must go on the third finger, and the catgut must be slack to use it and stop it at will.

A MUSIC PLAYER.

PYTHAGORAS' THEOREM.

[4219.]—REFERRING to C. J. Recordon's Fig. (4125, p. 203), as a new proof of Theor. Euclid I., 47, being in a square, while Pythagoras' is on a right-angled triangle of three unequal sides, I send a diagram illustrative of the ratios of squares on diagonals, and of the semi-square and quarter-square triangles on the same line, half the line, and quarter of the line: it may not be familiar to all your young readers. I have not met with it in any class book, and I therefore suppose it may instruct some, and, simple as it is, submit it for your insertion if thought worthy.



E F G H is the square of diagonal of the square A B C D, and is divided for showing triangular proportions of diagonals and squares. The inner square is half the square in the diagonal—the four triangles in the inner square equal half the eight triangles in the outer square. The square on half of a diagonal of a square is equal to one-fourth the square on the whole diagonal, and so, also, of a side of any square. The diagonal (B D) of the quadrant of a square (C B H D), is the side of another square (A B C D), of which the side of the former square (F G H E) is the diagonal, and so on.

J. BARWICK.

MUSICAL INSTRUMENTS.

[4220.]—I AM sorry that I cannot inform my friend "The Harmonious Blacksmith" of more than one of the eleven curiously-named instruments he has kindly placed before our attention. Perhaps I am selfish, but I wish we had more musical correspondents like him; there must be some, as evidenced by the interest shown at the sale of the Gillott's collection lately. I extract the following out of an old book:—"Basset-Horn, the richest of all wind instruments (called also cornet, by reason of its curvature), is believed to have been invented at Passau, in 1770. It was afterwards perfected by Theodore Lotz, in Presburg. It is, properly considered, an enlarged clarionet; and notwithstanding the difference of its form, it resembles that, not only in its qualities and tone, but also as regards its intonation, the mode of holding it, and fingering it, so that every clarionet-player can perform on it without practice. Besides the mouth piece, by which the intonation is given, it is formed of five pieces —the head-piece, called the barrel, two middle pieces, the trunk, and the bell, which is usually of brass. It has fifteen ventages, of which four are provided with open, four with closed keys. Its compass is three-and-a-half octaves, from lower F in the bass to double C of the treble. It is seldom used in the orchestra; however, it is found in Mozart's Requiem, and some other pieces. The Basset-horn may be also used as a bass instrument." FIDDLER.

NOVEL TELESCOPE.

[4221.]—SOME years ago I found that a chink in the slates of an unceiled schoolroom admitted an image of the sun. This was found to be inverted, and estimating the apparent size of the sun as less than a silver sixpence, the image was magnified five or six times. What most attracted my attention, was the passage across the disc of small cirrous clouds, whose transit I endeavoured to time by the beats of a chronometer watch. In the outside heaven, no cloud was visible, yet there, on the solar image, the hairlike wisps were seen passing rapidly. It is evident that if we could ascertain the height of these *cirri*, we might regard it as the perpendicular of an inverted triangle, whose base is the sun's diameter, and apex the pupil of the eye. Hence, by an easy proportion, the actual length of the base in miles, and the velocity of the wind which carried the *cirrus* across the sun. I cannot now recover the data and conjectural computation, but I remember that the result, 800 miles per hour, seemed incredible, and I halved it; still, 400 miles seemed to philosophical quidnuncs an impossible absurdity, and I was well laughed at. Meteorological investigations in the United States, 1¼ miles high, conducted on Mount Washington, have proved the velocity of the wind at an elevation far short of that reached by *cirri*, to be 150 miles per hour. Now, Gay-Lussac, having ascended in a balloon to a height of four miles and three-tenths, saw the *cirri* above his head, apparently as high as when he looked at them from the ground. Assuming them to have been eight miles and six-tenths high, this is more than six times the height of Mount Washington; and the measured velocity of the wind there, multiplied by six, would give 900 miles for the proportional, or probable, velocity at the height at which the *cirri* floated. The objection that aqueous vapour could not ascend so high is nugatory, since the *cirri* are certainly of electrical origin. THOMAS BUCHANAN.

SPECULUM WORKING, &c.

[4222.]—I SHALL be glad if you will insert in an early number of the ENGLISH MECHANIC the following account of the performance of a home-made speculum, as I think it will be encouraging to those readers who are desirous of constructing their own telescopes:—The mirror is 5⅞in. aperture, 51¾in. focal length, worked from a piece of rough plate-glass solely by hand, no machine whatever being employed in its production. It has been silvered by a modification of the Rochelle salt process, which gives good results, and which I will describe when I have perfected it in some details. I have mounted it in the Newtonian form with a "perfect plane" by Browning, and Huyghenian eyepieces with powers varying from 36 to about 270 diameters. The highest power is the one I generally use. It shows the stars as perfectly round discs, with one or two diffraction rings, but very few and short rays even with first-magnitude stars such as Vega, none at all with smaller ones. I can readily see two faint comites to Vega and the Debilissima pair between ϵ^1 and ϵ^2 Lyræ. The following stars are well divided with round discs, γ Leonis, ι Leonis, ϵ Boötis, ϵ^1 and ϵ^2 Lyræ, λ Ophiuchi, and ζ Aquilæ. η Coronæ is just divided, and ζ Boötis is seen as two discs in contact.

I shall feel obliged to any of your correspondents who will give me the most recent measures of the last two pairs, as they seem about my limit at present.

I shall also feel obliged to the Rev. H. Cooper Key if he will tell us what he finds to be the best proportion of diameter to focal length. My speculum is almost precisely 9 diameters. His large speculum, 18in. diameter, is, I believe, about 10ft. focal length, or about 7 diameters, but I understand he finds that this is too short a focus for the best results.

A. WOOLSEY BLACKLOCK, M.D.

High-street, Godalming, Surrey, May 20.

P.S.—With reference to silvered glass sun-screens, has anybody tried silvering the first surface of the ordinary rectangular prism? I should think this would be the best plan of all.

ERRATUM.—In my letter (4109) "On Communicating Rotary Motion to Ball Fired from Smooth-bored Gun," ninth line from top, for "150 turns a minute" please read 150 turns a second," the rifling of the Enfield being at the rate of about a complete turn in 6½ft.—PHILANTHROPIST.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10185.]—**Wallaroo Copper (U.Q.).**—In reply to "C. W.," I beg to state that this copper comes to England either refined or in bars, similar to what is received from Chili. It is used for the same purposes as English copper; the reason of its commanding a higher price than English or Chili copper is on account of its being generally of a superior quality.—J. ROSKELL.

[10844.]—**Chemical (U.Q.).**—In reply to "Cuprum," Muspratt, in his article on "Copper" (p. 528), and Mitchell, in his "Practical Assaying" (p. 365), give the equation as follows: — $2CuO + 2Cu = 2Cu_2O$.—J. ROSKELL.

[11196.] — **Turning Perpendicular Shaft.**—"Tubal-Kain" states that the sketch I sent on turning perpendicular shaft would not drive if carried out as per sketch. I beg to differ. I have tried the same upon an ordinary drill shaft, and I found that, unless the centre of the pulley on the perpendicular shaft was in a correct line with the vertical shaft, the band came off. Theory and practice oftentimes differ. Regarding my stating spur wheels for bevel, I stand corrected; it was an oversight on my part. I am well aware that the greater the distance betwixt vertical and perpendicular shaft the better for driving; in fact, if very close, they would not drive at all. I certainly in my sketch described them very close.—S. SMITHER.

[11228.]—**Stereotyping.**—No practical man would think of using any other than that which is known as the "paper" process, a description of which is given in a letter on "Stereotyping," page 231, Vol. XIII., of this publication. The process, however, is really much simpler than would appear from the description there given. Should "A Country Printer" require a cheap casting-box, I would call his attention to a letter on the subject on page 337, Vol. V. A complete apparatus for small sizes can be purchased for about £5; the one I have is of this description, and works well. In reply to "A Country Printer's" inquiries, (1) it is not sufficient to pour metal upon the mould, as the metal will cool before it can take a sufficiently clear impression. (2) Have nothing to do with plaster. (3) Old type metal is the best and cheapest material.—A CAMBRIDGE GRADUATE.

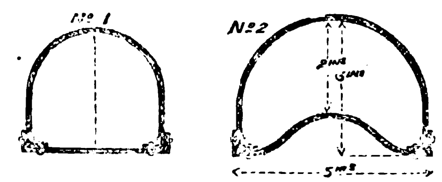
[11268.]—**Tempering Knives and Trowels.**—Would "Homer" kindly try a little water from the wash-basin, or soap-suds, say about a teacupful to a gallon of clear cold water, in which to immerse his hot steel blades; afterwards blaze off with oil to what hardness he requires, and let us know what progress he makes? Any buckle can easily be taken out by hammering on the anvil while still in a hot state with the burning oil, when once he has practised it a little.—LINUM.

[11324.]—**Salt Damp in Walls.**—Salt is very hygrometric. I think that it will be difficult to give a reliable remedy, but I would try the following:—Take off the paper, and after a few days of very dry weather apply hot irons to the affected spots to take out the damp to a certain depth in the plaster, and whilst the wall is still hot, give it a quick and liberal coat of some light-coloured oil paint; when dry, apply another coat, without heating it previously, and paper in due time.—BARBAROS.

[11338.]—**Motive Power for Amateurs.**—If "A Barrister" (p. 206) thinks I had any idea of producing perpetual motion he is mistaken. I took the idea from an illustration which appeared in the MECHANIC some years since. "A Barrister" proposes to have a fly-wheel fixed to the saw spindle, driven with a crank at one end. Where does he mean to get his power from—by treadle or hand? I think he forgets the speed a circular saw requires to run.—ZOO ANDRA.

[11349.]—**Heating Bar Iron (U.Q.).**—An ordinary smith's forge, blown by a fan, instead of the ordinary bellows.—W. H. HEY.

[11355.]—**Model Steam Boat (U.Q.).**—Not long since I constructed a boiler similar to what "N. G. H."



wants. It was made as No. 1 of copper, the thickness of a new sixpence; rivets ¼in. apart. I think you would get more steam out of No. 2, but I do not think the pressure you would obtain would be anything near 30lb.—T. W. M. J.

[11393.]—**Metallic Harmonicon.**—I am afraid that neither "Zoo Andra" not Samuel Kempling know the meaning of "inverted," for if they did they would not try to maintain that "inverted aquarium" (No. 11393, page 103) is correct; if this aquarium is to be "inverted," where is the "solution of alum" to go? On the ground certainly. I think "Zoo Andra" has made another great mistake in his "excellent description of the musical glasses in his possession;" he says that the great expense of making these harmonicons is getting the glasses all blown to the right notes; if the glasses are to have water in them that would materially alter the pitch, so all the bother of getting the glasses the right pitch would be useless, as they would (as it appears to me) have to be tuned by the quantity of water put into them.—TUBA MIRABILIS.

[11395.]—**Foreign Wood (U.Q.).**—In answer to "C. C.," I believe the fibre comes from India in bales, weighing 2½cwt., and of different colours, each being worth about £7; it is also delivered in another form, termed a "dole," which consists of a coil of the yarn closely tied up and bound with pieces of palm wood from ⅜in. to 3in. square. I might send a description of the manufacture and many interesting details concerning cocoa-nut fibre if approved by the Editor.—H. B. E.—[Please send.—ED.]

[11397.]—**Sting-proof Gloves (U.Q.).**—Try a pair of Hawesling gloves with long gauntlets.—H. B. E.

[11420.]—**Sewing Machine Extras (U.Q.).**—The sewing-machine extras in which there are no moving parts, are made of white metal, others of iron.—T. W. M. J.

[11458.]—**Carmine Staining (U.Q.).**—I cannot, unfortunately, lay my hands upon the number containing this query; but, so far as I remember, the querist wishes to know the proper time to commence the staining process. The answer is:—Immediately the section is cut, and whilst the specimen is living, or as near it as possible. In using magenta for staining wood sections it is immaterial when the section is stained, perhaps the older the better.—H. P. H.

[11519.]—**Horse-power of Compound Marine Steam Engine.**—This is "calculated" in the ordinary way, but taking into account the expansion of the steam. See the method of Mr. Gray on p. 188. G. Lamb says calculated, but does he mean for an engine actually at work? if so, that is done from the indicator diagram.—M. E.

[11528.]—**Silicate of Soda.** — For cementing object-glasses I should not recommend the above. You cannot be sure that the silicate will remain perfectly transparent; dry with two pieces of common flat glass and you will see the effect.—THE WELSH SHEPHERD.

[11531.]—**Water Wheel.**—I have not the number by me in which my answer appeared, but the assertion that "D. S." has made is partly true. I made the reply mentioned under a misunderstanding, because the term rotary engine is generally understood to mean a steam-engine, and it was in that sense I understood it. A rotary water engine is usually called a turbine, distinguished by the name of the inventor. I commend to the notice of "D. S." the following extract, from the *Engineer* of 1871. In a criticism upon a trial of water motors that had just taken place in Massachusetts, the editor says, "Massachusetts is blessed with a great deal of water power; as a result it is a very paradise for makers of turbines of all kinds. The turbine gentlemen are strong in the matter of circulars. For a long time past there has been a rivalry, not only as to who is the best maker of turbines, but as to who can write the best circular. Under the pressure thus brought to bear, the duty of the turbine has been gradually augmenting in Massachusetts, it has risen steadily from 75 to 98 per cent.; it stuck there for some time, until a new manufacturer came upon the field. He looked with scorn on a duty of 92 per cent., and boldly produced a turbine which gave out 135 per cent. of the gross power produced by the fall." This may be the case of our friend exaggerated. At the trial referred to, there was not one (and there was almost every variety of turbine tested) that produced 90 per cent. of the power of the water, and very few produced the power promised. This was at a trial, and every one knows that in general every-day work falls below the trial percentage. In conclusion, I would ask "D. S." how he knows what percentage he obtains from the wheel shaft, if he employs a dynamometer, and what construction is it? as I think that there must be some mistake in the enormous percentage named. If correct, if this invention were patented, the inventor would obtain a fortune as startling as the percentage.—P. W. H. J.

[11597.]—**Mean Longitude of the Sun, &c.**—Much obliged to "A Fellow of the Royal Astronomical Society" for his notice (p. 171) of my query. What I want is really a resumé of the motions of the sun and moon such as is given by Francis Baily in his "Astronomical Formula" (1827), only as adapted to the latest modern tables, which will be Leverrier for the sun, and Hansen for the moon. Delambre adopted for 1801:—

	Deg.	Min.	Sec.
Mean longitude of the sun...............	280	39	10·2
Longitude perihelion	279	30	5
Sec. motion for 100 years	0	45	45
Similar Burg. for the moon:—			
Mean longitude	118	16	56·1
Anomaly	212	6	56
Motion of mean longitude in 100 years	307	52	43

—W. H.

[11572.]—**Compressing Water.**—J. Westwood seems to ignore the explanation which I gave him on page 157—viz., that there is a known compressibility in water which is due to the air contained in it, which may be proved by placing water under the receiver of an air-pump, and, upon exhausting, the water will appear to be in a state or ebullition, similar to boiling, consequent upon the air leaving it.—A., Liverpool.

[11589.]—**Dry Steam.**—I trust that I am as willing to be corrected if I state anything which is contrary to known facts, as to give others the benefit of what little knowledge and experience I may be possessed of. It appears to me that it is "Caloric" who is in a fog, and not myself. I reassert that there is no necessity to go to the chemist's to answer this query, as the reply on page 157 is, in my opinion, correct, and I will take his own experiment to prove my position. Does he wish me to understand that if steam at 3lb. per inch be passed through pipes in a furnace that it will remain at that pressure? If so, I will believe that when I see it, but not before. It appears patent to me, irrespective of what the pressure might be in the boiler, that the steam exposed to a higher heat in the furnace will become, to all intents and purposes, high pressure; and, therefore, my answer that there will be plenty of heat, with but little of water in a given volume of it, is correct.—A., Liverpool.

[11594.]—**Foreign Calculation of Engine Power.**—A French horse-power is equal to 4,500 kilogrammetres per minute, equal to 32,549 foot-pounds. Do you want the formulæ for calculating? The English rules are generally used in the United States.—M. E.

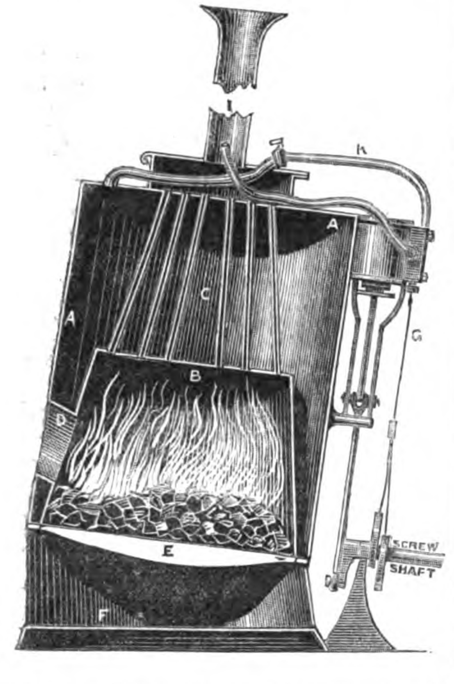
[11632.]—**Debility.**—I did not say (p. 182) that homœopathists had no cure for constipation, but that the patient under treatment for tumour was obliged to seek relief under another system for it, as the medicine given for tumour had no effect on the bowels. I may further add that the homœopathist on being pressed for opening medicine refused, stating the tumour must be cured first, recommending that fruit should be eaten instead. Thus the natural channel for removal of effete and noxious matter would have been closed had his directions been followed. Many common articles of food and drink of every-day use are forbidden to homœopathists, as they counteract the medicines. Now, can the votaries of this system say—not merely assert—but say with scientific certainty that they have discovered all the substances which produce this effect? Again, even perfumes will destroy the effects of the medicines; how, then, about the garden flowers, the hawthorn, the hay fields, and the sea breeze, which the happy dwellers in the country cannot avoid if they would? And should there be in any article of common use some undiscovered substance, some unknown quantity, that vitiates their prescriptions, then the followers of homœopathy are, despite all their precautions, "Walking in a vain shadow, and disquieting themselves in vain." As to whether the "Altera-Tonic" system is true or not I only ask investigation. For myself I am satisfied of benefits not only in my own case and that of my friends, but also with domestic pets. The mission of the ENGLISH MECHANIC, as I take it, is to answer the question of one of old—"What is truth?" but not like him to leave the Judgment Hall before the answer is given.—AMATEUR.

[11632.]—**Debility.**—I wonder if "Amateur" (page 182) was joking when he wrote of the above. I cannot imagine any one speaking seriously in that manner against one of the "learned professions." If "Amateur" has obtained a benefit from the use of the elixir, &c., let him still believe in it, and also in the fallacious idea that *all* disease originates in nervous debility. Others, on the contrary, will keep their own opinions without running down any one. I don't say that the elixir is useless, because it has never been my luck to try it. Of the antagonists of the *Anti-Lancet* I cannot so speak; still, it would be out of the way for me to try to prove their worth, for they are numerous enough to do it themselves in deeds, which are far stronger than any words.—OLD CHEESEMAN.

[11654.]—**Cleaning Violoncello.**—I bought a violoncello so completely encrusted with dirt that few would have taken the trouble to attempt to clean it. In the first place, I dusted it well, took down the bridge (there was only one string to hold it up), and removed the tailpiece, and then I washed it thoroughly with soap, water, and flannel, using turpentine to remove the rosin. After drying I rubbed the instrument all over with the naked hand slightly moistened with olive oil. The results were most satisfactory, and it has now a brilliant polish.—R. E.

[11655.]—**Making Gold and Silver Leaf Adhere to Fabric.**—Dissolve gum arabic rather thick, and add about one-third of brown sugar, lay it on the fabric with a camel's-hair brush, and let dry; now breathe upon it, and apply your gold or silver leaf, let dry again before you rub off the edges; or a still cheaper material is dissolved glue and about one-third treacle, applied warm to the fabric, and in about half an hour it will be ready for gilding. If your substance is too thick, thin it with water, if too sticky take less sugar or treacle.—THE WELSH SHEPHERD.

[11656.]—**Boiler for Small Steamboat.**—"L. M. F." has not stated how he intends to fit his boat up. I do not know whether he intends to fit up as paddle or screw. It is almost a general practice now to make small boats, screws. If that is his intention, he should have a short vertical boiler with one cylinder down the side, coupling direct upon the screw shaft; this is, I am confident, the best arrangement for a boat of that size. I send a drawing of the kind of boiler. I have seen a good illustration of that class of boiler in Shand and Mason's steam fire-engine. This boiler ought not to weigh more than four or five hundred-weight with fittings, the shell to be of mild steel, three-eighths or five-sixteenths of an inch thick; the tube plate ½in. best Lowmoor wrought iron, the tubes of hard soldered brass ⅛in. thick, and 1in. internal diameter; number of tubes, 8; length, 16in.; diameter of boiler, 2ft., height, 30in.; diameter of firegrate, 9in.; height of firebox, 1ft.; fire-door, oval, 6in. by 3in.; chimney, 6in. internal diameter, and ⅛in. thick sheet iron; height of chimney, 6ft. from stalk, with or without a hinge joint at the bottom, according to the height of the bridges. For such a small engine I would not recommend a Giffard's injector, being what Mr. J. Bourne would call a battle trap. With muddy water they are failures.



The engine to be 7in. by 3½in. stroke, connected with a clutch to the screw shaft to throw out of gear when pumping water; this secures the advantages of a donkey pump. Space occupied by engine and boilers, 2½ cubic feet. The space around the engine and boiler could be filled up by coal bunkers. This is a design for a river steamer. I would not recommend a small steamer for the sea; better make it a sailing vessel at once. There will be constant trouble on account of the tubes being encrusted with salt. If he intends the steamer for the sea, at the bottom of the boiler might be placed a cast-iron tank, to contain fresh water for the boiler. It will be of no earthly use trying to make so small an engine into a condensor. This engine will be 2 horse-power nominal. If "L. M. F." intends to make it a paddle steamer I will send a different design. References:—A, shell of boiler; B, fire-box; C, tubes; D, opening for fire door; E, fire-bars; F, ashpit; G, engine; H, smoke-box; I, chimney which lifts up with the hinge shown on the left hand; J, exhaust pipe; K, steam supply pipe.—P. W. H. J.

[11663.]—**Steam Power.**—I thank "P. W. H. J." for his answer (p. 207), but I find it is not quite what I want. Will he kindly say, if I make the flue of tubes, what size they should be, how many, and what distance they must be carried above the fire-box before emerging into the chimney? The steam pressure I could not state, not knowing what I could obtain in so small a boiler. The resistance would not be very great, as I intended my model to represent a steam crane. Could he tell me how to ascertain the pressure in model boilers? I want a small pressure gauge, but cannot afford to get one. Could I construct one simple and small? If so, how?—T. W. J.

[11664.]—**Polishing Bullock's Horns.**—Polish with oil and whiting, or willow charcoal powder.—W. H. HEY.

[11677.]—**Rendering Wood Incombustible.**—Deal boards become almost incombustible when painted over with a diluted solution of waterglass (silicate of soda). The waterglass is usually sold as a thick fluid, like honey. This may be thinned out with water, about six or seven times its own bulk. The water must be soft water; boiled water will do. Use a clean brush, and apply the solution warm. In about twenty-four hours a second coat, and perhaps a third, will render the wood almost incombustible. Use a new brush. Wash it in clean water after using it, or it will get too soft. Avoid grease or fat on the boards before you paint them. The felt recommended to you is most likely roofing felt, which I would not recommend in your case, as it soon becomes brittle, and is only preserved with pitch and tar—a very combustible material. It seems to me that slates are the only material for your roof.—THE WELSH SHEPHERD.

[11681.]—**Waterglass.**—Waterglass will not do for the bottoms of boots used in salt water, nor for boots used on land. Waterglass will do to preserve wood, mortar, cement, and stone, but not for leather.—THE WELSH SHEPHERD.

[11694.]—**Green Fly.**—It is clear "H. S. C." has never tried cigar ends. These rank bits of "'bacco" are regular settlers for all insect life, and beat shag tobacco and negrohead and tobacco paper hollow. *Modus operandi*: Place a small flower-pot, bottom up, on three bits of broken pot. Stand another pot upon it, keeping the holes one over the other. Put in a handful or two (according to size of greenhouse) of the cigar ends, together with a live coal, in the centre, and the tobacco will burn out steadily and thoroughly. These cigar ends are not easy to get; but at some of the large cigar divans can be bought of the careful attendant at 2s. per lb.—JANNIFRED.

[11706.]—**Optician's Lacquer.**—See p. 515 of last volume (query 10466).—W. H. HEY.

[11710.]—**Cleaning Oil Painting.**—The cleaning of oil paintings is in many cases a very difficult operation, which ought not to be undertaken by an amateur if the painting is a valuable one. There are many paintings spoiled by cleaning, because almost every painting requires a different treatment. Most of the early paintings upon wood are not oil paintings at all, but entirely prepared and painted with distemper or size colours, and only varnished over with sandarac or mastic varnish. Afterwards the artists used a distemper ground, and painted their pictures partly in size and oil colours. Then canvas pictures were painted entirely in oil, yet even many of those oil paintings have in some places touches of body or water-colours; in fact, almost every artist has a method of his own, and any one undertaking to clean a painting ought to see at once by what technical means the painting was produced, because what might be used with perfect safety to clean one picture would be harmful to another. The above general remarks on paintings will show to E. Parker that it requires more space to meet every case. However, I will give him one method which is safe in every case, but it may not always have the desired effect:—First, dust your painting with a dry brush or rag, then take some water which has been boiled for some time; when quite cold dip a soft sponge or a wash-leather in the water, and squeeze the sponge or leather so that it only remains damp. Now go over your painting, and wash your sponge out again until the water comes clean out of the sponge. When all the dirt is removed from the painting, a dry wash-leather or a very soft cotton rag will entirely dry the surface of the painting. The water should be used very sparingly, because water is a great enemy to oil paintings. Now, put your painting in a bright light (but not in the sun) and leave it there for a day. If the colours have become generally brighter, perhaps exposure to bright light for a few days will be sufficient; if not, take a piece of cotton wool and dip it in clean spirit of turpentine (not too full). Commence on the top of your painting, going lightly over it and so downwards; touch every place, but do not touch the same place a second time. When your cotton wool is empty, fill again until your picture is all gone over; in about half an hour you may go over your picture a second time. If not perfectly clean and fresh after the second operation it wants another treatment.—THE WELSH SHEPHERD.

[11711.]—**Time at Our Antipodes.**—I fear the diagrams in reply to this query on p. 234 will not be sufficiently intelligible to "T. S.," partly on account of my having omitted to give the corresponding astronomical and civil times at 270° and 90° respectively, and partly from "T. S." concluding that a message telegraphed from London at noon on Tuesday, May 7, would be dropped at New Orleans at 6 a.m. on the *same* day. Now, as Wednesday succeeds Tuesday, it must have an *absolute* commencement somewhere on the earth's surface. That Wednesday, reckoned civilly, commences at any place at the moment when it is noon at the Antipodes there can be no doubt; diagram No. 4 shows that the civil Wednesday commences at London when the sun passes the meridian on the same day at the Antipodes—*i.e.*, Tuesday 12 at night at London is synchronous with Wednesday 12 at noon at the Antipodes. Applying this to Calcutta and New Orleans the times for diagram No. 3 will stand thus:—

0° astronomical time,	Tuesday, May 7, 6 hours.		
civil	,,	Tuesday, May 7, 6 p.m.	
90° astronomical	,,	Tuesday, May 7, 12 hours.	
civil	,,	Tuesday, May 7, 12 night.	
180° astronomical	,,	Tuesday, May 7, 18 hours.	
	Wednesday commencing.		
civil	time, Wed.	May 8, 6 a.m.	
270° astronomical	,, Wed.	May 8, 0 hours.	
civil	,, Wed.	May 8, 12 noon.	

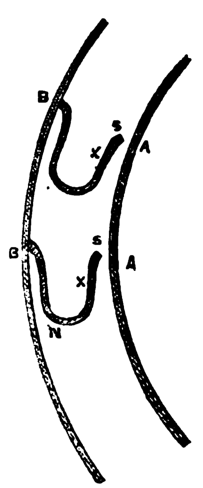
From these we find that when it is 12 at night at Calcutta, Wednesday commencing, the sun is passing the meridian at New Orleans 12 hours later. If now we take the times for diagram No. 2 we have—

90° astronomical time,	Tuesday, May 7, 6 p.m.	
civil	,,	Tuesday, May 7, 6 p.m.
0° astronomical	,,	Tuesday, May 7, 0 hours.
civil	,,	Tuesday, May 7, 12 noon.
270° astronomical	,,	Tuesday, May 7, 18 hours.
civil	,,	Wed. May 8, 6 a.m.

As, therefore, the difference of time between 12 at night and 12 at noon is twelve hours between any place and its antipodes, so in the case of London and New Orleans, the difference of time, reckoned according to the earth's rotation, is 18 hours, and the message is dropped at New Orleans 18 hours in time later than its despatch, or at 6 a.m. on *Wednesday* morning, not on Tuesday morning. I beg to apologise for having given this extra trouble to "T. S." and your readers.—W. R. BIRT.

[11721.]—**Assayer's Duties.**—I have been waiting for "Un Irlandais" to answer this query, as it was addressed to him. I am sorry to have to discourage "G. T. H.," but the knowledge which he seeks is considered a trade secret by all Cornish assayers acquainted with the subject, a great number of whom do not understand it themselves; if this had not been the case, I would have been happy to have given him all the information that lay in my power. To satisfy a person that this was kept a secret, I once wrote to a recognised assayer in Cornwall, and offered to pay him for instructing me in the method. His reply was in the following words:—"The information for which you ask is, if I may call it such, so much professional capital I should not like the idea of making a charge for instructions. The example given by "G. T. H." would, if worked out by the method given by "Un Irlandais," give the price to be paid for such ore almost £1 16s. per ton, whereas it is really worth about 16s. 8d. per ton, according to the right method of calculating. I trust "G. T. H." will not think me discourteous in thus replying to his query.—J. ROSKELL.

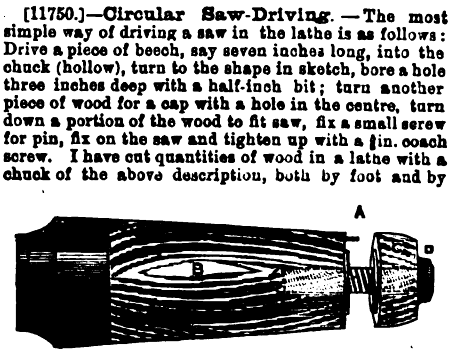
[11731.]—**Hairwash.**—If "Excelsior" will try a mixture of pure glycerine 1 part, and rosewater 4 parts, he will, I think, find that it keeps the skin of the head clean and soft, and prevents the formation of scurf. If he finds the wash too sticky he can add more rosewater. The above are the proportions used constantly by myself and many friends with perfect satisfaction.—SEPOR, St. Petersburg.



[11737.] — **Fairbairn's Ventilating Bucket.** — The peculiarity about these buckets is that they are made with one uniform curve, so as not to receive the water with such a shock; but they allow the water to transmit its force uniformly, and as a natural consequence it has more effect. I inclose drawing. A B are the buckets, and the ventilating spaces are A S. These spaces allow the buckets to empty themselves, but their greatest use is to permit the air in the buckets to escape easily. These buckets also empty themselves sooner than any other sort.—P. W. H. J.

[11749.] — **Cementing Iron in Wood.** — Take equal parts of powdered resin and dust of Bath brick. Mix, fill partially the hole in the wood, heat the screw well, and it will bed firmly.—JANNIFRED.

[11750.]—**Circular Saw-Driving.**—The most simple way of driving a saw in the lathe is as follows: Drive a piece of beech, say seven inches long, into the chuck (hollow), turn to the shape in sketch, bore a hole three inches deep with a half-inch bit; turn another piece of wood for a cap with a hole in the centre, turn down a portion of the wood to fit saw, fix a small screw for pin, fix on the saw and tighten up with a ⅝in. coach screw. I have cut quantities of wood in a lathe with a chuck of the above description, both by foot and by



steam power. Description of sketch: A, groove for the saw; B, the wood for the chuck; C, the cap; D, the coach screw partly screwed up. Do not use a 12in. saw if a 9in. or even 6in. will do the work. Make a table same as an ordinary stool, fastened to the lathe with a screw-bolt, or a table fixed in the socket of the rest.—SAMUEL SMITHER.

[11756.]—**Power of Water Wheel.**—I commence answering this query in ignorance whether the wheel is overshot, undershot, or breast. I also am not supplied with one of the dimensions of the buckets; these dimensions I shall have to suppose. If I am wrong, let "Water-Wheel" substitute the dimensions that he has omitted for mine, and if unable to work it out write again. I shall suppose the wheel to be a high-breast one. The water takes 90 seconds to traverse (100 × 3) feet, ∴ it runs $\frac{100 \times 3}{90}$ feet, or 20ft. in one second. The contents of the reservoir are 15,120ft. (cubic). The probable number of buckets on the wheel is 30, and the contents of each is (say) ½ c. ft. By tables in Molesworth's "Pocket-Book," I find that for that diameter of wheel the velocity of circumference to be 12·2ft. per second; and from that I deduce the number of revolutions to be about 15 per minute. Let T be the time that it would take to entirely empty the reservoir, then 15 × 30 × ½ c. ft. × T = 15120,

$\therefore T = \frac{15120}{15 \times 30 \times \frac{1}{2}} = 2\frac{7}{30}$, or 2¼ hours nearly.

There is a formula also given in Molesworth that, to be understood, I must give *in extenso*. Let Q be the quantity of water discharged in cubic feet per minute, h = head of water in feet, P = effective horse-power. Then $Q = \frac{881\ P}{h}$ for high-breast wheels. Then, applying it, ∴ Q = 30, P unknown, h = 6; ∴ $\frac{30 \times 15}{4} = \frac{881\ P}{6}$; ∴ $P = \frac{675}{881}$; but would practically be about 1 horse-power. Then 1 horse-power acts continuously for 2 hours, and it would be equal to ½ horse-power acting for 4 hours, or ⅓ horse-power for 6 hours, or ¼ horse-power for 8 hours. I don't exactly see the meaning of the latter portion of your query. There are three things that it may mean—viz., a sluice to let the water on the wheel, a tap or sluice to let the waste water out, or there may be a leak in the bottom, and you may want to stop it up. If you require a sluice, the best plan universally adopted is a sliding-door or shutter. The same remedy is best for the second supposition, and for the third part a leak can always be puddled up with clay.—P. W. H. J.

[11770.]—**Magnetic.**—Place the marked end (the north pole) of your magnet on the centre of compass needle, and draw it along to the end marked S on the needle. Repeat this operation about twenty times. Now place the other pole of magnet on centre of needle, and draw along to the end of needle marked N. This should be done the same number of times.—Glatton.

[11777.]—**Postage Stamps.**—Paper a room! The blue and variegated stamps arranged to form diamonds or other patterns, with the penny stamps as grounding, have a good effect. Paste on to what paperhangers sell as lining paper. The best structure to adorn will be, perhaps, that which George Colman, the younger, so neatly introduces

> And in the garden's deep recess
> He 'spied a house so little, it seem'd raised
> More for man's visits than his fix'd abode.

—Jannifred.

[11781.]—**Lathe Query.**—1. I send sketch of a tool called in the trade V screver; can be purchased at many tool shops; if far away from such procure an old file, soften the same, grind it to the shape, and cut a V groove with a small file on one side only; when dull sharpen or grind the reverse side. 2. A treading tool must be ground upon a sharp edge of the stone, moving it about so as not to flatten the same, then use a piece of Turkey stone, filed up to fit the groove, do not grind the flat side on the stone, but when sharpening the same

just touch it gently, the flat side on the stone; or a bead tool can be sharpened with a round file, but that is a makeshift way. I cut a groove ⅛in. deep in a small stone ⅛in. from the edge, the rounded projection to fit the tool; this is the best way that I know of. 3. When I wanted any ferrules I bought a piece of brass tube and cut them off with a small circular saw; the saw I used was only 3½in. in diameter. Iron ferrules I used to cut with a file, but the time occupied in so doing was so long that I found it pay better to use brass.—Samuel Smither.

[11785.]—**London Blackbeetles.**—A certain remedy is to procure some bracken, *Pteris aquilina*, or common fern, plentiful on commons, and put it down about the house at night. The blackbeetles will eat it ravenously and soon die, and their relatives will pick their bones. It is commonly used in the North of England.—Watts.

[11785.]—**London Blackbeetles.**—I know that a house terribly infested with this insect, a veritable pest wherever found, or under whatever name known, blackbeetles, cockroaches, or (Hibernicé) slocks—was clearedin a couple of weeks by a free use of chloride of lime. They were "upstairs and downstairs, and in my lady's chamber;" the chloride of lime was dusted and sprinkled plentifully, evening after evening, in the basement rooms, and on the cracks of the plaster of the walls, and corners of ceilings, turns of the staircases, &c., and in about a fortnight the whole colony had politely "skedaddled," and did not return. When once away they must be kept away by starvation—that is, not the least crumb of anything eatable is to be scattered about and allowed to remain on the floors, tables or shelves where the pests can reach them. In using chloride of lime be careful to secure everything in steel or polished iron from its fumes. The knives, door-keys, fire-irons, grates, &c., should be well oiled, and kept so while not in actual use, so long as the pungent chlorine prevails in the house; else rust will completely spoil them. Before I heard of the chloride, I once cleared an infested house by a daily and nightly crusade against the beetles, 50 to 100 being the number of our victims every twenty-four hours during one whole season; we managed to inveigle them into all sorts of traps—unwashed jamcrocks, with a little cold water in the bottom, paper bags which had held sugar, dust-pans and shovels with cucumber parings on them—set about the kitchen floor, a large pan of water left in the centre, the gas down, and all left quiet for fifteen to twenty minutes, when by a little quiet dexterity, one person going to each trap while one turned on the gas, we often destroyed twenty at a time, and could repeat this five or six times of a night.—H. O'B.

[11788.]—**Bunions.**—"Der Mond" must paint the bunion with Veratrum viride, which generally gives rapid and perfect relief. The lotion may be obtained of any homœopathic chemist.—Old Cheeseman.

[11791.]—**Colonel Stuart Wortley's Emulsion Process.**—*Collodion.*—Plain collodion 1oz., dried bromide of cadmium 7gr., nitrate of uranium 30gr., nitrate of silver 18gr. *Preservative.*—Gum arabic 60gr., sugar 60gr., pyrogallic acid 3gr., water 6oz. (this is the latest published, but the Colonel says he has discovered a better one). *Developer.*—A, carb. ammonia 64gr., water 1oz.; B, bromide of potash 24gr., water 1oz.; P, pyrogallic acid 96gr., alcohol 1oz.; M, methylated spirit; W, water. The solutions are mixed in the following proportions, and used in the following way:—Mix together 5dr. of W and 2dr. of M, and pour the mixture carefully on the exposed plate; pour it back into a developing glass, and add twenty drops of P, and pour on and off for about a minute; then add from twenty to thirty drops of A and five drops of B, and pour on again. The image should appear in about thirty seconds, and gradually acquire sufficient intensity to give good prints. If it comes too slowly, add more A; if there is any tendency to fog, add more B; fix with weak hypo. The exposure should be a little longer than for wet collodion. If "R. M. H." is inexperienced in dry plate work, he should let Colonel Wortley's process alone, and practice with tannin, collodio-albumen, beer, or coffee, by either of which first-class negatives may be obtained. If, however, he is thoroughly up to it, he may give it a trial; he must stick closely to the formulæ, see that his chemicals are perfectly pure, and be prepared to give ungrudgingly both time and patience; and, after all, if his success is no better than mine, he will lay it aside as unworkable, as no ordinary amount of development will give more than a faint image, utterly useless as a printing negative.—Auld Reekie.

[11792.]—**Compound Engine.**—There is not a fixed proportion, because it depends in some measure upon the pressure at which the steam enters and leaves the high-pressure cylinder. In an engine of 80 horse-power at the Royal Arsenal Gun Factory, at Woolwich, the diameter of the large or low-pressure cylinder is 31in., by 6ft. stroke; diameter of small or high-pressure cylinder is 15⅞in., by 4ft. 6in. stroke. Then, again, the dimensions of a 30 horse-power engine, the length of stroke of high-pressure cylinder 2ft. 9in., diameter 14½in. The length of stroke of low-pressure cylinder is 5ft., diameter 28½in. I believe that it is a general rule to have the steam-receiver of about the same capacity as the high-pressure cylinder.—P. W. H. J.

[11793.]—**Area of Chimney.**—The area will depend upon the height, because a tall narrow chimney will do the work of a broad-based one, within certain limits, not so tall. There appears, however, to be more advantage in increasing the height than the width, for a given quantity of bricks. The diameter at the base should not be less than $\frac{1}{10}$ height, as if so there would be danger of a strong wind giving it a "turn." There is a rule for steam-engine furnaces that might be applicable. Let F be the quantity of coal consumed per hour in pounds, h = height of chimney in feet, H P = indicated horse-power of engine; A = area of chimney at top in square inches. Then $A = \frac{15\ F}{\sqrt{h}} = \frac{150\ H\ P}{\sqrt{h}}$. As a general rule applicable to almost any sort of furnace, the chimney area should be from $\frac{1}{16}$ to $\frac{1}{20}$ of the firegrate surface. It might probably be $\frac{1}{25}$ with advantage in the puddling furnaces.—P. W. H. J.

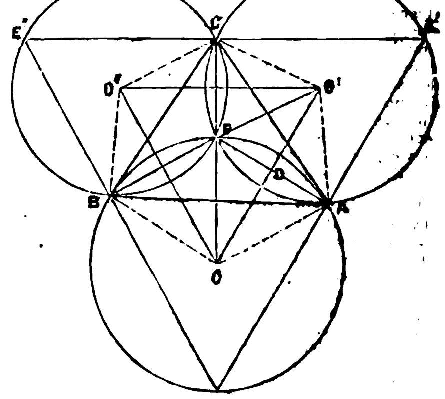
[11793.]—**Area of Chimney.**—There is no fixed area proper for a chimney in proportion to its fire-grate, for it depends upon, not the size of the grate, but the quantity of air that must pass up the flue, and the rate of the draught, both of which vary greatly, even for furnaces used for the same purpose. Some steam-engine furnaces, for example, burn coal at the rate of about four pounds a square foot of grate per hour; many burn four or five times as much, and some more than ten times as much, requiring, of course, far more air than the first. Again, some furnaces burn nearly all the oxygen of the air that passes through them; most do not burn half of it; and in many a still larger proportion of the air escapes unburnt and worse than useless, for the unburnt air carries away heat produced by that which is burnt. Far less attention has been paid than its great importance deserves to deciding what is the best proportion of air to burning fuel. If there be too little air, fuel is wasted by its imperfect combustion, especially of its carbonic oxide and other gases, and the formation of soot; if too much, heat is carried away uselessly, while if it be not sufficiently divided, and so chills the fire or flame, both forms of waste are caused. I believe "Falstaff's" safest plan will be to make his chimney flue a good deal larger than is strictly necessary (how large I cannot guess without more data), and to have some ready means (by damper or otherwise) of diminishing the width of the opening for smoke into the flue, which he can regulate by trial. As a general rule, a large rather slow burning, but not dull fire, gives more useful heat in proportion to the fuel it burns, than one burning fiercely.—Philo.

[11796.]—**Coloured Printing Inks.**—"An Amateur Printer" must first obtain the following articles: Three cans of varnish, strong, middle, and thin (it will keep any length of time); a marble slab, about 24in. by 18in.; a muller, and a palette-knife. Before beginning to mix any colour be sure that the slab, knife, and muller are perfectly clean. Suppose a nice red ink is required to print some fine work: Take a quantity of the best pale vermilion and spread it on the slab. Break it up with the muller, then add some of the middle strength varnish, and with the knife mix it up, adding very little varnish during the mixing; then give it a few minutes' rough grinding, after which scrape it all to one corner of the slab; then take a small portion at a time and grind until perfectly smooth. This is the whole process of grinding, varying slightly with coloured bill inks. A great deal depends upon the roller used in working with coloured inks, which, if possible, should never have been used for black. A roller cast hard, and quite dry on the face, will work the above red ink perfectly clean and regular; a soft roller would not take the ink at all. A little alteration is required in mixing the above ink where it is required to print with a forme containing large display lines. Use equal quantities of vermilion and orange lead, using more varnish so as to make it thinner, and therefore not so hard a roller will be required. Rose lake, crimson lake, and Indian red are used to produce the various tints of red. For a dark green, mix a bright blue, then add yellow in small quantities, prepared and mixed before from bright chrome yellow. For a light green, the yellow is first mixed and the blue added afterwards. Indigo and Prussian blue are very dark. Autwerp blue is a light and soft smooth colour, often used to lighten the above darker blues. Chinese blue makes a remarkably rich colour. In mixing these blues it is best first to grind them in water before adding the varnish, placing the slab before the fire to evaporate the water, adding the varnish in small quantities, and grinding as usual. Different shades of brown can be made by mixing red and black. For bill ink, mix first with a quantity of water, grinding with the muller; after this, take the thin varnish and keep adding a little as the grinding goes on until the ink is of the proper consistence. This process applies to all colours. For red the principal ingredient is orange lead, adding a small quantity of common vermilion. Any of the above colours and varnish can be obtained from the printing-ink manufacturers.—Zoo Andra.

[11797.]—**Preserving Moths and Butterflies.**—Merely touch the bodies of either moths or butterflies with a weak solution of chloride of mercury in alcohol by means of a soft camel's-hair brush. The spirit will dry off without injury to them.—W. J. May.

[11798.] — **Uncoiling New Wire Rope.**—"Boiler-Minder" should place the coil of wire rope on a revolving table, which can be made by a cart wheel, the axle made fast by wedging it in the ground; then put your coil on the table, loose the outside end; after you have taken the bands off the coil, then walk away with the end of the rope as the table turns round, having some one to instantly stop the table when you stop pulling the rope down.—An Old Rope Maker.

[11801.]—**Question in Trigonometry.**—Construct the triangle A B C, upon each side describe an equilateral triangle, from the centres of each equilateral triangle describe circles intersecting each other in P, which will make an angle of 120° as required. To find A P, first find the angle B A C, which will be found = 52° 2′ 37″; also the angles B A O and C A O′, each equal to 30′, which, added to BAC, make the angle O A O′ = 112° 2′ 37″; also A O′ = ½ A C × sec. 30° = 520 × sec. 30° = 600·444, and similar A O = 650·674, with A O = 650·674, A O′ = 600·444, and angle O A O′ = 112° 2′ 37″. Find the angles O O′ A and A O O′, which



will be found = 85° 31′ 41″, and 32° 25′ 42″ respectively. Then O A· × sin. O O′ A = 32° 25′ 42″ = A D = 348·919 = ½ A P, whence A P = 697·838, similar B O P = 497·462 = and B P = 602·342 are found; or with angle A P B = 120, A B = 1127, A P = 697·838. A B P = 32° 25′ 41″ is found, and B A P = 60° − 32° 25′ 41″ = 27° 34′ 19″ = sin. A P B : sin. B A P : : A B : P B = 602·342. Also C A P = B A C − B A P = 52° 2′ 37″ − 27° 34′ 19″ = 24° 28′ 18″ Then sin. 120° : sin. 24° 28′ 18″ : : 1040 : B P = 497·842. A demonstration and detail might be given, but it would take too much of your valuable space.—H. H.

[11801.]—**Question in Trigonometry.**—I presume "Numa" is quite as competent to answer as to ask this question; but as there may be, among the numerous readers of the English Mechanic, some who are not so, but who may nevertheless be interested in it, I will state for their information that they may learn how to solve it from Kerigan's "Mathematical and General Navigation Tables," Vol. I., page 623, and from various books upon trigonometry, but from none better, that I know of, than Kerigan. It is one of six cases or varieties of a general problem said to have been originally proposed by Richard Townley, Esq., and solved by Mr. John Collins, in the "Philosophical Transactions," No. 69, A.D. 1671. See pages 78 and 79 of "Elements of Plane and Spherical Trigonometry," by Dr. Gregory. The general problem is a very useful one in trigonometrical surveying, particularly in coast and harbour work. In the case put by "Numa," I believe A P = 700, B P = 600, and C P = 500.—THEODOLITE.

[11808.]—**Photographing the Sun.**—I cannot claim to be one of "our" astronomical correspondents, but I think I can give "Passyunk" a reason for his want of success in photographing the sun. I believe he has used too long exposure. We have until recently photographed the sun at this Observatory on every available occasion, and have found a much smaller slit necessary than the one named by your inquirer as employed by him. Our slit is adjustable, and the degree of aperture varied with the state of the baths, &c., between (say) 0·3in. to 0·10in.; only on very rare occasions do we open it to a greater extent. It is, of course, necessary to have a pretty strong spring to pull the frame containing the slit down very rapidly. In some of the instruments more recently constructed than the Kew heliograph, variation in the time of exposure is obtained by interchanging a series of diaphragms, having slits from one-fortieth of an inch to one-tenth of an inch, and by altering the strength of the spring, but I think such a complication is unnecessary.—G. MATHUS WHIPPLE, Kew Observatory.

[11809.]—**Cool Air in Hot Climates.**—I fear "C. H. B." will not find the machine for producing cold by first compressing air and then allowing it to expand, available as a cheap mode of cooling a house, though it is the cheapest plan I know for producing cold artificially on the large scale. This machine is used for condensing Young's paraffin, and is found cheaper than the one worked with ether. I believe the patent is for the particular form of machine in use, and do not suppose that it attempts to secure a monopoly of the employment of condensed and expanding air for obtaining cold. It is very possible that the manufacture of ice by such methods would be a paying business at such a place as Malta—*i. e.*, that it might be cheaper to import fuel to work an ice-making machine than to import ice from Etna or elsewhere; but it must, I think, be cheaper for "C. H. B." to buy ice to cool air than to work a machine to cool it. Mr. Julius Jefferies, F.R.S., the very ingenious inventor of the respirator (which has saved multitudes from death and suffering), once proposed to obtain cool air for the hospitals and barracks in parts of India by drawing from or driving through a number of dry wells the air needed for their supply. As the earth a little below the surface is at about the mean temperature of the locality, the air from wells dug in it is cooler in summer and warmer in winter than the outer air. There are several evident objections to the plan, and it has not, I believe, been tried, though it seems worth trial in places where the soil is dry and pure. Mr. Jefferies maintained that the interest of the cost for making the wells would be far less than the annual cost of other modes of obtaining coolness. The plan is described in detail at p. 177-8 of Vol. I. "Royal Commissioners' Report on the Sanitary State of the Army in India. 1863."—PHILO.

[11810.]—**Colds in the Head, &c.**—"X. Y." may cure a cold in the head, &c., by putting his feet into hot water until perspiration is caused on the forehead; drink a tumbler of cold water when in bed, and well cover himself with bedclothes.—OLD CHEESEMAN.

[11811.] — **Lime-juice and Glycerine.**— "Country Barber" should pay no attention to "Mayland," who evidently does not know anything about the subject. If carbonate of potass be added to lime-water, the lime will be thrown out of solution, and the resulting mixture will be a mess. The following formula is that of one of the largest wholesale houses in the trade:—Olive oil (bleached, if the cream be wanted white), 20oz.; lime-water, 20oz.; glycerine, 2oz.; essence of lemon, 100 drops. Of course, this is simply a lubricating preparation. If "Country Barber" wants something that will entitle him to print on his label, "One of the best preparations ever introduced for preventing the hair falling off, or becoming prematurely gray," he should add to the oil a quarter of an ounce of cantharides, shake it well occasionally, and after it has stood for 24 hours, filter through paper before adding it to the lime-water.—AULD REEKIE.

[11812.]—**Aerated Waters.**—If "Country Barber" wants aerated water in very small quantities, his simplest plan would be to get one or more of the ordinary gasogenes, perhaps the five-pint size would be the best. If they are required on a larger scale, but not large enough to keep a machine working, a coppersmith could easily construct a large enough apparatus on the gasogene principle. If the water is to be added to syrups, it does not need to be highly charged, as the sugar causes much frothing up.—AULD REEKIE.

[11818.] — **House Heating.** — "Relwot" might adapt to his purpose the plan to be carried out for heating the hall and passages of my house, where flues cannot be constructed for stoves. The fireplaces in the library, dining, and drawing rooms are supplied with sheet-iron (cast) backs: a hot-air chamber is built behind; pipes communicate with the outer air on one side, and with the hall on the other; the air enters the hot-air chamber, becomes heated, and passes into the hall. At the back of the kitchen range is a similar arrangement, though there a second iron plate is used, which is open to the scullery at the back, giving a hot surface for drying washed clothes in wet weather; the hot-air chamber between communicates with the room above, which is heated by this means. The name of the architect, who is an eminent man in his profession, would be a sufficient guarantee for the plan answering. —A CAMBRIDGE GRADUATE.

[11821.]—**Holly.**—I think "X. X." must have barked it before allowing it to season. That used by me retains its whiteness by keeping bark on till in condition to work up.—W. K.

[11824.]—**Punching Machines.**—Use cast steel, avoid upsetting the point of punch, temper down to a dark straw colour by heating thick end of punch.— KYRLE.

[11825.]—**Testing Bleaching Powder.** — The chlorine in bleaching powder (chlorinated lime: calcium chloro-hypochlorite) is easily estimated volumetrically by means of a standard solution of sodium hyposulphite. The hyposulphite solution is prepared of such a strength that a litre of it will exactly decolourise one-tenth of the atomic weight of iodine, taken in grms. To prepare it, dissolve 28 grms. of the crystallised hyposulphite in a litre of distilled water, fill at 100 c. c. burette with this solution, and drop it into an aqueous solution of 1·27 grms. of pure iodine (dissolved with the aid of about a couple of grms. of potassium iodide) until the colour of the iodine disappears. The exact point at which the reaction is complete is more readily determined if a little mucilage of starch is previously added to the iodine solution; the dark blue colour produced is not discharged as long as a trace of free iodine remains. Note the number (n) of c. c. of hyposulphite solution used, put 800 c. c. of the solution into a graduated jar, and add distilled water until it measures $\frac{800 \times 100}{n}$ cubic centimetres.

If, for example, 92 c. c. were used in the experiment, then (92 : 100 = 800 : 869 5) add water to the 800 c. c. until it measures 869·5 c. c. This forms the standard solution. To test the bleaching powder, weigh a grm. of it accurately, mix it with about a fifth of a litre of water containing excess of potassium iodide (say 8 grms.), and acidulate with hydrochloric acid; the liquid now assumes a reddish colour, or an intense blue colour if a little mucilage of starch be added. Into this carefully drop the standard solution from a burette until the colour is discharged. Probably about 85 c. c. will be required if the sample is of an average good quality. If the quantity is exactly 85 c. c. it represents 30·175 per cent. of available chlorine in the sample of bleaching powder. The theory of the process is as follows: On adding the bleaching powder to acidulated water, chlorine is liberated

$$Ca(ClO)Cl + 2HCl = CaCl_2 + H_2O + Cl_2,$$

which immediately displaces iodine from the potassium iodide

$$2KI + Cl_2 = 2KCl + I_2,$$

and when the sodium hyposulphite reacts on the solution containing free iodine, a colourless solution is formed containing sodium iodide and sodium tetrathionate

$$I_2 + 2Na_2S_2O_3 = 2NaI + Na_2S_4O_6.$$

As the two atoms of chlorine in the first equation liberate two atoms of iodine in the second, which require two molecules of hyposulphite for discoloration, it follows that two grm. atoms of chlorine—*i.e.*, (35·5 ×2=) 71 grms.—require two molecules of the hyposulphite, which are contained in 20 litres (=20,000c.c.) of the standard solution; therefore

				grm. chlorine in 1 grm.
c. c. = $2Na_2S_2O_3$	c. c. used	Cl_2		of bleaching powder
20,000	: 85	= 71	:	·30175

or 30·175 per cent.—NIL SINE LABORE.

[11825.]—**Testing Bleaching Powder.**—Obtain an alkalimeter tube, graduated to 100 parts, from the operative chemist. Take 50 grains of the sample to be tested, pound up in a mortar with a little cold water, let it settle, and pour the clear liquid into the alkalimeter. Add more water to the bleach grouts, and proceed in the same manner again until the alkalimeter is full to the graduation No. 0. If the operation is properly conducted all the chlorine in the sample will then be in solution, and transferred to the graduated tube. Next take 78 grains of protosulphate of iron reduced to a fine powder, and dried between blotting-paper, and dissolve in about 2oz. of warm water acidulated with a drop of vitriol. Then add the chlorine solution to the iron solution, until a drop of the latter ceases to produce Prussian blue when brought in contact with a drop of a strong solution of red prussiate of potass. The most convenient plan is to drop the potass solution on a white porcelain plate with a glass stirrer before commencing, in (say) 20 places. If a delicate test is required, the chlorine water should be added to the iron, drop by drop, as you approach the supposed degree of strength, and a drop of the mixture tested after each addition of chlorine. When the potass solution ceases to produce Prussian blue on contact with the iron solution, read off the number of degrees of your chlorine solution used, and divide 2,000 by the number. Add 1 for loss, and you have the answer. Thus, *e. g.*, if you have used 66-hundredths of the solution in the alkalimeter (2000 ÷ 66) + 1 = 31¼, which is the strength of the sample or the percentage of chlorine it contains.—F. C. S.

[11826.]—**Tinning and Soldering.**—Is not "A., Liverpool," doing wrong in recommending resin as a flux for soldering tin, &c. I think muriatic acid is generally used. The acid, or chloride of zinc either, may be removed from the hands by washing them in clear water before applying the soap.—W. T. M. D.

[11826.]—**Tinning and Soldering.**—The chloride of zinc causes the solder to adhere to the iron. The resin or tallow merely acts as a flux for the solder, and leaves a bright and clean surface on it. It is possible to tin the surface of iron with the aid of resin alone, but is both troublesome and difficult.—H. RULE.

[11827.]—**Sight.**—Yours is a case of myopia, which may be corrected by the use of suitable spectacles. From what you say, I do not think any other remedy is needed. The "invisible spectacles" are those whose metallic frames are so fine as to be invisible at a short distance—at least, mine were sold me under that name. The number of focus of the glasses may be ascertained from an optician or oculist.—OLD CHEESEMAN.

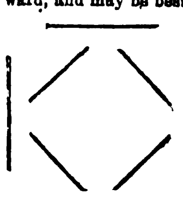
[11827.]—**Sight.**—I have in my eyes a disease called "conical cornea;" the right eye is worse than the left. It is the cornea or pupil of the eye grown too prominent or cone-shaped, causing my eyelashes to be in the way of vision. The right eye being more conical than the other, causes me to see things double. The shape of the cornea being so, it admits too much light. I wear concave spectacles, with brass plates blacked next to my eyes, the brass plates having vertical slots in them which limit the amount of light let into the eyes, but this improved the right eye but very little, the cornea in that eye being extreme conical. My right eye has been operated upon; it has had the point of the cornea taken off. As the eye is not yet recovered from the operation, I cannot tell you the result, but from present appearances I think it will be better. You ask if yours is a case of myopia, or weak sight. I should think, from what you state, it is the former, if it is not the same case as my own, as what you say about looking through a pin-hole resembles my looking through vertical slots. No doubt you find a person's face is confused unless nearly close to you, and the same with the letters across the street. Have you tried your eyes to see if they are both alike? as that is very likely the cause of your seeing things double, &c. By looking in a glass you may tell whether your eye or eyes are conical. If you live in or near London, I should advise you to go to some respectable optician, or to Guy's Hospital, and see Dr. Bader, who treated me. Should you like any further information, I shall be most happy to give you any, if you will send your private address through the MECHANIC.—T. BROWN, Shoreham, Kent.

[11831.]—**Thermometer.**—The division of the mercurial column in the stem of a thermometer is generally caused by the presence of a small quantity of air in the tube which has been insufficiently boiled before sealing off, and the thermometer having been shaken the mercury and air have become mixed. If "A. G's." instrument has a tolerably wide bore he may succeed in getting his column whole again by repeatedly knocking the bulb on a table, so as to jerk the air up to the top again; if, however, it is a fine tube he must immerse the bulb in a freezing mixture until all the mercury has contracted into it; on removing it vertically the air will ascend to the top of the tube, and his thermometer will be all right.—G. MATHUS WHIPPLE, Kew Observatory.

[11832.] — **Paper-hanging, Sizing, &c.** — Better let the walls get dry; after rub down with coarse glass-paper, on cork or small block of wood; use no umber, but well size the walls (dilute with hot water) when dry proceed to paper. Do not size the stone jambs, which is the cause of the paint chipping off. I should give two coats all turps paint. Regular mixing quantity. Extra boiled oil, which will give the required gloss.—W. K.

[11833.]—**Smoky Chimney.**—Try a galvanised sheet-iron pipe 2ft. higher than ridge.—W. T. M. D.

[11833.] — **Smoky Chimney.** — The smoke of "F. R.'s" chimney appears to be beaten down by a wave of wind passing over the higher roof ridge to the windward, and may be best guarded against by one of what used to be called Day's wind guards, the patent for which must have expired long ago. It consists of four sheets of iron set upright in a square, but not meeting at the corners, with four other sheets set also in a square, each opposite to a corner of the inner square, the opening at top being closed with an octagonal plate to stop any downward current. Whichever way the wind blows it is stopped from blowing into the chimney, while that which blows between the plates tends to rarefy the air in the chimney and help its draught.—PHILO.



[11834.]—**Springs.**—I have been a gun-lock filer all my life. If your steel is of a sharp nature do not heat it too hot; if of a soft nature, to a good heat. Cool it in water. Warm your spring over the fire just to dry the water, and then rub a candle over it. Put it over the fire, the strong part first, and the blaze will gradually run off. Allow it to cool of itself. You will find this all you will require.—HALIFAX.

[11835.]—**Arsenic in Wall Papers.**—Metallic zinc and dilute sulphuric acid are mixed in a bottle fitted with a glass tube drawn to a fine point at one end so as to form a jet, and fixed tightly into a bottle with a cork. Hydrogen will escape from the mixture, and after this has continued for a minute or so, the substance suspected to contain arsenic is to be added, and the cork and tube fitted tightly into the bottle. The gas is allowed to escape again for a minute or two and then lighted (it is necessary to allow the gas to escape, as, if there is any air mixed with it, an explosion would occur on lighting it), and a piece of white china held close over the flame, when, if arsenic is present, a bright black spot will condense on the china, like smoke. This is metallic arsenic. This test is based on the fact that nascent hydrogen in the presence of arsenic is converted into arseniuretted hydrogen, the burning of which consumes only the hydrogen, thereby setting the arsenic free. The ordinary commercial zinc and sulphuric acid both contain arsenic, so "G. C. C." had better procure them from some chemist.—F. GREENWAY.

[11835.] — **Arsenic in Wall Papers.** — The presence of arsenic in green wall paper can easily be detected by either of the following methods:—Take a test tube furnished with a cork, into which a glass tube is inserted. Scrape from the wall a little of the green powder, and place this with some clean granulated zinc in the test tube, add a solution of one part sulphuric acid to eight of water, when, if arsenic be present, arseniuretted hydrogen will be given off. On burning the gas arsenic is deposited in the metallic state upon a piece of cold porcelain held in the flame. Many compounds of arsenic heated on charcoal in the inner blowpipe flame give a garlic odour of arsenic.—E. B. H.

[11836.]—**Voicing Organ Pipes.**—It is impossible to give a clear explanation of voicing. It is the most intricate department of organ building. There are a few rules to be followed out, but the observance of these goes but a little way to producing fine quality of tone. To be a good voicer, one must have genius, coupled with experience. Zinc is the wrong metal for pipes; a fine quality of tone cannot be got out of pipes made of it, although some builders use this metal for large pipes, as it is cheaper than organ metal. If "Aleph" wishes to have a nice toned organ, he must have his pipes made of organ metal, block tin and lead. If "Aleph" can afford it, he should buy some metal pipes ready voiced from an organ builder. It would be better to have one good stop than three with a bad tone. If "Aleph" will publish his address I shall be pleased to send him more particulars.—PNEUMATIC LEVER.

[11839.]—**Plates Chemically Clean.**—In solar photography freedom from photographic defects in the negatives is a *sine qua non*, spotting by hand and touching up being, of course, out of the question. We have, therefore, had considerable experience in various plate cleaning processes, and I can speak as to the efficacy of potassic cyanide as a cleansing agent. We have always employed it as a solution made into a thin paste with Tripoli, and having well washed the plates after rubbing with it, have not found our bath deteriorated by its use. There is one drawback to this process—the time required for cleaning a plate is about eight to ten minutes, and so it would hardly do for quick work.—G. MATHUS WHIPPLE, Kew Observatory.

[11840]—**Whooping Cough, &c.**—This complaint is classed amongst the zymotic order of diseases by the Registrar-General, and, like its congeners, small-pox, typhoid fever, &c., must run its course, for there is no known successful method of cure adopted by medical practitioners. On this subject "T. C. H." may possibly with some advantage consult a few remarks in Vol. XIII., p. 413, letter 2259. The treatment there prescribed is based upon what are believed to be rational views; has never failed, within my experience, in zymotic complaints in general in preventing them, and has even cured a few cases of whooping cough; although this latter part is beyond my province as a sanitarian, and encroaches upon the duties of the physician.—W. R.

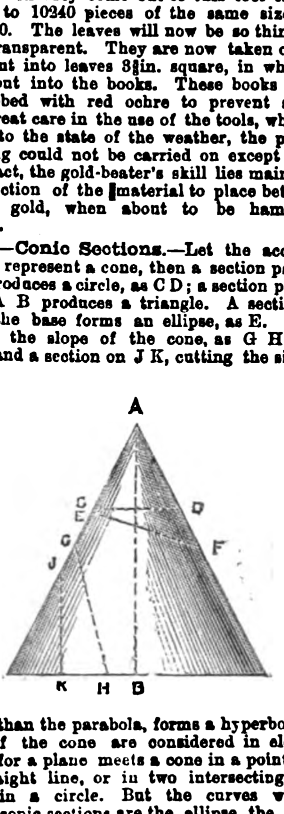
[11840.]—**Whooping Cough, &c.**—There is no ascertained specific that will cure whooping cough, and the medical profession is divided as to what causes it. Cochineal in one drop doses in water three times a day will give great relief. Proved.—WATTS.

[11840.]—**Whooping Cough, &c.**—If "T. C. H." lives in a town where there are some gas-works, and will take the person who is suffering from whooping cough into the purifying room connected with the gas-works during the time the men are employed taking out the lime, with which the gas has been purified, the person will derive an immense amount of benefit from doing so even for once. The time generally taken to effect a cure is about three times, though some have to go four times. In its pure state, the lime is slaked, and spread in layers about 2in. or 3in. thick on iron grates, and the gas allowed to force its passage through them for a certain time. When the covers of the purifiers are taken off, the lime is found to be caked; the impurities which are contained in the gas turn it to a green cast; it also gives off a very peculiar, and to those who are not used to it, a very sickening smell, which appears to have a very beneficial effect upon those who are suffering from whooping cough. At the first it irritates the patients very much, but after a time it seems to soothe them instead. If a child, its head must be held over the lime, so as to inhale some of the gas, as long as it can bear it. If "T. C. H." takes something with him to hold some lime, he can take some home for the patient to smell at occasionally during the day; he will find it will repay all his trouble.—THORP.

[11846.]—**Gold Beating.**—The gold is prepared by melting in a plumbago crucible, and then cast into ingots, forged, and passed between rollers until it assumes the shape of a long ribbon, and as thin as ordinary writing paper; each of these ribbons is cut into a number of small pieces, and forged upon the anvil. These small square pieces weigh about six grains and three-tenths each, and are about the 760th part of an inch thick; they are next annealed, and interleaved with vellum about 4in. square; about twenty vellum leaves are placed on the outside; the whole is then placed in a case of parchment, over which is drawn another similar case, so as to keep the packet tight and close on all sides. It is next laid on a smooth block of marble or metal, and the workman begins beating with a round-faced hammer weighing 16lb.; the packet is turned over occasionally, and the beating continued until the gold is extended to nearly the size of the vellum leaves. The packet is then taken to pieces, and each piece of gold is divided into four, with a steel knife having a smooth but not very acute edge. These pieces are next interlaid with pieces of animal membrane, from the intestines of the ox, of the same dimensions and in the same manner as the vellum. The beating is continued, but with a hammer weighing only 12lb., till the gold is brought to the dimensions of the interleaved membrane. It is now again divided into four, by means of a piece of cane brought to a fine edge, the leaves being by this time so thin that any accidental moisture condensing on an iron blade would cause them to adhere to it. The leaves are next divided into three equal portions, and interleaved with membrane as before, and beaten with the finishing hammer, weighing only 10lb. The packets are now taken to pieces with the aid of a cane instrument and the breath, are laid flat on a leather cushion, and cut into squares one by one, by a small square frame of cane made the exact size; and are lastly laid in books of twenty-five leaves each, the paper of which is first smoothed and rubbed with red chalk to prevent the leaves adhering. By the weight and measure of the best leaf gold it is found that one grain can be made to cover 56¾ square inches, and from the specific gravity of the metal, together with this admeasurement, it follows that the leaf itself is 282,000th part of an inch thick. This, however, is not the extensibility of the metal, for by computing the surface covered in silver gilt wire, and the quality of gold used, it is found to be only one-twelfth that of gold leaf, or 3,384,000th part of an inch in thickness; nevertheless, it is so perfect as to exhibit no cracks when viewed under the microscope. See Luke Hebert's "Mechanical Encyclopædia."—W. H. HEY.

[11846.]—**Gold Beating.**—The gold-beater first obtains a quantity of gold from the refiners, then mixes it with the requisite quantity of alloy; too much alloy will, however, completely spoil the colour. He then proceeds to melt it up in a small crucible by subjecting it to a very intense heat. When melted it is poured into a mould, and produces an ingot of 1½in. by ¾in. broad by ¾in. long. It is now rolled through rollers, gradually decreasing in size until it is a ribbon of more than six yards long, and three quarters of a yard wide. Next it is placed in the annealing furnace, and heated to a low red heat to soften it. It is then cut into 1½in. squares, weighing between six and seven grains. Each square is now placed between sheets of vellum, and the whole put into a sort of leather bag. They are not handled by the hands, but with tongs tipped with ivory. This bag is next beaten with a hammer weighing about 16lb. It is hammered until the little gold-leaves of 1½in. square become 4in. square. These leaves are again cut up. At this stage of the process the gold is what is called dentist's gold. The 640 pieces into which the 160 had been beaten are now in another bag placed between leaves of gold-beater's skin, and again beaten. When they come out of this tool the leaves are equal to 10240 pieces of the same size as the original 160. The leaves will now be so thin as to be perfectly transparent. They are now taken out of the tool and cut into leaves 3⅝in. square, in which state they are put into the books. These books have the leaves rubbed with red ochre to prevent adhesion. Without great care in the use of the tools, which vary according to the state of the weather, the process of gold-beating could not be carried on except at great loss. In fact, the gold-beater's skill lies mainly in the proper selection of the material to place between the sheets of gold, when about to be hammered.—P. W. H. J.

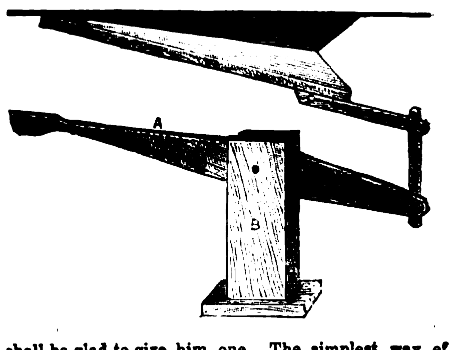
[11848.]—**Conic Sections.**—Let the accompanying figure represent a cone, then a section parallel to the base produces a circle, as C D; a section parallel to the axis A B produces a triangle. A section at an angle to the base forms an ellipse, as E. A section parallel to the slope of the cone, as G H, forms a parabola, and a section on J K, cutting the side at an



angle less than the parabola, forms a hyperbola. Some sections of the cone are considered in elementary geometry, for a plane meets a cone in a point, or in a single straight line, or in two intersecting straight lines, or in a circle. But the curves which are peculiarly conic sections are the ellipse, the parabola, and the hyperbola.—P. W. H. J.

[11850.]—**Pitches of Screws.**—The pitch of a screw should be about its diameter; 28ft. is a very coarse pitch for an 18ft. screw; however, the practical results obtained from fine-pitched screws running at a high velocity as compared with rather coarsely-pitched screws running at a lower velocity have not been very different. I think 20ft. quite too much for a 10ft. screw; where two small screws are used instead of a large one their combined area should not be so great, as they work at a greater depth in the water, and the water in escaping in the line of least resistance to the surface has a greater weight of superincumbent water to disturb. Bourne thinks well of twin-screws (his work on the screw-propeller is rather expensive—3 guineas, but if a reading of it can be obtained it gives a great deal of information). You do not say how much water the first ship draws. I think 10ft. too shallow a draught for the second. The resistance of well-built vessels, according to Bourne, depends mainly on fluid friction, principally the rubbing of the bottom against the water, and vessels of very shallow draught for their tonnage having so large a surface do not do well; also, if your first vessel has 18ft. draught of water, and (say) 9ft. over the screw shaft, your second would have only 5ft. of water over the shafts, and the water would be more likely to be churned. I am not a practical shipbuilder, however, but I should not recommend the plan. I give my opinion for what it is worth.—PHILANTHROPIST.

[11853.] — **Pedal Harmonium.** — What does "G. J. C." mean by putting reeds on to pipes? Is he thinking of the free reeds with tubes used in some organs? If so, the tubes are quite unnecessary in a harmonium. The ordinary harmonium reed of 16ft. pitch will do very well for a pedal stop. If "G. J. C." wants a plan of the pedals, action, and soundboard, I



shall be glad to give him one. The simplest way of applying a foot blower to the feeder is as under. This action should be made of hard wood for strength. The lever marked A must be placed to come to the proper position for the foot. It must also be centred so as to get the desired length of stroke. The fulcrum marked B should be screwed down to the floor, or be fixed firmly to the case.—PNEUMATIC LEVER.

[11856.]—**Military Examination.**—Both pure and applied mathematics are required, but the paper is not a very stiff one, except for the Royal Engineers and Artillery. In modern languages either French or German; I believe it is not imperative to pass in both, but certainly in one of them. It is necessary to serve as a sub-lieutenant for at least twelve months with one of the Queen's regiments, and then to pass a military examination, before being eligible for a subaltern's commission.—ARTILLERY CAPTAIN.

[11860].—**Magnetic Machine.**—I really cannot take on myself the construction or device of such an apparatus. For generation of oxygen on a large scale, the manganite of soda process would probably be much cheaper, and for a small scale even the chlorate of potass. A magnetic machine for the purpose would require steam power to drive, and be costly.—SIGMA.

[11875.]—**Spectrum Colours.**—There are no pure pigments. It is impossible to obtain a pure white by the use of the colour top.—H. P. H.

[11898.]—**Tempering Cast Steel Chisels.**—Bring them down to a blue, then immerse in cold water.—W. T. M. D.

[11898.]—**Tempering Cast Steel Chisels.**—A word of advice as respects making tools out of files. Unless all the teeth marks be well ground off before hammering the file, any chisel made will be worthless as when the teeth are hammered in they form cracks. Once more, as to tempering, do not heat during any part of the manipulation above blood red. Dip in water with the chill off, brighten on stone, and dip again when blue appears.—A., Liverpool.

[11900.]—**Electro Plating.**—One or two Smee cells will suit best, and all further apparatus would be a jar or two of the required sizes. I think Watts' "Electro-Metallurgy," published in Weale's series, about the best small manual. I hope shortly to be able to commence my own papers on the subject.—SIGMA.

[11918.]—**Fumes from Gasworks.**—These are mainly impure gas itself escaping and let off in opening purifiers, retorts, &c., also from the oxide of iron purifying material. They contain, therefore, excess of sulphur compounds, and also many hydrocarbons, much of which will be washed out in rainy weather while traversing a quarter of a mile of air. It would be a puzzler to give names to all the ingredients of these "perfumes," but it is the sulphur and ammonia compounds which give them their principal pungency.—SIGMA.

[11919.]—**Trigonometrical.**—The following is the solution "Thetamu" requires:—

$$\text{Sec. } 2A = \frac{1}{\cos. 2A} = \frac{\cos.^2 A + \sin.^2 A}{\cos.^2 A - \sin.^2 A},$$

$$= \frac{1 + \tan^2 A}{1 - \tan.^2 A},$$

$$= \frac{2 \tan. A + 1 - 2 \tan. A + \tan.^2 A}{1 - \tan.^2 A},$$

$$= \frac{2 \tan. A}{1 - \tan.^2 A} + \frac{(1 - \tan. A)^2}{1 - \tan.^2 A},$$

$$= \frac{2 \tan. A}{1 - \tan.^2 A} + \frac{1 - \tan. A}{1 + \tan. A},$$

$$= \tan. 2A + \tan. (45^\circ - A).$$

For A substitute $\frac{A}{2}$. Then sec. A = tan. A + tan. $\frac{90 - A}{2}$. *Q. E. D.*—F. B.

[11919.]—**Trigonometrical.**—Required to prove that sec. A = tan. A + tan. $\frac{90^\circ - A}{2}$.

$$\text{2nd side} = \frac{\sin. A}{\cos. A} + \frac{1 - \tan. \frac{A}{2}}{1 + \sin. \frac{A}{2}},$$

$$= \frac{\sin. A}{\cos. A} + \frac{\cos. \frac{A}{2} - \sin. \frac{A}{2}}{\cos. \frac{A}{2} + \sin. \frac{A}{2}},$$

$$= \frac{\sin. A}{\cos. A} + \frac{\cos.^2 \frac{A}{2} + \sin.^2 \frac{A}{2} - 2 \sin. \frac{A}{2}. \cos. \frac{A}{2}}{\cos.^2 \frac{A}{2} - \sin.^2 \frac{A}{2}},$$

$$= \frac{\sin. A}{\cos. A} + \frac{1 - \sin. A}{\cos. A},$$

$$= \frac{1}{\cos. A} = \text{sec. } A. \quad \textit{Q. E. D.}\text{—R. G. G.}$$

[11919.]—**Trigonometrical.**—W. R. B., W. Busk, Coriolanus, W. P. Wedgewood, and J. H. T. have also answered this query.

[11920.]—**To "Jack of All Trades."**—I apologise for answering this question, but have a fellow-feeling with our suffering friend, and sincerely hope he will get better. It is a case of over-taxed brain, and nothing but time will cure it, and a proper attention to the state of the blood. Plenty of cold water applied to the head, and rubbing with coarse towels. Drink a glass of cold water the first thing on rising; it is often better than an aperient taken the night before. Always walk four miles a day in pleasant places, or in pleasant company. Either find some new thing to occupy the mind, or rout up some old game of youthful experience, such as draughts, &c., with a chatty friend; in short try and be young again, and let the troubles alone, it's the best way, for they are very wilful, and don't care a button for us. Please return their compliment; get out of the doctor's hands as soon as possible. Never give way to extremes, and you will gradually get better. I had four years of it, and found the spring and autumn the worst times.—FIDDLER.

[11928.]—**Microscope.**—The later volumes of the ENGLISH MECHANIC contain several articles on the choice and use of the microscope, but as "A Canadian Subscriber" may not be able to procure these volumes except at great cost, I may, perhaps, be allowed to repeat in brief what I have elsewhere said at considerable length. The essentials of a microscope in its mechanical arrangements are steadiness, freedom from complexity, perfection of workmanship, and consequent smoothness of action of the moving portions. The optical requirements are clearness of definition, and freedom from colour. The powers will vary from 10 or 20 diameters up to 10,000 diameters with the objective used. The 2in., 1in., ½in., ¼in., and ⅛in., form a very good working series with oculars A B D. The price will vary from £5 5s. to £40. With the objectives named, a good monocular stand and various accessories should be obtained for the latter sum. The price of a really good and useful monocular stand only would be £10 or £12; the stage having concentric rotation, but not mechanical arrangements for moving the object. I should not myself advise the purchase of a larger stand than this, which, with a series of good working objectives (first-class quality), polariscope, &c., would cost from £20 to £25, and serve the purchaser for the rest of his life. What is known as the Jackson Lister stand is the best. It is not an easy task to give maker's names; to give all would occupy too much space; to give a few is invidious. Every worker has his own fancy and leaning towards a particular class of instrument, and is favourably disposed towards the optician from whom he has purchased it, or from whom he has received assistance in carrying out his crotchets. Messrs. Beck, Powell and Lealand, Ross, are of world-wide fame; Messrs. Swift, Crouch, Wheeler, Ladd, are well-known firms; but these by no means represent the quarter of our good and trustworthy opticians. My old, but very ugly, friend, Beck's "Universal," is the one I have chiefly used. My "first-class" one is by J. E. Winspear, of Hull, an optician whom it is my pleasurable duty to mention, on account of his great courtesy and assistance in various optical matters. "Canada" might safely trust himself to Mr. Winspear, or any other of our leading opticians. Prices and descriptions of particular instruments could only appear as an advertisement.—H. P. H.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last J. Roskell has answered 10185, 10344; W. H. Hey, 11349; "T. W. M. J.," 11355, 11420; "H. B. E.," 11395, 11397; "H. P. H.," 11458.

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QUERIES.

[11930.]—**Shape of Pitch Polisher, Figure of Speculum, &c.**—Will Mr. Purkiss kindly say if, when the pitch polisher is used for spherical polishing, he uses it with the marginal facets circular, or does he cut off the circular portion in order that each facet may be square? Likewise, in grinding, does he allow the glass disc slightly to exceed the size of the iron tool? I ask these questions because I experience some difficulty in figuring the marginal inch of my mirrors, consequently, I have re-read his instructions in Vol. X., and find that he there recommends, first, to prepare the glass disc, then the wooden model of the iron tool, and this model is to be exactly the same size as the glass disc. Now, an iron disc cast from this model, would be, when cold, somewhat smaller than the model. What I wish to know is, does Mr. Purkiss use it so? Again, will Mr. Purkiss, "F. R. A. S.," or any other of "our" readers well versed in such matters as the following, say what figure must a mirror be that shows an artificial star with a round disc, surrounded with two or three rings in their proper order, and then outside of this again, with a ring consisting of something like a score of wings of light? Is it marginal flatness?—OPTICAL BRICKLAYER.

[11931.]—**Hydraulic Indicator.**—Will some correspondent give me information respecting this instrument, how attached to a press, and what the action?—SEPOR (St. Petersburg).

[11932.]—**Organ Bellows.**—I have a small organ of seven stops, with two manuals and pedal. Each of the manuals has a separate bellows and reservoir, the two parts of the organ having been got at different times. Will some of our organ building friends tell me if it would be advisable to join the two reservoirs by a wind trunk, and so do away with one of the blowing handles? One bellows is considerably larger than the other, and would, I think, easily supply both reservoirs.—W. M. S.

[11933.]—**Botanical Query.**—Will any one tell me of a book by which I could study botany in the Bengal Presidency?—LINDSAY.

[11934.]—**Case for Violoncello.**—Will some kind reader give me some wrinkles for making a case for a violoncello—one strong for travelling, and to contain, besides the instrument, all that a player would want, at a distance from home? I know how nicely and completely violin cases are made now, but those for violoncellos are different. I do not know how to make or arrange the pockets, and to make the most of the space. Give some hints as to this, the thickness of the wood, the best material for lining, how padded, the proper place for bows, and such other information as will be useful. If a woodcut of the interior could be furnished it would be of much value. A paper by a competent hand, on cases for musical instruments, wind and string, now that amateur musicians are so numerous, would be of service to many.—R. E.

[11935.]—**Lacquer for Brasswork of Electrical Machines.**—With all the letters on electricity, and on the manufacture of plate and other machines, I do not think there is any mention of a lacquer or varnish for the brasswork, such as conductors. I have been making one, a large plate machine, but after finishing up the brasswork it soon gets dull and unsightly. Would it be as good a conductor if covered with a thin coat of lacquer?—G. H.

[11936.]—**Bachhoffner's Lamp.**—Can any of our numerous correspondents give particulars respecting Bachhoffner's "Domestic Safety Paraffin Lamp," its peculiarities and construction?—ULTRAMARINE.

[11937.]—**Filtering Water.**—Having the water supply of a mansion derived from the surface drainage from a clay soil it is much coloured. Can I by any filtering process discharge or precipitate the yellow colouring matter? The water comes from pond in earthenware pipe to cemented tank 10ft. square; thence by 1in. lead pipe to house, where a small charcoal filter in connection with cistern has hardly produced any effect on colour.—JANNIFRED.

[11938.]—**Carpenter's Bench and Tool Chest.**—Will some reader tell me what are the proper adjuncts and fittings of a carpenter's bench? Also the best way of fitting up a carpenter's or cabinet-maker's chest, so as to contain all the tools required for general work and so as to economise space as much as possible? I believe these questions were asked two or three years ago, but no replies were forthcoming.—R. E.

[11939.]—**Pantograph.—Wood Engraving.**—Will any reader be good enough to tell me how to make a pantograph for copying and reducing drawings? Also what books are best and most useful to learn drawing as applied to wood engraving? Any hints upon wood engraving, both as a pastime and profession, would oblige—ZOO ANDRA.

[11940.]—**Waterglass as a Preservative of Natural History Subjects.**—Will some one kindly tell me if waterglass can be used as a preservative for natural history subjects, and if they have tried it? I saw an account in the *Art Journal* two years ago, I think, of a method of applying the waterglass in a spray to moths and butterflies. Would there not be great waste of the glass by this means? Also, where can I get the waterglass, as I know nothing whatever about it? An answer will greatly oblige—G. W. C. H.

[11941.]—**Chemical Experiments.**—Would any of your chemical students who have successfully performed the following experiments, give me the necessary details including weights of materials employed. (1) Preparation of hydrogen by the action of zinc on caustic potash. (2) Preparation of ozone by acting on potassic permanganate by strong sulphuric acid. (3) Preparation of a solution of ammonic molybdate (for testing the presence of phosphoric acid). I have tried various methods proposed by various authors, but have been unsuccessful.—NIL DESPERANDUM.

[11942.]—**Steam Velocipede.**—Having a wish to construct a steam velocipede to carry two persons, would "Jack of All Trades" or some kind subscriber give me the following information?—The length of stroke and diameter of a pair of oscillating cylinders, with size of boiler; also the simplest mode of admitting and exhausting the steam, whether three or four wheels is best, and, if on three wheels, can it be steered with the third wheel behind? A sketch would greatly oblige—A SUBSCRIBER.

[11943.]—**Worms for Fishing.**—I remember that once there was given in the ENGLISH MECHANIC a way to prepare worms for baiting, but I cannot find it, in spite of hours of careful searching. Would any kind reader repeat it, or tell me where to find it?—BARBAROS.

[11944.]—**Fishing Rod.**—Would some one kindly tell me how to make a fishing-rod that can be turned into a walking-stick, what material to be used, and how to manage the joints? Length about 10ft. to 12ft.—BARBAROS.

[11945.]—**Leaky Tap.**—Is there any method of stopping a large brass water tap from leaking, beside grinding? This process has been tried twice, and cured for a while, but the too frequent repetition of it will lower the plug until it becomes useless. What is the best stuff to use for grinding taps?—W. T. M. D.

[11946.]—**Imitation Bronze.**—Will any of "our" readers inform me how to make an imitation bronze, the same as used by gas-fitting manufacturers? I have heard they coat the brasswork with corrosive sublimate dissolved in hydrochloric acid. If this is the case, is it put on with a brush, or how?—A. R. F.

[11947.]—**Power of Water Wheel.**—Required, the horse-power of an overshot water-wheel, 3ft. 6in. in diameter, and 6ft. wide. The weir to be close to the buckets, and its stream to be 1in. deep and 6ft. wide. Also, what must be the diameter of two pipes to supply the weir with that quantity of water?—N. K. R.

[11948.]—**A Bad Sleeper.**—After sleeping two or three hours at night I am woke up by an excessively dry mouth and tongue, and an exceedingly bitter taste. I eat but very light suppers. Age 56. Can any one tell me of a remedy?—N. K. R.

[11949.]—**Doctors' Commons.**—Will any subscriber kindly inform me the cheapest and best plan of obtaining a copy of my father's aunt's will without the expense of a journey from Scotland to London, or can any other than legal gentlemen obtain a copy by a visit to Doctors' Commons? Any advice on this subject will greatly oblige—AUSPICIOUS.

[11950.]—**Sewing Machine Difficulty.**—A few days ago I took to pieces a "Defiance" sewing-machine by Judkins, and, unfortunately, failed to notice the relative position of the shuttle to the needle-bar. Will "Jack of All Trades," or any one able, kindly tell me where the shuttle should be when the eye of the needle is on a level with the cloth plate? Needle bar and shuttle are actuated by separate spindles, and each spindle has a small toothed wheel at one end, both being worked by a larger wheel placed between them. It is the removal of this large wheel that has occasioned my difficulty.—LOVATT.

[11951.] — **Photography.** — Will some practical photographer kindly inform an amateur as to the best and most efficient way of washing prints, say a dozen or more at a time, size 6½in. × 4¼in.? I have no water laid on in the house, but have a pump handy. State length of time necessary to complete the operation.—CAMERA.

[11952.]—**Nettle and Ivy Leaves.**—Can any of "our" chemical contributors of the ENGLISH MECHANIC inform me what are the chemical and medicinal properties of the common nettle—also of ivy leaves—and what percentage of tannin and potash they contain?—INQUIRER.

[11953.]—**Chemistry.**—Among your correspondents are many able chemists, and among your readers there must be many who, like myself, acquired a few years ago, a more or less fair acquaintance with chemistry and the old system of notation. Will any one of the former do us the favour to give a short explanation of the changes that have taken place, so that in reading a chemical paper, all our previous knowledge may not be lost? At present I find it very difficult to recognise even old familiar friends.—PATERFAMILIAS.

[11954.]—**Harmonium Stops.**—I am a new subscriber to your magazine, and beg to put myself among the list of inquirers. I have a small harmonium without any stops, and only one row of vibrators, and knowing that the expression stop in larger harmoniums is merely a mechanical affair, I would like, if any of your numerous readers could inform me, how to apply it to my small instrument, or any means whereby I can make some variation in the tone, louder or softer at will, or if such a thing has been explained in any former number, please state which. Also if tremolo stop could be attached to such an instrument.—B SHARP.

[11955.]—**Traverse Gear for Engines.**—Would any kind reader of the MECHANIC be kind enough to give me an idea of the newest and most improved style of traverse gear for beetling engines?—AN INQUIRER.

[11956.]—**Pill Making for the Million.**—Will any of your talented readers suggest a way by which pills could be made in large quantities, the usual methods being anything but satisfactory, considering the high price of the machines? The confectioners, I understand, are able to produce small globular sweets, in form resembling pills, in considerable quantities; therefore, I think a modification of their process might be what I require. Perhaps some of your readers can assist me. —ACETUM.

[11957.]—**Straightening Band Saws.**—Can any of "our" practical friends inform me of a good method of straightening band saws? In my business, using as many as thirty saws in a week, or at least having them in use, I find sometimes several twisted, and, therefore, useless, unless broken and rebrazed, or sometimes hammered. Regarding the setting of band saws, would the following be a practical system of setting saws? First using an ordinary saw set, and afterwards drawing a piece of steel, with a groove cut the width of the set required, drawing the same completely round the saw. The usual mode of setting saws with the hammer oftentimes cracks the saw, thereby causing a breakage.—SAMUEL SMITHER.

[11958.]—**Level of Railway Curve.**—A locomotive engine weighing 10 tons, passes round a curve 560 yards radius, at the rate of 40 miles per hour. What should be the difference of level between the inner and outer rail to prevent accident? Space between rails, 4ft. 9in.—PUPIL.

[11959.]—**Vandyke Brown.**—Of what is this pigment made, and what is the method of preparation?—RECIPROCITY.

[11960.]—**A Brewer's Query.**—Will some of your chemical friends kindly answer me the following question? I am a maltster and brewer, and have my brewing copper very clean and bright. I find that in boiling with some hops it turns the copper very black at the top, and with other hops it does not. I should like to know the reason why?—BREWER.

[11961.]—**The Leclanche Cell.**—I wish to ask a question with regard to this much talked of cell. I have had them in use for ringing bells, &c., for many months, and like them better than any other form of cell I have tried for this purpose; when, however, there has been a continuous use of the current for (say) two months, I often find the zincs and porous pots covered with an almost insoluble white substance, and shall be greatly obliged if "Sigma," or some other brother reader who has had considerable experience, will kindly enlighten me and others as to the cause of this phenomenon, and the nature of the incrusting substance. According to my experience, the Lelanché cell is the least subject to local action or waste of material during the incompletion of the circuit of any other form. Will "Sigma" say if he knows of any other equal to the Leclanché in this important respect, also whether the zincs are amalgamated or not?—HERCULES.

[11962.]—**Telegraphy in the United States.**—Will you, or one of your numerous correspondents, favour me with the names of the principal telegraph companies of the United States, and their respective head-quarters? Information as to their relative commercial success will also be esteemed.—MANIPULATOR.

[11963.]—**Brass Springs.**—I am constructing a commutator for a telegraph, in which I require brass springs; I find the brass bends without springing back, how am I to get over this difficulty? Can the brass be tempered like steel?—GLATTON.

[11964.]—**To Prevent Paper Sticking to Silk after being Printed with Metal Leaf.**—Would some kind reader tell me what will prevent paper from sticking to silk after being printed or stamped with metal leaf? In printing or stamping silk for felt hats, we are obliged to put pieces of paper under every one, and the silk being so fine, the mixture of powdered resin and shellac runs through and makes the paper stick fast to the silk, and causes the work to look very bad; and if we use stiff paper, when we pull it off it breaks the stamp. We have rubbed the paper with French chalk, but without any effect. The mixture would not do to be made any weaker. The above is done with a hot brass block.—J. B. SHARPLEY.

[11965.]—**To Blacken Brass.**—Could any of your correspondents tell me how to blacken brass like the tubes of French opera-glasses?—INVICTUS.

[11966.]—**Dandelion Roots.**—Will some of "our" friends kindly inform me when the dandelion root has its best properties, and the proper time to get them up, so has to make wine of them? also, which has the advantage in its virtues, the flower or root?—LEICESTER.

[11967.]—**Emigration to San Francisco.**—If any brother reader can answer the following I should be most grateful. (1) Can a mechanic do better as regards saving money at San Francisco than he can in England? (2) I am aware that the wages are high, but I suppose the necessaries of life are so too. (3) Would it be advisable to take a good stock of clothing? (4) What is its distance from New York by rail, and how long does it take to travel it? (5) How do passengers manage, as regards provisions, &c.? (6) Where can I obtain a map and book giving information of towns, population, &c., of California? (7) Is San Francisco considered healthy? (8) Is there any other town preferable to it in the above State? (9) I noticed in a steamship company's circular this item: "Dogs not taken on any terms." Is this the case with all companies? (10) What is the rate of income-tax in the United States?—LIBRA.

[11968.]—**Dog with Weak Sight.**—I have a young dog near-sighted; I am afraid he will turn blind. Can any one tell me a remedy?—LIBRA.

[11969.]—**Cochineal.**—Can the cochineal be reared in this country?—WM. HAMILTON HEY.

[11970.]—**Water Regulator.**—Will some one give me a hint about making the above? My coil is too strong at present for taking shocks, giving 0·2 of an inch spark in air. How long should the glass tube be to give a moderate shock? Any information will oblige—GLATTON.

[11971.]—**Calcined Ironstone.**—Will any of "our" kind readers give a description of the calcining of ironstone in kilns, and if it is more profitable to calcine in kilns than in the open air?—LOVE.

[11972.]—**Hot Soldering Iron.**—I want a small soldering iron for soldering small articles about the size of match-boxes; I have no gas. Can I keep it hot by using benzoline oil in any way?—A COUNTRY TINKER.

[11973.]—**Magnetic Engine.**—Will any one give me information (with sketch) for making a simple electro-magnetic machine?—GLATTON.

[11974.]—**Arsenic in Sulphuric Acid.**—Will some of our readers inform me in what form arsenic exists in sulphuric acid made from pyrites, and what per cent.? Is it not as an arseniate?—IN DIFFICULTY.

[11975.]—**Silver Plating.**—I saw the other day a large plaster cast covered with a fine silver surface, which I was told was laid on with a brush, as the article was too large to operate on in a bath with safety. No doubt "Jack of All Trades" or some other of "our" contributors will be able to describe the process for me, and confer a favour upon—UN IRLANDAIS.

[11976.]—**Curve of Tensions.**—It is well known that if the base of a right-angled triangle be taken to represent the resistance of a telegraph line through which a current is passing, the altitude to represent the tension of the battery end of the wire, then the hypothenuse will represent the tensions at the different points of the wire—that is, supposing the insulation resistance to be infinite. Now, it is evident that when the insulation resistance is small, then the line of tensions will no longer be a straight line, but will dip. I want to know the exact nature of this curve, supposing the insulation resistance to be perfectly the same throughout the whole length of the line. Perhaps some of your talented electrical contributors can enlighten me.—O.

[11977.]—**Whistles.**—I have turned several ivory and other whistles, but find those of smaller bore are often louder and a better note than larger. What is the proper proportion of depth to size of bore, and what should be the relative sizes of the blow-hole and the escape-hole in proportion to the depth and diameter of the bore? There must be some rule. Is there any limit to size and power of a common whistle beyond that of the strength of a man's lungs?—JANNIFRED.

[11978.]—**Dyeing Mohair Dress.**—Will some one more learned than myself inform me if I can dye a mohair dress brown colour, the present colour being blue, with black stripes?—BLACKING.

[11979.]—**Tinning Iron.**—Can any reader tell me the process by which iron is tinned by dipping in a solution of tin in acid? I can tin iron in the usual way by preparing the iron by immersing in dilute sulphuric acid and dipping in molten tin, but if the other could be accomplished without heat it would answer much better. As it is for manufacturing purposes, none but a practical recipe would answer—such, plainly put, would be of great help to one who has often helped other readers. —H. RULE.

[11980.]—**Coal in Worcestershire.**—A relative of mine, owning a large estate in Worcestershire, knowing that coal is found in the county, wishes to know whether it is likely that coal exists on his estate, and as I have been much interested lately in an article on "Coal-Measures and Coal-Supply" in your paper, I venture to ask for further information on the subject, especially as to what strata usually overlie coal-measures, and whether the presence of coal on the estate could be ascertained by boring without much expense. The soil on part of the estate is very red in colour, but it varies considerably. The estate lies about four miles west of the city of Worcester.—AN OLD SUBSCRIBER.

[11981.]—**Science Examination.**—Will some of "our" science teachers tell me when will the result of the chemistry examination be known? How long is it, generally, after the examination takes place?—J. R.

[11982.]—**Thrush.**—Can any one tell me the proper food for a tame thrush, also the way to rear young ones?—A. C. L.

[11983.]—**To Gloss Ribbon.**—Will some one kindly inform me how to gloss and stiffen old silk ribbon that has been re-dyed when being ironed, in the same way which ribbon dyers do it?—GLARE.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

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ANSWERS TO CORRESPONDENTS.

, ***All communications should be addressed to the*** EDITOR ***of the*** ENGLISH MECHANIC, ***31, Tavistock-street, Covent Garden, W.C.***

The following are the initials, &c., of letters to hand up to Tuesday morning, May 21, and unacknowledged elsewhere:—

J. and A. Pumphrey.—W. J. Nash.—Henry Canning.—J. Belam.—Alex. Ross.—Elridge Fedd.—John Colby.—R. C. Munson.—Rev. B. Foster.—F. A. Paget.—J. Birmingham.—J. Bailey and Co.—E. A. Pittis.—Joseph Wiggins.—R. A. Proctor.—Barnes Richards.—Sigma.—T. Taylor.—B. Thompson.—P. J. Smith and Sons.—Silex.—C. A. S.—T. A.—F. N.—M. Pope.—W. A. N.—J. C.—Khoda Bux.—Shafto Douglas.—F. T.—Colney Hatch.—H. W. R.—Rook.—Beasley.—Erin.—Joseph Roskell.—A Sympathiser.—S. Bottone.—Rev. E. L. Berthon.—Amateur.—H. S.—T. Stockwell.—Kelby.—F. Gresham Young.—E. K. Thomas.—James Welsh.—A Beginner.—J. W. Rickford.—W. A. Ball.—F. T.—J. R.—J. Cohen.—J. M. Taylor.—Dædalus.—W. Webbank.—Bed of Stone.—Robert Hutton.—W. C. M.—R. J.—S. J.—J. Birmingham.—X. Y.—Lector.—M. O.—Theodolite.—E. J. D.—One in a Fix.—R. P. S.—C. B.—A Pattern Maker.—Surnn.—W. R. B.—C. G. P.—Robert.—Gerard Smith.—The Rolling Stone.—T. O. H.—F. J. Godden.—A Novice.—Ixion.—T. L. Watson.—J. and A. Williamson.—Eclecticus.—Inquirer.—C. Stacey Watson.—C. T.—P. Santalinus.—T. T. Greg.—Jannifred.—Jos. Barwick.—C. H. C.—H. C. Key.—C. H.—Bobo.—M. N.—T. J. Preston.—Pi.—Waterwheel.—C. S.—H. M. S.—Carl Pfeiffer—John Kingham, Jun.—W. Hargraves.—C. H. W. Biggs.—C. Lindley.—T. Thomas.—Aleph.—Nil Desperandum.—G. A.—George Stunt.—E. MacCarthy.—Jack of All Trades.—Baffled.—A. Z.—Schoolboy.—Artilleryman.—J. K. W.—Philanthropist.—A Dead Shot.—A Subscriber.—Geo. Beal.—G. E. N.—Inquiring Mind.—Leon Jourd'hui.—E. C.—Woodman.—Elijah E. Dunn.—J. M. Rodwell.—A.W.D.—S. H. Cash.—Zeta.—J. K. P.—John Hopkins.—A. K. L.—C. Glasgow.—Cobbler.—Artillery Captain.—Ignoramus.—A Glasgow Highlander.—J. C. J.—R. B.—Pulse.—E. W. D.—Geo. Fox.—J. B. Gill.—Waverley.—J. P. R.—A Paper Maker.—Saul Rymea.—Civil Engineer.—The Harmonious Blacksmith.—J. B. Smith.—A Gunsmith.

SNATCHBLOCK says "It will be a great boon to myself and others to see the ENGLISH MECHANIC printed in larger type."

INQUIRER.—First query inserted. A Cornish bushel is 8 gallons.

J. J. ALLINGHAM.—Please send us the results of your experiments. We can get bushels of illustrated patented inventions at the Patent Office, but, alas! how few of them are worth anything.

LINUM.—Your letter on the "Creation of Man," and Adam's duties and behaviour in the Garden of Eden, would take us a little beyond our depth as indicated in our pages.

Communications which can only appear as advertisements to hand from J. J. P., Charlie Brown, Speculator.

T. BORNY.—Consult indices for information on gilding.

R. BROWN.—What do you mean by colouring eggs in the sun?

J. B., G. F. B., R. B., H. A. K., H. J. H., A. C. L., Hard as Stone, Ashtonian, Economy, W. B. N., J. Renworthy, G. R. S., are referred to indices to back vols.

A YOUNG WOULD-BE BEGINNER.—You can easily get the information you want by writing the publishers.

AN OLD SUBSCRIBER.—The scanty particulars afforded render it impossible to tell whom your picture represents. Consult a dealer. We doubt its being by Sir Joshua Reynolds.

W. H.—Use a little violet powder.

A SUFFERER.—Consult a physician.

ONE IN A FIX.—You must have looked through your indices and prayed that you might not find it. See p. 546, Vol. XIL, for soldering without fire or cold brazing.

PNEUMATIC LEVER must leave the question of space to our discretion.

J. MORRAY.—You must search for yourself at the Patent Office. You can hardly expect us to find space for the descriptions of prior inventions bearing on a certain industry, that you may see whether yours is like them.

S. W. B.—We do not know what you mean; you cannot *magnetise* indiarubber.

Y. Z.—He can only enter the merchant service, unless you wait till he reaches the prescribed standard.

FLEXIBLE MARBLE.—With reference to our Useful Note on the subject, in No. 372, Mr. W. J. Hay writes that it may interest some of our readers to know that specimens of flexible marble can be seen in the Hartley Museum, at Southampton, which is open to the public daily.

J. GILBERT.—We do not remember your communications. We do not insert all replies that reach us—sometimes because we think a query has already received sufficient attention.

M. R. C. S.—The discussion is closed.

'OBBY 'OSS.—Please look up our back volumes, and you will find you are rather behind time in endeavouring to initiate a discussion on the respective merits of the Phantom and Tension bicycles.

ROLAND.—We fear none of our readers will be able to tell you "what induced Sir Walter Scott" to write the passage you quote.

SPEIGHT.—See description of Indian pellet bow in this number.

TEACHABLE.—You must repeat your query, and give more distinctly the dimensions of the gear. We cannot understand them.

APPRENTICE.—Order through Trübner and Co., Paternoster row; the other queries are advertisements.

ANXIOUS STUDENT.—Write to the Secretary of the Science and Art Department, South Kensington.

ERITO.—Acceptable.

NOBILITY.—The covers can be had. You may bind the advertisements up with other pages if you like.

S. SPIERS.—We cannot publish your address so that "Anglo-America" can write privately. Send what information you have for the benefit of all.

WEATHER.—Buy the back number, if you want the information.

SILVESTER FIRTH.—See reply 11656 in this number.

ONE IN A FIX.—In the case of a person dying intestate, leaving a wife and children, one-third of his personal property goes to his wife and the rest to his child or children. A mother-in-law takes nothing. We wish correspondents would adopt less common signatures. Another writes giving the same *nom de plume* as yourself, and neither of you add any place of address or anything else whereby we may distinguish you.

A SUBSCRIBER.—We do not charge for the insertion of queries, and have devoted your stamps to the Lifeboat Fund. For information about lumbago, see pp. 304.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MAY 31, 1872.

ARTICLES.

ASTRONOMICAL NOTES FOR JUNE.

By a Fellow of the Royal Astronomical Society.

THE right ascension of the Sun at Greenwich mean noon on June 1 is 4h. 38m. 40·85s., and his declination 22° 8′ 25·4″ north. He will consequently be found a little to the south-east of the well-known wide double star τ Tauri. He rises in London on the 1st at 3h. 50m. a.m., and sets at 8h. 5m. p.m., while on the 30th his rising takes place at 3h. 49m. a.m., and his setting at 8h. 18m. p.m. in the same locality. At 3h. 32m. a.m. on the 21st his longitude is 90°, or he is technically said to enter Cancer, and summer commences. As at this instant he attains his greatest northern declination the 21st will be the longest day, the sun rising at 3h. 45m. a.m., and setting at 8h. 19m. p.m., thus remaining above the horizon for 16 hours and 35 minutes. The absence of real night is now quite noticeable, twilight being perceptible from sunset to sunrise. The equation of time is subtractive up to the 13th, after which it becomes additive. On the 1st, 2m. 25·29s. must be taken from the instant of apparent Greenwich noon to give the time which a clock ought to show, and this diminishes to 11·62s. on the 13th. At noon on the 14th 0·95s. must be added to the time shown by a sundial or other meridian instrument to obtain true mean time, a quantity which increases to 3m. 22·96s. by the 30th. While on this subject, we may call attention to the fact that the 20th and 21st of June are excellent days for obtaining a meridian line by the method of equal altitudes, for setting a sundial, or for any analogous purpose; inasmuch as the Sun's change in declination at that time is practically imperceptible. The semi-diameter of the Sun at his transit at Greenwich on June 1 is 15′ 48·0″, and this occupies 1m. 8·43s. of sidereal time (convertible into mean time by the subtraction of 0·19) in passing the meridian. On the 30th the Sun's semi-diameter will have diminished to 15′ 46·0″, but this will take 1m. 8·79s. of sidereal time (or 1m. 8·60s. of mean time) for its transit. The Sun is now fast approaching his apogee. The sidereal time at mean noon on June 1 is 4h. 41m. 6·13s., and on the 30th 6h. 35m. 26·31s., the mean time at sidereal noon, or mean time of transit of the final point of Aries, being 19h. 15m. 44·02s. and 17h. 21m. 42·56s. on those days respectively. There will be an annular eclipse of the Sun on June 5, after our midnight, but it will be wholly invisible in this part of the world. Spots, faculæ, and other indications of solar activity continue to be manifest, though, as we have recently intimated, in diminished numbers.

The Moon will be New at 3h. 23·4m. a.m. on the 6th; will enter her first quarter at 7h. 19·2m. a.m. on the 14th; be Full at 6h. 57·7m. in the morning of the 21st; and enter her last quarter at 9h. 27·4m. at night on the 27th. She is 24·9 days old at Greenwich mean noon on the 1st, and, pretty evidently, 28·9 days old at the same hour on the 5th. Then on the 6th, at that instant, her age will be 0·4 day, and so on until the 30th when it will obviously be 24·4 days. At 6 a.m. on the 16th, Libration will bring additional surface in her south-east quadrant into view, while at 1 in the afternoon of the 28th more of her south-west surface will be visible from the same cause. The Moon will, however, in each case be, of course, below our horizon. She will be in conjunction with Mercury at 7h. 21m. a.m. on the 4th; with Venus at 3h. 16m. a.m. on the 5th; with Mars at 4h. 46m. in the afternoon of the same day; with Uranus at 5h. 18m. on that of the 9th; and with Jupiter a little later at 6h. 24m. Lastly, she will be in conjunction with Saturn 29 minutes after noon on the 22nd.

The Moon will occult only three fixed stars this month (two of them at very inconvenient hours), and approach very close to a fourth. The last-mentioned phenomenon will occur first in point of time, as at 51 minutes after midnight on June 17 she will be almost in contact with μ Libræ. Then on the night of the 21st at 10h. 46m. σ Sagittarii will disappear at her bright limb, reappearing at her dark one at 11h. 57m. During the early morning of the 27th, at 3h. 29m., 30 Piscium will be occulted by the bright limb, and reappear from behind the dark one at 3h. 52m. Lastly, at 3h. 9m. a.m. on the 30th, BAC 755 will disappear at the Moon's bright limb, and emerge from behind her dark limb at 3h. 52m. also.

The remarks which we made last month (p. 136) with reference to the unfavourable position of the planets for observation, apply with even increased force to the condition of things obtaining during June. Mercury is a morning star, and rises at the beginning of the month, about three-quarters of an hour before the sun (of course, in strong twilight), southing and setting in full sunshine. Every day, however, finds him closer and closer to the Sun, with which he will be in superior conjunction at 9h. 46m. on the night of the 24th. Mercury will be in conjunction with Mars at 4h. 14m. during the early morning of the 18th, and with Venus at 5h. 38m. in the afternoon of the same day. His conjunction with the Moon at 7h. 21m. a.m. on the 4th has been mentioned above.

Venus is also a morning star, and equally badly placed for the observer. Her diameter is only about 10″, and she is very nearly round; so that, even if she be caught in the field of the telescope, she is about as uninteresting an object as can well be imagined. She rises, souths, and sets in full daylight during the whole of June, and is rapidly approaching the Sun. We have referred previously to her conjunction with the Moon at 3h. 16m. a.m. on the 5th; and to that with Mercury at 5h. 38m. p.m. on the 18th. We may add that she will be in conjunction with Mars at 5h. 49m. in the early morning of the 17th.

Mars is much too close to the Sun to be visible; moreover, his apparent diameter only subtends an angle of some 4″. His conjunction with the Moon at 4h. 46m. in the afternoon of the 5th; with Venus at 5h. 49m. a.m. on the 17th; and with Mercury at 4h. 14m. a.m. on the 18th have been before spoken of.

Jupiter now, owing to the protracted daylight, and his steady approach to the west, is visible only during a comparatively short period of the early night. He rises, of course, in bright sunlight during the whole of June, is on the meridian on the 1st at 3h. 19·4m. in the afternoon, and sets about 20 minutes past 11 at night. On the 30th he will south at 1h. 49·2m. p.m., and set about 9h. 42m. He is travelling slowly through Cancer this month; and starting on the 1st from a point south of μ^2 in that constellation, will, by the 30th, be found forming an obtuse-angled triangle with η and θ. At 6h. 11m. in the afternoon of the 5th, he will be in conjunction with Uranus. It will, of course, be far too light for the smaller planet of the two to be discerned at the instant of conjunction with the amount of optical power at the command of those for whom these Notes are chiefly written; but, as Jupiter and Uranus will approach each other within a single minute of arc, they may be seen later on in the evening in the same field of view, even with a high power. At 6h. 24m. p.m. on the 9th, as indicated in a previous paragraph, the thin crescent Moon will be some 3° (and a few minutes) north of Jupiter.

The visible phenomena of Jupiter's satellites this month are few indeed. Satellite 1 will be occulted at 9h. 31m. on the evening of the 1st. If it be not too light on that of the 2nd, the egress of satellite 2 at 8h. 40m., and the egress of satellite 1 at 9h. 6m., may possibly be perceived. The shadow of satellite 1 will pass off at 10h. 2m.; as will that of satellite 2 at 10h. 30m., but Jupiter will be very low down at the time of the occurrence of the latter phenomenon. It is barely possible that satellite 4 may be seen to reappear from occultation at 8h. 12m. in the evening of the 6th; and further that the ingress of satellite 2 at 8h. 32m., and that of satellite 1 at 8h. 46m. p.m. on the 9th, may be detected. The shadow of satellite 1 will enter on to Jupiter's limb at 9h. 36m. on the same evening (the 9th), as will the shadow of satellite 2 (Jupiter being close to the horizon) at 10h. 11m. afterwards. On the evening of the 10th satellite 1 will reappear from eclipse (under unfavourable circumstances for detection) at 9h. 9m. 28s. On the next night, the 11th, it is just possible that the egress of the shadow of satellite 3 may be perceptible at 10h. 5m.; while the same may be said of the egress of the shadow of satellite 1 at 8h. 19m.; and the reappearance of satellite 2 from eclipse at 10h. 14m. 9s. on the 18th; of the occultation of the same satellite (2) at 8h. 43m.; and the egress of satellite 1 from Jupiter's disc at 9h. 37m. on the evening of the 25th.

Saturn is now above the horizon at a rather more convenient time for observation, but is so extremely low down that telescopic scrutiny of him is almost futile labour. He rises on the 1st about 20 minutes to 11 at night, and is on the meridian at a quarter to 3 o'clock the next morning. On the night of the 30th he rises at 8h. 42m., and souths 43 minutes after midnight. He travels during June from east to west, through a perfectly barren region in Sagittarius. We have already adverted to his conjunction with the Moon 29 minutes after noon on the 22nd.

Uranus continues to occupy a position somewhat to the south and east of μ^2 Cancri, and travels in an easterly direction through a small arc during the present month. As we remarked in our May notes, his proximity to Jupiter renders all our observations with reference to the visibility of that planet equally applicable to him. Their conjunction at 6h. 11m. in the evening of the 5th; and that of Uranus with the Moon at 5h. 18m. p.m. on the 9th have been spoken of under their proper headings.

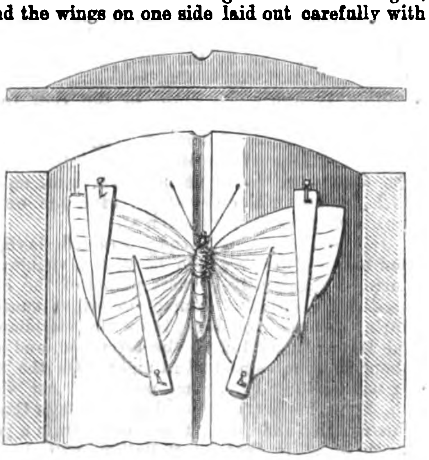
Neptune rising in twilight, and southing and setting in bright sunlight, is still, for all practical purposes, invisible.

June, from some cause unknown, is a month conspicuous for the absence of shooting stars from its night skies.

THE ARRANGEMENT AND PRESERVATION OF INSECTS.

WE promised in a recent article (p. 187) to give some hints on the arrangement and preservation of specimens of the Lepidoptera, and presuming that some few of our readers are anxious to have everything in readiness for the captures they hope to make, if they have not already made a goodly number, we proceed to give a few instructions which may serve to guide the entomological tyro in obtaining a practical knowledge, and preserve him from disappointment at the outset of his career. Probably the first thing which will trouble the would-be collector will be the cabinet or case in which he can preserve and exhibit his trophies, and it is a difficulty not easily overcome where funds are limited. There are numerous designs for cases and cabinets, all of which are excellent in their way, and serviceable articles for the purpose intended, but they are, unfortunately, also rather too costly for the means of many of our readers, while many others would not feel justified in spending so much money on "mere butterflies," as they are sometimes contemptuously termed. Nevertheless, it is quite possible to make cases at a moderate outlay, which, while answering all the purposes of the more finished receptacles, with their contents will still be not unornamental when seen in a parlour or drawing-room. It would be well for the embryo entomologist to settle at starting to what extent he is likely to be successful in his efforts at collecting, which will largely depend, of course, on the time at his disposal and the enthusiasm which he throws into the work. Where a complete collection of the Lepidoptera or Coleoptera of the British Islands is aimed at, a cabinet is certainly to be desired, as it admits of a more systematic arrangement of the specimens, and while keeping them all together facilitates reference. Where, however, the collector is contented with the more beautiful individuals of the family, or merely seeks to obtain specimens found in his immediate neighbourhood, a few of the ordinary glass-topped cases will answer his purpose, and these may stand on sideboards, tables, or shelves, or in any position where they can be shaded from the fiercer light of the sun. When we state that a good collection of the British Lepidoptera would require about 40 drawers, and that the price charged by the best makers for their cabinets (the cheapest, too, in the long run) is something like £1 a drawer we have furnished a few data to guide our readers as to how far towards a complete collection they are prepared to go. There is another plan, however, which is preferred by many of our best entomologists, who aver that it is superior to a cabinet, and that is a series of store-boxes made to imitate books, kept like them in a book-case, and lettered or labelled for easy reference. Under this system of arrangement there is, of course, no limit to the extent of the collection, save its completeness and the amount of shelf-room obtainable. We would not advise any of our readers, except those who are very skilful with tools, to attempt the construction of a cabinet, which is a difficult piece of work to turn out in a satisfactory manner; we may mention, however, for the benefit of those who may be determined to try, that a very suitable size can be easily found from the following dimensions. The number of drawers should be not less than 40, 18in. square (*i.e.*, the same width and length), and 2in. deep externally. They should be made to fit accurately and be interchangeable; and when arranged in two columns in a handsome case, with labels at the sides or on the front of the drawers, will be found all that can be required. The ordinary glass case, however, is not beyond the skill of the average amateur joiner or cabinet-maker, and besides being the least expensive, will be found to answer the purposes contemplated in these articles. The best wood of which to make these or any other receptacles for preserving specimens of insects is undoubtedly mahogany, either Spanish or Honduras. If this is procured from the yard care should be taken to ascertain that it is well-seasoned; but the cheapest and best way of obtaining suitable material is to purchase some second-hand fragments, such as the broken flap of a table, often to be picked up at the broker's shop or old-material dealer's. The size of the cases will depend on the taste of the maker and the positions they are intended to occupy, but like the drawers they should not be less than 2in. in external depth, and would be better 2½in., as there should be rather more than an inch left between the cork and the glass. They may be made of the same depth back and front, or constructed so that the glass may slope, at the taste of the collector, but if made only 2in. in depth the glasses must almost necessarily be fitted into frames to lift on and off. The easier way, however, is to construct the upper edge all round with a rabbet lined at bottom and side with chenille or velvet, into which the glass is dropped. The glass should be perfectly colourless, the kind used for pictures. "flatted sheet," as it is called, and should have a piece of ribbon fixed at one end or edge, by which to lift it up, an operation that must always be performed slowly and with care. The bottom of the case is to be entirely covered with a piece of cork of the best quality, about a quarter of an inch thick; but as it is rather difficult to obtain cork of the requisite quality and suitable dimensions, two thinner pieces are often glued together, or the lining may be filled in in sections of the size of the good material obtainable. Generally speaking, for cases of ordinary dimensions, a sound bottom can be secured by glueing two pieces, each nearly an eighth of an inch thick, together, for if there is a hole in one it will most likely be covered with sound cork in the other. The cork bottom being prepared and finished by smoothing it with glass paper, is firmly and evenly glued into the case, and kept in position by a piece of wood and a weight, till the glue is set and dry. The next operation is papering, *i.e.*, covering the bottom, and the sides if desired, with "tea" paper—the technical term for the sort used, but any paper possessing an even surface, perfect whiteness, and sponginess of nature, will answer the purpose. This should be carefully pasted in with thin paste, to which a few drops of carbolic acid or a small quantity of corrosive sublimate has been added to prevent mildew, as well as alum to insure hardness in drying. The case is now complete, with the exception of marking off the bottom into spaces, and before this is proceeded with, it will be well to obtain the dimensions of the principal specimens from a friend's collection or wait till the specimens themselves are caught. In the arrangement of a collection of Lepidoptera, those of the same family should be placed together, being divided into genera. A label with capital letters should run across the space so occupied above the first row, and above the first insect in the row should be placed a label with capital letters the initial of which is the largest; and under each species its distinguishing name in small letters, *e.g.*, VANESSIDÆ, the name of the family; VANESSA, that of one of the genera; and *Antiopa*, that of a species. Lists of the names are, however, sold at the naturalists' shops, which can be cut up and pasted in, and of course look neater as a rule than when the pen is used.

Having thus prepared the case, and presumably obtained some of the insects whose beauties we wish to retain as "joys for ever," the next [illegible] will be setting, and here we have a [illegible] methods—the saddle or rounded, the high, the low, and the flat. Neither of these plans represent the insect as found in nature, and as saddle-setting is the system generally pursued in this country, we shall content ourselves with giving a description of its principal points, leaving the refinements of manipulation adopted by some lepidopterists to be discovered by each collector for himself. For saddle-setting, then, cork saddles will be required, of the shape shown in plan and section in the figure; these are fixed to thin pieces of wood, and vary in size from ½in. to 5in. in breadth, and about a foot in length, depending as regards the latter measurement on the dimensions of the setting-house, where that useful adjunct is employed. These pieces of cork are best obtained from the cork-cutter, who can make the groove much cleaner and better than an unpractised hand, but if it is impossible to obtain his assistance the saddles may be made in two pieces, and glued side by side to the boards, leaving sufficient width between them to accommodate the body of the insect, or a V-shaped groove may be cut out with a penknife, but the cork must be finished off by smoothing with glass-paper all over. A setting needle and a setting bristle will also be required, which are fixed into corks or small pieces of wood as handles. The braces employed to keep the wings in position are wedge-shaped pieces of stout writing-paper, or card for large specimens, and are placed as shown in the engraving. The saddles being ready, one of the captures is pinned to a saddle of a suitable size —that is, rather wider than the insect with fully-expanded wings—the pin being inserted at the part marked by a dot, with its head slanting forwards a little. The legs are then arranged, and the wings on one side laid out carefully with



the bristle and the setting needle—the former being employed to press the wing down to the cork, the latter to lift and guide it into position from the under side. This accomplished, the fore wing is braced down as shown, and a similar course pursued with the hind wing. The other side is then treated in a like manner, the antennæ arranged, and the body raised by placing small pieces of wood in the groove when that is too deep, or by a brace under the whole length of the body. It will be obvious that the minutest directions will be of little avail where skill and lightness of hand are wanting, and what we have said will be sufficient to guide the uninitiated in doing good work where practice can alone give proficiency.

The setting carried out satisfactorily, the specimens must be allowed to remain on the saddles till perfectly dry, the time thus occupied varying with the seasons and the weather. For this reason, and from the danger of damage specimens run while lying about for weeks, many lepidopterists make use of a setting-house, which is easily made out of an old box (free from mites, though), by putting ventilators of perforated zinc or wire gauze in the bottom and the lid, and then turning the box on its side, and nailing strips of wood on the ends inside to act as ledges on which to rest the saddle-boards. These should be at least 2in. apart, so as to allow of a free current of dry air.

When the insects are thoroughly dry, which will generally be known by the stiffness of the abdomen, they may be removed to their permanent resting-places; and then will begin a whole host of troubles—grease, mould, and mites being the worst. Grease may be removed by sinking the insects on loaded corks in benzole or turpentine, and drying them in powdered French chalk. Mould should be prevented by keeping the case away from the damp and allowing a free access of dry air around it; but all the specimens should have the underside of the abdomen anointed with a dilute spirituous solution of phenol, carbolic acid, or corrosive sublimate. The strength of the solutions may be tested by trying them on black paper, on which they should become speedily invisible. Care should be taken that the glass of the case fits air-tight, and fresh specimens should be kept in a separate and smaller case till evidence is afforded that they are free from parasites. Various essential oils, camphor, mercury, and numerous insecticides are recommended to be placed in the case, but phenol properly used will be found as satisfactory as anything.

There is one other little point worth mentioning, and that is when it is found desirable to reset an insect, it may be relaxed either in a jar containing damp sand or in an ordinary flower-pot sunk a few inches in the ground and covered with a tile or a piece of slate, and the earth drawn over. When sufficiently limp the insect should be reset as soon as possible, and when dry, as far as Lepidoptera are concerned, the parts of the wings where they join the body should be slightly touched with a solution of pale lac. We have now, however, so far exceeded our limits that we have only space to wish all intending collectors the success they may merit.

THE SCIENCE DEPARTMENT AND SCIENTIFIC EDUCATION.

By C. H. W. BIGGS.

It is unfortunate, perhaps, that our daily and weekly press is mainly employed in criticising what is to be, instead of devoting some part of its labours to the discussion of what is. No doubt it is desirable to educate the public mind in regard to every important Bill before Parliament. The public mind educated, the public voice approving, the measure sooner or later becomes law, and then to a great extent passes out of men's minds. Witness the Irish Church question, how much paper and time was wasted before the Bill became law, yet how little has it been discussed since. Witness, again, the New Army Regulations; or, better still, the Reform Bill. Differing from any of these, and, perhaps, from every other topic of public discussion, the Education Bill is not relegated to obscurity; but there is a good reason for this, inasmuch as we have not yet settled our system of education. At present we are trying an experiment, a costly one it is true, and that is a very good reason why we should hope for the best. Still, I am sorry to say, it seems to me to be a failure. I am not thinking of the politico-religious part of the question, simply because I don't believe in it. There is a political question, but no religious one. So long as our primary schools are unconnected with the secondary and higher schools, so long shall we have to bewail an incomplete system of education; so long as compulsion is left to the liberty of the school boards so long shall we complain; so long as the schoolmaster himself occupies his present position in the social scale so long will there be strife and bickering. Who on earth would think of examining lawyers, or doctors, or architects, as to the attainments of their assistants, by means of men who know nothing of law, or physic, or building, except just so much as they had picked up during a university career? Yet, forsooth, schools are examined by men who know literally nothing of school work—men who have obtained their appointment because of a distinguished career at their Alma Mater, or from interest. Lawyers have the woolsack before them; doctors are honoured by knighthood; architects, literary men, civil engineers, and other professional men (if they are at all distinguished) make money, become landowners, get into Parliament, ay, and even into the House of Lords; but whoever heard of a schoolmaster, no matter how talented, how distinguished among his fellows, obtaining anything more than a school? Further, our existing primary schools are literally starved for want of funds. Ten times the teaching power is required for the schools to be brought up to any degree of excellence, and this teaching power can only be had by increasing the funds at the disposal of school managers. Again, what teaching power we have is to a great extent lost, because so widely diffused. In many towns there are a dozen little fiddling schools, where two good large ones would amply suffice, and then all the first divisions, thrown into two divisions, would require but two masters instead of twelve; the other masters could take the other divisions. In other words, by amalgamation, a class of about forty boys would be obtained of about the said attainments, and these a master could easily manage, instead of there being a little school of forty boys of different attainments, and, therefore, in different standards, and thus out of one man's power. But what has all this to do with the Science Department? More, much more, than my readers may at first imagine. However, these allusions have been thrown out more as hints than as consecutive, hardly-connected, I might say, arguments, in order that many more minds may give attention to the subject. Were I to attempt to argue the question fully, I should require not a column or two but several numbers of the ENGLISH MECHANIC.

Now, the ranks of the working classes, whether mechanics or farm labourers, are, for the most part, recruited from the boys of our day-schools. The Science Department was instituted for the benefit of these working men: for our engineers, our builders, our carpenters, our wheelwrights, our smiths, our ship-builders, and so on. Whether *these* people are benefited or not is another question. I know that many people who can and who ought to pay for their sons' education in various branches of science, send their boys to the science school, where for from 2s. 6d. to 4s. they receive certain instruction; these pupils are presented for examination, pass, and the country pays the master £1 or £2 per head, as the case may be. These students are sons of "foremen," "master-men," and so on; people who know—who realise the value of a technical education, who by means of their own technical knowledge have raised themselves above the majority of their shopmates. They are determined their children shall further improve upon their position, and thus constrain them to take advantage of the opportunities offered. They know that as a rule the lessons given, the lectures delivered, are the best that can be obtained; the men who give them know their business too well to do their work in an unworkmanlike manner. Why do the children of the rank and file of our workmen neglect to embrace these advantages? Is it because they know not the value of them? Is it because they are stubborn, clumsy, thickheaded clodhoppers? Oh! no. But there must be a reason. What is that reason? Is it not because the knowledge imparted to them in our primary schools is insufficient to allow them to understand, or, at least, is such that they cannot during the short course of lessons in the science class understand sufficiently well to be able to pass the required examination of the department? Surely, "To him that hath is given, and to him that hath not nothing is offered." Take the majority of cases: the boy leaves school at eleven or twelve years of age, he can read and write tolerably, knows the first four simple and compound rules, and probably a little of fractions. What can the science master do in one course of lessons? What does he do? Just enough for some 70 per cent. of his pupils to fail. Now if, on the contrary, there was a sufficient number of masters in our elementary schools the rudiments of science could easily be taught in these schools, and the pupils having received an elementary knowledge would when in the workshop see the necessity of extending that knowledge; thus our science schools would be filled by the very people for whom they were intended. Instead of being the mere cadres of classes the classes would have their full complements. With improved knowledge we get improved workmen, in every sense of the word, less publichouseism, more attention to home and home comforts, and, above all, an increased desire to see their children better educated. The Science Department must recast its system of examination. The papers now set are similar to those given to some of the higher forms in our large schools. Where the pupils have the best masters, the best apparatus, and a great deal of time for the study of the subject, it may suit some people to say these examinations are easy, so they are, in one sense, but they are very difficult for the people for whom they are intended; in fact, just difficult enough to keep the money necessary for the extension of the classes in the Government coffers, instead of being utilised by paying teachers, or rather, I should say, the money voted by Parliament is most unaccountably swallowed up by the department. If a statement in the *Schoolmaster* of May 18 is to be believed, no less than £90,000 was required to pay a staff of clerks, &c., to carry on the business of the department, whilst £20,000 found its way into the hands of the teachers. I wonder how many manufacturers spend £5 10s. on clerks to £1 on workmen; for this is about the proportion required by the science department. Further, although not agreeing with all the *Saturday Review* says, I can heartily acquiesce in its statements every now and then relating to this particular department. Over and over again has this paper required some alteration in the work given or undertaken by the head of the department. It argues, and with some reason, that a man cannot well do two things at once—cannot look after the science and art of the United Kingdom, and also devote attention to the annual international bazaars, not to mention other things. A deputation of science masters recently had an interview with Mr. Forster, and one ground of complaint was that they did not agree with the system of payment by results. Now, it would be well that all science masters—and, indeed, all masters—should understand that public opinion will not allow public money to be paid away without in some measure knowing what it goes for. If £90 goes to clerks, and £20 to masters, the country knows that the masters have passed a certain number of pupils, and that the clerks have written a certain number of letters, the examiners looked over a certain number of papers, and so forth. If, on the contrary, £50 is paid to masters because a certain number of lessons are given, then any one may give the worst lessons, do the least work, but get real pay. It can't be. Let us have fair examinations, and be paid fairly for our work. Local subscription fees, &c., one moiety, Government grant the other moiety. It is not about the payment by results that I find fault, it is that the examinations are not adapted for the working classes; the examinations are not conducted properly. The minimum number of lessons should consist of at least forty instead of twenty-five—that is, they should be given through the ordinary school terms—not during the winter months only, but throughout the year. It should be compulsory upon our elementary schools to teach the elementary branches of science. That this is not impossible I know, but the one great requisite "teaching power" must be obtained. A boy at ten years of age ought to—ay, and under able tuition would—be able to read well enough to dispense with "reading lessons," write well enough to dispense with writing lessons. The time previously devoted to these subjects might be given to others, more particularly to science. Boys read with avidity the penny-dreadful literature, give them something to interest them, and I'll warrant they will read. Their exercises will give them sufficient writing. By twelve years of age a boy should be able to manipulate fractions and proportion pretty thoroughly, and then his scientific education would advance a step. By fourteen years of age, or the time I would have fixed as the earliest for leaving school, he would be an interesting subject to be moulded and formed, licked into his true shape by the science master. Now all ye English mechanics who read this, give a small portion of your time to the thought of what is, and what ought to be; don't be led away by the counsels of anybody; if you are educated enough, that will suffice—if not, it is your duty to look around you for better means wherewith to accomplish the ends you have in view.

VEGETABLE PALÆONTOLOGY.

[FROM OUR OWN REPORTER.]

DURING his present course of Swiney Lectures, delivered at the Geological Museum, Dr. Cobbold gave a brief sketch of the science of fossil botany, of which we give the following abstract:—

This science has not had that time and attention bestowed upon it which it ought to have had, the truth being that other departments of palæontological science were not attractive. The geological record, too, is very fragmentary, as compared with that of zoology. A few eminent men, however, have worked at the subject and given it its present standing. Looking back, there are three names which stand out pre-eminently in this respect, Lindley, Brongniart, and Unger. In later times a number of workers have been engaged on this subject, and progress is daily being made. Hooker has described the subject as one of extreme difficulty, and the conflicting opinions held about various objects confirm this statement.

We may take as a starting point the following general proposition:—Throughout the entire series of fossiliferous strata which happen to contain fossil plants, there is no evidence of the existence of any type of plant life which cannot be referred to one or other of existing orders of plants upon the globe. In other words, there is no fossil plant known which is so distinct as to deserve being placed in a group of ordinal value by itself. Exception might be taken as follows: Some botanists place the Calamites in a separate family, and call it Calamitæ, or Calamitaceæ; but do they present characters of such extreme markedness or distinction as entitles them to be separated into an ordinal group by themselves? He (Dr. Cobbold) had looked very carefully into the matter, and he thought that although they present some features which distinguish them from all existing species of Equisetaceæ, they merge so imperceptibly into that group that they could not fairly be separated from them.

In this respect there is a great contrast between the palæontology of plants and animals, for of the latter 8 or 9—or some say 10—groups of ordinal value have flourished and become extinct.

The vegetable kingdom may be divided (according to Lindley) into seven great classes, as follows:—

1. *Thallogens*, as algæ, fungi, lichens, &c.; they are the lowest form of stemless plants, and are little better than mere masses of cellular tissue. The oldest representative of this class is Oldhamia in Cambrian times. It is one of those fossils about which there has been a great deal of discussion and a great variety of opinion, some placing it in the animal and some in the vegetable series.

2. *Acrogens*, a low class of plants with stems of a peculiar structure, flowerless—as ferns, mosses, &c. The earliest representative is Psilophyton, a gigantic lycopodiaceous plant, described by Dr. Dawson. This class was well represented in Devonian and Carboniferous times by ferns, calamites, lycopods, &c.

3. *Rhizogens*, or rhizanths, a small order, comprising the peculiar plants Rafflesia and Balanophous.

4. *Endogens*, comprising two divisions: (*a*) those with complete flowers, as palms, orchids, lilies, &c.; (*b*) those with incomplete flowers, as grasses, sedges, screw pines, &c. According to Professor Tournell, of Sweden, the earliest record of this class is Eophyton in Cambrian times, which he, at the Norwich meeting of the British Association, put forward as a monocotyledonous plant. The members of that Association, however, were divided in opinion as to its vegetable character, and the same uncertainty still exists. Mr. Carruthers, of the British Museum, believes in it. Mr. Etheridge does not. The lecturer said he himself had looked carefully into it, and as far as he was able to judge, he concluded that the evidence as to its vegetable character is entirely unsatisfactory.

5. *Dictyogens*. A small class, containing only four orders, and not represented as fossils. As examples may be mentioned yams and sarsaparillas.

6. *Gymnogens*, as pines, firs, yews, and cycads. As the name implies, they are naked seeded plants, and as a group have played a not inconspicuous part in the history of organic life on the globe. Their first appearance is in Devonian times, as Conifera, and they flourished in enormous numbers in the Carboniferous period.

7. *Esogens*, flowering plants having two or more seed lobes. This is the highest class of vegetable life, and is divided by Lindley into three divisions: (*a*) apetalous (willows); (*b*) monopetalous (laviates); (*c*) polypetalous (cruciferæ, rosaceæ, &c.). The earliest form is Esogeria in Jurassic rocks: the first trace of arborescent Esogens is derived from the Cretaceous beds.

In one respect there is a parallelism between the record of animal and of vegetable life, viz., that in ascending the geologic series, higher and higher forms successively appear, and the highest development of each kingdom was the last to appear. Certain of the older rocks give us a more or less fair and adequate notion of the extraordinary prevalence of plant life, and of the forms of that life in ancient periods of the earth's history. They show clearly that these forms were of a lower type than those which existed in more recent periods, and all discoveries tend to confirm the great truth above stated. With respect to the group which has played the most important part in ancient times we must say the ferns and their allies—acrogens—were most prominent.

A sketch of a portion of a Brazilian forest of the present day will serve to give some idea of the extremely luxuriant growth of vegetation in ancient times. The large tree ferns which exist in such numbers in that country were more num-

Carboniferous times, and nearly so in Devonian times. Nine-tenths of the flora of the Carboniferous period consisted of ferns, equisetums, and lycopods. The record which we have is only an imperfect record, and when we consider the whole mass of coal formed from these ancient forests, and containing myriads and myriads of these forms, we may, in some measure, realise the extraordinary state of things which obtained in that period. These productions, which imply a warm and moist climate, were not confined to tropical regions of the earth. At the present time as you go from the tropics towards the poles, the ferns dwindle in size from stately trees to mere shrub-like plants. There is one exception to this —viz., in New Zealand, which is an extra tropical country, and there we get tree ferns, but in no other part of the world in such a high latitude. But the most striking fact in this connection is this, that travellers who have investigated Arctic and Antarctic regions have found remains of ferns and dicotyledonous trees in latitudes as high as Bear Island and Melville Island. This implies that there was a time when the condition of our planet was such that a tropical, or, at all events, a sub-tropical climate, existed as far as 75° N. They found ferns and calamites in abundance in Carboniferous rocks. Dr. Hooker says the views of astronomers on this subject are merely technical, they cannot at present explain how it could have been that so high a degree of temperature should have occurred at such latitudes.

With regard to the first indication of vegetable life it is not positively ascertained. The earliest recognised form occurs in Silurian beds, but certain geologists carry the series farther back. Dr. Dawson and others have found in Laurentian rocks, in America, masses of graphite 25ft. in thickness. It is believed by every one who has chemically examined graphite that it results from the disintegration and decomposition of vegetable masses. All traces of structure have been lost, but the chemical constitution is such as to indicate that there must have been in those early times vegetable life of some kind or other—most likely of lowly organised stemless thallogens. If so we have a still further parallelism between the animal and vegetable series.

In Cambrian rocks occurs the disputed Eophyton, the vegetable character of which is not yet established.

The Silurian rocks chiefly contain fucoids, and these are the first undoubted vegetable remains. The following may be taken as type forms; one in the Llandovery beds, discovered by Mr. Lees, named by the lecturer on that account Leesia. In the next set of beds—Wenlock Limestone—occur Chondrites, and in the following Ludlow beds Actinophyllum; in the same set of beds and the succeeding passage beds are found Spongarium and Pachytheca. All the above are fucoids.

Devonian beds show an advance in structure from thallogens to acrogens and gymnogens. As type forms we may take Psilophyton, allied to Lycopodium; Dadoxylon, allied to the Araucarias of Australia and adjacent parts; Lepidodendrons, allied to ferns; Calamites, allied to Equisetums; Sigillaria, allied to ferns; and two fruits, possibly of flowering plants, *Cardiocarpon cornutum* (palm-like, monocotyledonous), and *Antholites Devonicus* (perhaps phenogamous, and allied to Liliaceæ).

The Araucarias, found in the Devonian and Carboniferous rocks in great numbers, are now confined to the southern hemisphere. They occur in Australia and the adjacent islands (Norfolk Island pine), and are large trees, 200ft. high and 20ft. in circumference. They existed in our country and in Scotland in Carboniferous times. The lecturer had seen the trunk of one of them, 30ft. long, dug out of a quarry in Scotland. The lepidodendrons form a group which some botanists think ought to rank as a separate family. They have very marked affinities with lycopods, ferns, and coniferæ, and may be regarded as an osculant, or rather, multiple type branching out in these directions.

In the Carboniferous period nearly all the Devonian types were repeated in far greater abundance. Besides those were *Megaphyton magnificum* (a tree fern), and Palmacites (monocotyledons), &c.

Permian beds contain no sigillaria, but ferns and calamites are abundant. Other type forms are Walchia (a conifer), and Podocarpon (palm-like trees).

In Triassic rocks ferns and equisetums are still abundant. Perhaps the most typical form is *Pecopteris Whitbyensis*, a fern. Pecopteris is also found in Carboniferous rocks.

Jurassic rocks have as type Podocarya (in the inferior Oölite), comparable to the screw pines (Pandanaceæ) found in Australia at the present day.

In the Cretaceous period diatoms are found, but it is not intended to say that this is the first time of their appearing; they also occur in great numbers subsequently in Tertiary times. Also Myrtaceæ and Proteaceæ (Banksia and Gryphyllia), and dicotyledonous trees, representing oaks, figs, and walnuts.

In Eocene beds the types may be taken as Chara, Comptonia, *Nipadites ellipticus*, and palms. The most interesting are the fossil fruits found in Sheppy (Nipadites, palms, &c.). Dr. Hooker says some of the palm fruits from Sheppy, which must have flourished on the banks of a river in Eocene times, cannot really be distinguished from palms which are living on the borders of the Ganges at the present day.

The Miocene floras are but feebly represented in Britain by the lignites of Mull and Bovey Tracey; the Pliocene floras still more feebly; while, as examples of vegetation in the Quaternary period, we have peat bogs and forest beds, with dicotyledonous trees in great numbers.

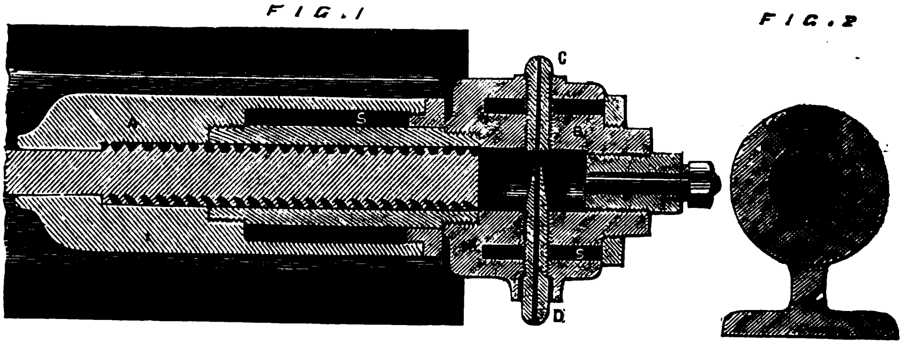
The above type forms must not be understood to be a complete catalogue of the flora of each distinct epoch, nor in all cases the most important parts of it, but are merely features selected from the various epochs which will serve as starting points for further research.

W. H.

WIRE-COVERING MACHINE.

A MACHINE for covering wire with rubber or guttapercha, or other insulating material for telegraphic and other purposes, has been patented in this country by Mr. A. G. De Wolfe, of Connecticut, U.S., the principle of which will be understood from our illustration, which represents the most important part of the apparatus. The principle of the invention consists in forcing the insulating material by means of a screw into a chamber through which the wire to be covered is made to pass at right angles to the axis of the screw. In Fig. 1, which is a horizontal section through the centre of the portion containing the essential features of the machine A is a cylinder, containing a screw of nearly the same diameter as the bore of the cylinder. This screw is constructed upon a shaft carried in suitable bearings, and receives motion from a pinion gearing into a toothed wheel fixed on the shaft, the end of which works against a thrust-pin in order to sustain it against the back-pressure produced by the action of the screw on the contents of the cylinder. B is a short extension piece screwed on to the end of the cylinder, and stopped by a screw plug, as shown, thus leaving an internal space of about 2in. between the end of the screw shaft and the stopper, which space, when in work, will be filled with the insulating material. In this extension piece on one side is screwed the die C at right angles to the axis of the screw shaft, and on the other side a guide piece D is inserted in a similar manner so as to be in line with the die. Around the extension-piece B, and part of the cylinder A, steam is circulated in the annular chambers S for the purpose of keeping the rubber or guttapercha at the required consistency. The cylinder A is, of course, fixed and mounted on a suitable frame, and the shaft being rotated any plastic material will be forced by the action of the screw into the space left in the extension piece B, and the wire being passed through the guide-piece D and die C is coated with the insulating material, the thickness of the coat being regulated by the bore of the die. The rubber, guttapercha, or compound used for covering the wire, is placed in the cylinder through an aperture near the back end of the screw, and is, of course, carried forward by the action of the thread of the screw; a section of the cylinder at this point is shown in Fig. 2. Tubing can also, it is said, be made by means of this apparatus, when the guide-piece D is removed and a suitable die substituted for the wire-covering die shown at C.

FIG. 1 FIG. 2



FRESH VEGETABLES AND SWEET SALADS.

THOSE who value fresh vegetables and sweet salads will have none washed in the garden. Neither the one nor the other should be washed, says the *Gardeners' Chronicle*, until they are just about to be cooked or eaten. Even potatoes lose flavour quickly after being washed, so do carrots and turnips; while water will speedily become tainted in summer in contact with cauliflowers and cabbages, and thus destroy their freshness and flavour. The case is still worse with salads. If washed at all, it should be only just before they are dressed, and they should be dried and dressed immediately. Nothing ruins the flavour of vegetables, and renders good saladine uneatable, sooner than water hanging about them. If lettuces are quite clean, they make the best salad unwashed; but if washed the operation should be done quickly, and the water instantly shaken out, and the leaves dried with a clean cloth. But, alas! how often are they cut and washed in the garden in the morning, and pitched into water in the scullery sink until wanted. Then we are gravely assured that our gardeners cannot grow salading like the French! But what French "artiste" would be mad enough to rinse out his salad juice, and then recharge his lettuces and his endives with semi-putrid water?

The best practice is simply to remove all superfluous earth by scraping or rubbing, and all rough tops or leaves by cutting. Enough tender leaves may still be left on cauliflowers and brocoli to overlap the flowers. Salad should be sent in from the garden with most of the outside leaves and main root on. The tender leaves are easily tainted and injured by exposure, and if the chief root is cut off sharp much of the juice oozes out at the wound. Where vegetables and salading have to be bought from a town greengrocer the conditions are altogether different. Not only washing, but soaking often becomes requisite to restore something like pristine crispness.

THE PREVENTION OF FIREDAMP.

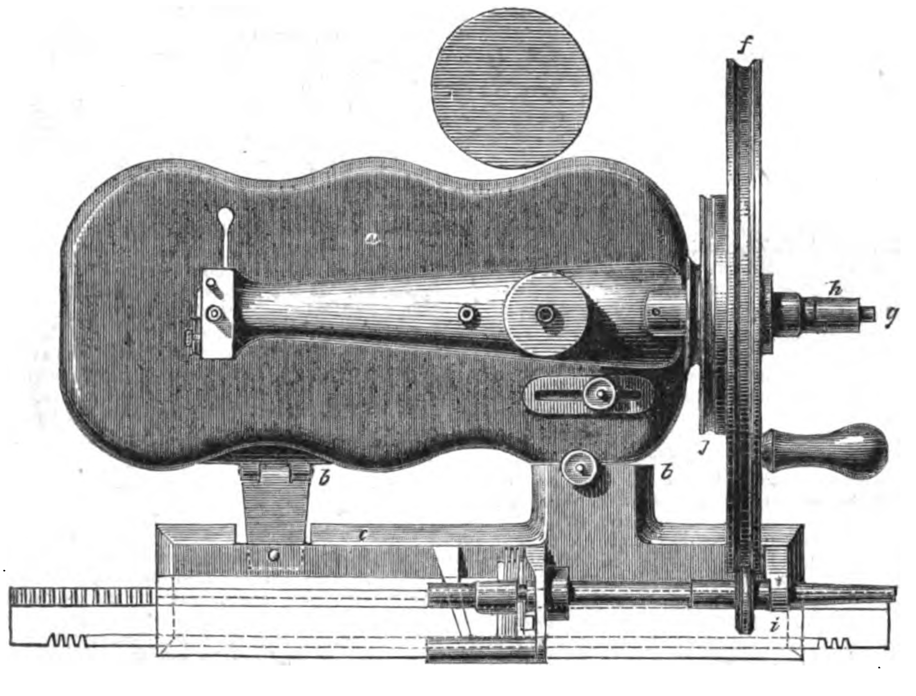
A FEW years since a very ingenious apparatus was invented for detecting the presence of firedamp in mines. It is known, says the Paris correspondent of *Engineering*, that when two different gases are inclosed and separated from each other by a light membrane, an exchange of the gases takes place through the diaphragm, and the pressure increases in the space into which the lightest gas flows. The inventor, founding his invention on this natural principle, known as endosmose, devised a box, the sides of which were formed of membrane; the air in the box was in communication with a mercurial gauge. When a rush of firedamp took place in a mine gallery where this apparatus was placed, the gas penetrated the sides of the box, and the pressure rose, sending up the mercury, which acted on a bell, or other indicator, and gave warning of the imminent danger. This invention is worthy of notice, but the many practical difficulties that attended its introduction into mines prevented its successful application, and now another apparatus having the same object has been introduced by M. Tarquan. This apparatus consists of a bell actuated by clockwork, the striking motion being checked by an unevenly balanced arm, the lighter end of which is held by a cotton thread impregnated with saltpetre. The apparatus is placed in a wire gauze cage.

The firedamp, when it occurs, penetrates with the air into this cage, and quickly ignites from contact with a lamp that burns therein, and as a necessary consequence burns the thread, and sets free the balanced rod that checks the bell, which then gives the alarm.

COMBINED KNITTING AND SEWING MACHINE.

THE sewing-machine has now become almost a sine-quâ-non in all well-appointed households, and a steadily-increasing number of machines are manufactured yearly, for the saving in the labour of the needlework necessary where there is a large family has made a very successful appeal to the thrifty housewife, who appreciates at its full value the advantages offered by the machine over the hand-driven needle. Another kind of useful domestic machine is also finding its way into public favour—viz., the knitting-machine, several descriptions of which we have illustrated from time to time. We have now to bring before the notice of our readers a method of combining a knitting and sewing machine in one piece of furniture, so that both can be worked simultaneously or either separately. In order to accomplish this Mr. A. Pilbeam, who has recently patented the combination, takes a knitting-machine of that class which has a single needle and a reciprocating comb, such as that described in the Specification of an Invention, No. 2639, 1869, which is commonly known as the "Hinckley" knitting-machine. In this machine the reciprocating comb is arranged to slide to and fro in front of the machine, and is operated through a rack by a peculiarly constructed switch wheel. This wheel carries on its shaft a frictional pinion, and thereby receives motion from a grooved driving-wheel. The machine is provided with an eye-pointed needle, operating with a reciprocating motion across the comb. The frame or bed of the knitting mechanism is attached by hinges or other suitable connections to the base or bed of the sewing-machine, in such a manner that the said knitting mechanism can be swung down in front of the machine away from the driving-wheel. The latter is preferably placed on the shaft of the sewing mechanism. There is also a counting or indicating wheel which may be removed from its usual position, and placed at one end of the machine, so that it shall not interfere with the desired adjustment of the parts. In some cases, instead of making the entire knitting mechanism adjustable, the driving-wheel may be supported in eccentric bearings, which may be turned on their axes to move the said wheel into or out of gear with the pinion. The sewing mechanism employed may be that of any ordinary sewing-machine which has a horizontal shaft for operating the needle bar. On the driving-wheel there is a smaller wheel to receive a belt or cord for operating the machine by a treadle. The driving-wheel is fitted to turn loosely on its shaft, but is provided with a clutch or other contrivance, whereby it may be connected to the shaft or released therefrom, so that the driving wheel may be made to drive the sewing mechanism, or may be turned without driving the same as desired. Sometimes an adjustable wheel is fitted to slide on a key or feather on the shaft, and arranged to enter within the rim of a small wheel fixed on the driving-wheel, thereby locking the two wheels together, so that the required motion is imparted to the sewing mechanism, the same being stopped by simply sliding the adjustable wheel out of the other wheel.

In the figure, which is a plan of the machine, showing the knitter turned up and in gear with the driving-wheel, A is the bed or base of the sewing mechanism, the table on which it is generally mounted being removed; B B are the joints or hinges which connect it to the bed C of the knitting mechanism. When the knitting mechanism is turned up it is supported on a board or slab placed over the recess which receives it when turned down. F is the driving-wheel, fitted loosely on the shaft G of sewing machine; H is the clutch whereby the wheel is connected to the shaft; when it is desired to release the wheel, one part of the clutch is withdrawn from the other part; I is the frictional pinion on the shaft of the knitting mechanism, which is made to gear with the wheel F when it is desired to operate the knitter; J is the belt wheel or pulley, whereby the machine is operated from a suitably-arranged treadle. When the sewing mechanism is arranged like that of the machine known as the "Willcox and Gibbs," and others of the same class having an under shaft extending below the cloth plate, the patentee prefers to provide for throwing the sewing mechanism into and out of gear by making the pinion which drives the under shaft slide into and out of gear with the wheel on the driving shaft.



DRYING BY CHEMICAL ACTION.

THAT wonderful property, says the *Scientific American*, called by chemists affinity, which exists between different substances, exerts a force so much greater than any which is practicable to the resources of mechanics that it may be made one of the most effective means known whereby the desiccation of substances can be accomplished. Sometimes it may be employed singly. In other instances, it may be used in connection with heat or mechanical action, or all three may be used together. There are few substances that have no affinity for water, but there are some which seize upon it and hold it with such intense force as almost to defy separation. The strongest chemical reagents, such as sulphuric acid and the other strong acids, the alkaline bases, potassa, soda, lime, &c., owe much of their usefulness in the arts to their affinity for water. There are few substances that have so strong an attraction for water that some one of the alkaline bases will not seize upon it and hold the whole of it.

Of course, when water is an essential ingredient of a compound, and not an extraneous substance, its removal effects decomposition; and in all such cases, the use of chemicals for drying—as it not only removes the superfluous water, but injures what remains—is, of course, inapplicable. One of the most important processes in which chemical drying is employed, and one of the best illustrations of the principles upon which it is based, is that of *separation*, as it is called, in the soap manufacture. The fats or oils used for soda soaps are first saponified by an excess of the solution of caustic soda, technically called "ley." The soap thus formed contains glycerine, excess of water, and soda, which it is desired to remove. Now, although the soap has a strong affinity for water, it could be dried sufficiently by the slow and careful application of heat, but to do this would require a long time, and, besides being very tedious, would be a very expensive process. Soda, or chloride of sodium (common salt), has a much stronger attraction for water than soap. If either of these substances in strong solution should be added to the soap in sufficient quantity, and heat be applied, the following actions are set up:—The soap floats upon a strong solution, "ley," of soda or salt (sometimes both are used). The heat applied to the bottom of the kettle drives off a portion of the water in the solution, which is replaced by water attracted to the salt or soda from the soap; this is in turn converted into steam by the heat, and so on, the soda or salt taking water constantly from the soap, which the heat expels until the soap has been sufficiently freed from water. Meanwhile the soda ley has dissolved out all of the glycerine, and the water in departing from the soap has carried with it the excess of alkali, adding it to the solution at the bottom of the kettle, and so the purified soap floats in hard grains or lumps upon the ley. The soap being then drained is ready for the subsequent operations, which fit it for sale and use.

This is a fine example of chemical action combined with heat to eliminate water. Another illustration is the production of absolute alcohol by distilling it in contact with quicklime, the latter seizing and holding all the water contained in the alcohol, which then passes over and is condensed in the receiver.

Chemists pass gases through quicklime, chloride of calcium, calcined potash, or soda, to rid them of watery vapour. Polished metallic articles, liable to tarnish through the action of watery vapour, may be protected by placing them in a case in which is also placed a little quicklime. Whenever the lime falls into fine powder, it is an indication that it has absorbed all the water it can hold, and that a new supply of quicklime is required.

Very rapid drying without heat can be accomplished by the use of quicklime and a fan blower, using the same air over and over, first passing over or through the substance to be dried, and then over quicklime in lumps. The process can be accelerated greatly by heating the air on its passage from the lime to the substance to be dried (the heating greatly increasing the absorbing power of the air) and keeping the lime cold by means of tubes through which cold water passes. By regulating the heat properly, very delicate substances may be thoroughly desiccated without injury. The writer has applied this process in certain operations with great success. Where an operation of this kind is conducted on a large scale, the lime can be renewed over and over again by calcination, which drives off the moisture (and, perhaps, carbonic acid) it has absorbed.

The hints thus thrown out may serve as a guide to inventors who are devising means for the desiccation of fruits, vegetables, meats, &c., and for the concentration of milk, &c. Processes of this kind are being extended rapidly at the present time, and the preparation of articles of food, in a palatable form, and in a condition to keep a long time, is daily becoming of greater industrial and commercial importance.

TEA DRUNKARDS.

DR. ARLIDGE, one of the Pottery Inspectors in Staffordshire, has put forth a very sensible protest, says the *Lancet*, against a very pernicious custom which rarely receives sufficient attention, either from the medical profession or the public. He says that the women of the working classes make tea a principal article of diet instead of an occasional beverage; they drink it several times a day, and the result is a lamentable amount of sickness. This is no doubt the case, and, as Dr. Arlidge remarks, a portion of the reforming zeal which keeps up such a fierce and bitter agitation against intoxicating drinks might advantageously be diverted to the repression of this very serious evil of tea-tippling among the poorer classes. Tea, in anything beyond moderate quantities, is as distinctly a narcotic poison as is opium or alcohol. It is capable of ruining the digestion, of enfeebling and disordering the heart's action, and of generally shattering the nerves. And it must be remembered that not merely is it a question of narcotic excess, but the enormous quantity of hot water which tea-bibbers necessarily take is exceedingly prejudicial both to digestion and nutrition. In short, without pretending to place this kind of evil on a level, as to general effect, with those caused by alcoholic drinks, one may well insist that our teetotal reformers have overlooked, and even to no small extent encouraged, a form of animal indulgence which is as distinctly sensual, extravagant, and pernicious, as any beer-swilling or gin-drinking in the world.

REVIEWS.

Natural Philosophy for General Readers and Young Persons. By E. ATKINSON, Ph.D., F.C.S. London: Longmans.

THIS is an elementary and popular Natural Philosophy, translated and edited by Dr. Atkinson from Ganot's elementary work. It has its origin in a suggestion frequently made to its Editor, that he should compile an abridgment from his larger work, well-known by the title of Ganot's "Physics," which should be suited for elementary instruction, and in which mathematical formulæ could be dispensed with. Finding that to produce an abridgment of the larger book would be a work of difficulty, and, if it was to be anything more than a mere collection of extracts, would involve the re-writing of the greater part of the matter, Dr. Atkinson resolved to translate the book which Ganot had written with a similar object, and which, we need scarcely say, is as well suited to its purpose as the larger work. The present volume is not a mere copy of the more elaborate one, although, as a matter of course, the facts, and in many places the phraseology, may be the same. Neither is it a strict reproduction of the French original, nor a mere rudimentary exposition of the subjects with which it deals; for Dr. Atkinson has made such alterations and additions as fit the work for use as a text-book for the middle and upper classes of schools, while sufficient information is given to enable the recipient to pass the matriculation examination at the London University. The book is abundantly illustrated with explanatory and pictorial cuts, and is really the best work of the kind for junior students and drawing-room readers. There is a slight error in one of the illustrations, which it might be well to correct in a second edition. In Fig. 260 the letters *v* and *j* will hardly convey the idea that they are meant to indicate the positions of the green and yellow in the spectrum to those unacquainted with French, though a mistake could hardly be perpetuated when reference is made to the well-executed coloured frontispiece which represents the solar spectrum with Fauenhofer's lines, and the spectra of potassium, sodium, cæsium, and rubidium.

The Sun: Ruler, Fire, Light, and Life of the Planetary System. By R. A. PROCTOR, B.A., Hon. Sec. R.A.S. London: Longmans.

WE have already spoken in a favourable manner of this book, and need not now occupy much space in noticing the second edition, the appearance of which we hail with great satisfaction, not alone because it affords some evidence that its author is in a pecuniary sense reaping the reward of his indefatigable and painstaking labours, but because it is also a proof that the public are inclined to pay more attention than was formerly their wont to scientific subjects. This edition has been thoroughly revised, and contains much new matter, such as an account and an analysis of the observations made during the eclipse of December, 1870. Although Mr. Proctor did not wait for the observations made during the recent eclipse, his chapters on the circumsolar region are none the less complete, though the facts on which they are based are less striking than the overwhelming evidence obtained in December, 1871. Several new illustrations supplied by Mr. Brothers, Professor Young, and others, serve to make the volume the completest as well as the most popular treatise on the nature and phenomena of the sun hitherto published.

Geometrical Conic Sections. By J. STUART JACKSON, M.A. *Solid Geometry and Conic Sections.* By J. M. WILSON, M.A. London: Macmillan & Co.

THESE are two little books which will be found useful and suggestive by students of the subjects on which they treat. The first has been written with the object of giving the student the benefit of the method of projections as applied to the Ellipse and Hyperbola, a method calculated to produce a simplification in the treatment of those curves, and to make their properties more easily understood and remembered. Mr. Jackson points out in his preface that by this method it is a consideration of importance that we can see at once from the form of the cone the general form of the curves cut from it by a plane in different positions; and by turning the plane about a certain line we see how the curves pass from one form into another.—The little work by Mr. Wilson is written with the view of introducing into schools some portions of Solid Geometry now very little studied in this country. Short appendices on Transversals and on Harmonic division are added, and the chapters on Conic sections are condensed to suit the wants of schoolboys by defining these curves as sections of a cone, and immediately deducing their fundamental properties, and by taking the ellipse and hyperbola together where possible.

A Treatise on the Metallurgy of Iron. By H. BAUERMAN, F.G.S. London: Lockwood & Co.

THIS is the third edition, revised and enlarged, of an account of the production of iron, which is tolerably well known, and is generally favourably received. It is a concise treatise on the manufacture of iron, giving a short but ample history of iron working, the methods of assay, with analyses of iron ores, and the various processes employed in the production of iron and steel. The author has availed himself of the numerous and valuable works published on the subject in Germany and France, as well as the elaborate and expensive volumes issued in this country. The additions to the present edition have been introduced in their proper positions, and include a notice of the Siemens-Martin steel process and the methods proposed by Heaton, Ellerhausen, and others; but we miss a description of the Danks' mechanical puddler, although previous attempts in this direction are recorded. This will be considered a fault in a work which is otherwise well suited to convey accurate knowledge on the most important metal industry of this country. The book appears to have been in the press in the autumn of last year, which would probably account for the omission—an omission to be regretted, but which by no means invalidates the book from being one of the best treatises on the subject in a small compass extant.

Electrical Tables and Formulæ. By LATIMER CLARK and ROBERT SABINE. London: E. and F. N. Spon.

MESSRS. CLARK AND SABINE have here brought together a mass of information of great value to telegraph inspectors and operators, which is, moreover, we believe, perfectly reliable. It would be impossible within the limits of a short notice to enumerate the various subjects on which information is given, suffice it to say that everything necessary for designing, working, and laying out telegraph lines, whether land or submarine, together with many useful tables founded upon actual practice, find a place in this book, and although the authors say that in bringing together so heterogeneous a mass of materials it was found difficult, if not impossible, to follow consistently any systematic plan of arrangement, the volume is none the less valuable on that account, while a copious index supplies an efficient remedy for a defect which was unavoidable. Many of the first electricians have furnished contributions, and the writings of others have been utilised in making the book a perfect vade-mecum for the constructors and manipulators of the telegraph.

Elements of Chemistry: Theoretical and Practical. By W. A. MILLER, M.D., &c. Revised by HERBERT MCLEOD, F.C.S. Part I. *Chemical Physics.* London: Longmans.

THIS is the fifth edition of Dr. Miller's well-known "Elements of Chemistry," which has been revised throughout, but without being altered unnecessarily. The rapid progress made by recent research in some branches of physical science, however, necessitated additions to the text as left by Dr. Miller in the fourth edition—the most important of these being, of course, those relating to solar chemistry and the theory of atomicity. Noting these facts is all that is necessary in recommending to students this new edition of a work of established reputation.

Geological Survey of Ohio. Report of Progress in 1870. By J. S. NEWBERRY. Columbus, Ohio: Nevins and Myers.

THIS is one of the yearly reports of those exhaustive surveys carried out in the different States of the great Republic of America, forming a volume of nearly 600 pages, with several maps and geological charts, showing the formation of the surface and the positions of the various strata as found in the State of Ohio. These geological surveys are prosecuted in America under State patronage, and by means of State funds, and result, as a rule, in the collection of information of importance, directly or indirectly, to every citizen of the State; thus the object of the survey is, first, a general view of the relations of agriculture to geology; a classification of soils according to their chemical and physical characters; an inquiry into their sources of fertility, their adaptability to different systems of agriculture, their deterioration, renovation, &c.; second, a description of the natural soils of the State classified by districts and properties; an inquiry into the sources whence they are derived, their adaptations, their changes under cultivation, methods and materials for the restoration and maintenance of their fertility, with an investigation into the properties and distribution of such fertilisers as are found within the district. Besides all this, chemical analyses of the minerals found are made; their uses and the best methods of working them are pointed out; in fact, this geological survey, of which these yearly volumes are but portions, embraces the physical features of the country, its climatology, and an account of its productions; the natural history of the principal animals inhabiting it, and elaborate treatises and catalogues of the botany, zoology, and palæontology of the region. It must be acknowledged that this is good work, work which will not fail to make a handsome return in the future for the money and time expended on it.

Pocket-book of Mechanics and Engineering. By JOHN W. NYSTROM, C.E. Philadelphia: Lippincott and Co.; London: Trübner.

THIS is a really valuable pocket-book for the mechanic and engineer, containing as it does the first principles of every science with which they have to deal, and of others with which they have no concern in their occupation. Thus, it includes the prominent facts of mathematics, with the integral and differential calculus, geometry, land surveying, "railway mechanics," astronomy, acoustics, dynamics, chemistry, hydrostatics, optics, &c. It is replete with useful and reliable tables, and bristles with formulæ. The calculations have all been made with Nystrom's Calculator, which received the first premium at the Franklin Institute Exhibition. There is an ample supply of explanatory woodcuts and plates, and altogether this is one of the best "pocket-books" we have ever seen.

Catalogue of Model Steam-Engines and Castings. London: John Bateman.

WE have received from Mr. Bateman a copy of his catalogue of model engines and castings, and the useful tools which he also supplies. Those of our readers who are intent on making model engines, steam-hammers, pumps, and sundry other machines, will do well to procure a copy. The idea of supplying the rough castings of the various parts, on which the amateur could exercise his ingenuity as fitter and finisher, originated, we believe, with Mr. Bateman, and a very good idea it is. There are hundreds of amateur mechanics who would occupy their spare time in a useful and instructive manner, if suitable materials for them to work upon were provided. The difficulty and cost of obtaining the requisite castings, which it is almost impossible the amateur should make for himself, has hitherto stood in the way of the more universal development of latent ingenuity and skill; but this state of things has been put an end to by Mr. Bateman, from whom the castings of parts of locomotives, engines for model boats, and various other mechanical contrivances, are now to be obtained at certainly a moderate expense, and with a very little expenditure of time and trouble. Those of our juvenile readers, too, who have a little spare time on their hands, cannot occupy it in a more pleasing or profitable manner than in constructing a model engine, and a perusal of Mr. Bateman's catalogue will show them how to set about it.

We have received numerous books which we cannot spare space to notice at present, and many others to which we can only briefly refer. Among these is a pamphlet *On the Curability of Cancer*, by Dr. G. von Schmitt (Wyman and Sons), in which the author asserts that cancer is curable by medical treatment without surgical operation. Dr. Schmitt employs plaisters and ointments as remedies for cancerous tumours, and says he has had fair success. He gives an account of the medicaments he employs and prints some of the "testimonials" he has received. Of his system we can only say that as condurango has been thought worthy of trial at several public institutions, the same plan should be adopted with Dr. von Schmitt's method—that is, if he is willing. — *Science Lectures* (John Heywood, Manchester) is a book of 140 pages, containing the discourses delivered in the Hulme Town Hall, last year, by such men as Professors Huxley, Roscoe, Odling, and Wilkins, and Dr. Carpenter. The lectures appear to have been well reported, and the book is simply "dirt cheap."—*The French Student's Pocket Vade-Mecum*, by B. E. le Bret (John Heywood), is a concise list of verbs, &c., for handy reference.—*A Bird's-eye View of the Metric System*, by George Hogg (J. Heywood), is a sheet containing the metric measures, weights, and money, with the British equivalents, but omitting the metric equivalents for the various English weights and measures. — Messrs. Griffin send an excellent series of *School Board Readers*, adapted to the requirements of the new code. The series comprises two parts of the elementary reading book, and books for the six standards, "containing no distinctive denominational teaching." The series has been edited by a former "Her Majesty's Inspector of Schools;" but we should think he would hardly award a prize for grammar to the boy who said "The sow is bad for the boy did hit *him*" (Lesson 15).—*The Year-book of Facts for* 1872 (Lockwood and Co.), is similar to the volumes issued in previous years. Independently of the fact that the "cuttings" are not always taken from the best sources, a few editorial notes would be of great assistance to uninitiated readers, numbers of whom may retain the impression, for instance, that Mr. Payne's magnetic engine is the wonderful discovery which the account given on page 143 makes it.

THUNDERBOLTS AND LIGHTNING.

WE are indebted to an American correspondent for a copy of the Philadelphia *Public Record* containing an account of a lecture delivered by Professor John Wise, at the Wagner Institute, on "Thunderbolts and lightning." The lecturer commenced by saying that he had no speculative theories to subserve, but would simply relate the facts as observed in his investigations of the phenomena of lightning, and would then show by these facts that the lightning rod too often played the part of an incendiary. After reviewing twenty-nine cases of lightning stroke that occurred in Philadelphia last summer, and showing that the greatest loss of property took place under the supposed protection of the lightning rod, he noted a large number of cases that occurred in other places. The destruction of the extensive pattern shop of Morris and Co., and the Pekin woollen mills of Manayunk, caused a loss of over 100,000 dollars, and both those establishments were defended by lightning rods. He stated that small bodies of iron when struck by a thunderbolt, will scintillate vivid sparks, and thus ignite any adjacent inflammable matter. He also reviewed three cases of lightning stroke as they occurred in Iowa City, Terra Haute and Indianapolis, where the lightning was communicated from the rod to the gaspipes in the buildings, set fire to the gas, and then passed out to the gas mains in the street, where, in one case, it burst the lead packed joints here and there for a distance of 1,000ft. and in the other two it totally burned out the lead packing, leaving nothing but a little dross in its place.

The lecturer arrived at the following conclusions derived from an examination of many cases during the last three years:—That lightning is an accumulation of force in the cloud. That when the cloud becomes surcharged it explodes with a discharge always toward the earth. That it generally comes from the west and south-west. That its main force is in its axial line of projection. That it strikes buildings indiscriminately as to lightning rod or no lightning rod, and that in either case its dynamic force appears to be the same. That when it strikes a bar of iron, as a spike or clamp, or even a shingle nail, it burns the surface and scintillates bright sparks, which are capable of igniting adjacent inflammable material. That a thunderbolt is neutralised the instant it meets its correlative equivalent of metal surface. That when it strikes the lightning rod, that being only a fractional quantity of its neutralising equivalent, and the earth or water at the rod's terminal point being but a poor conductor (four hundred millions of times slower than iron), it meets a cul de sac, recoils and heats the rod sufficiently to melt its point and to scintillate sparks from its surface which set fire to the building. That in a house with a metal roof there is no danger of harm from a thunderbolt, either to persons or property. That whenever the lightning rod is struck by a thunderbolt it proves its own inefficiency, since Franklin's theory was that it would prevent thunderbolts, not catch them. That there is no reliable evidence of upward strokes of lightning and that the recoil of a thunderbolt upon the rod is what leads to that notion.

VOLCANOES AND EARTHQUAKES.

THE following paper, by Mr. W. H. Corfield, which bears upon a subject of interest at the present time, and also upon the discussion which has been carried on for the last month in our pages, is extracted from *Nature*:—

The remarkable series of volcanic phenomena which have lately been exhibited at various parts of the earth's surface within so short a period of time, gives much matter for consideration, and must in due time afford us a rich harvest of facts with which to test the numerous theories which have been started to account for the occurrence of volcanic eruptions and of earthquakes. Even from our at present scanty information we have, I think, something to learn.

First in the series, so far as I am aware, was the very severe earthquake at Independence, Inyo County, California, which took place on Tuesday, March 26, commencing at 2 a.m., and lasting till 7 a.m., during which time "the earth was never for a moment perfectly quiet, and every few minutes heavy shocks, of a few seconds' duration, were occurring; in all there were more than fifty very heavy shocks." This place is only fourteen miles from the Black Rock, a volcano in the Sierra Nevada mountains, "the sides of which are covered with lava, and which is supposed to be an extinct volcano." It is stated that "during the time the shocks were most severe, flashes of light were seen to issue from the top of this mountain, and streams of fire ran down its sides."

The result of this earthquake is summed up in a few words as "the whole country turned topsy-turvy" (*Virginia City* (Nevada) *Enterprise*).

Then a few days afterwards came the terrific earthquake in Antioch, which commenced on April 3, and continued with greater or less severity, "in Aleppo, and as far east as Orfa, beyond the Euphrates," for more than a week, becoming very severe on April 10; here there appears to have been no actual volcanic phenomenon; but it appears from the letters of the Rev. W. Brown in the *Times*, that there exists in the immediate neighbourhood a mountain, "the peculiar conical form of which is very suggestive of an ancient volcano."

The latest African news tells us that "several violent shocks of earthquake had occurred at Accra, on the Gold Coast, on April 14 and 15, causing considerable damage to the place." And as unwonted atmospheric disturbances have often been connected with volcanic phenomena, it may not be out of place to mention here the fearful hurricane which wrecked every vessel but one in the Harbour of Zanzibar on April 15.

And then on April 24 began the recent eruption of Vesuvius, which will be for ever memorable, not only on account of its magnitude and grandeur, but also, and still most so, by reason of the amazing intrepidity of the man, who, from a pure love of science, remained at his post, like the gatekeeper of Pompeii, throughout the whole of that terrible time, but happily was not, like that heroic soldier, buried in a shower of ashes; the world was spared the loss.

Now, is there any connection between these phenomena exhibited in so distant parts of the earth's surface? One thing is certain—namely, that within the short space of a month all this has occurred, and one can hardly help thinking that somehow or other these volcanic countries must be connected underground; it has long been thought that Etna and Vesuvius are points on a volcanic area which passes north-west to the Eifel, Auvergne, and Iceland; has the neighbourhood of Antioch, with its unenviable notoriety for earthquakes, or the West African coast, anything to do with this area? But if so, what shall we say of the Sierra Nevada? Why should its volcanoes be active at the same time? Why should the country there be "turned topsy-turvy" by earthquakes?

While pointing out these coincidences, we must not jump too hastily to conclusions from them; for on the one hand we are told that although the Antioch earthquake extended so far east, yet, to the north and south, even at a few miles' distance, nothing whatever was observed; and, on the other hand, that the Californian earthquake was of so superficial a character that "at Hot Springs, while severe shocks were felt on the surface, the men in the mines, 200ft. deep, felt nothing of them." Now, the evidence goes to show that the latter earthquake was directly connected with the eruption of a volcano in the neighbourhood, so that, although the origin of the disturbance may be underground, possibly at a very considerable depth, the shocks are at a certain distance quite superficial, and, moreover, are transmitted in certain definite directions.

Taking all these facts together, they would rather seem to favour the conclusions that at any rate a great many, if not all, of the volcanic regions of the world are connected, and that they are not merely parts of the earth's surface which happen to be over isolated subterranean furnaces, but places where access to the exterior is more easy for the molten matter which lies underneath a great part, perhaps all, of the earth's crust. I must not be understood to be upholding the (shall I say exploded?) theory of the internal fluidity of the earth; I merely mean to point out that such coincidences in point of time ought to make one hesitate before rushing to the other extreme, and looking upon volcanoes as mere local eccentricities.

But it will be said, if there is any general commotion under even the volcanic area of Europe, why do not the extinct volcanoes of Auvergne break out again? Here is a difficulty which is not at all solved by the suggestion that at first occurs to one, that as the raising of the country has drained the enormous lakes, on the borders of which these volcanoes stood, there is no longer a supply of water to rouse them into action, for are there not lakes still in the Eifel, nay, are not those lovely lakes actually in the craters of extinct volcanoes?

Again, who has seen the wonderful natural harbour of Messina from the high ground above the town without believing it to be an extinct submerged crater? If there be still liquid rock below these craters, it may be that they are no longer the points of least resistance. And this is the probable explanation of their inactivity; for it must not be imagined that an eruption of Etna or of Vesuvius, or of any other volcano, necessarily means an ejection of ashes, lava, &c., from the crater, or from any crater; not at all, the weakest point in the vicinity gives way, and thus we have the numerous cones formed which surround every considerable volcano for some distance.

The mention of Auvergne leads me to make a few remarks on the disputed point, as to whether or not the volcanoes in that country have been in eruption within historic times, especially as I see that a correspondent (see also let. 4203, p. 254, from the Rev. H. C. Key) has come to the conclusion originally drawn by "an eminent historian and antiquary, Sir Francis Palgrave," as long ago as 1844, and adopted by theological writers ever since, that because a Bishop of Vienne established Rogation days on account of some alarming terrestrial phenomena which happened in his diocese, therefore the volcanoes of Auvergne were in action at the time. We have two documents which refer to this matter—a letter written by Sidonius Apollinaris (who lived in the very centre of the Chaine des Puys, and on the border of a lake which was actually formed by the damming up of a stream by one of the most recent of the lava-currents) to Mamertus, Bishop of Vienne, in which he speaks of the earthquakes that had occurred in the neighbourhood of Vienne; of fire issuing from the earth and wild beasts taking refuge in cities; and the Rogation Homily of Alcimus Avitus, the successor to Mamertus, which mentions the same catastrophes.

Now, in the first place, Vienne is more than seventy miles in a direct line from the more recent Auvergne volcanoes; in the next, Sidonius himself makes no mention in his writings of any eruptions having taken place in his neighbourhood, although he wrote poems describing the beauty of the scenery; and even Auvergne is not mentioned by any ancient writer, except by Cæsar, who encamped there and laid siege to a city situated on a table-land, with craters close at hand in almost every direction; nor by Pliny, who gives a list of all the then known volcanic countries, including some very out-of-the-way ones; nor by Strabo, nor by any of the poets, as a country where volcanoes were ever known to have been in action.

For these reasons, and because no volcano could have burst out near Vienne without leaving some traces of its existence, Dr. Daubeny concluded that the Bishops of Gaul alluded to earthquakes; especially as "the underground thunder, the opening of fissures in the ground, the bursting out of flames and gases, the projection of water and of stones, the smell of sulphur, the alarm evinced by the animals of the spot and neighbourhood, the elevation or depression of the land, noticed by Sidonius and by Avitus in the passages referred to by Sir Francis Palgrave, are all reported as concomitants of the great earthquakes which have occurred in more recent times." Geologists have since accepted this conclusion as the correct one, in opposition to what I may call the theological position.

There was, however, a volcanic region which had not been visited by any English geologist, and which had not been described—viz., the basin of Montbrison, through which the Loire flows. Of this Mr. Scrope says in his work (2nd Ed., p. 28), "a further examination of this basin seems very desirable;" now, as this district lies about half way in a direct line between the "Puys," about Clermont Ferrand and Vienne, it occurred to Dr. Daubeny that the disturbances spoken of as in the neighbourhood of Vienne, might have taken place around Montbrison, and accordingly, in the autumn of 1866, he visited that locality, and I had the honour of accompanying him on the occasion. We examined carefully the volcanic hills of the neighbourhood, and could find no trace of recent volcanic eruptions: in his own description of this expedition published in the *Quarterly Journal of Science* for January, 1867, and republished in his "Miscellanies" (Vol. I., p. 74), just before his death, he says:—

"I am now prepared to say that, without pretending to have surveyed the entire district, I saw enough to convince me that no volcanic disturbance which had occurred within this area at so late a period as that alluded to could have escaped our notice, and that every indication of igneous action which presents itself throughout the country bears marks of a much greater antiquity.

"Thus much, at least, I can venture to affirm—namely, that neither craters, streams of lava, scoriæ, nor even cellular trap, are to be met with anywhere within the limits of this district. On the contrary, the only igneous rocks which came under our observation consisted of a compact basalt, containing nests of olivine, a material which could only have been elaborated by the aid of great pressure, and under a different configuration of the surface from that now existing."

The Doctor therefore reiterated his statement that "the lively picture drawn by Sidonius" should not "be regarded in any other light than as the offspring of a lively imagination, dwelling upon reports which had reached the author with respect to some fearful earthquake which may have occurred in the neighbourhood of Vienne."

I will conclude by advising those who wish to study volcanic phenomena to go to Auvergne: they can do so at almost any time of the year, mid-winter, when it is far too cold for comfort, being the exception; they will there see results of volcanic action far more varied and instructive than at Vesuvius or even at Etna, and they will also be able to study the effects of denudation on a gigantic scale. Few geologists seem to appreciate the fact that within 24 hours of London is one of the largest, richest, and most beautiful of the volcanic countries in Europe.

HINTS ON COLOURING PHOTOGRAPHS.

THE increasing demand for coloured photographs, either as cartes-de-visite, stereoscopic enlargements, or slides for the magic lantern, opens a suitable field of labour, says Mr. J. Martin, in the *Photographic News*, for the educated of either sex; in fact, they are the only fit persons to undertake it, as it requires a lightness of touch not generally possessed by those accustomed to labour. But none can hope to succeed without some degree of talent, and who have had a sufficient practice in the use of colours to enable them to paint a tolerable picture without a copy, not a vile travestie of some chromo-lithograph, which is often the only practice afforded to school pupils. No particular box of colours, however prepared, will bridge over the want of experience.

The greasiness of the surface of albumenised paper offers some obstacle to the uninitiated, but this is easily overcome by adding a little prepared ox-gall to the colours used, or even by passing the tongue over the surface. The greatest drawback I have found has been the difficulty of obtaining purity of tints in the half-shades and reflections of the flesh, owing to the muddy-brown colour to which the print has been toned, a sort of smudge which no transparent colour can remedy. This, and the tendency of silver prints to become yellow by age, has often caused me to consider whether it might not be better, when they are especially prepared for colouring, to use some other process, which would give a more favourable tint for working upon. As I believe any variety of tint can be given in carbon printing, this, with its permanence, would point it out as the most preferable, but would, probably, greatly increase the expense of a single copy only.

When oil colours are to be used, two or three coatings of weak size, made of gelatine, should be given to the print beforehand, and allowed to dry. As in water, transparent colours can be used, and the effect much improved by touching the high lights with opaque ones.

In portraiture, should the painter be sufficiently master of his art to paint a good picture in the usual way, he will find it much better to use the photograph as a copy than as a substratum.

Transparencies on glass must always receive a weak coat of varnish before colouring, otherwise dabbing in the skies will do injury to the impression.

It should be understood that there is a great difference between colouring—that is, tinting—a photographic print and painting upon one; the former requires little more than tasty manipulation, the latter the skill of a well-trained artist.

Retouching negatives also offers suitable employment, especially for female artists, as it requires light and delicate handling. I should think that an artist capable of retouching from the life—that is, taking sittings from customers—would be considered a desideratum in many photographic establishments, and be liberally remunerated.

ACTION OF A MAGNET ON THE ELECTRIC LIGHT.

THE following account of the action of a magnet on the electric light is contributed by Professor E. J. Houston to the *Journal of the Franklin Institute*:—

Having occasion recently to set up a large battery for experimental illustration of the properties of the light of the voltaic arch, I noticed a fact which I believe has hitherto escaped observation. The battery consisted of about eighty half-gallon cells; fifty-five were Browning's modification of the nitric acid battery of Grove. The negative element consists of sawed strips of very dense coke, the positive element of zinc, so arranged as to use both surfaces of the coke. The remaining cells were of the iron battery. When first set up, the arch between the carbon electrodes measured fully 2in., while the flame frequently reached an equal distance above the upper carbon. The quantity of the current was very good, much better, in fact, than the size of the plates would have led me to expect.

The phenomenon to which I would call attention is as follows:—Wishing to show the well-known experiment of the rotation of the light by a magnet, I approached a compound bar magnet to the light, holding it with one end pointing directly to the arch, in a horizontal plane equidistant between the carbon electrodes. When the nearest end of the magnet was 4in. from the electrodes, the light was instantly extinguished. The regulator of the light which was employed is a form recently patented by Browning of London. The carbon points are kept at a constant distance from each other by the action of a small magnet worked by the battery current. Though inapplicable to small batteries, for the current I employed it gave a light admirable for its steadiness. Thinking that the extinguishing of the light was produced by some cause other than the approach of the magnet, the experiment was repeatedly tried in a number of ways, until it was clearly shown that the cause could not be attributed to accident, but to the approach of the magnet. Though I have failed to find any published notice of this phenomenon, it seems probable that it may already have been observed, as the conditions of the experiment would be almost exactly reproduced whenever the rotation of the light of the voltaic arch by the magnet was tried. Still, it may be conceived that though the necessary conditions for success in this experiment have often been *nearly* reproduced, they have seldom, if ever, been exactly reproduced; for it was noticed that in no case was the light extinguished, unless the length of the arch was nearly as great as the tension of the electricity admitted; that is, unless the electrodes were separated by nearly their maximum distance, consistent with the passage of the current. Were this condition not observed in all cases, the approach of the magnet produced no other effect than the rotation of the light, until it assumed a position in a vertical plane 90° from a similar plane passing through the magnetic axis of the bar. Then, again, another necessary condition is that both the tension and the quantity of the current be of a strength greater than that of the current on which the experiment of rotation is generally tried. I have experimented with flames when these latter conditions were absent, and although the rotation was observed, the extinguishing of the light was in no instance produced. The compound bar magnet employed is formed of three bars, held together by brass screws. It is 1ft. long, 1in. broad, and ¾in. thick, and is not at all remarkable for the strength of its magnetism.

As to the cause of the phenomenon, I think it may be attributed to the tendency of the flame to rotate on the approach of the magnet. This might cause the extinguishing of the light in two ways; either by the irregularities on the surfaces of the carbon electrodes offering greater resistance to the passage of the current from some points than from others, or by the current being unable to pass through the greater distance of the arched path, which is always assumed by the light on the approach of a magnet. Another assumption, which, though perhaps not as simple as those already mentioned, is at least as probable, is that on the approach of the magnet, there is a slight increase in the non-conducting power of the medium between the electrodes, produced by their polarisation, and which, though always acting, can only manifest itself in a striking manner when the distance between the electrodes is near a maximum, and the tension of the current is exerted to its utmost in passing through the non-conducting medium. This assumption of the polarisation of the medium between the electrodes, and its consequently diminished power of conducting the current, seems to be somewhat sustained by the fact, that a powerful electro-magnet, in the form of a horse shoe, when approached, did not extinguish the light, although it produced rotation of the current, for we may conceive that the two poles, acting simultaneously on the medium, would neutralise each other's effects.

I noticed, on several occasions, that the south pole of the magnet would not extinguish the light until it was approached 1in. nearer than the north pole, namely, to within 3in. of the electrodes. This, however, may have been accidental.

THE RECENT ERUPTION OF VESUVIUS.

THE following is the substance of a lecture delivered at the University, Naples, by Professor Palmieri, on May the 9th, as reported by the *Times* correspondent:—

Great interest was excited by it. Several thousands assembled, and on Professor Palmieri entering the hall he was received with a round of applause. The terrible conflagration of the 26th of April, said the Professor, may be regarded as the finale of the eruption which began on the 1st of January, 1871, and has lasted, with alternations, up to the present time. It generally happens that the eruptions, which are small and gentle at their commencement, terminate with great violence, carrying destruction to human dwellings and devastation to the country. Among the most fearful eruptions which history records was that of 1631. It is related that on that occasion 4,000 human beings were killed, and 6,000 animals, cattle and sheep. Three centuries had elapsed since the mountain had given signs of activity; grass grew in the very crater, and shepherds took their flocks there to pasture. Thus it happened that taken unexpectedly many were swallowed up in the abyss which was opened; many were drowned or buried in the fiery flood, and others were destroyed by the pumice and burning stones which were vomited out of the summit and from other mouths. In strong centrical eruptions—by which is to be understood those which come from the upper cone of Vesuvius—great fissures are usually produced, which eject matter from as many different mouths, the lowest of which are the most dangerous. Such was the case with the recent eruption; for on the night of the 26th of April a mouth was opened in the Atrio del Cavallo, in the long fissure which had been made previously. The opening of this mouth formed, as it were, a hill in the Atrio del Cavallo resembling a chain of small mountains, and from underneath the lava issued calmly and rapidly, like a river of fire, while from the principal cone was ejected a continuous and violent shower of lava, smoke, ashes, and other fiery projectiles, which rose to the height of 1,500 metres (between 5,000ft. and 6,000ft.), while the mountain thundered terribly. Many had gone on that day and evening to see the lava, several of whom the Professor had endeavoured to dissuade from entering the Atrio del Cavallo. Those who arrived later and remained until after midnight became the victims of their curiosity. Between 2 and 3 o'clock in the morning the Atrio opened with a fearful roar, and from the new mouth issued the lava with great impetuosity, wrapped in a cloud of "boiling" smoke, ashes, and red-hot stones. Those wretched persons who were there were scalded by the smoke and wounded by the projectiles; some of them died immediately, others later. Of the others who remained on the farther side no traces remained, they having been swallowed up and buried by the burning stream. Those tremendous disasters may be foreseen and prevented, but a good service of guides is necessary; moreover, the Observatory should be well arranged, well organised, and good *employés* appointed to remain on the mountain during the eruption to give the alarm. On the night of the 26th of April the lava precipitated itself into the Fosso della Vetrana, and, descending on the incline of the mountain over former beds of lava, invaded S. Sebastiano, Massa di Somma, and Coreola in the Cupa Giorvano, so called because, as it is said, that famous painter had a villa there. From 1852 to the present time the lava has filled up the Fosso della Vetrana to the height of 200 metres; if further additions be made hereafter, the Observatory must be destroyed, as the last lava is only a few metres under its level. The lava here has the breadth of a kilometre, and on the banks of this river of fire—a remarkable and novel phenomenon—small craters have been formed by the lava, which thundered like the principal crater, and ejected smoke, ashes, and stones to the height of 70 or 80 metres. These observations are of great assistance to science, as they show the course of operations in the interior of Vesuvius. I trust, said the Professor, that the lava will not make me pay dear for this good service by invading the Observatory. The velocity of the lava varies from 180 metres a minute to a few millimetres, depending much on the condition of the land, being quicker on the incline, less so on the plain and where there are obstacles. Issuing in a liquid form from the mouths, it runs with great velocity, but slackens its pace as it advances, cooling gradually, and forming, as it were, a skin on the surface. This increases in solidity, and so the progress of the stream is diminished. When the lava ceased, Vesuvius continued to eject ashes and pumice, and still thundered; then the roaring ceased, and the rain of ashes decreased in quantity. Afterwards came heavy storms, which are commonly dangerous, as they are the occasion of great floods which, carrying down the ashes and pumice which cover the mountain, complete the ruin of the lands which have been spared by the lava. After the eruption of 1631, the floods were so strong that the damage done by them was not less than that occasioned by the lava, and the lands of those who suffered were exempted from taxes for ten years, like those which were damaged by fire.

There are some who think—and the opinion is general among the agriculturists of the Vesuvian district—that the ashes are beneficial to the land as manure, but that they injure and sterilize it if water be added. The analysis of these ashes shows that a portion is soluble in water, another part not. This has the same properties as the contemporaneous lava, and is a species of silicate which may be useful to the land. After the eruption of 1812 there was an extraordinarily abundant harvest in the Puglias, and it was attributed to the ashes of Vesuvius, which had been carried there by the wind. The ashes soluble in water, however, containing chloric acid, sulphuric acid, salmarina, burn land and wither vegetation. The beautiful country near Vesuvius which had been exposed to the recent conflagration is now a scene of squalid desolation. The harvest of this year is absolutely lost, and of that of next year we cannot indulge any cheerful hope. During the late eruption a report was spread in the city, giving rise to great alarm, that the crater of Vesuvius had become an electric pile, and that at a certain hour a strong earthquake would shake Naples to its foundations. That report was exaggerated, but the currents of electricity developed in the volcano were very strong. These phenomena do not accompany all eruptions. In this, the latest, the Professor observed a large quantity of lightning which flashed in the great pile of smoke and ashes which rose from the crater. The noise which accompanied this lightning varied according to the length of its duration. When short, the noise was full and round, so to speak; when it was longer it produced a sound which was dry and hissing like that of tearing paper. The lightning is generated by the violent ejection of smoke and ashes, by means of which the electric current is established. The lava is now firm; is spent and yet smokes—not to be wondered at after so recent an eruption. We have seen the lava of 1858 still smoking in several places. These jets of smoke are called "fumaroli." These smoke-holes are communications between the upper crust of the lava which has hardened and the internal mass still incandescent. Around these holes are formed sublimates of oxide of copper, of chloric acid, of sal ammonia, of sulphur, &c., which invest the lava with forms and colours at times the most beautiful. The Professor said he had analysed the smoke which rose from the lava, and had discovered that it dissolves in salt water. From this he inferred that the waters of the sea are disturbed by those terrible convulsions, and are mingled with the fire. At the conclusion of his lecture, Palmieri said that on the evening of the eruption Vesuvius appeared to sweat fire through every pore, which by night appeared like so many specks of flame attached to the back of the dark cone; by day those flames were changed into smoke. Palmieri thanked the authorities and all others who had manifested so lively a sympathy for him, which had well repaid him for the labour and anxiety he had undergone for the benefit of science. What I now send is, says the correspondent, of course, only the digest of a lecture which will, no doubt, be published. It is, however, a faithful report, as I have been permitted to translate some notes which were taken on the occasion. Many addresses from public bodies have been forwarded to Palmieri expressive of admiration, and his Majesty has sent him a distinguished decoration—the Grand Cross of St. Maurice and Lazarus.

THE ANTI-MILDEW GRAIN PROTECTOR.

A MECHANICAL method of preventing corn and seed in bulk becoming affected with mildew has recently been shown in London by Messrs. Adutt and Co., of Mark-lane. It is an invention by Mr. Joannides, and consists of an arrangement of perforated and solid tubes, on the principle of the siphon, whereby the air is passed through the mass of the corn as stored in the hold of a ship, in granaries, or in warehouses. It is well known that the commercial value of cargoes is frequently reduced by a portion becoming damaged, and then as the samples taken from each hold are mixed by the brokers for disposal in the markets with a view to insure a fair average, the whole cargo thus really becomes reduced in price. This and many other illustrations which might be given would show that the prevention of mildew is not only of high importance intrinsically, but considerable expense might be well incurred to avoid the deterioration of large quantities on the voyage. For hay ricks, too, a good system of internal ventilation would go a long way towards preventing heating or in facilitating drying. The apparatus consists mainly of a system of double tubes, one external and perforated all over, the other internal and only perforated at the end of each branch. The arrangement is as follows:—There is first a vertical perforated cylinder, from which fore and aft and port and starboard perforated arms extend in single or in two or more tiers. The cold air taken in at the bell mouth of the vertical tube descends, and finds escape partly through its own perforations and partly through those of the branches, and thus intermingles with the grain through every interspace. When heated or under pressure in the closed hold, a portion of this air escapes by the internal tubes, and thus a constant circulation is maintained, as may be shown in the models by means of smoke. A full-sized machine ordered for Wallachia may be now seen at Messrs. Rotherall and Bastin's, Blackfriars. In length its tubes are 32ft., across the ship 19ft., the vertical tube being 13ft., or, in other words, the tubes extend nearly across the hold in both directions; above the hatches the tubing to the bell-mouth will rise some 7ft. For granaries and other magazines, where a strong current cannot be insured as on board ship, an Archimedian screw arrangement has been made for forcing down the air into the store amongst the corn. Experience will no doubt show other advantages and applications. The plan has the merit of simplicity and of working without need of any continuous attention.

CHEMICAL NOTES.

Potash from Maize.—The American *Journal of Pharmacy* gives the results of some researches into the chemical constituents of the cobs of Indian corn. In a series of analyses it was found that the cobs contain on an average, in 1,000 parts, 7·62 parts of carbonate of potash, or nearly twice as much as the best specimens of wood. Statistical data are given showing that, taking the average production of corn in the United States alone, there might be extracted from the ash of the cobs, quantities of which are used as fuel for steam-boilers, no fewer than 51,612 tons of pure carbonate of potash, while, moreover, a quantity of chloride of potassium may be simultaneously obtained: 100 parts of the cobs, dried at 100°C., contain on an average 1·171 ash, consisting of 0·899 KCl, 0·836 K_2CO_3, 0·230 silica, lime, iron, and charcoal, and 0·105 loss.

The Formation of Glycogen in the Liver.—Some years ago Dähnhardt removed the glycogen from numerous livers, and then found that, by the action of gently oxidising substances, glycogen could be obtained, which, by the action of saliva, was again convertible into sugar. In other words, he maintained that there was or might be a post-mortem formation of glycogen. Dr. Luchsinger has lately repeated these experiments in Kühne's Laboratory, with a different result. He thinks that Dähnhardt did not entirely remove the glycogen originally present, and that if this were thoroughly and completely extracted by rapid division of the organ after death, and boiling the pulp in successive quantities of water till all opalescence had ceased to appear, no further formation of that substance would occur.

Detection of Vitriol in Vinegar.—The following process will, says the American *Journal of Pharmacy*, detect the 500th part of free sulphuric acid, and is accurate for all practical purposes. An ounce of the vinegar to be examined is reduced by evaporation on a water-bath to about half a drachm, or the consistency of a thin extract; when quite cold, half a fluid ounce of strong alcohol is added, and thoroughly incorporated; the free sulphuric acid will be taken up by the alcohol, to the exclusion of any sulphates; the alcoholic solution should stand for several hours, and then be filtered; add to the filtrate 1 fluid ounce of pure distilled water, and evaporate the alcohol off by the application of a gentle heat; the remaining liquid is then left for several hours, and again filtered; to the filtrate, previously acidulated with a few drops of pure hydrochloric acid, a solution of chloride of barium is added, which, if sulphuric acid be present, will yield a white precipitate.

A New Method of Obtaining Potassium.—Professor Dolbear gives the following as a new method by which he obtained potassium:—White stick caustic potash of commerce was dissolved in water and then treated with sulphuretted hydrogen in the way commonly described for making potassium sulphide, K_2S. The solution was evaporated until it was solid when cool, when the yellowish mass was mixed with more than its bulk of iron filings and chips, and the whole put into an alembic for distillation. The heat of a furnace was applied till the alembic was of a bright red heat, and the products of distillation were received in common coal oil. The product was rather small, as some of the potassium vapour decomposed the heated vessel; nevertheless, the potassium showed itself, when the oil was poured off and the residuum turned upon water, by its characteristic ignition and flame. The reaction is simple, and may be thus represented: $KS + Fe = FeS + K_2$. He says that he has not conveniences for experimenting upon this on a scale large enough to test its comparative value; it needs some special arrangement of protected vessels, as it violently attacks common crucibles, porcelain, and glass. The materials used for thus obtaining it are of the required cheapness, and the iron sulphide product can again be used to furnish sulphuretted hydrogen for another quantity. It is probable that sodium can be obtained by an analogous process.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

GLASS SUN-SCREENS—THEORY OF VISION—PAINTING THE SPECTRUM—PURCHASE OF A SPECTROSCOPE—AND SECONDARY REFLECTIONS.

[4223.]—DID Mr. E. L. Berthon (let. 4148, p. 224) ever try *smoking* the field-lens of an eyepiece for solar observation? It is only a rather rough way of doing what he advocates, absorbing light and heat by minute solid particles. In the one case they are of carbon, in the other of silver; but the principle is the same. It is no novelty.

I begin to see that "E. J. D." (let. 4161, p. 227), is writing, not for his ostensible purpose of obtaining information, but in reality for the sake of arguing. Commencing on p. 510 of Vol. XIV. (let. 3493) with an account of an experiment which, I sincerely believe, he had never tried, he requested to know how certain alleged effects were produced? Since then he has kept up a desultory fire of questions, every one of which he might have answered for himself by reference to any decent work on optics; and now, in his last communication, he makes a variety of vague shots and random assertions, and demands an explanation *not of what really occurs*, but of his own imperfect and confused ideas of it. What, I should like to know, does he imagine to be (so to speak) the dimensions of a ray of light? because he talks of one as though it were a cylinder of the size of an average walking-stick. Has he no means of access to any work dealing with the amplitude of the vibrations of the differently coloured rays? And can he not thence form some notion of the uncountable millions of rays which would be thrown off his hypothetical statue? As for what he says about mirrors and their action, I confess that his argument might be enunciated in provincial Japanese for all that I can make of it. How on earth can "direct parallel rays" proceed from any part of a man's body to a mirror? Rays *diverge* from a point, though, of course, the more distant such point is the nearer they approach to parallelism. Surely, "E. J. D." does not wish me to reproduce the time-honoured diagram of the gentleman of easy manners in knee breeches and a bag wig, admiring himself in a looking-glass; which has done duty in books of optics as an illustration of reflection since a period long anterior to that at which any reader of these lines entered this world? I really should be ashamed, sir, to ask you to engrave it. Besides, "E. J. D." can easily make a simple sketch for himself. For example, if he will draw his own profile facing a mirror, surmount his head with a tall conical cap, and from the apex of this cap draw lines to represent rays radiating in every possible direction, he will find that a certain portion of such rays only will reach the mirror. If now, at every point of contact of these rays, he will erect a perpendicular, and make the angle of reflection of each ray equal to its angle of incidence, he will see immediately what rays will reach his eye, and will hence be able to determine at once in what direction the reflected image will appear. Again, his notion—or rather Sir David Brewster's—of "three primary colours," has been long since exploded, Helmholtz, Sir John Herschel, and Maxwell, all having shown that prismatic yellow and blue can, under no circumstances whatever, be made to produce green, while a mixture of prismatic green and red *does* produce yellow. Moreover, the spectroscope demonstrates irrefragably the definite character of the refrangibility of the various colours of the spectrum. Who, too, if it be not a rude question, has been cramming poor "E. J. D." about Encke's Comet, "and the settlement of "the ridiculous theory of ether existing in space"? and, supposing that it were proved to-morrow that Encke's Comet was retarded by (say) Mercury, how could, or would, that affect the theory of the luminiferous ether? The real fact, however, is that "E. J. D." has all this time (while apparently sitting in *statu pupillari*), been engaged in instructing me, and I, ungrateful wretch that I am, even now don't see it.

"Utile Dulci" (query 11875, p. 236) may paint the spectral colours upon his disc by employing the following pigments—he should use the ordinary cake (not moist) water-colour paints, and rub them up with water to the consistence of cream—carmine, Mars orange, cadmium, lemon yellow, emerald green, ultramarine, Prussian blue, and rose madder. I may add, as possibly being of some use to your correspondent, that if he divides the circumference of his cardboard circle into 360°, violet will fill a sector of 109°, indigo one of 47°, blue one of 48°, green one of 46°, yellow one of 27°, orange one of 27°, and red one of 56°.

"W. H. H." (query 11906, p. 237) will scarcely get a spectroscope of any use to him under five guineas, at which price what is called the student's spectroscope is sold. By the aid of such an instrument, and a Bunsen's burner, he will soon learn to identify the spectra of many of the metals and metalloids, and to map them; as also to compare them with the dark absorption lines in the spectrum of sunlight. I do not think that a micro-spectroscope is a good thing to begin with. It shows the absorption bands in various vegetable infusions, in blood and other fluids, &c., beautifully; but although all this is curious and interesting enough, it is of very limited and special use, and teaches the student very much less as to the great fundamental principles which underlie spectrum analysis than does the form of instrument which I have advised "W. H. H." to procure. Having mastered this, he may have a spectroscope fitted either to his microscope or telescope, and will be in a condition to employ it to advantage. I have mentioned five guineas as the smallest price at which an efficient instrument is procurable, but if my querist can afford ten guineas he will get a very superior one. Beyond this price, however, I would certainly counsel him, as a beginner, on no account to go. I would, in conclusion, recommend "W. H. H." by all means to go to the leading maker. A "cheap and nasty" spectroscope is an uncommonly poor investment.

Is Mr. Buchanan (let. 4188, p. 251) perfectly certain that the appearance which he attributes to double *refraction* has not its origin in double reflection instead? I mean to a second reflection from the inner surface of the window pane. This is a phenomenon of the very commonest occurrence.

A Fellow of the Royal Astronomical Society.

LONGITUDE — JUPITER'S TEMPERATURE — PRONUNCIATION—THE PLANET VULCAN—AND DOUBLE STARS.

[4224.]—In its existing form the letter (4143) of "L. T. Y." on p. 224 admits of no answer. All that your correspondent says, in effect, is that, by observing the transit of a star, or stars, he found his clock to be 49sec. wrong. But then he goes on to add the wholly inexplicable assertion that he "found the average correction to be 49·23 sec.," and that he has "since ascertained, from official survey map, the exact correction to be 49·87 sec." The exact correction with reference to what?—the difference of longitude between his observatory and his office—the Philadelphia Observatory, or where? because not a solitary scrap of information does he give with regard to this, the very gist of his question. The whole communication is a puzzle: because Philadelphia (the High School Observatory) is 7m. 34s. east, or fast, of Washington, the American initial Meridian. Nor does the introduction of the English *Nautical Almanac* mend matters, inasmuch as Philadelphia is 5 hours and 38 seconds west, or slow, of the Meridian of Greenwich, for which our British Ephemeris is computed. Besides, it is of no earthly use for a man to determine his local time (even with the most refined accuracy), for the purpose of ascertaining his longitude from some other station, unless he knows the precise time at such station at the exact instant of his own observation. How any possible means can exist of "determining correction for longitude without the aid of other observers" is a profound and awful mystery to me.

The question (11883, p. 237) of Mr. Whitaker directed my attention to the article in the *Cornhill Magazine*, "A Giant Planet," which I have since read through with a great deal of interest. After my own expression of opinion, repeated more than once in these columns, as to the enormous extent of Jupiter's atmosphere, my querist will readily imagine that I have somewhat carefully considered everything that has been advanced to account for the marked changes which even moderate telescopic power enables us to detect in it. I do not think, then, that I am exaggerating when I say that the author of the paper referred to seems to me to have propounded the only theory that gives even a plausible explanation of the appearances which we witness. If we assume, as we have every right to do, that the members of our own Solar system had a common origin, and have cooled down from a state of incandescent gas, then, obviously, the largest bodies, and notably those surrounded by the densest atmospheres, would retain their heat the longest. I find then no difficulty in the conception that Jupiter may, even yet, retain a temperature such as that postulated by the author of the essay in the *Cornhill*. I do not say that this theory will account for *all* the phenomena recorded, because other causes have probably operated in producing them. If, for example, there be any truth in the recently advanced idea that the colouring of Jupiter's equatorial region undergoes a *periodical* change, this certainly would seem to demand something more than the mere constant effects of an invariable high subjacent temperature, and of the planet's rapid rotation, to explain it; but this would scarcely invalidate the theory advanced by the *Cornhill* essayist, if we view it as an explanation of the leading phenomena exhibited by the "Giant Planet." "The name of the writer is not given," as Mr. Whitaker remarks, but I really should trouble myself exceedingly little as to the authorship of such a paper as the one we have been discussing. Personally, I should endeavour to ascertain, in the first place, whether the writer's assertions were made concerning facts; and in the next, whether his inferences from such facts were legitimate ones. Once satisfied on these points, it would matter nothing to me whether such an essay proceeded from the pen of the Astronomer Royal or from that of Orton "the Claimant."

In answer to the second part of Mr. Whitaker's query, I may tell him that Sirius is pronounced with the first *i* as in sit; and with reference to the third, express my belief that the planet Vulcan has no existence. I by no means intend to assert that a planet, or planets, may, and do, not exist between Mercury and the Sun; but as to Lescarbault's planet, to which the name of Vulcan was given and an orbit assigned, it seems morally certain that it *must* have been picked up long before this had it been an objective entity.

I cannot find any very recent measures of ζ Boötis (asked for in let. 4222, p. 257), although I have a strong impression that some were made and published not long since. The latest that I am cognisant of, of η Coronæ, are those by Mr. Knott, who gives position angle 45·85°, distance 1·003", epoch 1871·54. Why does not Dr. Blacklock try ξ Ursæ Majoris, of which the components are now, as nearly as may be, 1·05" apart? This is a good deal within the theoretical separating power of his aperture, but is a very good test notwithstanding.

A Fellow of the Royal Astronomical Society.

MR. GOSSE'S "OMPHALOS."

[4225.]—Mr. Gosse (let. 4204, p. 255) invites me to *answer* his "Omphalos." I most distinctly decline to do anything of the sort. There is simply nothing in it to answer. At the risk of being again accused of "gratuitous ungentlemanliness," I say, quite deliberately, that I never read such a mass of utter rubbish in my life as the book in question; and I assert with the utmost confidence that this opinion will be found to be justified by every single review of the work which appeared in the scientific journals at the time of its publication. I feel, however, that an apology is due to Mr. Gosse for my assumption that his performance had passed into the butterman's hands; as it would seem to be still cumbering the shelves of Mr. Van Voorst. Requiescat in pace.

I protest against the implied notion that an anonymous writer is bound to say smooth things. If there is one thing that I hate utterly, it is quackery, be it religious, scientific, literary, or political; and if any man, even my nearest and dearest friend, puts forth a mischievous or (as in this case), merely a hopelessly foolish book, neither fear nor favour shall prevent me from giving an honest opinion of it in the very plainest English at my command.

"Accepting my postulates," says Mr. Gosse. Exactly: Accept the postulate that 5 — 3 = 19, and see whether I will not deduce results before which "The Glorious Metric System" shall pale and dwarf into utter insignificance.

And now, lest, as is probable, a very large proportion of your readers should wonder what this precious book is all about, and imagine that there may really be something in it: let us hear its pervading idea, as tersely expressed by the great American essayist, Oliver Wendell Holmes:—"Mr. Gosse can believe that a fossil skeleton, with the remains of food in its interior, was never part of a living creature, but was made just as we find it—a kind of stage-property, a clever cheat, got up by the great Manager of the original Globe Theatre." This is "reconciliation"—with a vengeance!

A Fellow of the Royal Astronomical Society.

A NEW FORM OF COMBINED VIOLIN, &c.

[4226.]—I have before tried to deprecate any appeal to me by "The Harmonious Blacksmith" (let. 4201, p. 254) on subjects of which he is a most thorough master, but of which I am even as a little child learning its alphabet. If I wanted an opinion, or information, recondite or elementary, with regard to any form of musical instrument, he is (merely as a matter of course) the first man whose aid I should invoke; and here he is claiming *mine!* Such an inversion of the proprieties has scarcely occurred since Mr. Tapley was moved to exclaim (anent Martin Chuzzlewit's apology to him in Eden), "The head partner a asking forgiveness of Co., eh? There must be something wrong in the firm when that happens. I must have the books inspected and the accounts gone over immediate."

But, having guarded myself from any possible imputation of a claim on my part to speak *ex cathedrâ*, I may say that the ingenious instrument devised by "The Harmonious Blacksmith" seems to possess considerable capabilities for the performance on it of *simple melody*. It seems to me, though, that the bridge (or whatever answers to it, for this is not indicated in his sketch) would have to be very much arched, and this would necessitate a peculiar style of bowing. Fingering, too, would, I fancy, be a bit of a puzzle. These, however, are matters of detail, and in no sense affect the principle of the instrument. I should not anticipate the difficulty alleged as a probable one by "The Harmonious Blacksmith's" friend—viz., the want of synchronism in the vibration of the soundboards, tied together as they would be; but it is almost impossible to reason *à priori* with reference to so perfectly novel an arrangement, and "an ounce of practice" would most peculiarly in this case be "worth a pound of theory."

Should "The Harmonious Blacksmith" go to the cost of having his curious invention constructed, it will be interesting to learn the result of his first fiddle.

A Fellow of the Royal Astronomical Society.

OBSERVATIONS ON "THE HARMONIOUS BLACKSMITH'S" NEW FIDDLE.

[4227.]—Since reading the interesting letter of our musical friend, I feel several inches taller, and in return, hope "The Harmonious Blacksmith's" shadow will never grow less. But I must again draw "our" readers' attention to the great difference in producing tones by percussion and bowing. I may beat a drum more and more, and till it bursts it will sound louder and louder; this applies to all percussion instruments, but I cannot bow a string, increasing the pressure every time, and produce music; instead of that I should have a series of terrible noises or shrieks. Therefore, it seems to me impossible for one string (bowed) to move more than one soundboard, made of the same wood. Our new fiddle would do if we had a string to each soundboard, and I would ask could one string be connected with each breast without the admission of a soundpost? I do not mean to go through the middle of the series, but attached by some arrangement of bridges, bringing them under one bow. It may be remembered that I noticed lately the curious fact, that if a violin string is bowed directly on its side, half the power is gone (to be bowed near the nut), but still more curious, the tone when played in this mode is revived when the soundpost is removed. I think from this that the soundposts in the new fiddle would act as dampers to the tone, because the strings would be played on their sides. I say on their sides, for having no bridge there would be no distinction between one side or other of the strings. I wish all instrumentalists, especially violoncello players, to notice the hint I gave about sound reflectors for the back of fiddles. I tried the tone of a violoncello with a piece of mahogany placed against its back, and it was increased not a little, but very much. Of course, this is treating the fiddle as a musical box; it sounds better on a table than when held in the air. However, don't run away with the idea that a box made of hard thick wood would be better; it would act the contrary, so would a box of soft wood. Yet I am inclined to think that the reflector should not be of uniform thickness, but I am ignorant on this point. Two pieces of half-inch stuff, however closely placed together, make a bad reflector, but in the whole condition of 1in. is very good. Does not this seem to point to the idea of so many atoms or centres being required to each tone, these grains together forming columns of resonant matter? If the said columns were not required, metal soundboards or reflectors would do better than wood. The grain of the wood, I need hardly say, forms the columns I allude to. We may now understand the reason why the breast of a violin is made in two pieces or halves. The bridge has two feet, one on each piece, and they act and react on each other. Now, if we had more pieces, we should have more centres, atoms, and columns for the sound, but the bridge would have more feet to connect them, if that were possible to manage. I want to enlist the sympathies of Mr. Schucht in this matter of violin breasts and reflectors (both distinct things), especially after reading his observations on soundboard construction, on p. 71, let. 2734, Vol. XIV. There is a law hinted at and a promise to describe it. May I respectfully ask him to favour us with the description, as I think it might apply to the present subject? He states, I think, that in a soundboard constructed of narrow lengths of hard and soft wood alternately joined together, friction was caused between the two opposites. How about making the breast of two pieces, one thick, the other thin, hard or soft? If this would answer, then we might do without the back, and making another breast, so as to bring the different kinds of wood under each other, connected by soundposts alternating on each side of the bridge (it will never do to have them directly under each other), we should be able to bow the top side of the strings, and thus get the full benefit of this combination.

Fiddler.

STRANGE AND RARE MUSICAL INSTRUMENTS.

[4228.] — "The Harmonious Blacksmith" (let. 4137) will find a good description of the corno di bassetto or krumm-horn, in Albrechtsberger's "Thorough-Bass and Harmony," three volumes in one, p. 250. Extract therefrom:—"It is distinguished from the clarionet by being curved, and reaching a third lower, and has the largest compass of all wind instruments; contains four whole octaves in regular order. The clarionet is to the corno di bassetto what the hautboy is to the English horn, and both may be termed branches of the same stem. The scale is the same as clarionet, but it contains four lower notes.

Aleph.

[4229.]—Corno di Bassetto (not de), Basset Horn, a species of clarionet, sounding a fifth lower than its notation. Its tube, which is longer than the clarionet, is bent about the middle, forming an obtuse angle, and has at the lower end a small metal bell. By the aid of special keys it produces two notes which are wanting in the clarionet—viz., small C and D (really large F and G). Its scale is written in the G clef, extending from small E to three-lined D (really large F to two-lined G). Mozart uses it in his opera "Il Clemenza di Tito;" and in the Requiem wherein the whole chorus of wood instruments is represented by two basset horns and two bassoons. Its tone is soft, elegiac, and rather lugubrious; it is very rarely used, having given place to the more powerful clarionet. The Germans call it "krumm-horn"—*i.e.*, crooked horn, a corruption of which term, "Cremona" is still used by organ-builders, as the name for the stop which closely imitates its tone.

Strathburys, Glasgow. W. B. Marshall.

PRIMITIVE PIANOFORTES, *ALIAS* DULCIMERS, WITH AND WITHOUT STRINGS.

[4230.]—IT may be held to be evidence of an uncultivated musical taste, but I can't quite get over my affection for one of my early loves, to wit, the dulcimer. Doubtless, this is a very primitive sort of pianoforte compared with our modern repetition concert grands, but, like most old things, which have not become quite extinct, and also some which have, it has some elements of goodness, for it is capable of yielding sounds whose loudness and timbre may be varied at the will of a skilled player to a much greater extent than those of any pianoforte with manual keys I have had the good fortune yet to hear.

About forty years ago a man, then considerably past middle age, used to obtain his rather precarious livelihood by singing in the streets and in public-houses, especially at old Bagnigge Wells tavern, then one of the few existing predecessors of the modern music-hall. This not very refined vocalist, who, like Mr. Sims Reeves, was troubled with a chronic hoarseness, accompanied his not remarkably sweet voice on a large dulcimer, possibly ancient French "Pantaleone," "converted," as my religious friends term it, and having wire substituted for its original catgut strings. His instrument was far longer than any other dulcimer I have seen, being about 7ft. long by, perhaps, 2ft. 6in. wide in the middle. In form it was a truncated triangle, about half a yard wide, or, perhaps, less at each end, and its compass was, if I remember correctly, four and a half octaves from F F to C in alt. It was a trichord (although it had not what the piano advertisers term a "trichord action," whatever that may mean), for about two octaves, bichord to about C C, and below that note unichord. It had no covered strings, but F F, which was about 6ft. long, was strung with copper wire, nearly, if not quite, one-tenth of an inch in diameter. This instrument was tuned in the scale of F major, without any semitones not in that key, so but very little modulation was possible on it.

The certainly clever, if not very refined, performer on this primitive pianoforte, held in his hands two triple-headed hammers, whose three heads, each about 1¼in. long, were covered with leather, differing much in thickness and hardness, one pair being extremely hard, and used—excepting for the higher treble notes—almost exclusively for fortissimo passages; another pair, which were of medium hardness, were those he generally employed. The third pair of hammers being, like the writer, extremely "soft," made the instrument do what he has been doing for a long time—viz., "sing small"—*i.e.*, pianissimo. As these hammers were disposed radially at 120°, and their sticks had three flats—I don't mean E flat major, but three flat surfaces, whose positions corresponded with theirs—the performer could change his hammers instantaneously by causing their sticks to perform one-third of a revolution between his fingers and thumbs, by which he held them; in a word he was able very easily to "get down to the flats," which was more than the Claimant said was possible on or with the French horn. I fear he, however familiar with "flats," was not quite up to the Attorney-General or Mr. Hawkins, probably because they are "sharps," certainly not B or other flats.

This three-headed cerberus—I mean hammer—enabled the performer to vary the loudness and timbre of the sounds to a greater extent than any pianist can do (for few pianofortes are provided with two sets of hammers), even if his instrument be provided with that excellent thing the celeste; consequently, the powers of expression of the dulcimer player exceeded those of any young lady who has learned (or whose trusting parents fondly suppose to have learned) the "Pihanner." From the proportions of its strings I need hardly add this was a very powerful instrument, indeed this is a necessity when you have to perform in the public streets, and are *assisted* (?) by a continuous cart-wheel accompaniment. It was far louder than any grand piano then made; both its bridges were fixed on its sounding board, which must, I think, have caused it to produce louder sounds, at least in the bass; besides which, as the performer held his rather long-handled hammers in his hands, he was enabled to strike its strings with far greater force than any player can do who has to perform on an instrument provided with a mechanical action, be that action "Der Englisch Mechanick," the German action, invented by Stein, or even Erard's French mechanisck (said to be the most powerful of all, which I greatly doubt), Mata's, *alias* Hopkinson's, action, which I know to be more powerful than any other now in use, or even my own horizontal grand action, which far surpasses them all in the force with which its hammers strike the strings. This very primitive pianoforte, *alias* dulcimer, was, indeed, a very effective instrument for accompanying the voice, and was, in my opinion, far superior to small bells for instrumental performance.

Some quarter of a century later, when the performer on the above instrument must, in the ordinary course of Nature, have "gone over to the majority," as the French people express the termination of mundane life, I became acquainted with an old journeyman pianoforte-maker, who was often seen (and heard) in the City performing on a very powerful dulcimer, which he constructed something like one of the modern fashionable six-feet grands. It was a trichord instrument throughout its compass, six octaves from C to C, with the semitones complete, seventy-three notes, excepting about an octave and a half of bichord-covered strings in the bass. Although, perhaps, two feet shorter, it was considerably wider than its predecessor above described, and its sounds yet more powerful, excepting, perhaps, in the lower part of its bass; at this we need not be very much surprised, when I relate its trichord C's were strung with No. 16, 17, 18, and 22 wires. Power, in the sense of loudness, was, indeed, almost a necessity for accompanying the remarkably loud bass voice of its constructor, who, if surpassing Stentor had been the chief qualification for that office, might, like E. J. Reed, have been "Chief Constructor to the Navy," for his voice rivalled Lablache's in power if not in purity and sweetness—sooth to say, there was but little "sweetness or lightness" in it, and the very smallest conceivable "melos" in his melody. Genealogies are sometimes rather difficult to trace, but I think my "horsey" friends would, had they but heard him, have had not the least difficulty in determining its parentage, and that, in sporting phraseology, it had certainly been "got by Mr. Black Smyth's Big Rubber out of Mr. Ffrench Roll Baker's Rough Rasp." The "Harmonious Blacksmith" is extremely sorry to add that that regard for truth which distinguishes him compels him to testify that he often hears many voices, both masculine and feminine, which sound to him very much as if they were descended from the same dam and sire.

We owe something to the dulcimer, doubtless it was the father of the pianoforte, and is a very old friend indeed, not to mention that it formed part of the collection of musical instruments which belonged to our amative and harmonious sovereign, Harry the Eighth, who, poor man, must needs have required all the musical instruments he could purchase to preserve him in harmony with his many wives. It has not yet quite gone out of use even "until this very day," in those conservative—Mr. John Stuart Mill would have written "benighted"—localities yclept country places. Well can I remember, when a young man (alas! like the days when we went gipsying, "a long time ago") the dulcimer was in frequent use, not only for accompanying the voice, but even as a solo instrument, of some pretensions. It has long been known to the Wise Men—also to certaynge and sundrie other not wise—men of the East, under its oriental names, Santir and Sar Mudal. In Poland and Hungary it is known by the names Cymbaly and Cimbalon, but the old clavicembalo, or keyed cembalo, seems almost certainly to have been a virginal, spinett, or harpsichord, whose strings were plucked, not struck by hammers. Specimens of the Oriental santir, also of English and Italian dulcimers, are in South Kensington Museum, some of which have four, or even five, unisonous strings to each note, enough to frighten, if not to horrify, a modern pianoforte-maker, who fears to employ more than two or three strings at most for one note.

Although I see by an editorial announcement that "the pianoforte alliance" is likely to be carried out without any assistance of mine in what a fellow correspondent termed "organising a plan" (most cordially do I wish the said alliance every success, and that it may prove to its members "La Belle Alliance"). I fear it has been my misfortune (by incidentally mentioning the opinion of the late W. F. on the possible cost of producing good, plain, cheap, pianos) to excite hopes which seem far from realisation; for in our present not very far advanced state of civilisation, in which property is held by individuals and not in common, if a piano costs £10 to make its maker must possess an amount of self-abnegation—or imprudence—not very often to be met with in ye British manufacturer of pianofortes, or other commodities, if he were habitually to sell it for prime cost. "Needs must when the thingummy drives," and, there is no "thingummy" like poverty, so he may occasionally be compelled even to do this, which enables his Christian brother to take advantage of his misfortune, and practically illustrate the wise precept "do as you are done by," by buying a bargain; but such bargains, although advertised daily, are not always to be purchased, and, I fear—or rather hope—the members of the piano alliance will have to pay for their instruments prices which afford the maker sufficient profit to live on until all they, at least, have their turns served—after which, of course, the maker may go to the "thingummy" if he cannot do better. So much for the bargain hunters, with whom I have but small sympathy, but as many fellow readers resemble the writer in thinking they could spend considerably more money to advantage if they had it, and, possessing more brains than money—in which respect, by the way, they do not resemble the writer at all, for he possesses very little brains indeed—would be quite willing to purchase a piano if they could (but cannot) afford to do so, I would suggest that a very tolerable substitute for one—especially if only required for accompanying the voice—is a really good dulcimer, say such an one as that last described. It might be an improvement to extend its compass to F in the treble, and, where room is not important, to make it about 2½ft. longer, so that its C C C string might be about 6ft. long between its bridges. I should also recommend making all its covered strings the same length as the longest uncovered ones, which would be about those of C C, a bichord note of (say) No. 30 steel wire, the first four bichord notes below it being covered on No. 28, the eight notes below them, unichord, covered on No. 30. Such a primitive piano as this would not cost more than about a fourth what a plain piano stands its maker in, for like the unsuccessful litigant, it has "no case." I hope, Mr. Editor, none of my fellow readers will not consider it their duty to "abuse its solicitor."

Before I conclude—which by this time the reader will probably be quite willing I should do—I may remark that strings with a soundboard are not the only instruments of "mysick" which can be struck by hammers held in the hands, or impelled by some kind of "mechanick." Bars of wood, glass or metal, plates of either of the latter materials, whether flat or rendered concave (when they become gongs or bells, in proportion to the degree of concavity imparted to them), or, indeed, almost any sonorous and elastic substance, may be substituted for strings, often to great advantage; but the generic name of all these instruments is harmonicon, or harmonica, not dulcimer. According to the various materials employed for producing sounds, they "suffer a change," not invariably into "something rich and strange," for often they have assumed the various forms of the old familiar nigger wooden harmonicon which a fellow correspondent lately asserted was invented (?) by a German organ builder. So I suppose it logically follows that Lord Lytton's doubts as to the origin of the Teutonic race are now quite solved, and the Germans now proved to be veritable niggers, which must needs be a very great consolation to the French. The modern zylophone is another example.

(Query: Is this anything else than the claquebois, or straw fiddle, of the French?) the Greek name of which, evidently, was not selected by one whose head was also ligneous, for it is notorious that a good Greek word goes a long way in the musical as well as in the commercial world. Allied to these are the rock harmonicon and other harmonicons of glass and metal, of which the Javanese Gender is one of the very best, because its sounds are augmented by the resonance of air chambers. For this instrument the designation of dulcimer, in the sense of producer of dulcet sounds, would be very appropriate.

THE HARMONIOUS BLACKSMITH.

BELL PIANETTE.

[4231.]—I HAVE not at present the name of the patentee, but I will search and send it as soon as I can. In the meanwhile, "Ye Harmonious Blacksmith," may find, if he has not done so already, some very interesting descriptions of similar instruments in Dr. Brewster's "Natural Magic" (Family Library).

S. BOTTONE.

PIANO QUATOR, ALIAS TETRACHORDION.

[4232.]—ALTHOUGH not directed to me, I take the liberty of answering the query put in letter 4155, p. 225, as my relations with the inventor, M. Baudet, of Paris, and my business transactions with Messrs. H. Stead and Co., the purchasers of the patent, enable me to speak with confidence. The tetrachordion was first exhibited under the name of "Piano Quator" at the Paris Exhibition, 1867. The English patent was bought last year by Messrs. H. Stead during the course of the London International Exhibition of 1871. Messrs. Stead thinking, doubtless, that a Greek name would be more palatable to the English public than the French one, changed its title to tetrachordion, with what propriety I shall not attempt to determine.

S. BOTTONE.

HIMMER'S GALVANIC BATTERY.

[4233.]—THIS arrangement of cell, described by you in No. 369, p. 113, has had a careful testing at my hands. You express a desire that any of your readers who might experiment upon it should communicate the result. The following is my experience:—Two cells were constructed, the details precisely as you gave them, and then left undisturbed. In the course of a few hours the inner vessel C (in your diagram) became two-thirds full of the copper solution—in fact, it rose, as expected, to a level with the cork inserted in the flask. The current of these two cells, although feeble, was sufficient to work my electric clock, which it continued to do for a few days, but with gradually diminishing energy. I now found that although the copper solution formed a distinct line in the vessel, a slight diffusion took place throughout the whole of the saline solution in the outer vessel, giving it a faint blue tinge, and, of course, precipitating on the zinc, thus wasting that element and diminishing the energy of the combination. I am confident that no arrangement could be adopted where an entire separation of the fluids could be obtained for any length of time—we know that not even porous cells will effect it. The battery, therefore, in my hands is a failure. I trust, however, that the experience of other experimenters will be given in your pages, and that it may prove more satisfactory.

GEO. FOX.

SAFETY LAMP FOR MINERS.

[4234.]—IN your issue of May 17th, you have given a prominent place to an account of Mr. Plimsoll's Safety Lamp for Miners, as if it were a novelty. Lest he or your readers should suppose that the idea of making a lamp to go out when firedamp enters it is new in itself, or its application, I beg to draw your attention to the fact that the first lamps made by Sir Humphry Davy had the same objection (!) and were abandoned by him on account of the inconvenience which the extinction of the light causes. Others have made lamps on the same principle. I have in my possession one of Eloin's lamps, which is almost identical with Mr. Plimsoll's, and which inevitably goes out in an explosive mixture, and for that reason is not used or approved of. If the viewer of a mine, in searching for firedamp, had to grope his way in the dark back to a safe place every time he encountered a small collection of gas, in order to re-light his lamp in safety, his operations would be slow and laborious. The fact that an explosion of gas takes place, in any degree, within a lamp whose openings are so limited in number and extent, raises a doubt as to its safety. See Sir H. Davy's remarks and experiments on this point.

A. K. J.

ENTOMOLOGICAL.—ON EGGS.

[4235.]—EGG hunting is difficult from the smallness of the objects; however, many eggs may be found if diligently sought for. Both sides of the leaves, and also the stems of the food plants of the larvæ should be looked upon; the bark of trees, when rough, is often a favourite place to find eggs on. A few kinds lay their eggs on aquatic plants. One great secret in egg hunting is to know the appearance of the different kinds of eggs, of which, I fear, only a very few are even tolerably well known; and an examination of the anal segment of the female often will show likely positions for the eggs, according as the ovipositor is long or short. Of course, any unusual protuberance on plants should be well looked at. Another, perhaps easier, method of procuring eggs is that of inducing females to lay in captivity. Some kinds lay very easily, whilst others, on the contrary, lay with great difficulty, and sometimes need the food plant.

Most of the butterflies require space and the presence of the food plant, though I have found some (such as *A. Galatea*, *C. Pamphilus*, and others) lay without these incentives. Some of the moths require to be fed on sugar and water from a small piece of sponge, and many of them require suitable surfaces, whilst other moths cannot be induced to lay at all. I do not think that it is a good plan to put eggs on the food plant while being hatched, but they should be placed in the sun for a short time daily about the time of hatching. Finally, eggs should never be handled more than is absolutely necessary, and I recommend all collectors to make notes on all eggs they have anything to do with.

ENTO.

COLLIERY EXPLOSIONS AND THE WEATHER.

[4236.]—AN ingenious plan for diminishing the risk of explosion from increase of fire-damp with diminution of atmospheric pressure was suggested many years ago, but has never, so far as I know, been fairly tried; some of your readers may, however, be better informed. The proposal was to diminish the atmospheric pressure artificially in the mine when the men and their lights are away, so much as to make it unlikely that it would be as much diminished naturally when they are present. If this were done at short intervals (say once a day), it would most frequently prevent unexpected evolutions of gas from goafs, or other cavities, in excess of the ordinary ventilating power, and thereby diminish one of the great risks of mining. The mode proposed for diminishing the pressure of air in the mine was by stopping the downcast shaft, while the air is pumped out of the upcast by a ventilating engine or fan. It was expected that rarefaction, equal to a fall of an inch or two of the barometer, might be got, and as much of the gas of goafs, &c., forced out harmlessly as would be forced out by an equal fall of the barometer. I am sorry I cannot call to mind the name of the ingenious proposer of this plan.

P. H. HOLLAND.

AMERICAN SCIENCE.

[4237.]—"TRAVELLER" (let. 4214, p. 256) may be assured I do not "ignore all American Scientific Authorities," nor does he quite truly characterise my remarks (p. 228) as "sneering at the testimony of Americans." Science is of no nationality, except that, as far as America is concerned, the conditions of life, and the turn of the national mind, are unfavourable to that devotion to abstract research which constitutes science as distinguished from the practical application of the teachings of science. Therefore, of course, I should accept the teachings or evidence of an American scientific man as on a par with those of English, German, or French authorities. But it is very different with the mere loose gossipry which commonly passes for science, and very different when we are considering mere extracts from newspapers, or statements made in "popular" lectures.

The fact is, that there are constantly put forth in America statements which are utterly fallacious, often mere jokes, which pass from paper to paper till they assume the form of received truths. One instance is that to which I referred—viz., Paine's electro-motor, which was supported by the most determined assertions, and published as an established fact, despite of the ridicule and opposition of the really scientific men of America itself.

Another instance I will give, which touches also upon the authority of the "Year-Book of Facts," which, useful as it is, being a mere compilation, is not necessarily to be taken as an authority to be relied on. Some years ago (I do not now remember the time, but I think over twenty) there was a great American scientific discovery which was to supersede the "Morse's telegraph." One of those gentlemen who study Nature (?) discovered (or said so) that snails possess a power of sympathy closely allied to that claimed by human clairvoyants; two snails thus in sympathy would answer to each other's motions, though the whole body of the earth was interposed. The discoverer made up sets of nests corresponding to the letters and other signs needed, and in the corresponding nests placed snails thus "en rapport;" when the snail in (say) B nest, at New York, was touched, the sympathetic snail in B box, at London, moved its horns, and thus it was easy to transmit messages across the world. N.B.—I read the account of this in the "Year-Book of Facts," given with perfect calmness as one of the discoveries of the year, made in America, and quoted from American papers. No doubt it originated in a joke, one of those peculiarly American jokes. But such jokes are the ground of my remark that I should require anything rather out of the way, and given on American authority, to be well supported.

SIGMA.

ON MANCE'S METHOD OF MEASURING THE INTERNAL RESISTANCE OF A VOLTAIC CELL.

[4238.]—"SIGMA," in his excellent papers on electricity in the ENGLISH MECHANIC (which, it is to be hoped, will be published separately, and, if the suggestion may be pardoned, will include the method about to be described), did not allude to the mode of measuring the internal resistance of a cell, which Mr. Mance laid before the Royal Society in January of last year; and, as I have seen no notice of it in your columns, I am disposed to think it is not so widely known as it deserves to be: since, for simplicity, rapidity, accuracy, and elegance it has not, I believe, been surpassed.

Let X (Fig. 1) represent the cell whose internal resistance is to be ascertained, G a galvanometer, A and B two resistances, whose ratio is known, R a set of resistance coils, and K a key. The connections are shown in the figure. The current starting from X will suffer a bifurcation: one portion will pass through G (deflecting the needle) and R round to X, and the other part will go through A, B, and R to X. When the key K is depressed, a portion of the current which has passed through A will proceed at once to the cell X, without going through B or R. With the arrangement as here described, G will be always deflected; and, generally, if we depress the key K, the deflection will be altered—with a small or no resistance in R in one direction, and with a large resistance in R in the opposite direction. There is, therefore, a resistance which can be used in R, such that on depressing the key K the deflection of the galvanometer is unaffected. When this is the case, the following condition holds good:—Where X, A, B, and R represent the several resistances of the parts of the apparatus so lettered respectively—

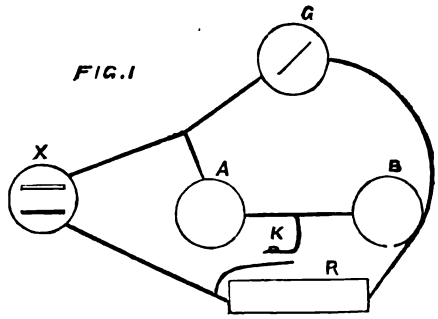


FIG. 1

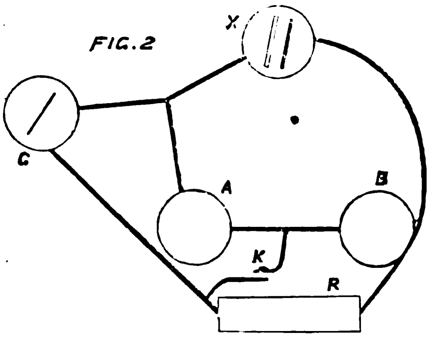


FIG. 2

$$X : R = A : B \quad (1)$$

$$\text{or } X = \frac{A}{B} \cdot R.$$

And, as we know the ratio $\frac{A}{B}$, we shall get at once the value of X. For example, suppose $B = 100$ A, or $\frac{A}{B} = \frac{1}{100}$, and that we wish to ascertain the internal resistance of (say) a Léclanché cell, and we find that on putting in R 654 Ohms, the deflection of G is unaffected when we depress the key K. Then $X = \frac{1}{100} \cdot 654 = 6{\cdot}54$ Ohms, the amount required.

We see that in this process we are quite independent of the resistance of the galvanometer (which, by the employment of a shunt, may possess any degree of sensibility we please), and of the electro-motive force of the cell, and it can be performed in a very few minutes. There is a corollary from this process, which was brought before the Royal Society by Sir William Thomson, at the same time that Mr. Mance's paper was read, and which, I think, may likewise be interesting to many of your readers. Transpose X and G in the arrangement before described (everything else remaining the same), which will then become that shown in Fig. 2. It is evident that as a portion of the current must pass through G, it will be always deflected. Add such a resistance at R that on depressing the key K, the deflection of G remains unaltered; and let G be the internal resistance of the galvanometer. Then—

$$G : R = A : B$$

$$G = \frac{A}{B} \cdot R.$$

In other words, we can ascertain the resistance of a galvanometer from the deflection of its own needle.

PI.

"UN IRLANDAIS" AND THE DELUGE.

[4239.]—IF it were not that three several querists, "F.R.A.S." (let 4184, p. 228), M. Paris (let. 4211, p. 255), and "Un Irlandais" (let. 4212), all independently, it would seem, and, besides, the original jocular propounder (let. 4086, p. 196, let. 4193, p. 252), repeat, in apparently sober earnest, his amusing question of "Where is the water gone to?" I should not think of answering it seriously. In the whole of this Deluge matter, observe, I am fighting alone (unless Mr. Gosse or some other physicist likes to help me), on behalf, not of any ancient document, but solely of *Natural Law* versus *Miracles*; the constancy or continuity of the known parts of the *course of nature*, against Lyell and other *miracle-mongers—i.e.*, resorters every moment to the unknown, to purely hypothetical interruptions or reversals of what is known. Accordingly, I thought it enough to tell the first questioner that the water of the Deluge, whether little or much, "obeyed all the same laws as yesterday's shower" (p. 226, bottom). It is impossible to do more with a man who replies that "this is absurd" (p. 252, bottom), and according, at the top of the same column, invents some unknown law whereby water that fell on land would not remain thereon long enough to *press* it? One who can thus catch gravity asleep (a problem to which I have been taught that even catching the weasel so was a trifle) is as much above physics as the emperor that declared himself "super grammaticam," and is truly consistent when, having thus got his water off the hills in such double-quick time as never even to exert pressure, he gets it back again in time, two paragraphs later, to repeat the "great question," where is it gone to? Whoever means to answer him (for I shall not) must at least be told first how he gets it back again from the sea, to which, just above, he has sent it all!

Now for the sober querists. Their question is, being on a globe, with a certain quantity of water, equivalent to a layer of fixed but unknown depth, so little known from soundings hitherto that probably no man can say whether (in a universal layer) it would be nearer 2 miles than 4, or nearer 4 than 2, but seemingly between these limits, they ask what is become of a still *less* known addition believed to have been made of this same substance; for I have observed (p. 226, col. 1) that while the cometary fall is certain (as I am bound to show by many more evidences yet unmentioned) its amount may, for aught I can see, have been either several furlongs, or not a quarter of a furlong. If the present stock is only equivalent to 2 miles, and the diluvial fall was 5 furlongs, then the antediluvian stock was but 11 furlongs. If the present is as much as 4 miles, and the addition was but half a furlong, then the previous stock was 31½. But whatever the ratio of the antediluvian stock and the addition, whether 2 to 1, or 50 to 1, the addition is simply gone *wherever there is water*—part into the querist's inkstand, and part into his veins, and some into the 8 or 10 inches that the atmosphere holds in circulation (as it did previously), and some more, in their several proportions, to the Caspian, and Lake Tchad, and the ocean.

Some may need to be reminded, by the way, that for long after our fathers' descent from Ararat, that mountain must have been on a coast, the coast of the great Central Asian sea, then covering most of Tartary, which took centuries to evaporate down to the low level of its now shrunken remains, the Caspian Sea and Lake Aral, and during all those ages must have made the Asiatic climates far moister than now. If much of the Sahara be below sea level, of course that also took a long time (but less) to evaporate.

As my last questioner, "Un Irlandais" (p. 256), couples this with two other questions, in seemingly a more decent temper than most, I may here reply to him. His second is, "What proof is there that comets are composed of water at all, or that they contain any?" Answer: No proof whatever; and, though none can tell what to-morrow may prove, I do not the least anticipate any such proof, because I think it most probable there is *no* water in most of them, or even in any. This, at least, has been my belief hitherto. But the question has no more connection with the Deluge, or my theory thereof, that I can see, than the question whether floods kill sea fish (let. 4211), or whether land animals have last spread from one hundred centres or one thousand. Their spreading from "*a single*" one (lets. 4049, p. 171, 4184, p. 228) is simply an absurdity, and I never heard of another person than "F. R. A. S." or of *any book* or serious writing, that assumed such a thing. If he has rightly quoted Professor Owen, it would seem such an absurdity has somewhere been broached, and it might be interesting to be told where; but I have nothing to do with it till "F. R. A. S." or some one explains what bearing it has on any deluge. As for Noah's, according to the professedly contemporary journal, the oracles predicting it (Gen. vi.) declared that every living substance was to be destroyed *from off* (v. 18, marg.) the earth, land, or ground; and survivors accordingly held (for nobody could have *seen*) that whatever was "on the dry land" died (vii., 22). In other words, every living substance, animal or plant, was either drowned or *off the ground*. Whatever was not afloat was to die, and whatever did not die, to be afloat; and doubtless plenty of organisms would be both one and the other; but before "F. R. A. S.," or any one, can add that *whatever* died *also* floated, or *whatever* floated *also* died, he must write a new Bible of his own, with which I have no more to do than with any of those quoted by Colenso; with that reverend divine, for instance, who (according to him) writes that the door of Noah's Ark was in its bottom story!—or any other miracle-mongerer. Old documents, as well as new, of any soberness, always presupposed in the reader, whether in relating divine or human words, not only thorough inquiry into their language, but also some little common sense.

For the third question, "Un Irlandais" will content himself by asking me to prove *to him* "that a comet could cause the Deluge." Well, to any one who may show that he knows the chief points yet discovered (and by "discovered," observe, I mean *ascertained*) respecting comets, the earth, and the properties of fluids —at least water and elastic fluids, and their relations to heat—if any one decently acquainted with these things asks for such proof I will give it. But as no one so acquainted *would*, I conceive, *ask* for proof of anything so obvious, the most natural inference is that "Un Irlandais" has never cared to learn more of them than his letter shows, or than "Santalinus," M. Paris, or even our joker of p. 252 (against whose diffuse chaff I must protest, as covering too much paper), who ignores (p. 196, col. 1) any difference between undulating strata and undulating ground!—evidently assumes the chalk downs, as the last review ground at Lewes, to be plutonically crumpled up, strata and all, into their knolls and coombs!—imagines "mathematicians can show" the earth to have a "crust some 800 miles thick," (whereoff earthquakes are continually shaking bits without being felt 50 miles off!—a building shaken down the other day in Furness peninsular without Manchester knowing of the shock,—and dislocating cracks confined to a few miles long, not only ancient ones by countless thousands, but five modern, cracked in colonised countries within living memory, none 100 miles long; and the two in Cutch not 10 miles apart, thrusting up a wedge of all the strata but 10 miles wide, and, "mathematicians" are to show, 800 deep! "Un Irlandais," for aught that yet appears, may be of the calibre of this chemical joker, who, when challenged to prove a comet weighing less than a trillion tons, quotes triumphantly one (p. 252, col. 3) whose mass is declared to be, "astronomically speaking, inappreciable." His wisdom takes for granted that, in the said comet's place, a trillion tons would be a mass astronomically *appreciable!* "Un Irlandais" may be as profoundly ignorant of all the sciences he is meddling with as even this joker, and in that case I entirely deny any such right as he would seem to claim to tell me I show *nothing* till I have taught *him* the facts of astronomy, geology, general mechanics, and pneumatics, that he has not cared to study, and newspapers do not happen to thrust on him. I will teach them, if any fairly inquisitive readers desire it, but this has not yet appeared. Fairly inquisitive ones would know the evidences that all comets are globes of aëriform fluid, much rarer even at their centres than our air; in short, atmospheres without a planet (as our moon seems a planet without atmosphere), and simply what our fluids, one or more, would be if isolated in space. Our sea, or a tenth part of our sea, detached and left alone to revolve about the sun, would be merely a comet *of steam*, and a very large one, but as rare even at the centre, and of a mass as "astronomically speaking, *inappreciable*," as any of the 300, large or small, on record. If Roscoe or Huggins, or any F.R.A.S., ever wrote or said (which I do not believe yet), that "we do not know whether there is *as much* matter in this comet (whatever one be meant) as would fill this room," that is logically a fact, perhaps. Possibly we are *not* certain there is more, but if Roscoe or Huggins ever said so he was merely playing the buffoon, as much as his quoter (p. 252). He must have known it was just as unproved, whether in "this comet" or any other, there was "*as little* matter as a trillion tons," and it is equally unproveable, as yet, whether a tenth of a trillion, or a twentieth, or a hundredth of that mass, of any aëriform fluid (therefore, of any comet) would be little enough to fall on the earth without deluging her. Any weight approaching the first-named would infallibly do so, whether it were of steam or any dry uncondensable gas, because, in either case alike, the vast equal addition of pressure on highlands and seas would so tend toward equalisation of their loads, *at first*, as to level them. But with dry air only added, this levelling (and therefore inundation) would be far more permanent than with steam precipitated as rain, the latter making only a short temporary levelling, followed by upheavals into still *more* inequality than before, as well described by our joker at end of his paragraph (top of col. 3, p. 252), and there is abundant evidence of such effects, and all others of a *steam* comet-fall 50 centuries ago, but not of one of *gas* for at least many thousands. I can but conclude by challenging, as before, any scientifically informed reader to dispute soberly any single position in any line I have yet written on the subject (pp. 91, 146, 175, 200, 226, 229).

E. L. G.

"E. L. G." AND HIS PET DELUGE.

[4240.]—"E. L. G." (in let. 4176) has given about the most delightful piece of romance I have seen for a long time; it is a fine specimen of Dr. Tyndall's scientific use of the imagination. It puts me in mind of a pamphlet I had the pleasure of reading some time ago, written by (I think) Dean Cockburn, who, on the strength of having walked through the Box Tunnel, thought himself competent to annihilate and utterly smash up the geologists. Does "E. L. G." really expect us to swallow all his poetical descriptions with the all-digesting faith he ascribes to the Lyellists? Unfortunately, facts are dead against his theory, which has only a comet specially manufactured for the occasion from the recesses of his inner consciousness, like the German's camel, to support it. I will cull a few facts which are, to all unprejudiced minds, utterly subversive of "E. L. G.'s" fancies. For instance, the high Alps have a flora very much resembling (and identical in some species with) that of the Arctic regions. If the Alps only arose four or five thousand years ago, how did this flora get there? On the other hand, if the Alps existed before that time, the hot water and steam would have destroyed all these Arctic plants. Again, Mr. Wallace has shown that in passing from one island to another in the East Indian Archipelago over a deep strait of only fifteen miles in width, he leaves one fauna, and arrives at another perfectly distinct. If animals were floating about on islands of matted timber would they not have become mixed? How does "E. L. G." account for that phenomenon? Then there are the reef-building corals, which "E. L. G." so carefully avoids mentioning; these animals, as Mr. Gosse can tell him, cannot live in fresh water, nor at a greater depth than thirty fathoms, yet Prof. Agassiz, no Lyellist, mind you, but a cataclysmist of the deepest die, reports, from personal knowledge, that they must have been growing without a break for at least thirty thousand years. Yet "E. L. G." would have us believe that these animals existed comfortably under the pressure of a mile more or less of fresh water, to say nothing of the temperature. After all, where is the necessity to do all this violence to nature? Noah's flood might easily have been partial, if one must have it. How could Shem, when he left his untouched journal for the perusal of that accurate Hebrew scribe, Samuel, the first of his race, how could he, I repeat, know that the whole earth was under water?

P. SANTALINUS.

SELENOGRAPHICAL.—GASSENDI.

[4241.]—I SEND a sketch of Gassendi to show the features *a* and *b* as they appeared to me on May 18, at 9h. 30m., Dublin mean time, omitting several minor objects which I saw on the same occasion. Striking differences will be observed between M. Gaudibert's sketches (lets. 3462 and 4076) and mine in the way they represent the above formations—differences that doubtless show the effect of different states of illumination when the several observations were made.

J. BIRMINGHAM.

CONCRETE.

[4242.]—SHORT hours of labour—high wages—trade-unions, and the suicidal policy of putting the best workman on a level with the worst, are putting the ordinary mode of building with stone, brick, or timber quite out of the power of those who cannot command the enormous rents paid in large towns, and who may wish either to construct cottages for the labouring classes at a fair return of profit, or who are compelled to erect farm buildings to keep pace with the modern improvements in farming. There is one solace, however, to those who, like myself, are afflicted with a building mania. The complaint brings about its own cure either in diminished work or the application of scientific processes almost entirely independent of what is called, or rather miscalled, skilled labour. High prices and inferior work in the building trade have set the brain of the mechanician to work to design apparatus, and that of the chemist to discover compounds by which the material may be made, and the house constructed at one and the same time by labour that does not arrogate to itself the term skilled, but which is content to earn a fair wage in exchange for a fair amount of labour. As far as the mechanic is concerned, there is luckily not much scope for ingenuity. The alleged inventors of framing, notwithstanding their claims to protection under the magic word "patent," with the exception of a larger use of iron in the place of wood, have advanced but little beyond the appliances used by the Moors in Spain 700 years ago, or the Lombards in Italy longer. For my part, had I not laid out a heavy sum in frames, bolts, and ironwork, I should, at all events in walls of a thickness of 1ft. and upwards, use the old plan of wooden putlogs, mortised to receive the ends of the uprights kept together at the top by a rope, twisted in the same manner as a frame-saw is kept tight. The task for the chemist, however, is one of infinite difficulty and perpetual experiment, the successful result of which often depends upon a difference so slight as to escape the eye or head of any one, save that of the never-wearied chemist. Latterly, the attention of the chemist has been drawn to the feasibility of doing artificially what has been done by nature on a large scale in the formation of stone, by means of heat and pressure and a due admixture of silex, alumina, lime, and the oxides of iron. Until very lately the expense of the cementing medium has been a great bar to the substitution of artificial material as a substitute for the brick or the stone taken from the earth and worked by man for the required purpose. The prejudices of architects and builders, and a fear of disturbing vested interests, have also had their effects in preventing the more general application of artificial stone. The engineering necessities of the present day have necessitated the uses of artificial stone in submarine constructions and other works, where there was either a difficulty in procuring stone of sufficient size, or a difficulty of placing stones of a large size in proper position. These necessities created a demand for cement, and this demand in its turn has caused a supply of a good article formed from lime, clay, and silex, at a cost which puts it within the reach of those who feel inclined to construct. To bring cement, however, into general consumption, it must be produced at a still lower rate than at present. The chemical discoveries of late years, however, seem to indicate that, valuable as the Roman cement invented by Barker, and the Portland cement invented in 1824 by Aspdin, of Wakefield, are, there are other materials that afford a strong, nay, a stronger cement than the carbonate of lime burnt with silex and alumina alone. Mr. Ransome, by his ingenious process, has formed a stone by means of silicate of soda (made by heating flints and soda under a pressure of several atmospheres), mixed in certain proportions with clean sand, in which he can cast the most exquisite mouldings with an arriss as sharp and clear as the most skilled of masons can form on Bath or Portland stone, and then by a still more ingenious process he converts his silicate of soda stone into a hard and durable silicate of lime by a bath of chloride of lime: the chlorine leaving the lime to go to the soda and form common salt, and the silex and lime combining and forming a very hard stone. Whether this stone is lasting or not time alone can prove; but I believe the stone has been exposed to extremes of heat and cold with impunity. Curiosity led me about two years ago to send out some of the Ransome's grindstones to India to some works with which I am connected, and also to buy three or four for home use. One of the latter has been in use incessantly since then, and if it has worn a little, at all events it has worn evenly, and completely put to the blush the old Newcastle grindstone. It is a great favourite with my carpenters, who one and all agree that it is the best they ever saw. Again, General Scott, R.E. the constructor of the Albert Hall, has invented a cement which I see advertised in your columns as selenitic mortar, in which, as far as I can make out, by the application of sulphate of lime with the decarbonised carbonate of lime, he produces a cement at a very moderate cost; and if the advertised results are borne out in actual work, a cement of wonderful powers has been made. Curiosity, and your notice of the selenitic mortar in a late number of the ENGLISH MECHANIC, led me to call at the wharf in the Belvedere-road, Lambeth, where I was shown samples of concrete of different sorts, all apparently good. Among the rest a piece of concrete was shown to me said to be formed of selenitic mortar 1 part, selenitic clay from the neighbourhood of Leicester 5 parts, sand and gravel 40 parts. As far as I could judge, the concrete seemed sufficiently good for any thickness of wall. Its value will depend upon its power to resist compression; if good in that respect, the uses of this lime at 25s., and of the selenitic clay at 16s. per ton, will reduce the cost of concrete made with the selenitic mortar as compared with Portland cement very materially. It appears now that General Scott is converting the sediment of town sewage into selenitic mortar. I have ordered a truck-load of five tons of selenitic lime; the result shall in due course be communicated to you.

Another most important discovery has been made of late years in the production of an artificial stone of surpassing hardness, and capable of a beautiful polish by the mixture of caustic magnesia slacked with chloride of magnesium. This is an invention of M. Sorell, which he communicated to the French Academy as far back as 1867. So great are its agglutinative powers said to be that one part of the chloride of magnesia is sufficient for twenty of agglomerates in the shape of sand, gravel, stone, &c. I am afraid, however, the cost of the magnesia would make it too expensive a cement. The experiments of M. St. Clair Deville, however, seem to point out a mode by which the magnesia may be availed of at a less cost, and by an apparently easy process, by the burning the dolomite or magnesian limestone to an extent sufficient to decarbonise the carbonate of magnesia entirely, and the carbonate of lime only partially. This result was commented on in a late number of this journal.

If Deville's process can be carried out on a large scale in the factory successfully, we have the means within our reach of forming a cement of agglutinative powers, vastly superior to the Portland cements, by a comparatively easy process, avoiding the construction of the expensive drying vats and furnaces necessary for the due admixture and subsequent calcination of the clay and lime of the Portland cement. For Deville's process all that seems necessary is the proper calcination of the magnesian limestone. This can be done effectively at a moderate cost, nature having placed the limestone and the coal close together, as the coal-fields of England, from Durham down to Nottingham, seem to be skirted on their eastern side by the dolomitic formation. General Pasley, in his experiments thirty years ago, tried magnesia and lime for an hydraulic cement, and he seems very nearly to have hit on Deville's discovery, but he did not go far enough.

I am not a chemist (would that I were); it strikes me, however, that the result of M. Deville's experiments in the calcination of the dolomite is another example of the necessity in chemical experiments of examining closely the state of things, not only after entire disintegration has taken place, but also during the intermediary process. After all that has been said by Vicat, Pasley, Austin, Totton, and a host of other writers, on cements and mortar, on the necessity of thoroughly decarbonising the lime, one would scarcely have expected to find that in the mixture of carbonate of lime and carbonate of magnesia, the cementing powers depended entirely on a partial decarbonisation of the lime. The magnesian limestone, which supplies the lime for the greater part of the West Riding of Yorkshire, burnt as it is in the neighbourhood of Pontefract, forms but an indifferent mortar; burnt, however, under the eye of the far-seeing chemist, it appears to make a superlatively good cement. If this Dolomitic cement can be made at a cost exceeding but a little the cost of ordinary lime, its use will result in concrete monolithic erections throughout the kingdom, and then for ever farewell to bricks, brickmakers, bricklayers, and stonemasons, and all their wicked devices of needles in clay, soda-water bottles filled with explosives, picketing, rattening, and intimidation, which are rapidly converting good mechanics into worthless workmen, and driving capital away from the kingdom. The applicability of concrete in a monolith to large and high buildings, in the shape of warehouses, has been shown by the erection of the warehouses in Great Guildford-street, Borough, where Mr. Tall converted all the old brickbats, broken bottles, and oyster shells that he could get together into as strong a set of buildings as could be contrived. My belief is, provided a cement can be formed of strong agglutinative powers, like that of M. Sorell or St. Clair Deville, at a less cost than the present cost of good Portland cement, that in twenty years monolithic concrete buildings will supersede bricks and mortar, just as much as iron has superseded wood in the construction of ships. It is for the chemist, however, to discover the means of making a good cheap cement, and it is my belief that brains and money together would, in following out the track pointed out by Deville, find an ample reward in the manufacture of dolomitic cement. I trust that this letter will elicit some remarks from some of your able correspondents on questions of chemistry.

KHODA BUX.

HOW WE SEE A DISTANT OBJECT.

[4243.]—"E. J. D." (letter 4170) says that I forget "that if the black statue were placed in a room hung with black, and the sunlight admitted, that the statue would be quite distinct in all its details;" but "E. J. D." forgets to state what the texture of the hangings is to be, whether black calico, or black silk, or black cloth. Let us suppose it to be cloth. No doubt the statue would be distinctly visible, for the simple reason that the so-called black cloth is not black. "E. J. D." is an amateur artist; let him paint a portrait of a friend in a black cloth coat, if he has not done so before, and he will be surprised to find how great a quantity of white he has to mix with his black pigment in order to get the correct hue of the cloth, and the reason is not far to seek. If we examine the cloth under a microscope, we find its surface to consist of innumerable little black filaments, each with its own appropriate glittering high light, dispersing small glints of light in all directions. No wonder, then, that the statue should appear distinct against such a background. The true test would be to place the statue in a room the walls of which were equally as black and polished as the statue. "E. J. D." then proceeds to say: "In fact, a light background would render the statue more indistinct." Surely, "E. J. D." does not contend that a black statue against a white wall is not more visible than if against a black one. These are very simple matters, but it is absolutely necessary that we should reduce such questions to axioms before we can arrive at a clear solution of the question "How we see a distant object." It is much more necessary to settle a little question such as this than to speculate on the physical constitution of light; deeply interesting as those speculations are, they should be eliminated from the present discussion; rays, vibrations, undulations, pulsations of ether, &c., are no doubt good working hypotheses, but at the same time they are only so many ways of saying that we don't exactly know what light is; but we do know some of the invariable laws of its action—*e.g.*, the equality of the angles of incidence and reflection, and we know that any theory that contravenes or ignores that law must be wrong. "E. J. D." seems to think that the well-known laws of the action of light do not adequately account for the fact that an object is distinctly visible to numerous spectators in various positions; but if we consider that in ordinary daylight light pours down upon an object from all directions, the infinite reduplication of reflection in the air itself, which is a reflecting medium, and from surrounding objects, and then consider that almost every object we see is either fibrous, or granular, or striated, it is not wonderful that reflections of that light (according to the law of incidence and reflection) should be found to suit the requirements of any number of spectators. The polished statue is granular in its texture, but, generally speaking, the more polished an object is the less visible are its details at a distance. The ancients were aware of this, and in statues destined to be placed at great heights were in the habit of granulating the surface artificially by pitting it over with a small punch, so as to give more angles of reflection. Glass, though a good reflector of light, is not very visible; but if we grind the glass, so as to comminute the reflection, it becomes more visible.

What does J. Barwick mean by the remark that reflected light will not penetrate paper or porcelain? This is surely contrary to our every-day experience. I write this in a room with a north aspect; no light enters the window but reflected light from the clouds and the houses opposite but that light shines bright enough through paper or a china saucer. BOBO.

[4244.]—IN let. 4160, p. 227, occurred the gross error, "Brings light to us from the sun in 192,500 seconds of time;" of course, it should be, brings it at the speed of 192 500 miles per second (*i.e.*, according to Herschel); the wave of light is but 474⁶/₇ seconds in transit from the sun at that rate, or, roundly, eight minutes. And in the next sentence occurs, "If, however, different notes of the spectrum travel like distant notes of sound;" "notes of the spectrum" should be colours, or tints, or waves of the spectrum, for light has waves within waves more than any intricate machinery has wheels within wheels. Thus set right myself, I go on to "E. J. D.;" he must place his meaning of "but if a mirror be placed where the eye was, the rays to it causing reflection proceed from the object to the mirror in right lines parallel to each other" in more lucid language if he wants satisfactory elucidation of fact. He must look, too, at light as radiating by a fluid whose pulsations of condensation in front, and rarefaction behind, extend (with varying force, it may be) all around, except where intervening objects intercept. Angles of incidence and reflection are not those by which objects are directly seen, but as seen by reflection, as from a surface of mercury; so that it is wrong to speak of light as passing from objects only in one angle. As to the rays which reach the eyes of the spectator of his own reflection on the mirror when he looks at the feet, he sees those rays (or receives those pulsations) which, shaped and tinted by his shoes and stockings, strike the mercury; and his eyes receive corresponding rays from thousands of so arranged atoms (say) of the cosmic fluid, as well as do the eyes, and every portion of all the objects intercepting (but themselves unintercepted) all around.

The telescope renders distant objects more distinct by concentrating rays to a focus; parallel, if not divergent rays striking the lens are all converged by it to enter the eye, and are adjusted to a more suited focus than the unaided eye could adjust for. The man's eyes whose crystalline lenses are smaller than his neighbour's sees less of surrounding objects than his neighbour does, because fewer of the illuming ether atoms can impinge thereon. Not long ago, I used to write more strongly than "E. J. D." about the "ridiculous theory of ether existing in space"; and before he writes more thus presumptively, he certainly, as I have done, should closely study Tyndall's two works on Heat and Sound, and then have a sparring match with Tyndall's exposition of the theory, instead of with the phantoms of not over-imaginative brains. If "E. J. D." finds the study of the position and the size of the orb in combustion, whose agitation of the cosmic fluid or ether forms the sight-giving waves, too deep, he may as well drop the sight subject altogether.

J. BARWICK.

BRIDGE CONNECTING ENGLAND AND FRANCE

[4245.]—I THANK "A Friend of Progress" (p. 201) for the interest he has taken in experimenting on the practicability of my plan of building the bottom piers or abutments required in the construction of bridges, where the depth of water has hitherto proved an insurmountable barrier to their accomplishment, that barrier being now removed. I have no doubt but that he has been fully able to convince himself that my plan of building is not only suitable for deep sea water but also for rivers of moderate depth, such as the Severn, Thames, Humber, Tay, and others, where the trade and commerce of the country renders it desirable to have bridges constructed much nearer the sea coast than formerly, as in all such rivers where the bottom is found to be free from naked rocks, my plan of building on the surface of the water will be found decidedly preferable and inexpensive compared with any other plan that has as yet been adopted.

I was scarcely prepared to admit that a vacuum could be formed with any shroud sunk only to a depth of 4ft. 7in., however compact the beds may have been, as it is evident that many particles of the bed would be displaced and forced aside by the shroud in the act of sinking, which, I should imagine, may explain the reason why the pump had to be kept in motion three minutes before any indication of a vacuum could be perceived, as it would require some time before the action of the water could arrange or carry down sufficient deposit to fill up the displacements, and until this was accomplished no vacuum would be formed, as otherwise the water would enter the shroud. I observe by "A.'s" letter (p. 230), that he considers compressed air as the reason, but except some obstruction were placed to cut off the communication with the pump, compressed air could not occur, as I have shown in my former letter (p. 63), where I say "and when they (the shrouds) are correctly set (or sunk) the pumps should be put in motion, not sooner, as the inclosed water under the timbers B and C escapes through the pump valves, keeping them open so long as any sinking takes place." I am very well pleased with the experiments made by "A Friend of Progress," and if my plans are as eagerly entered into by railway companies and others, we may soon expect to see our rivers spanned with what may be termed our treble combined railway bridges.

SHOLTO DOUGLAS.

THE ALCOHOL QUESTION.

[4246.]—WHAT I complain of in Mr. Barwick's treatment of this subject (see lets. 4052, 4216) is not so much that *he* should take a "leap in the dark" as that he should bring forward his crude hypotheses and pit them against the well thought-out theories of scientific men. Since writing my previous communication (let. 4098) I have read Dr. Richardson's paper, and I send an extract bearing on the point in dispute in order that Mr. Barwick may see the doctor's estimate of the theory, against which, but without offering a single particle of evidence tending to prove its incorrectness, he has brought forward *his* idea of "too suddenly" carbonised and hydrogenised blood producing an acceleration of heart-beats. Dr. Richardson says: "Recently some new physiological inquiries have served to explain the reason why, under alcohol, the heart at *first* beats so quickly and why the pulses rise. At one time it was imagined that the alcohol acted immediately upon the heart, stimulating it to increased action, and from this idea—false idea, I should say—of the primary action of alcohol many erroneous conclusions have been drawn. We have now learned that there exist many chemical bodies which act directly by producing a paralysis of the organic nervous supply of the vessels which constitute the minute vascular circuit. These minute vessels, when paralysed, offer inefficient resistance to the stroke of the heart," &c. It will be seen from this that Mr. Barwick has taken up with a portion of an old theory which was "at one time supposed" to be correct, and he has spoilt even that fragment. It will also be seen that I have italicised the word *first*, to draw Mr. Barwick's attention to a point I mentioned before, that granting his assumption of "rapid oxidation," how are we to account for the diminution of temperature as the stages of alcoholism progress, for the blood on his hypothesis must be more and more carbonised and hydrogenised the more alcohol one drinks, and must necessarily require more "rapid oxidation" still? Mr. Barwick now writes, with all gravity I presume: "As for assuming that alcohol too suddenly carbonises and hydrogenises the blood, I did not expect any scientific person could doubt it." I do not know that I am a scientific person, but I beg to inquire of Mr. Barwick, first, how he imagines the blood becomes carbonised and hydrogenised; second, how that effect is accomplished suddenly; and, third, how "*too*" suddenly? I wish to know, also, what "scientific person" ever asserted that the blood *was* carbonised and hydrogenised by the imbibition of alcohol. It appears to me that Mr. Barwick should not throw aside so readily the oxygen contained in alcohol, for it would at all events go a little way towards preventing the necessity for "rapid oxidation." Is it possible, however, for alcohol to carbonise and hydrogenise the blood without being split up into its constituents? If Mr. Barwick says yes, will he kindly say, also, whether it acts upon the red corpuscles or upon the serum, or on both, for at least one "scientific person" has some little doubt upon the point. I think Mr. Barwick will acknowledge that Dr. Richardson has just one or two claims to be considered a "scientific person," and I find him saying, "When I sat down to write this essay, I noted many points of peculiar scientific interest as deserving my attention, and amongst these one specially important—the question how alcohol, after it has been taken into the organism, is disposed of, whether by conversion into a new product, by which it *ceases to be alcohol*, or whether by leaving the body as it entered it, an unbroken chemical compound." This question he does not answer, because he is merely giving an account of the effect of alcohol on the body, but I will venture to predict that when he does answer it, his theory (if not something more conclusive) will be that alcohol leaves the body as C_2H_6O, an unbroken chemical compound. Mr. Barwick seems especially fond of quoting symbols and formulæ, but may I ask him why he speaks of alcohol as boiling at 78·4° C., and as composed of C_2H_6O? Why, that is alcohol, it is true, but such alcohol as no one ever drank and lived to tell the tale! Surely, Mr. Barwick knows that the alcohol spoken of by Dr. Richardson is the ordinary spirit supplied by the wine merchant and the publican (and the grocer), which, when of a strength known as proof, fortunately rarely sold and still less rarely consumed, contains 50 per cent. of water. I don't think I shall be far wrong, indeed, if I assume that every 100 gallons of commercial "spirits" dispensed for drinking purposes contains 70 gallons of water; and this proportion is often still further increased by the consumer who is a trifle wiser than the confirmed dram-drinker. Mr. Barwick will see that the proportion of carbon (supposing the alcohol is really split up and assists in forming blood) is very different from what he puts it, being considerably reduced by the hydrogen and oxygen of the water.

Why Mr. Barwick should have written such a rigmarole as that on p. 256 passes my comprehension. What "muscular metamorphosis by oxidation" has to do with this question directly I do not see; for a man may get drunk almost without moving a muscle. Neither can I accept the phrase from the scientific schoolboy's copy-book—"All heat, from whatever burning source, is but solar heat"—as an answer to the question, What becomes of alcohol in the system? because it appears to me to be a trifle too vague, and because also I can conceive that there may be and are other suns possessing their own "potential fires." Mr. Barwick, however, assures me that "all the energy from it (alcohol) is derived by the conversion of it into some portion of tissue." This is, unfortunately, a statement with a double meaning. *All* the energy may mean *none*, even as the words are written; but it also means none, because in the opinion of more than one "scientific person" alcohol is never converted into tissue.

I would also caution Mr. Barwick against his favourite Gatch (no doubt a remarkably "scientific person"), because if Mr. Barwick really believes that the whole 28lb. of blood in his body passes through his heart every three minutes he is a most remarkable example of a "scientific person." Why, at what rate does he think the blood travels in the capillaries, where the "atomic clashing or interchange" is prevented by "obstructive molecules," which upset the "true vital order of atomic recombinations"? Would it surprise him to learn that it crawls along very slowly, in order that those very "atomic recombinations" of which he so glibly speaks may be effected. What manner of "scientific person" is he who asserts that the quantity of blood in an average man's body weighs 28lb., and that it *all* passes through the heart in three minutes? (Don't tell me Gatch, if you please.) What I mean by the heart having no sense is simply this: It cannot possibly know that the blood is carbonised, for it has no nervous *system*: it is utterly devoid of sense and feeling, is incapable of experiencing pain; and, when we consider the work it performs, on which, too, our very existence depends, we must acknowledge the wisdom which so made it. It is a wonderful piece of mechanism, but physiologically it may be likened to a bag of muscle with telegraph wires to the battery governing its motions. Therefore, I still hold it true that alcohol is not food: it is eliminated or excreted as it came in, unaltered save that it may be robbed of its flavouring essence. Even so small a quantity as a spoonful in a pail of water would not be split up by the digestive organs. But alcohol is probably vaporised in the stomach and partially dispersed over the system. We know that it gives off vapour or a subtle ether—witness the powerful odour of rum, which has often been detected in the brain cavities of those dying of alcohol-apoplexy when the head has been opened—no slight proof that Mr. Barwick's hypothesis is utterly untenable; for if spirits were digested and split up, their peculiar odours would be in doubt whether to accompany the carbon or the hydrogen, or the oxygen which Mr. Barwick has unaccountably lost, although he acknowledges that its proportion by weight is 8 ($C_{12}H_8O_8$). Mr. Barwick also seems to be unaware that although the action of the heart is accelerated, the quantity of blood propelled into the arteries is not thereby *necessarily* increased.

SAUL RYMEA.

[4247.]—"BUSY BEE" (let. 4156) wants to know if I can furnish any reason for my remark as to alcohol, tea, and lemonade. I can. H_2O, water, is common to them all; C_2H_6O is ethyl alcohol; theine or caffeine, $C_8H_{10}N_4O_2$, is the active principle of tea and coffee; and $C_6H_8O_7$ is citric acid, which, along with a little malic acid, gum, &c., characterises lemon-juice. The grand distinction is the very small quantity of O in alcohol, the large quantity in lemonade, the large quantity of N in theine or tea, and its total absence in alcohol and citric acid. Pure tea has a most soothing and invigorating effect on the nerves and brain, is a most wholesome stimulant (with sugar and cream), aiding the latter processes of digestion, and arousing the faculties to renewed activity. Theine contains all the organic elements; but if "Busy Bee" is hard-worked, tired, and hungry, bread and butter and eggs will supply elements needed by the brains, and which neither theine, cream, nor butter contains.

As regards alcohol, a little experience in the trade and bustle of the world shows that its imbibers carry around them the most offensive atmosphere, which might accelerate the growth of timber in the direct rays of the sun, but is certainly very damaging to the air of rooms, offices, or shops; alcohol much promotes heat, but fires and closeness of houses promote it better.

The large proportion of O in citric acid, and still larger in tartaric acid ($C_4H_6O_6$), in which by weight we have C_{48}, H_6, and O_{96}, whilst citric acid is C_{72}, H_8, and O_{112}, renders those acids, I presume, sources of oxygen beyond the air at the lungs, which their enlivening properties indicate, whilst alcohol after a short period of stimulation torpifies and stupefies.

I agree with "Busy Bee" that we need a better knowledge of the constituents of all our food substances, and I smile at the alacrity displayed about the weights of bread and the measures of barley being tested by accredited inspectors, whilst a callous indifference is manifested on all sides about the testing or ascertaining the precise composition, in its chemical formula, of every article offered in our markets for food. Society is surely in its infancy; and chemistry in its relation to the laws of life and health lamentably too little recognised. If the people, instead of but striking for wages, would combine to support accredited testors in every town and village through the land, they would impress ultimately on society a respect and admiration which they certainly cannot by agitation about wages, which they do not know how to spend most economically. As for distinguishing foods from stimulants I cannot, unless we say *mere* stimulants, as certainly a few good cupfuls of tea with nice etceteras is at once highly stimulating, strengthening, and nutritive.

J. BARWICK.

SPECULUM WORKING.

[4248.]—IN reply to Dr. Blacklock's question (let. 4223), I beg to say that I consider 12 diameters of the speculum to be the best for the focal length. Beyond that there is no advantage, either in ease of vision or facility in figuring. A focus of 9 or 10 diameters gives admirable results with care; but he who attempts 8 or 7, even though he be a perfect master of the process, must be prepared to bestow a considerable amount of patience and time on the work. I do not believe it is possible to produce as good a speculum of 8 diameters as of 12.

The focal length of my own 18in. speculum is 7 diameters, and it is not a bad one. I am inclined to think that the great facility in using so large an instrument which this short focus gives me, counterbalances the slight disadvantages. Still, were I to do the work again, I would have worked to 13ft. focus. I heartily congratulate Dr. Blacklock upon his success.

H. C. KEY.

[4249.]—IN answer to "Optical Bricklayer" (query 11930, p. 263) the edge of pitch tool should be circular, and its polishing surface precisely the same diameter as speculum, but to insure the edge facets giving the same pressure as the rest, I find it better to have the iron tool a little larger (as Mr. Key recommends), say not less than ½in. larger than the mirror, so as to allow the pitch the same slope at the edge as in the gutters, as it is of great importance that the edge facets should exert as much pressure as the central ones. As far as my own practice goes, I have worked several good mirrors on an iron tool no larger, and in one case even smaller than the mirror, but the figuring was very troublesome, and led me to prefer a larger tool, which admits of greater accuracy with much less trouble. It must not be forgotten, however, that whatever may be the size of the tool the polishing surface should exactly correspond to the size of mirror.

I could not give "Optical Bricklayer" much idea of the figure of his mirror unless he states the appearance of the enlarged star disc, either within or without the focal point, as the focal point itself is of no use whatever as a test. I should imagine the appearance he describes indicates hollowness at the edge of mirror; to prove it let him push in the eyepiece, and if the wings which surround the star disc contract the edge of mirror is too hollow, but if the wings expand the edge is too flat.

W. PURKISS.

ATMOSPHERIC ELASTIC FORCE.—SUPPORT OF SPINNING-TOP.—UPWARD DEFLECTION OF BULLET.

[4250.]—THANKS to "Philo," to "A.," and to M. Paris for their obliging replies. The attempt to balance a top (without rotation) in that position which it assumes in spinning being quite futile, we become aware that the upsetting force of gravitation has to be encountered from first to last in order to its support while spinning. This upsetting force is thus understood to be constant in its action, and is clearly defined in direction. If certain forces, therefore, are named by the replicants as nullifying or overcoming that of gravitation, it becomes them (especially if their argument is advanced in the form of positive statement) to show that the forces to which they attribute the support of the top do act in a direction opposite to that of gravitation, or that out of the conflict of them a resultant force is produced opposite in direction to that of gravitation, and in power equal or superior to it.

Now, supposing that the word "tendencies," which "A." and M. Paris oppose to gravitation, can be admitted in mathematical demonstration when a defined and active force is required, yet the very language in which they describe the action of such tendencies or forces forbids the conclusion at which they arrive—viz., that they nullify or overcome gravitation. For if (let. 4130) under their action "the body has an equal tendency to fly away in all directions," this equality of forces or tendencies can only operate to the nullification of each other, and the independent force, gravity, is left as free to act as though the others had no existence. And if (let. 4131) "the attraction of cohesion" fully explains why a body should rotate rather than scatter its component particles in tangential lines, it offers no explanation why the axis of such a rotating body should assume and maintain a certain direction when free to take any other. But supposing that these "rectilinear tendencies" become rectilinear forces, pulling the top from various points as by multitudinous lines, so as to hold it in a certain position, they must be all equal, or the preponderating force of some of them would drag the body out of that position of repose which a top assumes and maintains while spinning with full power. But if they are all equal and opposite, and all in one plane or system of parallel planes of revolution, then they neutralise each other, and leave no resultant to oppose to the upsetting action of gravity.

But let us suppose a top to be set on its point, and from three points in the circumference of any plane of rotation equidistant from each other three lines pass over three pulleys with equal weights to act on them, then the supporting effect of these rectilinear tendencies will be fairly represented. Then, in what position of the axis will the top be supported? Only in that wherein its equilibrium is perfect independently of those three forces; for the slightest declination of the axis from that position would cause one or more of those equal rectilinear forces to preponderate over the rest, and upset the top. In short, in all such explanations as those afforded by "A.," or by M. Paris, the idea of a perfectly upright position or equilibrium of the top seems to have been unwittingly assumed, and the subsequent reasoning arranged to satisfy it. Thus it is only the maintenance of the position which enters into the question, and "equal tendencies" seem to satisfy it. But the real nature of the phenomena are such as require a very different solution. A top scarcely ever falls from the hand of the spinner with its axis in a vertical line. It (1) assumes that position; (2) maintains it; (3) can recover it again and again if disturbed; (4) it can prolong resistance (more or less according to shape) after it has finally lost the vertical position, to the final result of gravitation. "Equal tendencies" utterly failing to account for this conflict with gravitation, from first to last, I suggest to your readers that however advantageous a vacuum may be for the revolution of a body when the axis is duly provided with bearings, an experiment will go far to prove if the support of the spinning-top is not rather due to an elastic cushion of compressed air called into action by the resistance of the vis inertiæ of the atmosphere to the velocity of the rotation, and by the superior density of each lower stratum. Such a theory accounts, I think, for every phase of the phenomena. The proof, at any rate, is very simple, afforded by the air-pump. By withdrawing the atmospheric support, it must at once become evident how far that support is necessary. My three replicants all give specious (though, I think, unsound) reasons why it should spin better in vacuo; and it would seem, I think, that M. Paris's information "it is found" to do so has come to him from a theoretical rather than a practical source. I shall be much surprised to hear that a spinning-top will stand erect in vacuo for a moment, and I should expect that a few strokes of the air-pump would at once destroy the stability of its vertical position. In proportion to the fineness and smoothness of its point, the top shows less and less disposition to travel about. It requires only vertical support at that point up to the last moment of its struggle with gravitation. We see, therefore, that "A.," of Liverpool, in his sketch of a very simple form of the gyroscope, is showing us only a suspended top. The string remains plumb, I think, because the point only requires vertical support. In this suspended position the support of an air cushion to the body of the rotating instrument becomes still more probable.

A few more words on the atmospheric theory next week in my reply to "Philo" on the upward deflection of the bullet. I have satisfied myself, by experiment, that this upward deflection, more particularly in the case of the smooth-bore, is no imaginary thing. Finally, I would suggest, by way of showing that the atmospheric theory may prove of practical value, that the stable position of the bicycle-rider is due to the same elastic force when excited by sufficient velocity of motion.

J. M. TAYLOR.

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ELECTRICITY—WHAT IS IT?

[4251.]—UNDER this title, in your last impression, Mr. B. Thomson refers, in a desultory manner, to the considerations which led some electricians to the crude *à priori* notion that since sound, heat, and light have been shown to be modes of motion, electricity might possibly be placed in the same category, and its effects explained analogically. He makes, however, no progress whatever towards answering the question with which he sets out; and the *petitio principii* with which he commences his second paragraph, and ends the present portion of his paper, must appear somewhat ludicrous to those who are acquainted with the present aspect of this question. He cannot, I think, be aware that I claim to have proved, by experiment, as well as by reference to verified and accepted principles, first, that electricity cannot, in accordance with our present knowledge, be regarded as a "force" or as a form of motion; and secondly, that in no case can it be shown that electricity is converted into heat or work (*vide* the *Engineer*, July 18, August 14, September 4, 1868, &c.).

I should, perhaps, have abstained from offering any remark upon Mr. Thomson's papers until after their conclusion; but I imagine that there is no probability of his strengthening his position by a fair consideration of the question as it stands.

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MAMERTUS AND FRENCH VOLCANOES.

[4252.]—THE statement that the "Rogations" (now called the Litany) and "Rogation-days" originated with prayers against the volcanic eruptions in Languedoc during three years (458-460) is quite correct, and Mr. Cooper Key will find the two contemporary authentications thereof in (1) the Epistles of Sidonius Apollinaris, Book VII., Epistle 1 (to Archbishop Mamert); and (2) the Homily of Alcimus Avitus (successor of Mamert) on the Rogations. Both are in Migne's *Patrologia*, tom. 57, p. 563, and tom. 59, p. 289. I do not see that these eruptions have any particular bearing on any current geological question, and they did not proceed from the Auvergne craters (as the correspondent of *Nature* and Mr. Key in "ours," p. 254, seem to imply), but from some of those in the two more south easterly provinces of Velay and Vivarais, as the ashes repeatedly reached the capital of the Burgundian monarchy, Vienne, then the most important place in the country, and Mamert's See. As no writings of St. Mamert himself are extant (unless his Litany), nor of any Gallic contemporary but those two, the phenomena stand in the singular position of being attested by literally *every* contemporary author; and yet, strange to say, passed into such oblivion that *no* chronicler of the next age, not even Gregory of Tours, mentions them, as Mr. Key found. It is a most instructive caution, and geologers would do well to read pp. 293, 297, of the late Sir F. Palgrave's essay entitled "The Conquest and the Conqueror," in the *Quarterly Review* of October, 1844.

E. L. G.

REVOLVING PUDDLING FURNACES.

[4253.]—"R. S." (let. 4172) has not succeeded in explaining away the facts already adduced in reference to Mr. Danks' claim to the invention of the revolving puddling furnace. Mr. Walker's experiments failed for the want of a proper chimney for his furnace—this was not his fault, but his misfortune; while even with the aid of a good chimney Mr. Danks' furnace is reported to be a "bad melter." As a manager of iron works and a practical mechanic, I consider Mr. Danks' furnace to be neither more nor less than a combination of the inventions of Messrs. Walker and Tooth; and, until Mr. Danks has otherwise proved his claims to this invention, "R. S." has no right to put forth his humble opinions as to the superiority of Mr. Danks' furnace. An invention lying in the pigeon-holes in the Patent Office is not lost, or a thing to be pirated with impunity; neither can a mere improver in any sense of the word be considered an original inventor. The Danks' furnace appears to me a second edition of the American reaping-machine. In 1825, if I mistake not the year, an English mechanic invented a reaping-machine; it was tested and did its work well. On the first public trial the machine was smashed to pieces and the inventor pelted with stones by an enraged mob of farm labourers. This invention lay dormant until the Great Exhibition of 1851, when the reaping-machine again appeared as a new invention from America, and, of course, patented. The trick was exposed, and the patent, like the revolving furnace, fell to the ground.

"R. S.'s" laudations of the Iron and Steel Institute are rather out of place. It cannot be admitted that that scientific body has acted fairly by rushing with an iron-melting-temperature zeal at Mr. Danks' furnace before the original invention at home had been practically tested. In the absence of this fair play on the part of this institution the pleasant trips across the Atlantic, the convivial dinners and speeches, the gushing votes of thanks from the lordly lips, the full-siced portrait of the noble President, certainly have that smack of egotism already described. The old proverb informs us that things dear bought and far fetched are greatly admired by fantastical ladies; even so, apparently, with the Iron and Steel Institute. Had the Iron and Steel Institute acted on the motto, "Fiat justitia, ruat cœlum," justice would have been done to Messrs. Walker and Tooth, without injury to Mr. Danks. G. S. (Civil Engineer).

A NEW MODE OF CONVERTING MECHANICAL FORCE INTO ITS HEAT EQUIVALENT.

[4254.]—IT has struck me that the following experiment, which, however, I have not tried, would be a fitting addition to those for the determination and illustration of the mechanical equivalent of heat. When a disc is made to revolve it may be noticed that it offers resistance to being turned in a plane perpendicular to the plane of its revolution. This is the principle of the sustentation of the disc in the gyroscope, of which instrument we heard so much of in the ENGLISH MECHANIC some time back. If I construct a machine so that while a heavy disc is made to revolve rapidly in one plane its axis is made to revolve in another perpendicular to the former, an amount of force will be absorbed independent of the friction of its parts. From the first principles of natural philosophy I think it follows that this force must appear as heat in the disc, and the amount could be measured by a thermometer inserted in the disc. If so, I do not think that the conversion of mechanical force into heat force is traceable to friction, percussion, compression, electrical, or chemical action, the usual means for the evolution of heat, as the machine can be imagined perfectly rigid in its parts, and frictionless without interfering with its principle. I am also curious to know if all discs of equal weight and diameter (the thickness, of course, being in inverse proportion to specific gravity), but of different materials, would offer the same resistance, and consequently evolve the same amount of heat worked at the same velocity. The arrangement of the machine is very simple, and if any one thinks of trying the experiment I should be happy to supply the design. A. R. M.

HOW TO USE A BOOK WITHOUT HANDS.

[4255.]—IT must be very gratifying to you, Mr. Editor, to know that the ENGLISH MECHANIC has been the means of procuring for the unfortunate man who had lost his hands the useful and very ingenious instrument described at p. 224, which "M. O." has been clever enough and generous enough to contrive and make for him. It is something like, but an improvement on, the instrument I saw many years ago for turning over music with when the hands are engaged; and it is likely, if "M. O." would make such for sale, that violin and flute players would be glad to purchase it, and I for one should be glad to know that its ingenious and kind maker reaped profit as well as the praise and thanks he is so justly entitled to.

PHILO.

RELIEF FOR CATARRH.

[4256.]—A FOREIGN (Dresden) correspondent says that the following has been found very effective in relieving cold in the head, and not unpleasant:—Fill a wide-mouthed stoppered bottle with cotton or asbestos, saturated with a mixture of pure carbolic acid, 5 parts; rectified spirit of wine, 5 parts; strong solution of ammonia, 6 parts; water 10 parts. The vapours are drawn into the nose and mouth frequently, it is said with great advantage. M. R. C. S.

ELECTRIC BELLS ANTICIPATED.

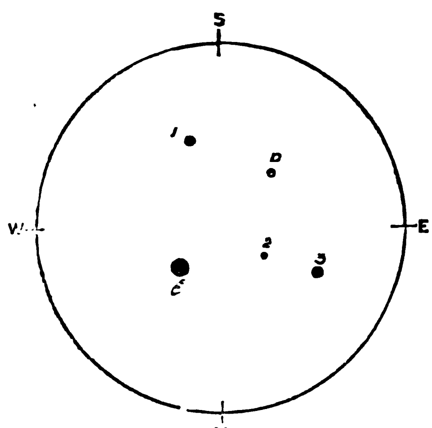
[4257.]—THERE is an account of a similar apparatus to that referred to in let. 4200, p. 253, as employed by the Moors of Grenada, where there was a certain armed figure which, on the approach of an enemy to the city, turned and pointed its spear in the direction from whence he was coming. But, useful as these figures must have been, we have equally well-authenticated accounts of far more valuable products of the wisdom of our ancestors, of which we have not yet recovered any reminiscences, even so faint as our electric telegraphs are of these ancient sentinels. For instance, our commissariat departments in their endeavours to accommodate our troops in the autumn manœuvres, fall very far behind the possessors of the tents described in several old works, which would fold up into a pockethandkerchief, and yet extend so as to shelter a whole army. Then, again, even our express trains and finest ocean steamers are miserable attempts at locomotion compared with the lost art of manufacturing carpets on which it was only necessary to sit and to be at once transported to any part of the earth at pleasure. Those, no doubt, were the good old days, and we mere moderns are poor pretenders. SIGMA.

NEW DOUBLE STARS.

[4258.]—I BEG to report the following double stars found with my 6in. Alvan-Clark refractor a few evenings since:—

CORVI = L 23488 . 12h. 26m. 7s., S. 15° 56′ : 8, 14 : 260° : 10″. This pair is 3m. f δ Corvi, and about 20′ further south; the northern of two 8 mag. stars, about 25′ apart. Probably a moderately difficult object.

BOÖTIS = L 27106 . 14h. 46m. 31s., N. 19° 16′ : 8, 10 : 180° : 1″. I would call particular attention to this exquisitely beautiful double in the immediate vicinity of the well-known pair ξ Boötis, f that star 1m. 6s., and declination 23′ less. I have only seen it once, and although on that occasion it was well separated with clean, sharply-defined discs, it cannot be a very easy pair with a 6in. aperture, except in very good weather. It is a little strange, however, that it should have escaped observation, when ξ has been observed and measured for so many years. It is certainly a very beautiful pair under favourable conditions, and sufficiently difficult with small instruments to make it an interesting object.



The accompanying sketch will enable any one to find this without an equatorial mounting, the star marked D being the pair in question. The stars marked 1, 2, and 3 are respectively Nos. 955, 989, and 1008 (= L 27137) of Weisse's "Bessel." The double is not included in that catalogue, but is No. 27106 of Lalande. Is 3 variable? Its magnitude in Lalande is 7, and in Weisse 6·7. It is now very plainly visible to the naked eye at any time. Argelander, whose "Uranometria Nova" is almost perfect in this respect, has not given it, from which some change might perhaps be inferred.

Will Mr. Knott give some later measurements than those made by Mr. Dawes, of OΣ 288, if any have been made? A few evenings ago I picked up this pair (R.A. 14h. 47m. 13s., N 16° 14′), and at first supposed it must be new, as my estimate of the distance was so much greater than that of OΣ. Looking at it again, just before finding the pair given above, I felt certain that the pair I had found was identical with OΣ 288. In Otto Struve's first catalogue it is marked "fortasse oblonga," and in the catalogue of 1843 the distance is given as 0·5″. Dawes measured it in 1847, making it 0·6″. Now, its distance is at least twice that. My estimate before identifying it was 1·5″, and it cannot be less than 1¼″. It is now a comparatively easy object. The new pair given above is apparently half a second closer.

The new pair $s. f.$ 6 Comæ turns out to be quite a delicate object, and more difficult than I at first supposed.

Chicago, May 6, 1872. S. W. BURNHAM.

IS LIGHT INVISIBLE.

[4259.]—SOME time since I saw an experiment described to prove the invisibility of light. I should like an explanation of the following:—The undulatory theory of light assumes that a subtle elastic fluid pervades and fills infinite space, all fluid, solid, and gaseous bodies, and is called luminiferous ether, which ether, in a state of rest, is darkness, and in a state of undulatory motion is light. This theory assumes that light is not in itself matter, but is a state of matter. Supposing, then, I cast my eye upon an object, I do not see the object, but the rays of light that are reflected from the object. Thus, when I look upon the green fields before my house, I do not see the fields, but the rays of light that are reflected from the fields, and the reason why they appear green is because they absorb all the colours of the spectrum, excepting the yellow and blue, which go to make up the green appearance. Here I am in a fix. In the first place, I do not see the object; in the second, it is asserted I do not see the light—what do I see? A simple experiment is enough to prove I do not see the object I cast my eyes upon. If I walk into a darkened apartment I see nothing. I light the gas and see, or imagine I see, everything. I have added nothing but a light, therefore it must be the light I see. It may be said that the waves of luminiferous ether strike the eye with inconceivable rapidity and produce the sensation of light. Well, be it so, the luminiferous ether then becomes visible, and it is light; if not visible in the ocular sense, it becomes visible to the touch—the touch upon the eye. JOHN HOPKINS.

ATOMICITIES.—ELECTROLYSIS AND MODERN CHEMISTRY.

[4260.]—HOWEVER simple the facts involved, it is not easy to clear away the muddle and confusion of diatomic philosophy. "Sigma" says we cannot escape from what are diatomic elements, such as zinc, copper, sulphuric acid, &c.; and, therefore, we are bound to consider electrolysis as subsisting with a linear chain of H_2, Zn, ϴu," &c. In other words, it is a circuit of molecules, and not of atoms. In this great assumption the whole secret is involved.

If a tension of 1 volt. (roughly the force of 1 Daniell cell) in a voltaic circuit involves an energy equivalent to 4,673 foot pounds per equivalent, and if this action is not through "chemical equivalents of matter," but a force "transmitted through the centres of attraction, or of atomicity by which the molecules are constructed," then I hold that this unit of force should be 9,346, and not 4,673. But wherefore this dire necessity—this thraldom, which "cannot escape" from diatomic or doubled atoms? One paragraph of diatomic evidence would be of more worth than pages of assumptive reiteration.

As to the unfortunate reasons which have led to this doubling of many atoms, I would refer to a paper "On the Atomic Weights" (*Chemical News*, February 9, 1872). Such great chemists as Berthollet, Bouchardat, and a host of others, look with dismay on their distorted alphabet. Then, as to the curious facts which have puzzled electricians, and led to "imaginary laws of electrolysis," what are the laws referred to I know not; but, if they are more imaginary than the atomicity electrolysis of "Sigma," I do not covet their acquaintance. As to the copper difficulty, I do not see that the diatomic device affords any enlightenment. "Sigma" has—

No. 1.	$\begin{matrix}H\\H\end{matrix}\!>SO_4 \quad H_2 = O$	$Cu<\begin{matrix}Cl\\Cl\end{matrix}$	$\begin{cases}Cu - Cl.\\ \mid \\ Cu - Cl.\end{cases}$
No. 8.	H_2O	$Cu\ Cl_2$	$Cu_2\ Cl_2.$

Now, taking No. 8 on the simplest chain, we have, first, a molecule of H_2 = 2 vols., connected with half a molecule of oxygen = 1 vol.! Secondly, we have a weight of copper which is both atom and molecule in one, associated with a molecule of chlorine = 2 vols. Thirdly we have a double molecule of copper connected with 1 molecule of chlorine; and, to the explaining power of all this, I would say—Prodigious!

The chemical peculiarity involved in what is called cupreous chloride, ϴuCl. or Cu_2Cl, I have pointed out in a paper "On Some New Sulphur Salts" (*Chemical News*, Vol. XXI., p. 123). On this occasion I would further illustrate this allotropic peculiarity by a somewhat similar action in organic chemistry. A new field of great interest is opening up in what are called "condensed molecules." The compound radicals, which act and react like elements, are found capable of condensation, so that two or three atoms condense into one, in which state they are truly single atoms, and volumetrically or chemically (and, might I not say electrolytically?) they comport themselves as such. They combine with one H and form characteristic hydrides, or with one O or one Cl and form corresponding acids or bases; they replace one H in varied ammonias, alcohols, glucosides, &c.

A clearer conception of this law of action will tend to remove certain anomalies in old mineral chemistry, as copper, and some other elements certainly share this affection. Here, then, is a problem for some inquiring electrotypist, for he may, in a given time, or with a given potential, deposit a double weight of allotropic copper!

I cannot enlarge here on the chemical evidence in this direction, and briefly compare this view with the molecular chain of "Sigma"—

HO | CuCl | ϴuCl.

Here we have one oxide and two chlorides, all strictly analogous, both in type and function.

"Eclecticus" is pained at the thought of "quarelling" with an accomplished chemist, who bids fair to rank high where only great ability and attainments can succeed. In descending to the level of an outside thinker, G. E. Davis is both fair and courteous, and commands only high respect and esteem.

ECLECTICUS.

CEMENT FOR AND ATTESTING MEERSCHAUM.

[4261.]—MANY thanks for the advice and suggestions in reply to my queries. To "Jack of All Trades," I attach the greatest weight, and from my own practical experience. The cement mentioned by "Saul Rymea," is very inferior to a mixture of double gum and plaster of Paris, and the mode for testing a meerschaum pipe mentioned by "A., Liverpool," is erroneous; rank imitations will float as stated by "C., Glasgow," in your issue of May 10. The cement mentioned by W. R. Donaldson will have my immediate attention, for which I must thank him. The Germans in town have now a neat way of mending meerschaum pipes broken in the middle of stem (some of which are as thin as tobacco pipes), by inserting a fine fitting bone or lead tube, 1½in. in length, to connect the broken part, which is also cemented, the broken part forming one side of a neatly carved buckle. I beg to add, for the information of your subscribers, the account given by Professor Smyth, M.A., of this mineral, in his course of lectures on "Mineralogy," to the students of the Royal School of Mines, Jermyn-street, and which lectures were not published. Meerschaum is a hydrated silicate of magnesium. Its chemical composition is ($Mg_2Si_3 + \frac{3}{2}$ H) and its percentage composition is—

Silica	62·6
Magnesia	28·3
Water	9·1
	100·0 (Nicol).

Several varieties are known, generally associated with hornblendic rocks. It breaks with a fine earthy fracture, that is, like fine grained chalk. Its hardness is about 2°, or, in other words, it may be scratched with the finger nail. Its specific gravity is 0·8, hence it will float in water, and it is from its being picked up at times floating on the sea that the Germans call it "foam of the sea," this being the meaning of the word meerschaum: meer, a lake or sea; schaum, foam or scum. It has a greasy or soapy feel, in common with most magnesium minerals. When a fractured surface is applied to the tongue it adheres strongly. It is brought principally from Asia Minor, Greece, near Madrid, and Toledo, Moravia, and Wermeland. Real meerschaum pipes are turned and carved from the solid mineral, and steeped in wax, inferior articles are made from compressed scrapings and steeped in oil, and generally heavier and less perfect than those made from the solid mineral. The Turks absolutely employ meerschaum as a substitute for soap in washing, for it is quite soft and soap-like when first dug from the earth, and it lathers in water and will remove grease.

Reading. ZETA.

CHLOROFORMING BEES TO REMOVE HONEY.

[4262.]—THINKING it may be useful to many readers of "ours," I subjoin a method for the above which has been practised several times with success. The quantity of chloroform required for an ordinary hive is the sixth part of an ounce: a large hive may take nearly a quarter of an ounce. Place a table opposite to, but about four feet distant from, the hive. On the table spread a thick linen cloth, in centre place a small shallow or soup plate, which cover with a piece of wire gauze to prevent the bees coming in immediate contact with the chloroform. Now quickly and cautiously lift the hive from the board on which it is standing, set it down on the top of the table, keeping the plate in the centre, cover the hive closely up with cloths; in five and twenty minutes the bees are not only sound asleep, but not one is left among the combs, the whole are lying helpless on the table. Now remove what honey you think fit as expeditiously as possible, and replace the hive in its old situation, and the bees, as they recover, will return to the domicile. A bright, calm, early morning is the best time. Be cautious at first, but practice makes perfect.

H. B. E.

INCUBATORS.—To "HATCHER," AND ALL READERS IT MAY CONCERN.

[4263.]—YOU are quite right in what you say on p. 229. The incubator does absorb the moisture of the eggs too much; I therefore advised you to damp the eggs well. I find it a good plan to float the eggs in warm water for a minute or two, a day or two before they are due. The hens, if set in a very dry place, get a small brood; I therefore set them in a cool damp place if I can, or I put two shovelfuls of fresh earth under the nest before I make it up, or a large sod fresh cut. I know this is contrary to most people's notion of keeping the hens warm, but it prevents the increase of vermin, and I get more chicks. I am corroborated in this opinion by Mr. Wright, in his "Poultry Keeper's Guide," and he is a trustworthy authority. In the incubator I now make a cotton bag, and put in a quart of damp warm bran, flat it down to about an inch thick, and put it upon the eggs under the glass; this gives the required pressure, and in a great measure prevents the absorption so detrimental to the welfare of the chicks in the eggs. This bran bed will require renewing about every third day or so; in this way you will get good results. If you are timid about it, try it on part only, and see the difference; with the bed they require no more damping. The floating the eggs the last day or two certainly assists in freeing the chicks from the shell or inner lining should they be gummed thereto, which you cannot ascertain until too late.

M. O.

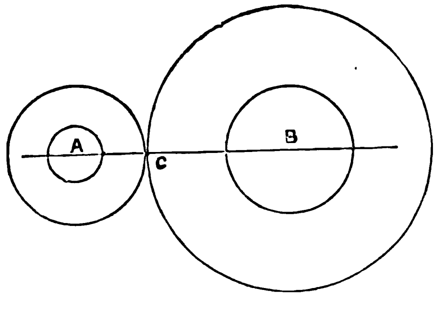
OF AUGUSTUS LE PLONGEON, M.D., ON THE COSMIC FLUID.

[4264.]—THE cosmic fluid or ether I suppose to rotate and revolve in orbit amidst the aërial atoms along with the great orbs of space. W. Matthieu Williams, F.C.S., in "The Fuel of the Sun," published in 1870, opines all space is filled with an atmosphere like the one we breathe except in its extreme rarity; that our atmosphere has no limit, but grows rarer and rarer as it recedes from its attracting centre until terrestrial gravitation is neutralised by that of some other orb at the point where the attraction from each is equal. Between the orbs A and B, for instance, the point C exists as a centre of equilibrium.

The point C, where the two atmospheres join, is distant from A and B in the ratio of their respective weights, thus—

$$AC^2 : CB^2 :: A : B.$$

Now we infer the moon has no atmosphere of nitrogen, oxygen, &c., like ours, but has the like cosmic fluid, which will rotate and revolve with it, and, I ask, are we, when it passes between Sol and us, to infer that the three atmospheres are crushed to that extent closer? A solar eclipse in such case displays its corona through an extraordinarily dense medium. Dr. Plongeon asserts the cosmic fluid opposes the orbit motion of the earth; that this front resistance causes diurnal rotation of the earth and its conical movement, occupying 25,868 years; its tide-producing vibration; and continuous friction throughout its surface, but mainly at the equator—a cause of heat at the earth's surface. Is not such result from interstellar fluid quite an over estimate? We see because objects rebound ether, but even this without force enough to disturb the equilibrium of a feather floating in the air; but were the ether equally dense in space, where, I ask, but in falling meteors or aërolites can there be friction? After the first impulse to motion each orb in motion creates a vacuum behind it, which is rushed into with an impetus to the orb, evidently as acceleratingly effective as anything in front is obstructive. What obstruction is there in front to an orb that carries along with it everything around it, especially in front of it, in an unresisted orbit? Suppose the earth, by some terrific collision, driven off from its atmosphere and orbit by suddenly acquiring a speed it could not all at once impart to its air, how would the air, once the earth's atmosphere, deport itself? Would not it gravitate to the nearest powerful enough orb unless held back by some centre of equilibrium? Why do not all the atoms of nitrogen and oxygen and all other fluids descend by the law of gravity to the surfaces of all their allied orbs, but because they vibrate molecularly to the creation or maintenance of vacuum which buoys them up? In so far as rotation causes easterly and westerly winds it produces friction and heat, but the easterly wind being mostly northerly, destroys much more heat than it imparts. I am quite afraid the doctor is importing into his theory more imaginary causes than he can adduce reasons to support. Did any one live to testify as to the temperature of a cannon-ball on leaving the cannon and its fire? If on splitting we find the interior hot and exterior cool, it seems to have cooled by its excursion. But enough: I wait to see if some veteran soldier in science do not tilt to discomfiture some of the over-brave utterances of a nevertheless clever M.D.



In my diagram the outer circles denote extension of the atmospheres within the bounds beyond which they would intersect each other; how far, beyond this, rotation influence extends, of course, is matter for speculation, and to be considered in results, in observations.

J. BARWICK.

SULPHUR AS A BLEACHING AGENT.

[4265.]—I HAVE looked forward with special interest to Mr. Bottone's papers on the sulphur compounds, in the hope that he would attempt some explanation of the manner in which sulphur acts as a bleaching agent. Chlorine we know, acts in this manner, in the presence of water, by uniting with the hydrogen and liberating the oxygen—the true bleaching agent: this is intelligible enough. When Roscoe and others, however, go on to tell us that the action of sulphur is just the opposite of this, that sulphur dioxide bleaches by deoxidation, what are we to infer with regard to the nature of its action? What is the true bleaching agent in the case of the sulphur compounds, and how does it act? Does it, like oxygen, form insoluble compounds with the vegetable colouring matter present? In what sense, again, are the colours said to be merely masked? If Mr. Bottone will kindly come to our assistance in this matter, I—and, I doubt not, other readers—will feel greatly obliged to him.

A. E. S.

"JACK OF ALL TRADES."

[4266.]—FEW of your readers have not admired, and many have profited by, the varied and accurate knowledge displayed by this contributor, which he has always been so kindly ready to communicate; and the very least we can do, now he is suffering from illness and the effects of it, is not merely to desire but to do our best to promote his recovery. It is not possible to form a very accurate opinion of a case by description alone, but "Jack" has said enough to show that he imperatively needs complete mental rest, and especially relief from worry, and, very probably, at least a temporary change of residence; he certainly needs that if he be still living in the place where he contracted his ague, unless, indeed, it be one which is free from ague during a great part of the year, and even in that case a temporary change of residence would probably be very beneficial. It often happens that doctors, in ignorance of their patients' circumstances, advise that to be done which is impossible, and that may be the case now. Our good friend may have been so ready to give his knowledge for the help of others as to have neglected his own interests, or his severe illness may have caused such loss and expense as to place mental rest and freedom from anxiety, which are essential to his recovery, out of his reach, unless some of the many whom he has often and so kindly helped will now join together to help to save a life so valuable. As I am in absolute ignorance of the sufferer's circumstances, this suggestion of aid possibly needed may appear to be an impertinent intrusion; but if the case be as I suggest as possible, I trust it will not wound our friend's delicacy to receive help in the only form in which most of us can offer it, and that he will feel under no painful obligation towards us, who feel ourselves that we are simply discharging a just obligation, and acting towards another as we would wish others to act towards us under similar circumstances. If, Mr. Editor, you think such aid is needed, my guinea is ready; and if all who have benefited by "Jack's" advice will pay for it, he will be freed from all anxiety on that score. It will be only payment of just, though not legally enforcible, debts.

PHILO.

[Mr. J. W. Hayward, of Tonnage House, Carrow, Norwich, has also written a kindly-worded letter on the health of "Jack of All Trades," and suggests that he should, if possible, visit Smedley's Hydropathic Establishment, Matlock, for a short time. "If," says Mr. Hayward, "'Jack of All Trades' is poor, I should be happy to forward him £1 to help to pay his expenses, if he would accept it." We may inform our readers that our versatile friend "Jack" is a hardworking man with a large family, and from what we know of him we believe that he is as ready to help his neighbour as he is willing to give the best advice he can to those who ask it in our columns. No doubt such a change as that suggested by Mr. Hayward would re-establish his health. If three other correspondents would imitate the unsolicited example of "Philo" and Mr. Hayward, making in all £5, the Editor would cheerfully double the sum, and we hope "Jack" would not be too independent to accept the present.—ED.]

DRYING PLANTS FOR HERBARIUM.

[4267.]—IN my juvenile days, being a great rambler amongst the fields and along a sea-shore margin, I collected a large number of plants of various kinds, and dried them by means of warm sand and sheets of blotting-paper, changing and drying both sand and papers very frequently. My press was the sacking-bottomed and loose-cushioned old-fashioned sofa (not old fashioned in the days I allude to), so that every one who visited us, and accepted a seat on the said sofa, was so far a contributor, unwittingly, to my *Hortus Siccus*. I still possess most of those specimens, almost fifty years old, and when I look at them, I can say, with Montgomery, "Days of my childhood, hail!"

H. O'B.

MARSH MALLOW FOR HARDENING PLASTER OF PARIS.

[4268.]—THE following may prove useful to your correspondents, on which subject I contributed a short article to the *British Journal of Dental Science* for April. Having suffered much inconvenience from the porosity of plaster of Paris, and having tried alum (subsulphate of alumina), salt (chloride of sodium), &c., and finding no improvement, I remembered that I had somewhere read of marsh mallow (Malva: a genus of the Monadelphia polyandriæ) as a remedy for the above defect; I therefore procured 1oz. of the above, half of which I placed in a pint bottle, on which I poured boiling-hot water, using half the above solution and half water to mix the plaster to the required consistency, and have since had no trouble whatever, it being quite hard and non-porous.

E. GRAHAM YOUNG, S.D.

HOW TO OBTAIN DOUBLE FLOWERS FROM SEED.

[4269.]—MANY years ago I was very fond of flowers, and had the advantage of a fine garden. I was very successful in obtaining double flowering plants of the different species of stock gillyflower. The plan I adopted was frequent transplanting the first year, with good rotten compost, generally taken from an old hot-bed. As the plants began to prepare for flowering, I stripped them of all side shoots, and selecting such as from the appearance of the buds would be likely to produce semi-double flowers, I first staked and secured them with a string of bass, and then with a sharp penknife took off a strip of bark, ¼in. deep, three-

REVOLVING PUDDLING FURNACES.

[4253.]—"R. S." (let. 4172) has not succeeded in explaining away the facts already adduced in reference to Mr. Danks' claim to the invention of the revolving puddling furnace. Mr. Walker's experiments failed for the want of a proper chimney for his furnace—this was not his fault, but his misfortune; while even with the aid of a good chimney Mr. Danks' furnace is reported to be a "bad melter." As a manager of iron works and a practical mechanic, I consider Mr. Danks' furnace to be neither more nor less than a combination of the inventions of Messrs. Walker and Tooth; and, until Mr. Danks has otherwise proved his claims to this invention, "R. S." has no right to put forth his humble opinions as to the superiority of Mr. Danks' furnace. An invention lying in the pigeon-holes in the Patent Office is not lost, or a thing to be pirated with impunity; neither can a mere improver in an sense of the word be considered an original invent The Danks' furnace appears to me a second edition the American reaping-machine. In 1825, if I mist not the year, an English mechanic invented a reap machine; it was tested and did its work well. On first public trial the machine was smashed to p and the inventor pelted with stones by an en mob of farm labourers. This invention lay do until the Great Exhibition of 1851, when the re machine again appeared as a new inventior America, and, of course, patented. The tri exposed, and the patent, like the revolving furn to the ground.

"R. S.'s" laudations of the Iron and Steel are rather out of place. It cannot be adm that scientific body has acted fairly by rushi iron-melting-temperature zeal at Mr. Da before the original invention at home had cally tested. In the absence of this fair part of this institution the pleasant tri Atlantic, the convivial dinners and gushing votes of thanks from the lordly sized portrait of the noble President. that smack of egotism already descr proverb informs us that things dear fetched are greatly admired by fantas so, apparently, with the Iron and Ste the Iron and Steel Institute acted on justitia, ruat cœlum," justice would Messrs. Walker and Tooth, with Danks. G. S.

A NEW MODE OF CONVERT FORCE INTO ITS HEAT

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ammonia, 6 parts; water 10 parts. The ... drawn into the nose and mouth frequently, it is said with great advantage. M. R. C. S.

pervades and fills in gaseous bodies, and is ca

·num." I should say "you" can ·to a pound of flour, and produce ·er compounded of these" (num· ·compound numbers, of water or ·would be "concrete multiplica· ·e) " will represent." Now, 2 is a ·of two numbers, one and one, ·ld not be far from the mark in ·would be 2 pounds, or 2 pints, of ·exactness is required—*fiat experi*·it be determined by experiments.

M. A.

A GIANT PLANET.

·rticle which appears in the *Cornhill* ·month (May) under the above title, ·the exception of a few preparatory ·, pp. 244 and 245 of "ours," bears ·oming from the pen of Mr. Proctor, ·the *Spectator* in the leading article of ·n your foot-note, and if so, it will be ·dix to his "Essays on Astronomy," ·a compilation of most of his previous ·ent serials, and, in its present con· ·ll worthy the study of all students in

·tor is always so accurate in his quota· ·tions on which he bases his theories, ·in pointing out an apparent omission Where the satellites are regarded as ·Jupiter's luminosity, the writer quotes ·observation of Dec. 30 last, of the fourth ·dark transit," and also Padre Secchi's ·of Feb. 3 of the third satellite in "dark ·states "that the comparative darkness of ·ites will have been established;" he omits, ·give the instances of the first and second "dark transit," as the remark of Padre ·narrative that "this fact is not a new one ·r satellites," appears to apply to the imme· ·t as to the behaviour of the satellites close to ·nd not to their transit as dark spots across ·ler of disc. I was favoured, through ·der optical means (a 4·28-in. refractor by ·witness three "dark transits" during the ·tion of Jupiter—viz., the fourth satellite on ·d Feb. 18, and the third satellite on March 24 ·e latter case, the satellite not being on the ·e same time as its shadow (as in Padre ·bservation of Feb. 3, I had not the means of ·o accurately the comparative darkness of but it appeared to be almost as black as its ·which came on afterwards. I would again call ·to the peculiarity I pointed out (No. 362 p. 608) ·bservation of the transit of satellite 4 on 18th ·y last, the satellite showing itself as a dark ·rer to the western edge than it did to the ·edge of Jupiter after passing on at the com· ·ent of transit.

·is no more interesting study with instruments ·rient excellence than the observation of the ·s in the tints of the equatorial zone of belts with ·r-varying changes of their form, and the great ·r of minute cloud-like markings sometimes seen, ·ich probably give to Jupiter the mottled appear· ·observed under less favourable conditions. By the Mr. Buckingham's fine 21-in. refractor is men· ·d in the article as showing these minute clouds, ·as I have seen that instrument noticed several ·s in newspapers without stating the maker's name, ·nk it is not generally known that, though the ·er constructed the equatorial mountings and fit· ·s, the credit of the optical part (the most essential), ·due to Mr. Wray. As many of "our" astrono· ·cal readers may not have seen the quaint account ·an observation of Jupiter given in the first number ·the *Philosophical Transactions*, published in Lon· ·on on "Munday, March 6, 1664 5," I now append ·n extract from the original:—"The ingenious Mr. Hook did, some months since, intimate to a friend of his that he had, with an excellent twelve foot telescope,

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

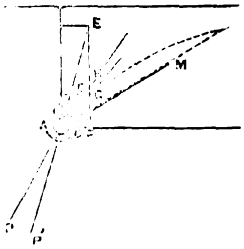
HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10478.]—**Pork Diet.**—I am glad to find some one who thinks as I do, and congratulate the "Mother" on having had the courage to introduce the subject of "Pork Diet;" for it requires courage to again raise a question which has been discussed so often and so ably, and generally with the same result—which result is not satisfactory to non-pork-eating people. When in No. 356 there appeared a query on the same, I hoped it would have met with a more general response. "Philo" alone answered, and not to the point. It was disappointing, but what can one say to these older and wiser heads?—except, indeed, that "wisdom is not always with the mighty, nor understanding with the strong." Had "Philo" and the other gentleman worn out less carpet in lighting or not lighting electric sparks, we might have had some valuable reasoning from them. As it is, I hope that some earnest and capable mind will take the matter up, and so convince some others of the unfitness of the pig for food. Rabbits and shell-fish are equally rubbish. They are coarse, impure diet, and have a vile and lowering influence on the mind. It may be that much of the crime and misery among the lower orders originates from such a cause as this. I have frequently noted the effect of such food on those about me, causing irritability and peevishness in both young and middle aged, and if there be a "deaf grandmother" she will be more deaf because more crochetty. If such is the influence on refined and educated minds what can it be with the untaught but hurtful and debasing?—SARAH.

[10640.]—**A Reason Wanted.**—I beg to state, in reply to Mr. Taylor (p. 204) that it is in the act of breathing out that strength to lift weights is increased, and that I firmly believe breathing out air from the lungs is not the same thing as breathing in. I beg to add that, very often, I have found breathing out air from the lungs greatly help in ascending hills, giving a compactness and sense of lightness to the body, pleasant to experience, as well as helpful in the ascent. Breathing in reduces both the lifting and the ascending power. Such is the fact, and experience of—GERARD SMITH.

[10664.]—**Angle of Incidence and Reflection.**—I thank "Billiardist" for the illustrative case he has given on p. 204, and his explanation, so far as it goes, is correct, but still it does not account for the fact that both times the ball should take the same course after having struck. I am afraid I cannot explain it, but shall venture to hint at a probable reason. By the nature of the problem, the red ball having to return to its original position at the instant of striking the line joining their centres must be perpendicular to the end of the table, and if the balls were perfectly elastic, the result in all cases with any angle or velocity would be that the striking ball would proceed parallel to the end of the table; this is on the supposition that the balls are physical points. The elasticity not being perfect causes the ball coming from P to take the direction A D, $\frac{B\ D}{B\ C}$ being the co-efficient of elasticity, similarly a ball coming from P′ with a velocity A E should pass through a point G, $\frac{E\ G}{E\ F}$ being the same co-efficient of elasticity. But this co-efficient has been proved by experiment to be less with increased velocity; it should, therefore, pass in some such direction as A H, in place of which it appears it travels in direction A M. Now, I venture to suggest the following as a reason, but should be glad to have the opinion of more competent persons — viz., when the balls strike a whirling motion is imparted to them, the ball A rotating in direction represented by the arrow. The effect of this motion rubbing on the table must be to retard the motion of the ball on the one side more than the other, acting as a rudder, and causing it to describe a curve, such as indicated by the dotted line. Now, with a greater velocity, and at particular angles of striking, this rotary motion is increased, and, consequently, its deviating effect. I have no doubt some of your correspondents will be able to give a better explanation.—F. N.



[10731.]—**Fastening Escape-Wheel in Lever Watch.**—I have not the time nor the desire to enter into a war of words with "West Cornwall." I will tell him, in confidence, I do love soft solder, it is so very convenient. Last week I had a first-class lever watch to repair. It had three of the teeth and a part of the rim broken out of the fusee-wheel. There had been a fracture of the brass, done, I presume, when the metal was condensed, and unfortunately it was opposite the slit of the maintaining power spring. I recommended a new wheel, but the question was asked, "Can you not repair this one?" I said, Certainly I can. Now, dovetailing alone would not have done. Hard soldering would have softened the metal, therefore I made use of a dovetail and the convenient soft solder, and made a good job of it, which will stand as long as the watch will last. I will give "W. C." one of my practical wrinkles for soft soldering small jobs, which I have no doubt will be useful to many readers of the ENGLISH MECHANIC. Take a common German silver spoon, drill a small hole in the middle of bowl. Now take a spoonful of melted metal and run it along any cold surface, and you will make small solder wire, about the thickness of staff wire; run it into four or six-inch lengths. Cut a short piece of peg wood, make a hole in the end, press in the end of a length of solder-wire. Now take a piece of mainspring, press into the slit of a batswing gas-burner, close down to the bottom on one side and a little from the bottom of the other. Turn on the gas, and you have a small horizontal fine-pointed jet of flame. Now place the peg wood end of solder in your mouth as you would a blow-pipe; put a drop of spirit on to your work. You have both hands at liberty: bring the two pieces together you wish to solder, and let the tip of flame impinge upon it. By this method any amount of work can be done in a quick and neat manner. I use it for all kinds of common jewellery work. "W. C." says I entirely omitted Geneva watches. Why import them into the controversy? "S. H. L." asked to know how to collet an English escape-wheel. It could not be a Geneva, as the Swiss workmen do not employ collets, but seat their wheels on the pinions.—A YORKSHIRE PIVOT.

[11108.] — **Tilt Hammer.**—As Mr. Fennell still persists that his drawing of a tilt hammer is correct, I must again warn the readers of the ENGLISH MECHANIC that it is an ingenious impossibility, would cost five times the price of a proper hammer, and not do the duty expected. I have not time now to go more into detail or send a sketch, but will do so if wished.—A BARRISTER.

[11120.]—**A Question of Sight.**—To "E. L. G." —By "air under special mechanical pressure," I mean air subjected to pressure beyond that of the open air superincumbent and around it. As "E. L. G." will not accept my feeble illustration of a single needle reaching from the sun, let him suppose the cosmic fluid to be a dense solid (of course he drives me to suppose the "impossible") from the sun to the earth; then, if without a vacuum between any of its atoms, it would strike the earth when it itself was struck at the sun, how can he state such to be longer than light, which travels at less than 200,000 miles per second, whilst the sun is distant more than 95,000,000 miles. I think I never could be so abstracted as to put down 17,000 feet as the speed of light, though I may have let feet slip in for miles. I regret it, and will try to mend.—J. BARWICK.

[11275.]—**Darkening Walnut (U.Q.).**—Boil the husks or skins of walnuts when they are black and rotten to a jelly and use hot or cold. Will keep any length of time, and does not spoil the look of the grain. —F. J. G.

[11333.]—**Motive Power for Amateurs.**—I am sorry that "Zoo Andra" should be annoyed by my classing his plan with those fancies—plausible in themselves—which are the bane of young and enthusiastic mechanics. He will find the pendulum idea one of those proposals to gain or multiply power which are only varieties of the perpetual motion scheme. If "Zoo Andra" will refer to page 206 he will find the plan recommended there is for a single-handed saw—*i.e.*, one to enable a man to do the largest amount of work without assistance, and of course worked by a treadle. I have had some experience with circular saws from 4ft. diameter to 3in., and although I grant speed is advisable, it is of no use without sufficient power, and the plan proposed by me will allow much harder work to be done than can be managed by a saw fitted to a lathe in the usual manner. A circular saw will cut very well at a slow pace if sufficient power be applied to keep it going, and will, in many cases, cut more at a moderate than a high speed; the reason of this is that the teeth are frequently too close, and do not take proper hold of the wood. The teeth of all saws require to be enlarged as the speed with which they are driven is increased.—A BARRISTER.

[11386.]—**Crystals in Gas Tar.**—(To MR. BOTTONE.)—I have always taken the term artificial alizarine to mean the substance prepared from anthraquinone, as distinguished from the natural substance extracted from madder, and the term is certainly generally used in this sense: *vide* any of the scientific periodicals for the last two years. I am acquainted with the substance termed naphthazarine by Schützenberger, but I never heard of the term artificial alizarine being applied to this body, which, probably, has the same relation to naphthaline that alizarine has to anthracene.—ETHYL.

[11452.]—**Rain-water Tanks (U. Q.).**—"Rosso" had better construct his tank of galvanised iron, which is far preferable to bricks and mortar. I have a large tank made of it, and it has answered efficiently. The cover can be made on a hinge, or one with handle to lift right off. If "Rosso" requires the water clean for any special purpose, he had better have the tank in an fourths round the stalk, taking particular care to leave one-fourth of the circle of bark intact. The seed from the plants so treated produced nearly all double flowers. The principle on which I acted was, that the blood or sap of a plant ascends through the centre or pith, which may be called the artery; and again descends between the stem and bark, corresponding to the veins of a living animal. The partial stoppage of the descending current was to give the plant a sort of apoplexy. By this means the finest double anemones can be produced, and plants beautifully striped can be obtained by crossing. Thus select (say) a crimson for the male plant, to be crossed with a white (the female). As soon as you can carefully open the petals of the white flower, extract all the stamens with a small pincers, and immediately cover both flowers with a fine muslin bag. Examine frequently with a hand microscope the stamens of the red, and when they appear ripe, extract them carefully one at a time, and removing the bag from the white flower, gently rub the pollen dust over the pistils. Then cover the impregnated flower again with the bag for a few days until all danger of extra impregnation from insects is over.

From an old gardener who was celebrated for his stock gillyflowers I obtained the following information: His plan was to save seed from the semi-double plants only, and to carefully wrap up the seed in brown paper, not to be again opened for five years. He showed me his collection of seeds, and gave me some of white and crimson from packages, which he declared had been saved five years. I sowed those seeds, and the next year found nearly all the plants produced double flowers. E. J. D.

MICROSCOPE.

[4270.]—As the microscope trade is stocked with a class of instruments which are constructed merely to hold together while being sold, a few words on the subject may assist others besides "A Canadian Subscriber" in making a judicious bargain. First, then, where to purchase. If the buyer is disposed to contribute to the support of an expensive front shop he will find every facility for doing so, but let it be understood that he thus allows the shopkeeper a ruinous percentage for the mere trouble of selling. The majority of this class are mere salesmen, and their whole knowledge of microscopy might, as a rule, be condensed into the text, "Here are the instruments and I want to sell them." In support of this statement I quote Mr. J. F. Heather, who, speaking of microscopes in his well-known book, says that "many so-called opticians are mere sellers of articles, of the qualities of which they are totally ignorant." And I would add that an instrument bearing an eminent name often emanates from the hand of poor Bill somebody, who lives, works, and appears very likely to die, in some garret or kitchen.

In the mechanical part nothing is of greater importance than the focussing rack motion; and, therefore, it should be seen that it has a good, even, and parallel fitting, without the least "shake," false motion, or nasty grating, produced by the pinion being set too deeply into the teeth. Put an object under a ½in. power on the instrument and watch it (the object) as it gradually comes into focus; if it is seen to move about in the field the rack is imperfect, and should be rejected. Next, try the fine adjustment with a higher power, and the same rule applies to both. Notice that the "core" through which the rack bar slides is fitted by a separate plate, as many are made to fit by a gentle use of the hammer round the top. The pinion bearings are often packed up with leather, &c., which, on wearing away, leave the instrument as innocent of anything like "cobbling" as it is incapable of proper adjustment. If the object is in focus at one side and indistinct at another, the probable cause is that the stage is not at right angles with the optical axis of the instrument, though the object may be imperfectly mounted, so, to make certain, turn it upside down or try another, using a high power for this. Take out the objective and eyepiece, and looking straight down the tube turn the diaphragm round and see that the apertures are pretty central, as they appear successively in the field. See that the motions for mirror, &c., are reasonably tight, and that the whole is steady, proportionate, and well-fitted.

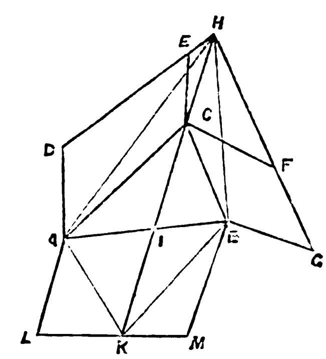
A set of French achromatics containing three powers (that is, in all, three pairs of lenses) will do excellently for all general purposes of interest, but in the deeper studies there are many things which cannot be properly seen without the use of first-class objectives, which are very expensive. Good test objects are the Navicula sigma, a minute shell found in fresh pools, which should appear completely covered with a number of longitudinal and tranverse lines, and the Podura flambea, or skip-tail, a small wingless cellar insect the size of a flea, which should appear covered with a number of delicate marks like notes of admiration. In choosing a binocular look first into the straight tube, and notice the exact position of the object in the field, and in what parts it touches the edge; then see the image in the side tube, and it should exactly correspond; should it not touch the edge at the same part the error may owe its cause to one aperture being larger than the other, so put the right side eyepiece into the left body, and *vice versâ*, when, if this fault is still apparent, the prism must be set wrong or the body at a wrong angle. The arrangement for raising or lowering the draw tubes should move smoothly, and both eyepieces at the same time, as, if one is higher than the other, that image will be the most magnified and an indistinctness will be the consequence; place both eyes over the instrument and adjust the tubes to their proper height by shutting the right eye and looking down the left tube, and then shutting the left eye and looking down the right tube, so that both images are seen at the same time; they should then appear stereoscopical and sharply defined, free from darkness and prismatic or other glare caused by the entrance of light between the bodies, the right one often being unavoidably lighter than the left, but there are many who fail to see the binocular effect. Now, if I have not exhausted the subject, I nevertheless must have exhausted the patience of those who read this letter, so conclude by informing "Canada" that the price varies from £4 to £400, but a very serviceable instrument may be had for about 14 guineas, with three powers, mechanical stage, condensor, frog-plate, polariscope, parabola, live box, neutral tint reflector (or camera lucida), forceps, and all accessories, but in one of the best kind double that amount may easily be given for the lenses alone. C. G. P.

NEW (?) PROOF OF PYTHAGORAS' THEORY.

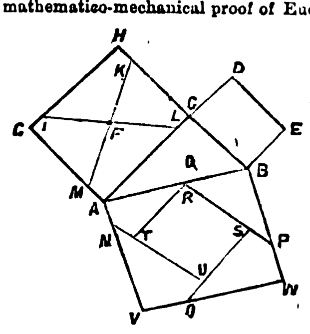
[4271.]—In your number of 10th inst., p. 203, Mr. Recordon has exhibited an old arrangement. I refer him to "Un Million de Faits" for a generalisation proved by Clairaut's brother (query, dating from the ancient Greeks)—viz., thus:—"On any $\triangle ABC$ erect any lateral parallelograms, ACDE, BCFG. Let DE, GF produced, meet in H. Join HC, produce it to cut AB in I, and extend to K, IK = CH. Draw AL, BM, parallel and equal to IK, join LM. Then shall AK = AE, BK = BF, and parallel AM = parallel AK + parallel BF." For, join AH, AK, BH, BK. Then $\triangle ACH$ is half AE (same base and same parallels); $\triangle ACH = \triangle AIK$, equal bases on same line HK, and same vertex; $\triangle AIK$ is half AK (same base and same parallels), whence LI = CD; similarly MI = CG. *Q. E. D.*

Very Special Case.—DAC = right angle = CBG, also DA = AC, GB = BC, AM = square. (Euclid 47, I.)

Is it possible that this diagram will illustrate the composition of oblique velocities, forces, moments, &c., as Euclid 47, I., does that of rectangular ones?



My friend Mr. Perigal many years ago gave a mathematico-mechanical proof of Euclid 47, I., as follows:—On right angle $\triangle ACB$ describe lateral squares AH, BD, AW. Bisect each side, AB in Q, P, O, N; draw QT, OS parallel to AC, and NU, PQ parallel to BC intercepted at R, S, T, U respectively. Through centre F of AC square, draw IL parallel to AB, and KM perpendicular to AB or IL. Then shall the eight four-sided figures IFKH, KFLC, LFAM, MFIQ, ANTQ, QRPB, PSOW, OUNV, be all equal and similar to each other; and RSTU is a square = CBED. Then AH may be cut up and its pieces placed round BD, so as to produce AW—proving it to the layman as well as the student of mathematics that $AB^2 = Ac^2 + Bc^2$.



S. M. DRACH.

RECURRENT VISION, &c.

[4272.]—The following fact may help to elucidate the "recurrent vision" of Professor Young (see p. 190): The image impressed on the retina, after looking at a contrast of colour, is reproduced alternately by each eye, and is not a continuous impression, as it ordinarily appears to be when the eyes are equal. This may be proved by any one who can combine the two views of a stereograph without a stereoscope (by directing the axes of the eyes parallel as in looking at a distant object, and yet focussing the eyes as for a near object). Thus, stick two discs of black paper (about half an inch diameter) on a sheet of white paper, the distance between them being equal to the distance between the eyes; then, holding the paper about a foot from the eyes, so that a line between the discs would be exactly parallel to a line between the eyes, combine the discs as a stereograph, so that the right eye looks at the right disc, and sees the left disc rather indistinctly, and the left eye sees *vice versâ*. After gazing at them thus in a strong light (keeping the eyes steadily fixed on the centres of the discs) for about half a minute, shut the eyes quickly and wait (sometimes for a few seconds) until the images appear, meanwhile shading the eyelids and gently pressing them if the images do not appear easily, or if they cease for a few seconds (a good impression, with pressure or rubbing, lasts off and on for about a minute), and if the trial be successful, there will appear a central strong disc image, formed by the right image of the right eye and the left image of the left eye overlapping, the second images of each eye alternately appearing one on each side, one becoming visible when the other disappears. Each of these transient images lasts about two or three seconds, sometimes five or six alternations being perceptible, as the images of each eye strengthen and diminish.

Now, whether Professor Young's recurrent vision results from a shorter period of recurrence of rather a different character, affecting both eyes simultaneously, or whether one of his eyes reproduces images far more vividly than the other, is uncertain, but the above phenomenon may throw some light on it.

While on visionary subjects, I may as well mention a remedy for the dazzles, with which many of your readers may be troubled, as was the late Sir John Herschel; by the dazzles I mean a quivering appearance of a dark and light, or coloured shade or impression of lines moving angularly or serpentinely, which commences at the extreme limits of vision, and gradually encroaches towards the objects of view, until in about five minutes the whole vision is affected, so that it is impossible to see anything distinctly, though the forms and positions of objects appear quite unaffected by it. A fraction of a grain of sulphate of quinine will remove this appearance in about ten minutes, though otherwise it will continue for some hours. This is the homœopathic consequence of the fact which was first perceived—namely, the production of the dazzles by a small quantity of sulphate of quinine, which is an effect any of your readers who are curious on the matter could doubtless produce, if not already drugged with large doses of that medicine.

W. M. FLINDERS PETRIE.

COMMUNICATING ROTARY MOTION TO BALL FIRED FROM SMOOTH-BORED GUN.

[4273.]—"PHILUS WARD" (letter 4159, p. 227) may perhaps not have heard of the Mackay gun, which was tried some few years ago near Liverpool, against a target of the "Agincourt" pattern, if I remember rightly. Mr. Mackay used a rifled gun, from which he fired cylindro-conoidal shot, without studs or any other contrivance to take the rifling. The shot was rotated by the gas escaping alongside the shot, through the grooves; hence it was called the "Windage gun." I remember seeing the target shortly after the experiments, and the shot seemed to have done good work upon it. The system soon afterwards sank into oblivion, for what reason I can hardly say, but there must have been something wrong somewhere.

ARTILLERY CAPTAIN.

CONCRETE MULTIPLICATION.

[4274.]—I HAVE no desire to be hypercritical, and only again object to "Sigma's" further explanation of "concrete multiplication" (let. 4188, p. 223), because I believe that, being erroneous, it may tend to produce confusion of ideas in others. It is worth while on some occasions to dispute about words; for nothing has occasioned greater conflicts of opinion than misunderstanding the terms involved in the subject in dispute. Now, what is the meaning of multiplication? It has either the simple arithmetical sense of repetition a certain number of times (integral or fractional), or it has a more general algebraical meaning.

In the first case, it refers to the arithmetical operation upon another number, abstract or concrete, in which case anything foreign to the idea of number cannot become introduced, and so there can arise no idea of squareness or solidity. In the second, results of a very general character may ensue, but in neither case is it a valid reason against the possibility of any operation that it has no meaning. We may, for instance, in algebraical operations arrive at the result $\sqrt{-a}$. This is an impossible, and itself an unintelligible, quantity, but it does not disprove the correction of the operation of which it is the result. Another explanation, then, must be given of the result of the so-called "multiplication of concrete" quantities, and I believe the correct one to be that which I have already given, that the unit is supposed to be changed before the multiplication takes place. If pounds cannot be multiplied by pounds there is no reason, either *à priori* or *posteriori*, why feet can be multiplied by feet. To say that "concrete multiplication" is an arithmetical dodge is quite beside the subject: what is so called is a straightforward and simple proceeding when rightly explained. Nor can I allow "the true explanation" to be that "concrete numbers are only susceptible of addition and subtraction." This can only mean, I think, that though we cannot multiply a pound by a pound, yet we may increase a pound by a pound, as if the pound were the arithmetical operation, and not the increase or addition of it. I need not pursue this question further, but I can discern no other reason for "Sigma's" assertion than this supposition. The fact is, that concrete, as well as abstract, quantities are susceptible of multiplication and division as well as of addition and subtraction. We do not in any case perform the operation by means of the concrete quantity, but with respect to it.

Lastly, I can see nothing impossible in "Sigma's" last example, which, I suppose, is intended for a "reductio ad absurdum." I should say "you" can "add a pint of water to a pound of flour, and produce paste, which a number compounded of these" (numbers, I presume, for to compound numbers, of water or flour, or even paste, would be "concrete multiplication" with a vengeance) "will represent." Now, 2 is a number compounded of two numbers, one and one, and I think we should not be far from the mark in saying that there would be 2 pounds, or 2 pints, of paste. If greater exactness is required—*fiat experimentum!*—let the unit be determined by experiments.

M. A.

A GIANT PLANET.

[4275.]—The article which appears in the *Cornhill Magazine* for this month (May) under the above title, and given, with the exception of a few preparatory sentences in No. 374, pp. 244 and 245 of "ours," bears evident marks of coming from the pen of Mr. Proctor, as surmised by the *Spectator* in the leading article of May 4, as stated in your foot-note, and if so, it will be a suitable appendix to his "Essays on Astronomy," lately published, a compilation of most of his previous papers in different serials, and, in its present connected form, well worthy the study of all students in astronomy.

As Mr. Proctor is always so accurate in his quotations of observations on which he bases his theories, I feel diffident in pointing out an apparent omission in the article. Where the satellites are regarded as photometers of Jupiter's luminosity, the writer quotes Mr. Lassell's observation of Dec. 30 last, of the fourth satellite in "dark transit," and also Padre Secchi's observation of Feb. 3 of the third satellite in "dark transit," and states "that the comparative darkness of all four satellites will have been established;" he omits, however, to give the instances of the first and second satellites in "dark transit," as the remark of Padre Secchi in his narrative that "this fact is not a new one for the other satellites," appears to apply to the immediate context as to the behaviour of the satellites close to the edge and not to their transit as dark spots across the remainder of disc. I was favoured, through much smaller optical means (a 4·28-in. refractor by Wray), to witness three "dark transits" during the late opposition of Jupiter—viz., the fourth satellite on Dec. 30 and Feb. 18, and the third satellite on March 24 last; in the latter case, the satellite not being on the disc at the same time as its shadow (as in Padre Secchi's observation of Feb. 3, I had not the means of judging so accurately the comparative darkness of satellite, but it appeared to be almost as black as its shadow, which came on afterwards. I would again call attention to the peculiarity I pointed out (No. 363 p. 608) in the observation of the transit of satellite 4 on 18th February last, the satellite showing itself as a dark spot nearer to the western edge than it did to the eastern edge of Jupiter after passing on at the commencement of transit.

There is no more interesting study with instruments of sufficient excellence than the observation of the changes in the tints of the equatorial zone of belts with the ever-varying changes of their form, and the great number of minute cloud-like markings sometimes seen, and which probably give to Jupiter the mottled appearance observed under less favourable conditions. By the way, Mr. Buckingham's fine 21-in. refractor is mentioned in the article as showing these minute clouds, and as I have seen that instrument noticed several times in newspapers without stating the maker's name, I think it is not generally known that, though the owner constructed the equatorial mountings and fittings, the credit of the optical part (the most essential), is due to Mr. Wray. As many of "our" astronomical readers may not have seen the quaint account of an observation of Jupiter given in the first number of the *Philosophical Transactions*, published in London on "Munday, March 6, 1664 5," I now append an extract from the original:—"The ingenious Mr. Hook did, some months since, intimate to a friend of his that he had, with an excellent twelve foot telescope, observed some days before he then spoke of it (viz., on the 9th day of May, 1664, about nine of the clock at night), a small spot in the biggest of the three obscurer belts of Jupiter, and that, within two hours after, the said spots had moved from east to west about half the length of the diameter of Jupiter."

LINBA.

Extract of Meat.—Professor Artus, of Jena, recommends a new method of making extract of meat which possesses the advantage over that of Liebig in retaining the albumen, gelatine, and fat, which are all removed by Liebig's process, and which would seem, from recent experiments, to be the only really nutritious elements of the meat. For this purpose, by a very simple apparatus, an extract of the meat is made first with cold water; this dissolves out the soluble salts, the albumen, and part of the gelatine and creatine. The meat, after extraction in this way with cold water, is then boiled for an hour in a Papin's digester, and the liquid pressed out. The fat is skimmed off the surface, and this extract is mixed with the cold extract. The mixed extracts are then evaporated down to a proper consistence in a sand-bath, or better, in a vacuum-apparatus. This certainly, says the *British Medical Journal*, seems a much better way of preparing an extract of meat than any of the methods which necessitate the throwing away of the most valuable constituents.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

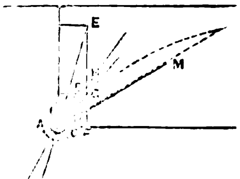
HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10178.]—**Pork Diet.**—I am glad to find some one who thinks as I do, and congratulate the "Mother" on having had the courage to introduce the subject of "Pork Diet;" for it requires courage to again raise a question which has been discussed so often and so ably, and generally with the same result—which result is not satisfactory to non-pork-eating people. When in No. 356 there appeared a query on the same, I hoped it would have met with a more general response. "Philo" alone answered, and not to the point. It was disappointing, but what can one say to these older and wiser heads?—except, indeed, that "wisdom is not always with the mighty, nor understanding with the strong." Had "Philo" and the other gentleman worn out less carpet in lighting or not lighting electric sparks, we might have had some valuable reasoning from them. As it is, I hope that some earnest and capable mind will take the matter up, and so convince some others of the unfitness of the pig for food. Rabbits and shell-fish are equally rubbish. They are coarse, impure diet, and have a vile and lowering influence on the mind. It may be that much of the crime and misery among the lower orders originates from such a cause as this. I have frequently noted the effect of such food on those about me, causing irritability and peevishness in both young and middle aged, and if there be a "deaf grandmother" she will be more deaf because more crochetty. If such is the influence on refined and educated minds what can it be with the untaught but hurtful and debasing?—SARAH.

[10640.]—**A Reason Wanted.**—I beg to state, in reply to Mr. Taylor (p. 204) that it is in the act of breathing out that strength to lift weights is increased, and that I firmly believe breathing out air from the lungs is not the same thing as breathing in. I beg to add that, very often, I have found breathing out air from the lungs greatly help in ascending hills, giving a compactness and sense of lightness to the body, pleasant to experience, as well as helpful in the ascent. Breathing in reduces both the lifting and the ascending power. Such is the fact, and experience of—GERARD SMITH.

[10664.]—**Angle of Incidence and Reflection.**—I thank "Billiardist" for the illustrative case he has given on p. 204, and his explanation, so far as it goes, is correct, but still it does not account for the fact that both times the ball should take the same course after having struck. I am afraid I cannot explain it, but shall venture to hint at a probable reason. By the nature of the problem, the red ball having to return to its original position at the instant of striking the line joining their centres must be perpendicular to the end of the table, and if the balls were perfectly elastic, the result in all cases with any angle or velocity would be that the striking ball would proceed parallel to the end of the table; this is on the supposition that the balls are physical points. The elasticity not being perfect causes the ball coming from P to take the direction A D, $\frac{B\,D}{B\,C}$ being the co-efficient of elasticity, similarly a ball coming from P′ with a velocity A E should pass through a point G, $\frac{E\,G}{E\,F}$ being the same co-efficient of elasticity. But this co-efficient has been proved by experiment to be less with increased velocity; it should, therefore, pass in some such direction as A H, in place of which it appears it travels in direction A M. Now, I venture to suggest the following as a reason, but should be glad to have the opinion of more competent persons — viz., when the balls strike a whirling motion is imparted to them, the ball A rotating in direction represented by the arrow.



The effect of this motion rubbing on the table must be to retard the motion of the ball on the one side more than the other, acting as a rudder, and causing it to describe a curve, such as indicated by the dotted line. Now, with a greater velocity, and at particular angles of striking, this rotary motion is increased, and, consequently, its deviating effect. I have no doubt some of your correspondents will be able to give a better explanation.—F. N.

[10731.]—**Fastening Escape-Wheel in Lever Watch.**—I have not the time nor the desire to enter into a war of words with "West Cornwall." I will tell him, in confidence, I do love soft solder, it is so very convenient. Last week I had a first-class lever watch to repair. It had three of the teeth and a part of the rim broken out of the fusee-wheel. There had been a fracture of the brass, done, I presume, when the metal was condensed, and unfortunately it was opposite the slit of the maintaining power spring. I recommended a new wheel, but the question was asked, "Can you not repair this one?" I said, Certainly I can. Now, dovetailing alone would not have done. Hard soldering would have softened the metal, therefore I made use of a dovetail and the convenient soft solder, and made a good job of it, which will stand as long as the watch will last. I will give "W. C." one of my practical wrinkles for soft soldering small jobs, which I have no doubt will be useful to many readers of the ENGLISH MECHANIC. Take a common German silver spoon, drill a small hole in the middle of bowl. Now take a spoonful of melted metal and run it along any cold surface, and you will make small solder wire, about the thickness of staff wire; run it into four or six-inch lengths. Cut a short piece of peg wood, make a hole in the end, press in the end of a length of solder-wire. Now take a piece of mainspring, press into the slit of a batswing gas-burner, close down to the bottom on one side and a little from the bottom of the other. Turn on the gas, and you have a small horizontal fine-pointed jet of flame. Now place the peg wood end of solder in your mouth as you would a blow-pipe; put a drop of spirit on to your work. You have both hands at liberty: bring the two pieces together you wish to solder, and let the tip of flame impinge upon it. By this method any amount of work can be done in a quick and neat manner. I use it for all kinds of common jewellery work. "W. C." says I entirely omitted Geneva watches. Why import them into the controversy? "S. H. L." asked to know how to collet an English escape-wheel. It could not be a Geneva, as the Swiss workmen do not employ collets, but seat their wheels on the pinions.—A YORKSHIRE PIVOT.

[11108.] — **Tilt Hammer.**—As Mr. Fennell still persists that his drawing of a tilt hammer is correct, I must again warn the readers of the ENGLISH MECHANIC that it is an ingenious impossibility, would cost five times the price of a proper hammer, and not do the duty expected. I have not time now to go more into detail or send a sketch, but will do so if wished.—A BARRISTER.

[11120.]—**A Question of Sight.**—To "E. L. G." —By "air under special mechanical pressure," I mean air subjected to pressure beyond that of the open air superincumbent and around it. As "E. L. G." will not accept my feeble illustration of a single needle reaching from the sun, let him suppose the cosmic fluid to be a dense solid (of course he drives me to suppose the "impossible") from the sun to the earth; then, if without a vacuum between any of its atoms, it would strike the earth when it itself was struck at the sun, how can he state such to be longer than light, which travels at less than 200,000 miles per second, whilst the sun is distant more than 95,000,000 miles. I think I never could be so abstracted as to put down 17,000 feet as the speed of light, though I may have let feet slip in for miles. I regret it, and will try to mend.—J. BARWICK.

[11275.]—**Darkening Walnut (U.Q.).**—Boil the husks or skins of walnuts when they are black and rotten to a jelly and use hot or cold. Will keep any length of time, and does not spoil the look of the grain. —F. J. G.

[11333.]—**Motive Power for Amateurs.**—I am sorry that "Zoo Andra" should be annoyed by my classing his plan with those fancies—plausible in themselves—which are the bane of young and enthusiastic mechanics. He will find the pendulum idea one of those proposals to gain or multiply power which are only varieties of the perpetual motion scheme. If "Zoo Andra" will refer to page 206 he will find the plan recommended there is for a single-handed saw—*i.e.*, one to enable a man to do the largest amount of work without assistance, and of course worked by a treadle. I have had some experience with circular saws from 4ft. diameter to 3in., and although I grant speed is advisable, it is of no use without sufficient power, and the plan proposed by me will allow much harder work to be done than can be managed by a saw fitted to a lathe in the usual manner. A circular saw will cut very well at a slow pace if sufficient power be applied to keep it going, and will, in many cases, cut more at a moderate than a high speed; the reason of this is that the teeth are frequently too close, and do not take proper hold of the wood. The teeth of all saws require to be enlarged as the speed with which they are driven is increased.—A BARRISTER.

[11386.]—**Crystals in Gas Tar.**—(To MR. BOTTONE.)—I have always taken the term artificial alizarine to mean the substance prepared from anthraquinone, as distinguished from the natural substance extracted from madder, and the term is certainly generally used in this sense: *vide* any of the scientific periodicals for the last two years. I am acquainted with the substance termed naphthazarine by Schützenberger, but I never heard of the term artificial alizarine being applied to this body, which, probably, has the same relation to naphthaline that alizarine has to anthracene.—ETHYL.

[11452.]—**Rain-water Tanks (U. Q.).**—"Rosso" had better construct his tank of galvanised iron, which is far preferable to bricks and mortar. I have a large tank made of it, and it has answered efficiently. The cover can be made on a hinge, or one with handle to lift right off. If "Rosso" requires the water clean for any special purpose, he had better have the tank in an open place; to catch water from roof, have it made lip level with shoot. The water can be drawn off with a tap or bucket; I have a tap for mine, which avoids the necessity of getting to the top with a bucket. I know of no method to clean out, except drawing all the water off. Perhaps some correspondent of "ours" can give a plan for the edification of "Rosso," myself, and other subscribers.—H. B. E.

[11572.]—**Compressing Water.**—To the question asked by Mr. Westwood—viz., how it is when the pressure is pumped up and allowed to remain on for a quarter of an hour that the indicator never alters—I offer the following suggestions :—Mr. Westwood answers his own question thus : "That proves to me that the water is compressed." Now, I think, it is a proof that the water is not compressed, but is driven out of the cylinder, either through the joints or into or through the pores of the steel. It would require an enormous pressure, no doubt, to drive water into the ring of steel forming the sides of the cylinder, 8in. thick, but there seems to be a very great pressure in use. Deduct the weeping acknowledged from one gallon (277 cubic inches), and suppose the remainder driven into the pores of the cylinder sides—into, that is, something like 60,000 cubic inches of steel, or (say) one cubic inch of water into 200 cubic inches of metal, and the gallon of water is disposed of. I am supposing the conditions first stated to be perfectly accurate, viz., that the head and foot of the ram are perfectly immovable at the moment when the extra gallon of water begins to enter the cylinder. Otherwise there is nothing in the question, because it only requires a motion of less than ½in. in the ram to dispose of the whole gallon of water. To the extent to which water is compressible it probably is so because of the air it contains, and in that case would probably be equally as elastic as compressible; and, if so, the pressure indicator would necessarily rise, while the fact is stated to be that the indicator remains stationary. For this reason, I think, some other means of disposing of the extra gallon of water than by compressing the cylinder full to the extent of about a 220th part of its bulk must be sought. Water is supposed to be slightly compressible, but nothing like to this extent. A few trials with this machine, and very accurate records of the proceedings and result, would be of general interest.—C. S.

[11572.]—**Compressing Water.**—One million parts of water are reduced by 51 parts for each atmosphere of pressure—about 15lb. on the square inch. This is Colladon and Sturm's results, which Regnault, however, considers a trifle too high. Thus, suppose the hydraulic press to hold one million half-pints when the ram is driven up so as to just touch the head-block, we know that it is possible to pump in more water, and this amount will be in round numbers 50 half-pints for each "15lb. per square inch" of additional pressure. Regnault calculates the diminution in the bulk of water under the pressure of each additional atmosphere to be forty-seven millionths. The compressibility of water is greater at low than at high temperatures.—SAUL RYMEA.

[11589.]—**Dry Steam.**—According to Henri St. Claire Deville, steam gets dissociated into its elements at the temperature of 250° Centigrade, and not until it has reached that degree of heat. Now, it is not likely that, this being the case, steam has been split into its elements; but, being superheated, its molecules occupy a larger area, and being most tenuous, give up more readily their oxygen in presence of red charcoal, and, consequently, the hydrogen thus liberated burns also. That this is the probable influence of superheated steam may be concluded from a series of experiments made by Prof. Frankland, if I am not mistaken, and which prove that a candle, on burning at the top of a mountain, gives less smoke than at the bottom of a mine, although (and especially because) the air is more tenuous at the top of a mountain than in a plain and at the bottom of a mine.—F. T.

[11615.]—**Teeth.**—Tincture of iron will not cause the teeth to become loose. I should not recommend your correspondent to use alum (subsulphate of alumina and potash), as it contains sulphuric acid, which has a very injurious action on the teeth. There are many lotions recommended for restoring the attachment of the periosteum, but they are not to be much relied on. Have you been, or are you, suffering from salivary calculus? If so, that would account for the looseness of your teeth, as this is constantly gravitating from the salts of which the saliva is composed, and collecting about the necks (cervix) of the teeth, when it causes inflammation, and consequent recision of the gum. The only efficient remedy for this is to undergo the operation of having your teeth scaled, and then using astringent lotions, such as tincture of myrrh, or the following preparation :—Mastic (in powder) 2dr.; balsam of Peru, ½dr.; gum, 2drs. or grs.; orange flower water, 6 fl.oz.; tincture of myrrh, 2 fl.dr.—F. GRAHAM YOUNG, S.D., Bristol.

[11632.]—**Debility.**—Any one who discovers, or has discovered, "two *most noble* medicines" which effect the cure of all disease, and refuses to make them known, must not complain if he is looked upon as a quack. I do not say that he is not entitled to reap a pecuniary reward for his discovery, but there is a difference between inventing a new method of making steel and discovering a means of curing the diseases which afflict mankind. SAUL RYMEA.

[11687.]—**Speeding Machinery.**—Suppose that a pulley of 18in. in circumference is on the driving shaft. If we require (say) three revolutions of the driven shaft, its pulley should be $\frac{18}{3}$ = 6in. in circumference. If great accuracy was required, the thickness of the belt might require consideration, as a pound of water raised 1° Fahr., represents, theoretically, 772 foot-pounds.—PHILANTHROPIST.

[11697.] — **American Lathe Chuck.** — The Warwick or scroll chuck is extremely useful, also the twist drills, as they will cut rapidly to any depth in solid metal. As sold, however, they are ground with too much cut, which causes them sometimes to run in and stop, especially just as they are through the work. I should not now like to be without a set, as when properly ground they are by far the best drills I ever came across.—ROOK.

[11711.]—**Time at our Antipodes.**—This is a most interesting question, and is not yet disposed of, notwithstanding all that has appeared on the subject in your very valuable journal, so that I for one rejoice that you have allowed the discussion to be continued a little longer. Many communications addressed to you have not helped us a bit to solve the problem, but have rather tended to "darken counsel by words without knowledge." Amongst the latest of these I am sorry to have to reckon Mr. Birt's diagrams and explanation, which I have made three attempts to understand without success. One of the best letters is the one preceding this, by "T. S." If some of our "masters in Israel," to whom we look for help, will kindly answer the letter of "T. S." in as lucid a manner as it is written in, your readers will be greatly indebted to them. I have pondered this matter for years, and hail with joy the discussion of it. Will any of our savants kindly answer me this question? One of the Feejee Islands (Vuna) is exactly on the meridian opposite that of Greenwich, or 180°. On this island there are English missionaries. As I write it is exactly 12 o'clock by Greenwich mean time at midnight between Friday the 17th and Saturday the 18th of May. Consequently, at Vuna it is exactly 12 o'clock at noon. Is it with those Englishmen 12 o'clock at noon on Friday the 17th or Saturday the 18th? Which do they call it?—KELBY.

[11711.]—**Time at Our Antipodes.**—I have every reason to speak with respect of Mr. Birt, but this will not prevent me saying that he is evidently lost in a fog on this subject. In his letter which appears in this week's (May 24th) ENGLISH MECHANIC, he positively says that "T. S." is wrong in assuming that a message telegraphed from London at noon on Tuesday, May 7, would reach New Orleans at 6 a.m. on the same day, but that it will not reach that place till 6 o'clock on Wednesday, eighteen hours after its despatch. That is to say, that when it is 12 at noon at London on Tuesday, May 7, it is 6 a.m. Wednesday, May 8. Now, every tyro knows that the sun (in appearance and in effect) moves round the earth from east to west, passing over 15° in one hour. New York is about 75° to the west of London; therefore the sun reaches London five hours before it reaches New York; so that when it is twelve at noon in London it is 7 a.m. of the same day in New York. We verify this calculation every morning by reading the telegraphic messages from New York which are found on our breakfast tables. New Orleans is 15° west of New York. and, therefore, when it is 7 a.m. at New York, it is 6 a.m. at New Orleans. We are sure about the time of New York from the scores of messages which are flashed from New York to London, and from London to New York every day. Now, if Mr. Birt's theory be correct, when it is 7 o'clock a.m. of Tuesday, May 7, at New York, it is 6 a.m. of Wednesday, May 8, at New Orleans, which is a *reductio ad absurdum*. Further, if Mr. Birt's theory be correct, then it would happen that the news from New Orleans, New York, and other cities of the United States which appears in the morning newspapers of a Wednesday would be, not the news of the previous Tuesday, but of the following Thursday, or, at all events, of the latter part of the same day. Every newspaper reader knows this is not so. It is said that the manager of a theatre in New York, one evening before the performance commenced, addressed his audience thus: "Ladies and gentlemen, I am sorry to inform you that the —— Theatre, Paris, was burnt down this evening, at 12 o'clock." Such a feat might be accomplished in New York in speaking of Paris, but cannot be done in Paris or London in relating New York news.—KELBY.

[11715.]—**Testing Acetic Acid.**—CORRECTION.—I omitted when describing the mode of testing for free sulphuric acid, at p. 234, to state that after decomposing the surfeited sulphate of barytes by heating it, mixed with charcoal, by a blowpipe flame, that the sulphide formed must be decomposed by hydrochloric or other strong acid, when sulphuretted hydrogen will be formed. Of course, the carbonate of lead used must itself be quite free from sulphate, of which common white lead often contains a little.—PHILO.

[11731.]—**Hair Wash.**—It seems to me that a superabundance of scurf in any head—except in a diseased condition of the scalp—is simply, to use plain English, a case of dirt. Scurf is a natural healthy condition of the head. It is the continuous moulting of the scurf skin which occurs all over the body, but becomes entangled in the hair in flakes. Now all washes and messes that have not as their base a liberal supply of soap and water, are but aids to its formation. Would any bath-loving Englishman or woman consider such a concoction as any one of those recommended to "Excelsior," a cleanly substitute for his or her daily ablution? Fancy taking a bit of flannel soaked in glycerine, honey, borax, camphor, or quicklime, and with it anointing one's face, body, arms, and legs, and then saying, "I'm clean!" The absurdity is at once apparent. Why, then, treat the head to such disease-producing agencies? Has it not the same number of pores per square inch to be purified as other members of the body? In all these patent and home-manufactured washes the *modus operandi* and results are as follows: The wash is poured on flannel or sponge and briskly rubbed into the roots of the hair until the scurf is dissolved and the skin looks white; then the head is considered clean, whereas it merely melts the grease, scurf, and dirt into the hair, where it dries to form a trap for fresh scurf and dirt. As for the tooth-comb, it is a capital instrument of torture for such undue irritation of the skin as will produce a seriously diseased condition. I know many ladies object to washing their hair on account of its length and the time taken in drying; but is that an excuse for such a state of unhealthy hidden dirt as must exist after the use of these washes? No matter what length the hair may be, where it is regularly cleansed, five minutes for washing and about fifteen for drying with warm towels is ample. The use of soap and water, with a little ammonia to aid in dissolving the grease, regular brushing of the skin of the head with a moderately hard brush, and just enough pomatum to supply needed oil, will speedily remove unsightly scurf, except in the case of genuine skin disorder, when a doctor should be consulted.—M. POPE.

[11752.]—**Meerschaum Pipe.**—"F. G. C." cannot remove the black colour produced by a solution of caustic, for it is not only impregnated in the wax, but burnt in by smoking. The only plan is to have the bowl rewaxed, at any pipe-makers in town, which will cost about 2s. It is the thin coating of wax on all pipes that holds the colouring matter, and when warm from smoking is very susceptible of any liquid matter, and even the perspiration of the hand.—ZETA, Reading.

[11756.] — **Power of Water Wheel.**—Many thanks to Mr. Gillaird and "B. A." for taking notice of my queries respecting the power of water-wheel. I now send the particulars they required concerning it. There is at the bottom of the reservoir a conical plug 8in. in diameter, tapering down to 7in., raised by a screw to regulate the flow of water; the distance from this to the top of water-wheel is 110 yards, and diameter of the pipe 9in. inside; the fall from bottom of reservoir to the top of the wheel 6ft., and from the mouth of the pipe to the bottom of wheel-pit 14ft. 9in. The wheel is an overshot, and 14ft. in diameter; the width of the iron rim is 10in., and 1¼in. thick, made of six segments on each side. The wheel has 48 buckets, each will hold 5 gallons of water, the circumference is 44ft. 2in., and makes 6 turns in a minute in thrashing corn; the shaft is of iron 5ft. long, and rests on brass bearing; the diameter of the bearing 5in., and weight of shaft 10 cwt. Buckets and arms are made of wood.—WATER-WHEEL.

[11762.]—**To take Honey from Bees by Using Chloroform.**—If it is of any use to "W. T. B.," I will give him an account of an experiment I made with chloroform in the autumn of 1869. I selected three strong stocks, in common straw hives, weighing about 30lb. each. Before dusk I loosened the hives from the stools with a long knife, that I might lift them off quickly. After they were quiet, I placed a stool close behind the hives, on which I stood a common earthen pan large enough to admit the hive about two inches, and tapering to the bottom. In the bottom of this I placed a small bedroom candlestick, with the candle holder filled with cotton wool. On this I poured one-third of an ounce phial of chloroform, placed the hive over, and threw a wet cloth over the whole. In five minutes, after tapping the hives a few times, most of the bees were in the pan below. I then took about half the comb out, emptied the bees back into the hive, and placed it on the stool again, and repeated the operation with the other two. In neither hive were the bees quite stupefied, but could only crawl. All the stocks lived through the winter, but did not do very well the next swarming season. The honey was a much better colour and taste than sometimes it is when taken with the brimstone matches. It was a rather troublesome affair, and I thought it rather expensive, as, to the best of my recollection, they (the three stocks) did no farther good. I have not tried the experiment since. In the summer of '70 I wrote a few letters to "ours" on "Bee Management," and asked that some of my brother bee-keepers would tell me if any of them had made a trial of chloroform, but was only answered with a half-ridiculous half-sarcastic letter from "Receps" and though a constant reader have not since troubled "ours" with any of my experience, &c.—BERKS LATE OXON FARMER.

[11762.]—**To Take Honey from Bees by Using Chloroform.**—The quantity of chloroform required for an ordinary sized hive is the sixth part of an ounce; a very large hive may take nearly a quarter of an ounce. Set down a table opposite to, and about 4ft. distant from the hive; on the table spread a thick linen cloth, in the centre of the table place a small shallow plate, which cover with a piece of wire gauze, to prevent the bees coming in immediate contact with the chloroform. Now, quickly and cautiously lift the hive from the floor-board on which it is standing, set it on the table, keeping the plate in the centre; cover the hive closely with cloths, and in twenty minutes or so the bees will be sound asleep. You can now remove the honey you require, replace the hive, and the bees, as they recover, will return home.—J. W. RICHFORD.

[11789.]—**Effect of Temperature on Ale.**—I have noticed the same effect on ale brewed at home with soft, and almost chemically pure, water, so that hard water has, probably, little to do with the phenomenon. Most likely, water at low temperatures has less capacity for holding extraneous matter in solution, and hence turbidity may arise in wine and vegetable decoctions, as well as in ale. There seems to be no remedy but keeping the ale in a cellar of suitable temperature, and, indeed, if "W. A. N." could discover a method of brewing ale which would keep its qualities and appearance under all temperatures, cellars might speedily go out of fashion.—J. COLBY.

[11789.]—**Effect of Temperature on Ale.**—I am obliged to Augustus Avame for his answer. Does he mean me to understand that by the use of Beane's patent material such a thing as my ale going cloudy from cold will be entirely prevented? If the nature of the water is not the cause, how is it that a glass of bright ale drawn from a cask will, upon being exposed to cold, go cloudy and go bright again when brought into a warm atmosphere? and how does he account for the fact of the cold not having the same effect on other ales, mine being the only ale that I know of that is affected by cold in the manner mentioned? Of course, there may be plenty of other brewers labouring under this difficulty as well as myself, as in winter time it is a great drawback to my success in brewing. Will Augustus Avame say if he knows an instance of this difficulty having been got over, either by the use of Beane's material, or any other means? If I had to use this material would there be no insoluble matter in the casks, as I can scarcely imagine that to be the case?—W. A. N.

[11799.]—**Botany of Cornwall.**—Your correspondent will find a catalogue of the mosses and lichens of Devon and Cornwall, by Messrs. E. M. Holmes and F. Brent, in Vol. III., of the Annual Reports of the Plymouth Institution and Devon and Cornwall Natural History Society (Plymouth: Keys and Son). The best book with plates for naming flowering plants is Sowerby's "English Botany," now publishing in parts, but this is a very expensive work. Hooker's "Student's Flora" (Macmillan) is an excellent book for naming flowering plants, but has no plates.—H. F. P.

[11800.]—**Cool Air in Hot Climates.**—The danger of breathing unwholesome air, from which Mr. Bottone suffered by sleeping in a cellar when residing in Italy (see p. 285), will not be incurred if the cooled air be drawn from dry wells dug in the subsoil, below that which is charged with organic matter. There is a strong and very natural dread in many places—especially in those where the difference between day and night temperature is great, and the formation of dew therefore considerable—against admitting the night air into dwellings, and it is very common to attribute the injury often sustained to the coldness of the air, which is really caused by the mist, or rather by the organic matter, perhaps by the living organisms contained in the mist. That this is so is shown by the fact that those who sleep at a level above the mist suffer less than those who sleep near the ground level, and that even such a slight obstacle to the entrance of mist as a muslin blind is a considerable though incomplete protection against the effects of night air, which, it is evident, can scarcely affect either its temperature or its composition, except by intercepting floating particles, whether solid or liquid. It is highly probable, though not, I think, proved, that if malarious air were filtered through charcoal it might be breathed with impunity, and it is certain that danger from it would be much diminished.—PHILO.

[11810.]—**Colds in the Head, &c.**—If "X. Y." will pay attention to the following I think he will find relief:—Procure a pair of rough bath-gloves and rub the skin all over the body every morning until a burning sensation is produced; then rub briskly with a dry towel; if convenient, a cold sponge bath every morning with above would be better. Keep the bowels laxative (with a little castor oil), if necessary, and abstain from all stimulating liquors. This I have tried, and now enjoy perfect relief from some complaint, which was constantly annoying me. As a rule, I found drugs only gave me temporary relief.—A SYMPATHISER.

[11810.]—**Colds in the Head, &c.**—"X. Y.," if not now a daily bather, has a grand career and cure before him!—viz., the simple adoption of means to rouse the skin to healthy action; and this can be done only by a daily washing. In my younger years I was a victim to colds in the head; eyes, ears, and throat being continually affected, off and on, and worse in summer than in winter. At length, when I was about twenty years of age, my kind doctor lent me Coombe's "Physiology," with the remark that it would not suit him to lend it to all his patients to read. By his advice I then began the "daily sponge," using a long and rather coarse sheet as an enveloper from cold air, a small diaper towel to rub dry under said sheet; and now, after forty years' trial, I am more than ever thankful that I was so persuaded; and attribute a large portion of prolonged life to this regular daily cleansing of the skin, winter and summer alike, at home or abroad, from top to toe—not requiring to spend more than from five to seven minutes every morning at it; but I should not know how to dress without "sponging," and often am surprised at the muddy state of the water when the sponge has been well squeezed in it to get out the scales of "skin dirt." Already I have made scores of converts, and hope to have added to them many of "our" intelligent readers.—ONE WHO PREACHES AND PRACTISES.

[11814.]—**Lathe Queries.**—I have unfortunately mislaid my copy of the ENGLISH MECHANIC of the 10th of May; but from what I recollect of the query under this number (11814), "A., Liverpool," while taking the answer out of my mouth, has forgotten what the question was. My impression is that another and, if possible, simpler way of fitting a double-bearing mandril than Whitworth's from the drawing appears to be was the thing asked for. "A., Liverpool," has given the ordinary way of making a single collared lathe, not intended to be fitted up for self-acting sliding at all. The cone of the rear end of the mandril is commonly reversed, and the steel fixed collar also reversed, the movable collar being then bored through and ground out truly cylindrical, and fitted on a plain part of the mandril with a thin key to insure its turning at the same time, and with a nut fitted behind it to adjust it for tightness and wear. It is, perhaps, a little easier to make a mandril this way, as only one collar has to be welded on the mandril instead of two; but it involves an extra piece—viz., the adjustable cone, which must be made in the most accurate manner to fit very tight on the mandril, although, to be sure, I have seen one on a new lathe that would fall off of its own accord when the mandril was held perpendicularly. I have a very good head on my lathe with a homogeneous iron (mild steel) mandril, not hardened, running in Babbet's metal bearings, which were cast on the mandril in paper moulds with wooden bottoms, and turned on the mandril itself to fit the holes in the head-stock, into which they were afterwards forced by screw pressure, assisted by a big mallet, and the collars were afterwards eased a little inside by scraping with a penknife. It won't do to let these white metal bearings get dry. The mandril above-mentioned is fitted as described with reversed cones.—J. K. P.

[11816.]—**Fixing Balance Wheel on Verge.**—In reply to "S. H. L.," choose a verge the proper length, cut the pallet-leaves the right width; now put on to the pallet next the collet a screw ferrule. Prepare a bow in the following manner:—Take a piece of whalebone eight or ten inches in length, scrape it with a sharp knife until, when holding by one end, you can bend it by blowing at it. Now make a bow of it with a fine horsehair; put your verge into the turns, and run it backwards and forwards with the bow; bring the tool up to the work only when drawing the bow towards you. This requires a large amount of practice (it is an easy matter to write down here to do a thing, but the skill to do it only comes by practice). Turn down the collet till the hair-spring collet just fits tight on to it. Now turn down the seat for the balance, turn the bottom of seat flat, not hollow, else, when riveting on, the edge gives way, and your balance will not be true. Drive on the balance, and mark where it will want turning down; leave just enough to rivet (you can leave the top hollow, it is better to rivet when left so). Take pivot calipers and get size of bottom pivot of old verge, run down new pivot, right size, cut off proper length, round up and polish. The same with the collet pivot, except that you must turn up true before using pivot file. Now rivet on balance and finish up top—you will find it a much more difficult job than turning a collet on 'scape staff. Take off ferrule, put it into the turns, and see if the balance is really a balance; if it is it must not be left so (not in verge watches). When the balance is put in and in a state of rest, the point next the follower of crown wheel must be left a little the heaviest, as all verge watches lose a certain amount of the cross of the balance when the figure 12 is downwards, and therefore gain time. I have no faith in the isochronous properties of the hair-spring when applied to recoil escapements like the verge. I have always improved the time-keeping, without exception, of old verge watches I have so treated.—A YORKSHIRE PIVOT.

[11825.]—**Testing Bleaching Powder.**—I would have answered this query sooner, but I have been very busy with the manufacture of this article. The method proposed by our mutual friend, Mr. S. Bottone, would, I fear, be found rather expensive for general use, not to speak of the length of time required for each estimation. The following (Gay Lussac's) method will, I think, be found very satisfactory. It is based upon the circumstance that the contact of chlorine with arsenious acid, in presence of water, gives rise to the formation of arsenic acid and HCl:—$AsO_3 + 2Cl + 2HO = AsO_5 + 2HCl$ 1 eq. of $AsO_3 = 99$, requires accordingly 2 eq. of $Cl = 71$ for its conversion into AsO_5. Consequently, the amount of a solution of chlorine required to convert a definite quantity of AsO_3 into AsO_5, indicates at once the amount of chlorine present in that solution. To prepare the AsO_3 solution, dissolve 99grs. arsenious acid in 4,000grs. msrs. water. This strength will be found most suitable. Suppose you work upon 50grs. of the powder, and convert 1000grs. msrs. of the AsO_3 solution into AsO_5; then, as $4000 : 71 :: 1000 : 17{\cdot}75$grs. Cl in 50grs. of the powder. $17{\cdot}75 \times 2 = 35{\cdot}5$ per cent. Cl in the sample of chloride of lime. The powder must be triturated in a mortar with water, and the point of saturation will be known when the liquor ceases to give a purple colour with starch paper. I will be happy to give further particulars if this is not sufficiently clear.—AUGHRIM.

[11825.]—**Testing Bleaching Powder.**—The plan of acting on the powder with dilute sulphuric acid, and conducting the gases evolved into a solution of silver nitrate, as recommended by Mr. Bottone, is open to several objections, and is more calculated to mislead any who may try it, than aid them. In the first place, Mr. Bottone in his directions says, "the quantity of nitrate of silver must be equal to the amount of chloride of lime to be tested." Now, say we start with 100 grains of each; many samples of bleaching powder contain 35 per cent. of available chlorine, so that if all the chlorine were driven over it would require nearly 108 grains of pure silver, or 172 grains of nitrate, even to fix the chlorine; secondly, chlorine does not act upon silver nitrate so as to produce only silver chloride and nitric acid, but it also produces silver hypochlorite (Balard), a soluble, but very unstable, salt, which is soon resolved into a mixture of chloride and chlorate. The formation of silver chlorate would cause a loss, it being a soluble salt; thirdly, some of the chlorine would remain dissolved in the liquid in the vessel A, and there is no provision shown in the sketch for its final and total expulsion. In lieu of this process I should recommend the well-known and thoroughly reliable method introduced by Penot, which consists in adding to a definite quantity of a solution of the bleaching powder an alkaline solution of sodium arsenite till a point is reached when a drop of the mixture ceases to form blue spots when placed on paper imbued with a mixture of potassium iodide and starch. The mode of operating is as follows:—1. Dissolve 99 grains of pure arsenious acid with 350 grains of pure crystallised sodium carbonate in 6,000 to 7,000 grains of water with the aid of heat, allow to cool to the temperature of the air, and then make up the solution to exactly 10,000 grains measure with water; 1,000 grains measure of this solution represent 7·1 grains of free chlorine. 2. Take 50 grains good starch, and 4,000 grains water, raise slowly to boiling, and add 15 grains each of potassium iodide and crystallised sodium carbonate. Soak strips of good filter-paper with this and dry them. Keep them well secured from the air in a bottle. 3. Take 100 grains of the bleaching powder and rub it up in a mortar to a perfectly smooth paste; with water pour the liquid into a 10,000 grain flask, rinse the mortar well out several times with fresh water, and make up the whole to 10,000 grains. Agitate the whole well, and remove 1,000 grains of the turbid liquor by means of a pipette to a beaker. Arrange a number of small pieces of the starch paper on a plate, and from a 1,000 grain burette add carefully the arsenic liquor till a drop of the mixture just ceases to cause any coloured spot; the point can easily be hit to one drop. Suppose in an experiment 450 grains measure of the arsenic solution are consumed, then as 1,000 grains of the liquor are equal to 7·1 grains of chlorine, 450 grains are equal to 3·195 grains—that is, 10 grains of the bleaching powder contain 3·195 grains of available chlorine, or 31·95 per cent. If the arsenious acid and sodium carbonate are quite pure the standard solution will keep a long time unaltered. I believe this to be the only mode of proceeding which enables us to discriminate between the calcium hypochlorite and calcium chlorate; of this last salt, bleaching powder often contains several per cents., which in the ordinary way of testing, would indicate as chlorine, though really this salt is of no use practically in bleaching.—ETHYL.

[11826.]—**Tinning and Soldering.**—In my remarks on this subject, p. 261, "tin, &c.," has been substituted for the word "zinc."—W. T. M. D.

[11840.]—**Whooping Cough.**—The remedy recommended by "T. C. H." is also strongly recommended in Australia.—MANUS.

[11840.]—**Whooping Cough.**—The remedy for this complaint very much in use in Berkshire, and found effectual in many cases, is as follows: In a half pint of best vinegar put a new-laid egg (shell and all) at night, and leave it until dissolved the following day, when beat it up well and strain. Dose, a teaspoonful three times a day.—ZETA, Reading.

[11840.]—**Whooping Cough.** — Try Roche's enbrocation, to be used externally by rubbing in the chest every evening at bedtime. It can be bought of any druggist for a trifle, or may be made by mixing olive oil 2oz., oil of amber 1oz., and oil of cloves 1 drachm.—H. B. E.

[11841.]—**Human Relics.**—Yes—it is too true! In the Etruscan vase room of the British Museum, in the bottom compartment of a cheap glass case, with no external mark to call attention to it, or to distinguish the relics from the old pots and pans surrounding them, lie the well-preserved mortal remains of "Mykerinus the Holy," the pyramid builder, the cotemporary of Abraham. Even with the help of a catalogue you will not readily find it out. While mushroom monarchs of yesterday are thought worthy of glorious shrines, the British nation thinks this treatment good enough for the remains of a mighty monarch of the days when the earth was young, who has left his stamp on its face in the shape of a monument of exquisite taste, which Time seems powerless to destroy. His sarcophagus lies at the bottom of the Bay of Biscay, and it would be better for our credit if the body lay there also, decently buried within it. The object of the museum authorities appears to be to overcome the monarch's aversion to return to dust. "Dust thou art and unto dust shalt thou return," should be placed as a motto over the compartment. They seem to have about as much respect for the king as the historian of the khaliphs had, who records about the opening of the sarcophagus, "that they found in it nothing but the rotten carcase of an infidel," which, accordingly, they turned out on to the floor and left there. Would it be too much to expect that the remains should be at least removed to the Egyptian room and placed in an air-tight glass case, and that some pains should be taken to preserve them from the rapid destruction which exposure to the air must be bringing about? It would, I suppose, be too much to expect that anything in the way of harmonious surroundings should be added thereto, such as our neighbours would indulge in if they had it in the Louvre. The late Baron Bunsen made some sharp remarks, in his "History of Egypt," about our treatment of these remains, which should long since have shamed the authorities of the museum into some action about them; but it takes a deal of kicking to move us Britons.—T. C. H.

[11841.]—**The Oldest Human Relics.**—On what ground does Mr. Matthews (p. 286) regard the skeleton of Pharoah Mykerinus as the *oldest* human relic? Has he never heard or read of the Neanderthal and Engis skulls? If not, Sir John Lubbock's admirable work, "Prehistoric Times," will enable him to correct his ideas on this most important subject.—A Fellow of the Royal Astronomical Society.

[11847.]—**Curry.**—The recipes for true Indian curry are numerous, and vary much in proportion of ingredients. The total quantity of powder in each of the following recipes being nearly equal, the relative proportion of the different colouring, heating, and flavouring ingredients, will at once be seen. Dr. Kitchner complains that the proportion of cayenne is generally so large that a proper quantity of the powder cannot be used to obtain the benefit of the other ingredients; and the late editor of the *Pharmaceutical Journal* justly complains that many recipes contain too large a proportion of turmeric. All the ingredients should be of fine quality, and recently ground. No. 1, I think, will be found very nice.

—	1	2	3	4	5	6	7	8	9	10	11	12	
Turmeric	9	6	6	8	9	9	9	4	6	6	7	8	Parts.
Coriand'r seed	9	16	12	22	10	9	16	12	11	16	18	12	
Mustard	3	—	—	—	3	3	—	4	—	—	—	—	
Cayenne	2½	4	1½	1	1½	3¼	1½	2	1	2	1	1	
Black pepper..	6	3	8	2	3	3	2½	4	5	1¼	5	4	
Allspice	—	—	—	—	—	—	—	—	2	¾	—	—	
Cloves............	1	—	—	—	½	—	—	—	½	¼	—	—	
Cinnamon	2	—	—	—	—	¾	—	—	3	¾	—	—	
Ginger	1	—	—	—	3	3	—	—	2	1½	—	4	
Mace	1	—	—	—	—	—	¼	¼	—	½	—	—	
Fenugreek	—	—	3	—	—	—	—	2	2	3½	3	—	
Cumin	—	—	2	—	1	—	3	2	—	—	3	1	
Cardamoms ...	2	3	—	—	1½	1½	—	—	—	—	—	2	

—Beasley.

[11857.]—**Gelatine Moulds for Plaster Ornaments.**—A mixture of good glue, not too stiff, with fine brown sugar, will give flexible moulds.—S. Bottone.

[11861.]—**Glove Cleaning.**—Put the hand in the glove, and while on the stretch, carefully rub with a fine piece of old flannel dipped in benzole. One night's exposure to the atmosphere will rid them of all smell. —T. I. Preston.

[11862.]—**Charcoal.**—The produce in charcoal is apparently at first sight very variable. The experiments undertaken by Junker, at the instigation of Berthier, at the smelting works at Planen, are of all others the most trustworthy. The woods burned were all 32 years old. Dry oak, peeled 2 years, yielded 25·7 per cent. charcoal, and ·84 per cent. half charred wood; unpeeled, yielded 24 per cent. charcoal, ·3 per cent. half charred wood; green oak, 22 per cent. charcoal, ·3 per cent. half charred wood; green oak with lops, branches, &c., yielded 18·5 per cent. charcoal, ·4 per cent. half charred wood. The wood was charred in heaps of 21ft. diameter. The commercial products that can be obtained are tar and pyroligneous acid. The sale of these is very much dependent upon the nature of the country in which you are, and is often exceedingly small, and yet various methods have been tried, though not always with success, for collecting them. The retort furnace admits of all the produce being completely collected, an advantage which is only counterbalanced by the necessity of employing small quantities of wood at once; for it is clear that the bad conducting power of wood and charcoal must offer an insurmountable obstacle to the penetration of heat from without, into the interior of a larger furnace, and that its full action cannot there be exerted. This kind of furnace is exceedingly appropriate for the production of tar, when charcoal is not the chief product required, but when the chief product required is tar. According to Stolze, the amount of tar in oak is from 10 to 20 per cent. When the retort begins to be at a red heat, the first gases which appear are combustible. At some furnaces there is a small fire kindled with twigs under the retort until it is at a red heat (it need not be upon a grate), and then the gases are lighted and turned into the furnace, which they will now entirely support without any stoking for about 16 hours. The gases are now to be turned off, and the retorts drawn. This is the most economical manner of disposing of the combustible gases. I don't think that the other gases arising from the contamination of the charcoal could be profitably disposed of.—P. W. H. J.

[11862.]—**Charcoal.**—"Prentice" would get about 8¼ cwt. of charcoal from a ton of oak tops dried in the air by burning them in a retort; and 5 cwt. by the process of pit burning. The gases evolved during the distillation in the retort are condensed. Pyroxilic spirit, and pyroligneous acid are produced, used by calico-printers and others.—Woodman.

[11864.]—**Rabbit Disease.**—I once had a rabbit affected in the same way as that of James King's, and I completely cured it by rubbing flowers of sulphur on its skin every morning, and it had no return of the complaint again.—J. W. Richford.

[11864.]—**Rabbit Disease.**—Let your rabbits have as much fresh air and as good food as possible. Rub into the bald patches every day a little of the diluted nitrate of mercury ointment; if this fails try the tar ointment.—T. I. Preston.

[11867.]—**Separating Tar from Wool.**—Pure benzole will easily remove tar or pitch from wool. It will also remove paint, if it has not remained too long on wool.—F. T.

[11867.]—**Separating Tar from Wool.**—Washing with benzine, turps, or coal-tar naphtha will effect this.—S. Bottone.

[11868.]—**Ash Timber.**—Ash timber felled in winter is best when cut into planks for seasoning as soon as felled; but I would advise "Ash" to let his timber stay with the bark on until next autumn, and then cut it up, as if done now, and hot weather sets in, it would crack and warp. I should advise him to put his timber in a shed, as it would keep it a better colour. Good ash timber is worth about a shilling a foot cube when within ten miles of a manufacturing town. When sold by the inch it is quoted at, say, 2d. per in. for 3in. plank—that is, 6d. per superficial ft. It is sometimes sold by the lineal yard of 9in. wide—thus, 9 superficial ft. equal 4 lineal yards.—Woodman.

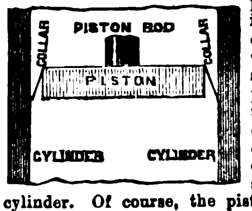
[11869.]—**Zinc v. Coal.**—Coal can unite with a greater quantity of oxygen during the process of combustion than zinc does, and, therefore, gives out more heat, the amount of heat given out being in the proportion of the quantity of oxygen combined with. I extract the following from "Recent Improvements in the Steam Engine," by Bourne, p. 5:—"In the animal economy a given quantity of carbon produces its equivalent of power with far less waste than in the best steam-engine, although the temperature is not great; and the same result takes place in a voltaic battery—the electricity generated by which may be made to work an engine with far less loss than its equivalent quantity of heat. It does not, however, appear to be in the least probable that electro-magnetic engines will be brought into use to supersede steam-engines, unless some means should be discovered of obtaining the electricity from coal instead of zinc . . . A pound of coal consumed in an engine will produce more than twice the power produced in a galvanic battery by a pound of zinc, and the cost of the coal will also be very much less." In the best steam-engines only about one-tenth of the value of heat is obtained as power.—Philanthropist.

[11872.]—**Carbonic Acid Gas and the Atmosphere.**—The pressure of the air is 14·75 (say 15lb. on the inch. It varies at different places at different times, as we see from the fluctuations of the barometer. Calculate the weight of the atmosphere by finding the number of square inches on the earth's surface, and multiplying this by 15, 8,000 miles is the diameter of the earth approximately. $(8,000)^2 \times 3·1416$ = area of earth in square miles (say) 200,000,000. There are 63,360 inches in a mile, or $(63,360)^2$ inches in a square mile. In round numbers 4,000,000,000 square inches.
200,000,000
400,000,000

80,000,000,000,000,000 pounds is the weight of the atmosphere, or about 35,600,000,000,000 tons. I am not sure of the proportion of carbonic acid in the air in its normal state—perhaps, one part in 10,000; if so divide by 10,000. If the carbonic acid were increased tenfold or less, animal life would suffer seriously.—Philanthropist.

[11875.]—**Spectrum Colours.**—It is almost impossible to get a pure white with our known pigments, the nearest approach being a light gray. Divide your disc into 4 equal parts, colour two divisions with the best Prussian blue, one with carmine, and one with gamboge yellow.—S. Bottone.

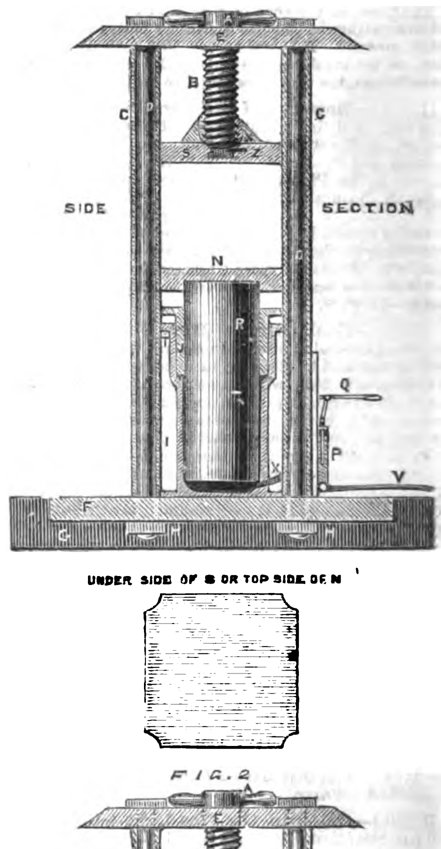
[11876.]—**Hydraulic Press.**—I could send you a drawing, or a calculation; I cannot go much into the workmanship. The great difficulty, which was to



prevent the water escaping past the piston, was obviated by Mandsley, who used a leather collar secured round the upper part of the piston, so that the greater the pressure of the water the more closely the leather collar or flap was pressed against the inside of the cylinder. Of course, the piston is made to fit very accurately. I gave a sketch showing the piston too small to indicate the action of the collar.—Philanthropist.

[11876.]—**Hydraulic Press.**—I inclose sectional drawings of the press. The size that I have calculated for is, I think, about the smallest size that can be made, and yet show its effects practically. This press can be used for experimenting upon the crushing strain of wood and metal, and if well got up, will form an appropriate and ornamental machine to receive prizes at the local industrial exhibitions. The barrel of the ram would bear a pressure of three tons per square inch, and the pillars will bear about the same amount of tensional strain, if made of the dimensions specified. I have introduced a novel feature in the hydraulic press, which extends its range of action to nearly double of what it would otherwise be. This is more important in small machines than in large ones, as it is difficult to make screws of relative size for large ones, and easy for small ones. The modification consists in the screw B, Figs. 1 and 2. If "Ricardo" prefers otherwise, he can dispense with the screw, and use my other dimensions. Now for the specification. The ram to be made of a piece of solid brass rod, turned to 1in. diameter, and about 3½in. long; it must be turned truly parallel, and polished as bright as possible, as by so doing it will save much friction. Thickness of barrel to be ¼in., no less, and if possible, thicker; it is to be made of gun metal, or very fine brass. It would be best to make a complete casting of the bottom of the ram with the top and body with a wide ledge or flange at the bottom, as shown in drawing; this flange to be ¼in. thick, and 3½in. diameter. This must then be turned on the exterior, and bored just where the stuffing-box gland has to go in. The stuffing-box gland had best be a casting 2½in. diameter at the top, or greatest diameter, and turned to 1½in. at its other exterior diameter, and ¾in. deep, as at J, in the drawings. It must now be put into its place and drilled with the five holes for bolts. The bolts are to be made of one-eighth or three-sixteenths iron wire, at least 1½in. long. The bolts having been put into their places, the gland and the ram barrel are to be bored together; this will be best done by a workman. The cross plates S and N are to be ¼in. or ⅜in. wrought iron, finished off bright with semicircular holes filed or drilled in them so as to be able to slide smoothly.

FIG. 1



UNDER SIDE OF S OR TOP SIDE OF N

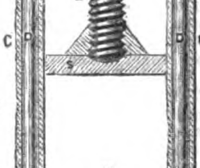
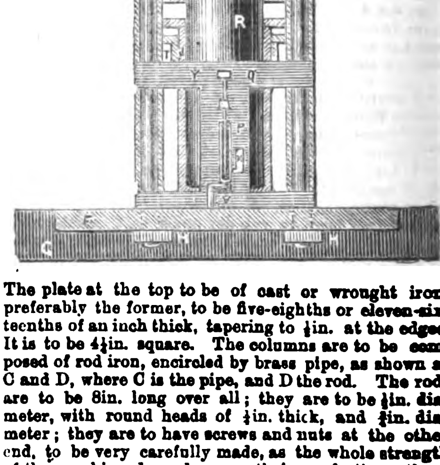


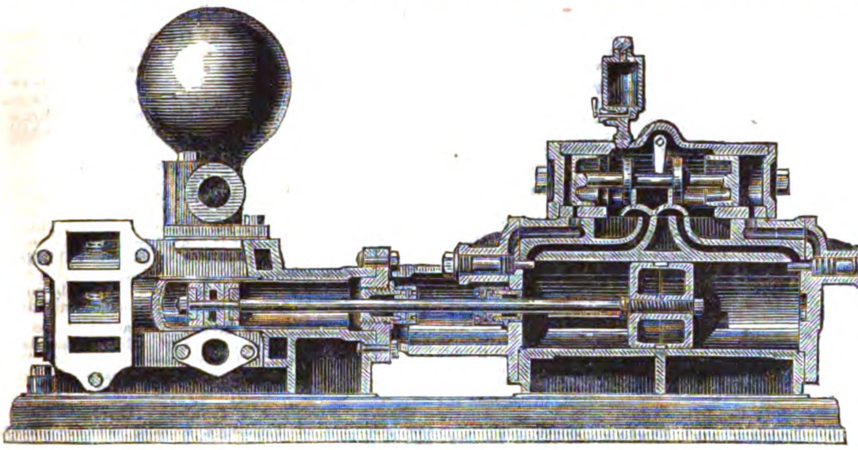
FIG. 2



The plate at the top to be of cast or wrought iron, preferably the former, to be five-eighths or eleven-sixteenths of an inch thick, tapering to ⅛in. at the edges. It is to be 4½in. square. The columns are to be composed of rod iron, encircled by brass pipe, as shown at C and D, where C is the pipe, and D the rod. The rods are to be 8in. long over all; they are to be ⅜in. diameter, with round heads of ¼in. thick, and ⅝in. diameter; they are to have screws and nuts at the other end, to be very carefully made, as the whole strength of the machine depends upon their perfection—those with bad screws should be rejected; the nuts to be hexagonal, ¼in. thick, and 1in. diameter. All these columns to be carefully turned to fit the brass pipes. They are to be placed 3½in. distance from each other. The screw B would be best chased with a coarse chasing tool with a square thread, and, if possible, it should be made of steel, if not of wrought iron. The screw should be ⅝in. diameter, if of wrought iron, and about ⅝in. diameter if of steel (not hardened, as it diminishes its tensile strength, and it will last long enough without). The small wheel at the top is to be cast of brass, without arms, but one solid piece, 1¾in. diameter. It might be milled at the edge, and if so, would do without handle; the handle to be of rod copper, ⅜in. thick, and ¾in. high, turned to some ornamental pattern. The foundation plate to be ⅝in. thick, and 5in. diameter, to be turned out of a piece of boiler plate, and polished; this is to be let into a square mahogany plinth, 6½in. or 7in. square, and 1in. thick. The cross plate N can be soldered to the top of the ram R, as there will be no strain tending to separate them. The directions for making a force-pump were given some weeks back, and by altering the dimensions, the same plan of construction could be used in this case. The plunger can be made out of a piece of brass wire, screwed into a little brass block for the pump lever to work in. The pump plate is to be made of a piece of plate brass, ⅛in. thick, 3in. high, and 4in. wide, sawn out to shape, shown as Y in the drawings. The pump can be screwed, or if screws are not obtainable, hard soldered to the pump plate. The pump lever is to be made out of a piece of brass or iron wire, ¼in. thick, and 2¼in. long, having three holes, one ¼in. from one end, and the others at ½in., 1in., respectively distant from it. There is also a short connecting rod between plunger and lever; this is to be made of two sides of brass plate, soldered together in the middle, the holes drilled at the ends, and the ends bent apart, so as to allow the top of plunger and the lever to slip between and be pinned on; it is then to be finished off bright. For the stuffing boxes, I would not advise "Ricardo" to use leather, but well-greased hemp strands.—P. W. H. J.

[11876.]—**Hydraulic Press.**—It is almost impossible to give "Ricardo" any information, as his question is in such general terms. If he will give some idea of the size he wishes to make his model press, and what amount of actual work he wishes it to do, I will try and help him.—ROOK.

[11877.]—**Slide Valve Question.**—The slide valve is moved by a small piston, the steam for actuating which is admitted alternately at each side by means of spindle valves in the covers of the main cylinder, and which are opened by the piston just before it reaches the end of each stroke. I send a longitudinal section showing internal passages.—ROOK.



[11878.]—**Photography.**—"Camera" will find a soft lead pencil applied to the varnished surface of the negative as convenient as anything for retouching. The parts so treated will not require varnishing again; but my advice is that he should try and get his pictures as perfect as possible by photography alone, and not trust to retouching, as only bad negatives are at all improved by it. The cause of the difficulty mentioned in the second query is over-exposure, the light being so much more intense out of doors than in. —DÆDALUS.

[11878.]—**Photography.**—It is a sign of bad management if a negative requires "touching." Try to make perfect negatives; without this you will never be a successful photographer. The reason why your outdoor pictures "flash out" is because they are "over exposed." In the open air expose only one-tenth of what you do under glass.—S. BOTTONE.

[11878.]—**Photography.**—Your landscapes flash into view the moment the developer is applied because you have probably not taken into due consideration that landscape negatives require considerably less exposure than pictures taken indoors. Indeed, under favourable circumstances, landscapes require little more (if any) than instantaneous exposure.—QUERCUS.

[11878.]—**Photography.**—I presume "Camera" means spots and pin-holes in his negatives; if so, they should be stopped with Indian ink, applied with a small brush. The negative will not require varnishing again. For outdoor work he should use a weak developing solution, and be sure not to over-develop or he will fog his picture. As soon as he can see the detail in the shadows when looking through the negative he should wash off the developer and clear (fix) the picture.—C. S. W.

[11883.]—**Sustaining Power of Cast Iron Column.**—The column may be, practically considered, as one of 7½in. diameter. At all events our error will be on the safe side, and I don't see that such a small difference in the top and bottom diameters could create much difference in the result. Hurst gives in his tables, the safe load = one-tenth breaking weight. He gives for that diameter of column, the safe load to be 164·8 tons, but there is a correction to be used when the length of the column is less than 30 diameters. Let S be the strength for long columns given in the table; and C = 49 times the sectional area of the metal in inches. Then strength for long columns = $\frac{S\,C}{10\,S + \frac{3}{4}C}$. Then substituting S = 164·8 and C = $49 \times (7\frac{1}{2})^2 \times {\cdot}7854 = 2164{\cdot}76$. $\therefore \frac{164{\cdot}8 \times 2164{\cdot}76}{1648 + \frac{3}{4}(2164{\cdot}76)}$ = 273 tons about.—P. W. H. J.

[11884.]—**Power of Water Wheel.**—As "R. S." has not told me the number of buckets, I shall use Fairbairn's rule for finding them. Let D be the diameter of the wheel in feet, and N the number of buckets. Then for wheels of from 25ft. to 40ft. diameter, N = D × 2·3 = 25½ × 2·3 = about 56, and the circumference of the wheel = 80·1ft., therefore the buckets are at a distance of $\frac{80{\cdot}1}{56}$ft. = $\frac{801}{560} \times 12 = 17\frac{1}{4}$in. nearly. Then suppose that each bucket contains upon an average 8 cubic feet, then the number of cubic feet consumed by the wheel = 56 × 8 = 448 per revolution. Then the proper velocity of periphery I find by tables to be for that head of water = 6ft. per second, or 6 × 60ft. per minute = 360ft., and the circumference of the wheel = 80·1ft. ∴ the number of revolutions per minute = $\frac{360}{80{\cdot}1}$, or nearly 4½ revolutions. ∴ quantity of water consumed per minute = 448 × 4½ cubic feet. Then let P = effective horse-power, Q = quantity of water in cubic feet per min., and h = head of water in feet. Then P = ·00113 Qh in high breast wheels. Then substituting Q = (448 × 5), and h = 19ft. ∴ H.-P. = ·00113 × 448 × 4½ × 19 = 43·28352, so that the wheel would work about 40 horse-power economically.—P. W. H. J.

[11884.]—**Power of Water Wheel.**—Had "R.S.", given the depth of shrouds to the water-wheel name any practical millwright might have answered his query. Water-wheels are usually formed so as to work at full power with the buckets three-fourths full. The horse-power of the water to be applied in this case will be

$$\frac{\text{cubic feet per minute} \times \text{fall in feet} \times \frac{3}{4}}{528} = \text{H.-P.—S. J.}$$

[11884.]—**Power of Water-Wheel.**—The data is insufficient; you do not say how much water passes over to the wheel per minute, nor how much water a bucket holds. The buckets should be large enough not to be completely filled, as in that case a deal of water is lost by running out of them before the level of the tail race is reached.—PHILANTHROPIST.

[11885.]—**Power of Boiler.**—If the tank were jacketed in wood or some other non-conducting material less heat would be required.—PHILANTHROPIST.

[11886.]—**A Thick Soled Shoe.**—If "Wee Pet" intends making a sewed shoe, the best way is to put on a thick welt made thin inside; fill up with a piece of cork afterwards; sow on sole, on top of which peg a clump sole, this will give him about ⅜in. sole. Unless "Wee Pet" has made a sewed boot before, I would say, "Don't try."—COBBLER.

[11887.]—**Hair Dye.**—Let me advise "Gray Beard" to sedulously avoid nitrate of silver as a dye; it is injurious to both hair and skin; he will find the solution of the terchloride of gold more useful and more efficient; the latter produces a light brown colour. But if he will use the silver dye here is a formula:—Nitrate of silver, 40gs.; glycerine, ½oz.; rain water, 20 fl. oz. Mix, and preserve in a blue-glass stoppered bottle.—T. I. PRESTON.

[11889.]—**Hedgehog.**—The hedgehog will require little looking after. A box with some shavings, placed in a cool place, where it can use it at pleasure, and a saucer of milk occasionally, is all it requires. It will crack beetles like nuts, also destroy spiders and mice, but beware how you leave eggs in its way, for they will assuredly vanish. It soon becomes tame enough to be handled and have its cheeks stroked. One I had took up its abode in the cellar, and was sometimes invisible for days, though it was always on night duty, as it entirely freed the house from beetles. I see "G. W. C. H." and "Emily" recommend cucumber rind and phosphorus paste. The former will do well enough where beetles can be counted by the dozen; but, from experience, I can say it is useless against such brigades of the "varments" as sometimes swarm into our kitchens. As for the latter, surely no one with children or live pets would venture to use it.—M. POPE.

[11889.]—**Hedgehog.**—I hope Mr. Pope will not think it presumptuous of me in answering "F. S.," but I have had a hedgehog for the same purpose, and I thought "F. S." would be glad of all the information he could get. He will find it a most amusing pet, and it will get very tame in a few days. They are very fond of warmth; mine used to get under the kitchen grate in the cold winter evenings, and occasionally sleep with my dog (who is a curly one) to the no small annoyance of Tiny. They will eat meat raw or cooked (which must be cut small), as they like a change of diet, and are very fond of milk, but will drink water. They will require a bed of hay to sleep in during the day. I used to keep mine in a cage till night, and then let it out to devour those London pests, and they will not refuse a few crickets.—J. W. RICHFORD.

[11891.]—**Contents of Cistern.**—We can regard the cistern as half a cylinder. The first step will be to find the number of cubic feet in the cistern. Let D be the breadth at the top of the cistern, and L the length. If the contents of a cylinder, having a diameter of D be found, then one-half of that will be the contents of cistern. The contents of cylinder are $D^2 \times {\cdot}7854 \times L$ cubic feet, and then $\frac{D^2 \times {\cdot}7854 \times L}{2}$ number of cubic feet in cistern, and as there are 6·2355 gallons in one cubic foot, ∵ the number of gallons in the cistern is $\frac{D^2 \times {\cdot}7854 \times L \times 6{\cdot}2355}{2}$.—P. W. H. J.

[11891.]—**Contents of Cistern.**—Multiply the area of the base in square feet by the depth of water in feet and this product by 6·23 for the contents of the cistern in gallons.—S. J.

[11898.]—**Tempering Cast Steel Chisels.**—The easiest way to harden and temper steel chisels is to heat the chisel to a bright red about half-way up, and then cool it about an inch up, which will harden it; now you want to let it down to the required temper; you must now rub the cooled part with a piece of brick or rough stone till bright. The brightened part will now change colour, beginning at a light straw till it gets to a purple. The best colour for "Inquirer" is between the two; cool it when the required colour comes.—R. WELBANK.

[11899.]—**Etching on Glass.**—"Un Irlandais" can buy the hydrofluoric acid much cheaper and stronger than he can make it, but if he would like to try, here is the process:—Heat some calcic fluoride (CaF_2) with twice its weight of sulphuric acid (SO_2HO_2) in a leaden retort, and pass the gas evolved through a U-shaped lead tube, surrounded by a freezing mixture, a volatile and colourless liquid is obtained. To etch on glass, heat some white wax or beeswax in a beaker, and apply it to glass, to be etched with a feather or small brush; now, very gently warm the glass over a Bunsen or a gas jet, and well float the wax until it lays even, pouring off any excess; after cooling, take a needle and write on any design, and flow on the acid; the result will be that the glass is etched where not protected by the wax.—LICTOR.

[11900.] — **Electro-Plating.**—With "Sigma's" permission, I beg to inform "Un Irlandais" that he will get all the information he requires from a cheap manual, published by Virtue and Co. I believe it is called "Electro-Metallurgy Practically Treated," by Alex. Watt. It is one of the well-known Weale's series.—QUERCUS.

[11901.]—**Grip Chuck.**—To "F. G. T."—You only want one tap to make your left-handed jaw with; dies are of little or no use for such a job, as the screws ought to match perfectly, and you cannot make sure of getting them to do so when marked out with dies; they should be done in a screwing lathe. From the way in which you speak of Whitworth's "set of four right-handed" taps, I guess you are rather a young hand. I don't approve of the right and left-hand screw grip chucks for general purposes. They are useful in manufacturing where you have a great number of things from the same pattern to do, but for jobbing give me a four jaw chuck.—J. K. P.

[11902.]—**Chlorine.**—The gas evolved from hypochlorite of lime is undoubtedly very injurious, and if long continued would produce serious consequences to the mucous lining of the throat, mouth, and lungs. The irritation would set up a low form of inflammatory action.—T. I. PRESTON.

[11902.]—**Chlorine.**—The gas evolved from the substance commonly called chloride of lime, or bleaching powder, is not chlorine, but hypochlorous anhydride, which is removed from the above compound by the carbonic anhydride present in the air of the room. That gas, as well as chlorine, becomes injurious when it is in a moderate quantity. The quantity of bleaching-powder put in a room ought never to exceed two or three ounces, especially at night, as there is not sufficient ventilation. Great precautions must be taken as to chlorine, or hypochlorous anhydride, as they exercise a most suffocating and offensive action on the lungs.—F. T.

[11902.]—**Chlorine.**—I speak from five years' daily or rather nocturnal, experience. Chlorine, in modera tion, is not injurious in a sleeping-room; on the contrary, I have found very great benefit from it.—S. BOTTONE.

[11903.]—**Quinine.**—Sometimes adulterated with the salicine, and phloridzine group of alkaloids; sometimes with the less active cinchona alkaloids.—S. BOTTONE.

[11903.] — **Quinine.** — When the adulteration is white sugar, it is detected by the solution of the suspected salt in as much potassic carbonate as will saturate the sulphuric acid. If sugar be present it will then be detected by the taste. If the adulteration be starch, a portion of the suspected salt will remain insoluble in cold water; and if the mixture be heated to 170° Fahr., then cooled, and tincture of iodine added, the starch will be made evident by the blue colour. Boracic acid is detected by dissolving the salt in alcohol and setting fire to the solution; if boracic acid be present, the flame will be green. It is more difficult to detect the sulphate of lime, which is manufactured in acicular crystals, expressly for the purpose of adulterating the sulphate of quinine. It may, however, be detected by exposing the suspected salt to a red heat; the sulphate of quinine is decomposed, but the sulphate of lime merely loses its water of crystallisation, and when mixed with water, it rapidly absorbs the fluid, and will solidify in a few seconds. If the adulteration be an anhydrous sulphate of lime, it will remain insoluble in water while the sulphate of quinine dissolves. 10 grains of sulphate of quinine, with 10 drops of diluted sulphuric acid, and ½oz. of water, form a perfect solution, from which ammonia throws down a white precipitate. This redissolves on agitating the whole with ½oz. of pure ether, without the production of any crystalline matter floating on the lower of the two strata, into which the agitated fluid separates on rest; this indicates the absence of quinidine and cinchonine. It is doubtful if quinine can of itself cause salivation; a condition, known as cinchonism, has been met with, the chief symptoms of which are intense headache, accompanied by running at the eyes and nose. As it is not an uncommon procedure to commence a course of quinine by taking purgatives, the salivation might have been produced by calomel. Amorphous quinia may be produced by dissolving the disulphate of quinine in dilute sulphuric acid, and evaporating to dryness.—T. I. PRESTON.

[11911.]—**Lathe Head Mandril.**—In answer to "Anglo-America," I don't see how such bearings as he sketches would be applicable to an eccentric chuck, and I think they would be much more troublesome to fit than the ordinary ones to a lathe mandril, and, therefore, less likely to be well done.—J. K. P.

[11912.]—**Chemical.**—For the purpose of initiating the student into the changes brought about by modern theories, I can recommend Hoffman's "Introduction to Modern Chemistry," 1851; and Odling's "Manual of Chemistry."—S. BOTTONE.

[11912.]—**Chemical.**—Fowne's "Chemistry," published by Churchill.—T. I. PRESTON.

[11929.]—**Chemical.**—Nothing.—S. BOTTONE.

[11951.]—**Photography.**—Procure a small keg or cask, stand it on end, insert a small tap at lower extremity. Place your cask in some convenient mode, so that the waste water may run down some sink. Fill your cask with water, place your prints in a dish just below the tap. Now turn on the water in a fine stream, not exceeding the thickness of a straw. The superfluous water will flow over the sides of the dish, while the prints will remain in it. From six to ten hours will be required to remove entirely the hyposulphite.—S. BOTTONE.

[11961.]—**The Leclanche Cell.**—I believe that the crystals which form on the porous cell and on the zinc are a double chloride of zinc and ammonium. They are easily removed by soaking in warm water, and their production may be prevented by using only a half saturated solution instead of a saturated one, as usually directed. For such purposes as bell-ringing I do not think there is any cell to compare with the manganese, of which the Leclanché is the most readily obtained form. The zinc need not be amalgamated, but the force is somewhat higher with amalgamated zinc.—SIGMA.

[11963.]—**Brass Springs.**—Brass can be tempered by hammering. Take a stout brass wire, place it on a smooth steel anvil, beat it to the required thinness with a round-faced hammer, and you will get it as "springy" as you please.—S. BOTTONE.

[11965.]—**To Blacken Brass.**—Pass over the surface to be blackened with a sponge dipped in a dilute solution of bichloride of platinum.—S. BOTTONE.

[11966.]—**Dandelion Roots.**—Is in perfection now. Cannot recommend the wine for medicinal purposes. The extract, or even the simple decoction, is preferable. Flowers much used by druggists to make extract. Capital tonic, bitter and aperient, especially recommended in cases of torpidity of the liver.—S. BOTTONE.

Carbonic Acid in Charcoal.—Dr. H. Vohl, of Cologne, supposes he has proved that the carbonic acid obtained by heating charcoal is not derived from the charcoal itself, but is carbonic acid occluded by that substance, being derived from the atmosphere. He states that charcoal freed from carbonic acid, and made to absorb oxygen, does not show a trace of the former gas, even when heated to 680° Fahr.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "F. J. G." has answered 11275; "H. B. E.," 11452.

11596 Photographing Engravings, p. 131
11603 Dinas Firebrick, p. 132
11605 The Organ Built. To "J. D.," 132
11609 Screw Cutting, 132
11611 Opaline Photographs, 132
11613 Stuffing and Preserving Animals, 132
11625 Deaf Dog, 132
11630 Compendious Perpetual Calendar, 132
11634 Tudibi Gum, 132
11635 Davis's Refrigerator Car, 132
11637 Cormona Wood, 132
11642 Romsey Observatory, 13
11643 Estate Agency, 132
11650 Annealing Steel, 132
11652 Tasmania, 132
11659 Black Varnish for Microscopic Objects, p. 133
11662 Colouring Walls, 133

QUERIES.

[11984.]—**Tea Testing.**—Being anxious to test my daily manufacture of tea—in cup or infusion, for strength, flavour, pungency, and briskness; as to good quality; and sourness, mustiness, and flattishness, when of bad quality, throughout the season—but not knowing how to set about it, would any of your readers put me in the way of doing so, as to requisite chemicals (if any) and instruments for the tests, together with detailed information as to operations for the different qualities? Is there no instrument, or cannot one be introduced for testing tea in strength, in the same manner as they tell spirits? If so, where is it to be had, at what price, and is it efficient? If not, could any one suggest a suitable instrument? We generally test by tasting as the brokers do, but it is not at all times satisfactory; for one's stomach may be out of order, or may be, sickness may prevent one, or one's mouth may be out by having attended a dinner party, &c., the previous night.—ANON.

[11985.]—**Machine to Cut Leaves.**—I wish to cut 240lb. of green leaves daily (from 3in. to 8in. in length) as chaff is cut. Can any one suggest a simple and suitable machine, to be worked by a couple of boys (one feeding the machine, and the other working it)? A detailed illustrated explanation will oblige—ANON.

[11986.]—**Chemical Properties of Tea Leaves.**—What properties are there in tea leaves, to give the manufactured tea therefrom strength, briskness, pungency, and flavour? How do the chemical actions take place to secure the above qualities?—ANON.

[11987.]—**Draft Holes in Fireplaces.**—Of what use are draft holes in fireplaces, and why? Previous to my arrival here some fifty fireplaces were erected for drying the green tea leaves, but without draft holes. I wish to know whether this has any effect on the fires, and what effect? and why would draft holes in them remedy them in any way? I forgot to say over each of these fireplaces there are five trays for drying the leaf in, and a sixth for catching the tea dust, to prevent it from falling into the fire.—ANON.

[11988.]—**Dyeing and Fixing.**—Wishing to dye with Judson's dyes, can any one inform me what are the several mordants for fixing the different colours sold, and how the operation for the different colours is to be carried on?—ANON.

[11989.]—**Extract of Tea.**—How can I make the extract of tea, so as to be used in the same manner and proportion as the essence of coffee? Explanatory illustration of instruments and operation will oblige—ANON.

[11990.]—**Ice Making.**—It is 97° thermometer in the shade, water lukewarm. Can any one suggest a compact, portable, and cheap machine, for making from one to two pounds of transparent or other ice at a time? The materials to make it with I should like to be procurable in India, and of that description as to be used over and over again without much loss of them. The machine to be capable of cooling a couple of bottles of liquor when ice is not being made; and the machine to be as small as possible. An invention of a machine was advertised in the *Lancet* of February 6, 1864, procurable for a few shillings, by which transparent ice could be made, and supplied by Brown Bros., of 43, Cranbourn-street, W.C., London. An explanatory and detailed illustration of this machine will greatly oblige.—ANON.

[11991.]—**Focal Length of Lenses.**—What is meant by the focal length (as 4½in. or 3in.) or focus of a lens in camera or telescope? How is it ascertained, and why is it necessary to know it?—ANON.

[11992.]—**Edwards' Graphogenic Apparatus.**—An illustrated explanation of this apparatus in detail, with the working of it, will oblige—ANON.

[11993.]—**Photographic Process.**—Is any one acquainted with a process of a dry nature (as dry plates) which is as good or at all approximate to the wet collodion processes, in certainty, perfection of detail, and rapidity of action? The process, if possible, must admit of any number of plates being prepared at one time, keep for weeks and months (the longer the better), not needing to be developed for days after exposure. The plates must bear carriage for the use of a tourist, and, if practicable, prepared on mica instead of glass, so as to involve as little weight as possible. Information on the preparation of plates, exposure, development, with chemicals, &c., necessary, and operations of working, will greatly oblige. I want it for one of Murray and Heath's miniature photographic apparatuses for moving objects.—ANON

[11994.]—**Instrument for Measuring and Recording the Amount of Light for Photographic Purposes.**—Is there any portable and cheap instrument invented for the purpose of recording the differences of light (sun) on different occasions or days, which could be temporarily fitted to a camera and taken off and on in a moment, so as to aid photographers (amateurs) for a certainty, as to the time requisite for exposure of the plates? Of course it must be procurable, with information as to the differences of light, when using lenses of different sizes and qualities, and size of opening used.—ANON.

[11995.]—**Patent Rights.**—Somewhere about ten or twelve years since, I made a machine (which is still in use), and I have noticed that recently a patent has been granted for one similar to another firm. Can you or any of your correspondents kindly inform me whether this patent affects me in any way?—MATTHEW COUCHMAN.

[11996.]—**Deafness Arising from Cold.**—Will any of "our" readers kindly inform me of some effectual remedy?—R. C. Y.

[11997.]—**Warming Greenhouses with Gas.**—"Houblon" will greatly oblige by giving a drawing and fuller description of his apparently excellent plan for the above, mentioned in reply 8735, p. 44, Sept. 29, 1871, and say if it stood the test of winter.—H. B. R.

[11998.]—**Dry Solder.**—What is meant by dry solder?—W. T. M. D.

[11999.]—**Chuck.**—Will any one give a description of the interior of the American chucks, as advertised in the ENGLISH MECHANIC?—W. A. M.

[12000.]—**Insects in Tables and Chairs.**—How can I stop these? They are, I presume, what is commonly known as wood lice; the holes are numerous and about as large as pinholes. I should be glad of a recipe for arresting further depredations.—FOX.

[12001.]—**Hair Turning White.**—To "AULD REEKIE."—Will "Auld Reekie" (reply 11811, p. 261) say whether I am to put the cantharides to the glycerine and lemon as well as oil and lime-water or not? Also I should like "Auld Reekie's" advice or opinion upon the following: My hair turned white, also one eyebrow, at the age of sixteen, present age twenty, is there any cure? If not, is the above recipe the best I can use to prevent its extending or turning all my hair white?—J. A. A.

[12002.]—**Zinc for Aquarium.**—Will any of your correspondents kindly inform me if an aquarium partly constructed of zinc be detrimental to fresh water fish, or the best means of constructing an aquarium?—A THREE YEARS' SUBSCRIBER.

[12003.]—**Keeping Dust from Turret Clocks.**—A valuable turret clock is being erected in a position where there will always be a good deal of dust: a glass case has, therefore, been ordered for it, which is to be made as dust-tight as possible. There seems to be some danger (when a case is nearly air-tight) of moisture condensing on the works of the clock in damp weather. (See "Clock and Watchmaking," Weale's series, p. 218, 5th edition.) Of course this must be prevented from happening in some way or other. Would it answer to put a jar half full of strong sulphuric acid into the case? Or would a jar full of pieces of calcium chloride be better? Could not the jar full of the same pieces be used for a long time if it is heated in an oven occasionally, to drive off the moisture which the chloride has collected? Sulphuric acid gives off no corrosive fumes at ordinary temperatures, is calcium chloride equally harmless?—E. G. LODER, Trinity College, Cambridge.

[12004.]—**Nitrate of Soda.**—Can any correspondent inform me concerning nitrate of soda, whence does it come, and is the supply likely to be permanent? When genuine what is there in it which causes such extraordinary effects on the wheat plant?—A FARMER.

[12005.]—**Fleming's Locking Corks.**—What is the principle of Fleming's locking corks?—PHILANTHROPIST.

[12006.] — **Liquor Oils.** — Would some of your numerous readers who understand chemistry well (and they are many), confer a favour on me, by giving, through your valuable journal, the process of manufacture of the different liquor oils, or essences, that are used by brandy, gin, rum, cider, and wine makers, with the different articles used? also, the whole process of manufacture? If some one would confer this favour, and the editor not consider too much space occupied, they would very much oblige—R. R.

[12007.]—**Purification of Iron.**—Can any of your readers inform me whether a stream of superheated steam with atmospheric air has ever been used in the puddling of iron, with a view to separating the sulphur and phosphorus—as sulphuretted and phosphoretted hydrogen—and would some of your readers practically and chemically acquainted with the subject, give me their opinions on the matter?—WM. U. BUEL.

[12008.]—**Cork Cutting.**—I should feel obliged if some kind reader would furnish information through the MECHANIC regarding the best cork-cutting machine, and price of same. Also whether it can be worked by a person unacquainted with cork-cutting, and if the corks so cut are quite as good as those cut by hand.—CORTEX.

[12009.]—**Photographic Lens.**—Will some photographic friend kindly inform me whether it is possible to take a picture by the calotype process, with a single double-convex lens? If so, what would be the right size and focus for pictures 4½in. × 3¼in.?—A BEGINNER.

[12010.]—**Bee Management.**—I am sure we all appreciate Mr. Abbott's letters on bee management. I have, like him, been obliged to have recourse to feeding, having noticed several dead larvæ at the mouths of the hives, which were strong and would have swarmed ere this, but for the wet and cold weather. But I would ask Mr. Abbott to explain what he means by "Some fitful hours of sunshine made them believe in the almanack." By them he means the bees, I suppose, and again, "they have exhausted their store of honey through faith in the infernal almanack." Now, I have kept bees several years, and have never heard that bees have anything to do with almanacks, nor can I find any by searching in the hive. The Rev. J. G. Wood, in his excellent work on bees, says: "Would one could look at a few of the bee blue-books." Now, by this letter, it would seem that there are such things as books used, and faith put in by the bees. I am sure the Rev. J. G. Wood would like (and so should I) to see an almanack that the bees have read and have such faith in, even though it was an infernal one.—COLNEY HATCH.

[12011.]—**Magic Lantern Effects.**—Can any correspondent inform me how to make a slide to exhibit falling snow in the dissolving view lantern?—likewise moonlight effect?—DRAWDE T. REHCTELF.

[12012.]—**Water Power.**—"Ignoramus" would be pleased to learn what actual power he could procure from a 3in. run of water (through a 3in. pipe) constant? and what would be best medium of power, water-wheel or turbine, and cost of each, and how made? Fall 6ft. at least.—IGNORAMUS.

[12013.]—**The First Watch and Clock Made.**—As it happens to be my lot to make a living by watches and clocks, I have been anxious for years past to get some information regarding when, and by whom, the first watches and clocks were made; also on their improvement up to the present time. Will any reader kindly inform me through the ENGLISH MECHANIC if such is in print?—A GLASGOW HIGHLANDER.

[12014.]—**Organ.**—To "J. D."—Will "J. D." or some other correspondent kindly answer this question. The pipes of the organ are placed, are they not, upon long boxes connected with the bellows, with a small pallet to each pipe, inside the "box." How are these pallets connected to the trackers coming from the keys? If you bore a hole through the bottom of the "box," I fancy you will lose a large quantity of wind, for you could never get them air-tight, and yet be able to move easily enough.—E. C.

[12015.]—**The Gyro Pigeon.**—Can any of your readers inform me if the gyro pigeon, described on p. 222 of the MECHANIC, No. 373, can be made to describe its flight, right, left, or straight forward, by any arrangement of the apparatus? What is the price? Can the shot marks be readily effaced after one good hit, so as to show clearly the result of the next shot? and how far does the pigeon fly before reaching the ground? As I want a little practice before August 12, I shall be greatly obliged for a little information.—A DEAD SHOT.

[12016.]—**Cutting Cardboard Mounts.**—Will any correspondent tell me how the white Bristol board used for putting over water-colour drawings, &c., is cut? The cut is so clean, and the bevel usually so true, that it looks as if it were done by machinery. Is this work done by a machine or by hand? What tool is used, how is the board kept steady, and on what is it placed for cutting?—J. K. W.

[12017.]—**Electro Iron.**—Can any of your readers tell me how to deposit electro-iron? I do not mean the steel facing of copper, but a fair deposit of reguline iron. I have specimens of electro iron from Russia (by Jacobi's patent) but can not find any one in England who will do the work. I have myself deposited a thin film of bright iron, but it then turned to mud.—BAFFLED.

[12018.]—**Star Distances.**—Will Mr. Proctor or "F. R. A. S." kindly inform me what are the distances of stars, from the 1st to the 12th magnitude, inclusive?—DORSET.

[12019.]—**Damp Walls.**—A wash is frequently used to prevent damp walls, consisting of a solution of soap, allowed to dry, and followed up by a solution of alum in water. Sometimes soap, linseed oil, and alum, are mixed and applied at once, and the efficacy of both processes is, I believe, well attested. Will "Sigma" or Mr. Bottone kindly tell the chemistry of this?—A. C. G.

[12020.]—**Tireing Cart Wheels.**—Could any one oblige by informing me the way to tire a dished cart wheel? Say a wheel 3ft. 8in. high, 1¼in. dished, how much should the bar be hollow on the edge, to come the same dish or bevel as the wheel? Any information will oblige.—U. V. W.

[12021.]—**Turning.**—What is the best kind of chuck to be used for turning down castings of model engines?—GLATTON.

[12022.]—**Forest and Rainfall.**—It is asserted that the destruction of forests causes a diminution in the rainfall. Where can the best information on this subject be found?—ELM HIRST.

[12023.]—**Dissolving Bone.**—Will any of "our" readers kindly inform me by what means I can dissolve bone, so as to mould it to any shape required?—A. S. A.

[12024.]—**Photographic.**—Will some reader kindly tell me how to get out of this fix? I have a ½in. plate portrait camera and lens which is quite light-proof, but when I take a portrait I focus the face, and I find it nice and sharp, but all round—hair, neck, hands, &c., are very dull. I photographed a large placard the other day, and the letters in the centre of it were plain, but those above and below and each side of the centre are almost invisible. Are the glasses of the lens in wrong, as they have been taken out to be cleaned? If wrong, how should they be put in, or what else can cause it?—TOM IN A FIX.

[12025.]—**Chiding Stone.**—I have a print representing a large boulder lying on a large square slab of stone, with the name "Chiding Stone" under. Can any one tell me where it is?—J. K. P.

[12026.]—**Greenheart Timber.**—At a sale of surplus stores at one of the Government dockyards, I purchased a considerable quantity of greenheart plank. Not knowing what to do with it, and being utterly ignorant of its specialties, I laid it down for a granary floor, screwing, not nailing it down. Happening to take a strip sawn from the edge to get the planks straight and square, I was much struck with its wonderful elasticity, almost equal to whalebone. I had a rod of 1in. square prepared; this I supported on trestles 2ft. 8in. apart, and weighted with bricks in the centre. To my surprise this 1in. square rod took no less than 413lb. to break it. Under this load it gradually gave way, breaking up in long fibres almost like hemp in a rope yarn. I tried with other woods of equal size, and under similar conditions. Among the rest the heart of pitch pine; this broke short (without warning) under a weight of 323lb. My object in writing this is to get from "Jack of All Trades" or some other of your knowledge-imparting contributors, some account of this wood and its specialities. What is its action under the influence of the sun? Is it fit for outdoor work, in the shape of field-gates, &c., or for indoor work? Would it do for cattle-feeding troughs, or purposes where it is alternately exposed to rain, sun, or moisture? It is rather expensive working it for rough purposes, as it will not stand nails; splitting up so readily. Perhaps at the same time I might get a similar answer as to the specialities of Santa Maria timber, of which I bought one or two lots, and which I have been using up for door and window cills, and also with advantage for cart shafts. Any kind friend among your contributors who will give information on the above will greatly oblige—KHODA BUX.

[12027.]—**Albert Durer's Engravings.**—Will any one give some information on the distinguishing marks of original etchings by Albert Dürer? Where can undoubted originals be seen? Is the water-mark of the paper any guide? I have three; one, "The Anointing of the Body," has for the water-mark of the paper "A. M." Another, apparently a subject from the Apocalypse, is marked, as well as I can make out, "D. Riaw." The third bears the water-mark "Vienne."—KAPPA.

[12028.]—**Dimensions of Balloon.**—Can any correspondent give me the dimensions for a balloon to carry 120lb.? it would be inflated with pure hydrogen. Also I should be much obliged for the names and price of any good books on the construction of balloons.—THE ROLLING STONE.

[12029.]—**Object Glass.**—Why are some object-glasses balsamed? Is it to correct defects or merely to hold the lenses in place? Do balsamed glasses perform as well as those not balsamed? Would observing the sun disturb the balsam, thereby spoiling the view?—C. B.

[12030.]—**Sun Screen.**—If Rev. E. L. Berthon (letter 4037, p. 150) will oblige by stating the way to deposit the silver on the field-glass of telescope and proportions of chemicals required, I shall esteem it a favour.—C. B.

[12031.]—**Hot Peas.**—The hot-pea hawkers have a mode of cooking their peas that makes them very savoury, soft, and swollen, as big as, if not bigger than, when full grown, unplucked from the stalk. If any brother reader could and would describe how they are done, he would greatly oblige—POOR TEETH.

[12032.]—**Fishing Nets.**—Can any one give the particulars of process used by the French fishermen for tanning or barking their nets, thereby rendering it unnecessary to dry them occasionally, or re-bark so often as the fishermen of this country do? Cutch catechu and Gambier are the ingredients used here, but they do not seem to answer the purpose, as the nets require re-barking and drying often, whereas the French can be fished with for months without either.—ERIN.

[12033.]—**Waterproof Fishing Socks.**—Can any fellow reader tell me how I can make a cheap pair of waterproof socks? I have thought of indiarubber solution laid on canvas, but I am afraid it would be too sticky. Any information on the above subject will oblige.—WADER.

[12034.]—**Ordnance Map of London and Environs.**—The altitudes are given in feet above the approximate mean water at Liverpool. Can any of your readers inform me what difference there is between mean water at Liverpool and high water at London-bridge?—ROOK.

[12035.]—**The University of Turin.**—Will our kind friend Mr. Bottone give a little information as to the University of Turin? Whether Englishmen can be educated free, and any particulars suitable to a young man who desires to go there to learn the languages, &c.—SILEX.

[12036.]—**Engine.**—Would any of your correspondents favour me with an answer to the following? What would be considered the proper dimensions of a boiler for a small horizontal engine 1in. bore, 2in. stroke? and what would be the power of an engine of the above sized cylinder, and length of stroke?—F. GRAHAM YOUNG, S.D.

[12037.]—**Mining Query.**—What is fire-setting, and how is it applied?—WM. MCCULLOCH.

[12038.]—**Atmospheric Electricity and Magnetism.**—Will "Sigma," or some other kind reader, state how the amount of atmospheric electricity can be registered, what apparatus is required, and can it be procured at a moderate cost? Also, how is terrestrial magnetism observed? Can instruments for testing intensity be purchased of ordinary scientific instrument makers?—R. C.

[12039.]—**The Pressure of the Wind.**—Perhaps some of your correspondents might inform me if any experiments or observations have been made from which the following point may be determined. Suppose two polished plates, a foot square each to be placed, the one vertically, at right angles to the direction of the wind, and the other horizontally on the surface of the ground. Suppose the pressure of the wind, urging the vertical plate forward, to be equal to one pound, what is the amount of pressure exerted on the horizontal plate tending to move it forward along the ground, the wind, of course, being assumed to act only on the upper surface of the plate, and not on its edges? The particles of the air strike the surface of the horizontal plate obliquely, consequently the pressure of the wind is exerted obliquely in the plate. Conceive the pressure decomposed into two components, the one vertical to the surface of the plate, and the other horizontal. The question to be determined is, what is the amount of the horizontal component?—JAMES ELLIS.

[12040.]—**Navigation.**—Will some practical reader—say the mate of a ship—kindly tell me the best books to read, and the easiest way of picking up sufficient knowledge of this science to interest one, and to fill up some of the weary hours on board ship? Although not a sailor by profession, I have, in common with many others, often regretted my ignorance during the many long voyages I have made?—A. B. C.

[12041.]—**Burnishers for Brass-work.**—Will "Jack of All Trades," or any other of our readers, kindly inform me what kind of burnishers brass finishers use for burnishing their brasswork, either before or after it has been lacquered?—J. W. CARD.

[12042.]—**Boiler.**—I have a 1 horse-power tubular boiler, and will be glad if some of your kind correspondents will assist me in answering two questions. 1. It has two pipes inside from the bottom, each side meeting in junction, or T piece to a thin casing close up and under steam dome. I want to know the use of them. 2. The boiler plates are three-sixteenths of an inch in thickness in sides, one-eighth of an inch in back, and copper riveted. I want to know at what pressure I may work it with safety.—STEAM.

[12043.]—**Poultry Breeding.**—Could any of "our" readers inform me if there are any places in England where they breed poultry on a large scale for the purpose of profit? and if so, would they kindly say where, and any other information they could give me, as I want to inspect one, to enable me to commence operations myself?—C. H. C.

[12044.]—**Rosin Grease.**—Can any of your readers tell me how rosin grease is made, the materials used, quantity of each, and the process of manufacture?—INQUIRER.

[12045.]—**Analysis.**—Will G. E. Davis, or S. Bottone, or any other chemical reader, assist me in the following difficulty? I have a substance which I was told consisted of beeswax and sulphur, but I want to know the exact percentage. I was told by a Professor of Chemistry that beeswax could be dissolved in ether and alcohol, and that the sulphur would be left behind; but on trial I had no residue. I next tried dissolving in bisulphide of carbon, and then allowing to evaporate; but no crystals of sulphur were left. I think that the substance has been melted together, and then ground to a fine powder. I am very anxious to be able to get at its proportions. I may say it is used in the construction of telegraph cables.—LICTOR.

[12046.]—**Endorsing Ink.**—Will some reader of "ours" oblige me with a receipt for endorsing ink for brass stamps? The desiderata are that it shall dry rapidly on the paper, but not dry on the ink pad.—F. V. H.

[12047.]—**Radius of Sector.**—Will "E. L. G.," "V. B.," "J. K. P.," or some other kind person show me, as simply as possible, how to find the length of radius of a sector (like figure in query 11166, p. 650, Vol. XIV.) when the measurement is given as chords; also, when given as curves?—T. E. G.

[12048.]—**Trip to Ireland.**—I intend, during July, spending a week in and about Dublin. I shall go from Liverpool direct to Dublin and places about Wicklow, Bray, and Parsonstown. I would like a reliable guide-book. I would also be glad of a good map, geological preferred.—A WANDERER.

[12049.]—**Aerated Water Machines.**—Would any reader inform me if there is a book on the construction and management of the above machines?—A MECHANIC.

[12050.]—**Socotrine Aloes.**—Will any of your readers inform me why it is this drug when ground varies in colour from a dark rich brown to a light drab?—B.

[12051.]—**Fire Engines.**—Will "Philanthropist," who, in No. 370, proffers further information in connection with Shand and Mason's steam fire engine, say what advantage is obtained from an air vessel being fitted to the suction side of the pumps in these engines?—A. GRAY.

[12052.]—**Rust in Brewing Water.**—Will any of of your numerous readers inform me how to construct a cheap filter to separate rust from water, imparted to it in passing through cast-iron pipes? I should require to filter about 1,500 gallons (say) in three hours. The distance from tank to inlet pipe overhead is 8ft., so I could not insert a thicker filtering medium.—CROMWELL.

[12053.]—**Canaries.**—I have a hen canary that is at present sitting on rotten eggs. She is constantly wheezing and sniffing as if she had a bad cold. Can any one inform me what is the cause of this? May this not have something to do with the rotten eggs? What is the cure for this? I have also a cock canary similarly affected. He is only now beginning to whistle, although he was a splendid whistler not long ago. I have given them egg and maw seed "with a muchness." Would it do them any harm to be put out in the open air for a few hours daily?—BED OF STONE.

[12054.]—**The Needle Lock.**—Can any kind reader give a detailed description of the needle unpickable lock?—A STRUGGLING ORGANIST.

[12055.]—**Works on Pedal Playing.**—Can any musical reader give the names of some of the best works on pedal playing for the organ?—A STRUGGLING ORGANIST.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£335 5 7
J. K. D.	4 0
	£335 9 7

Water of the Deep Sea.—An apparatus for obtaining water from the depths of the ocean has been invented in Germany. An open vessel of suitable form and size is lowered by means of a rope, and when the desired depth has been reached an electrical current is transmitted through a wire that accompanies the lowering rope, and this current, inducing activity in an electro-magnet attached to the apparatus, releases powerful springs, which act upon stop-cocks, thus inclosing the water at any degree of depth. Some useful experiments in the determination of the carbonic acid in sea-water have been made through the agency of this apparatus.

Raphael's Cartoons.—With a view to preserve accurate copies of the cartoons of Raphael, the Lords of the Committee of Council on Education, acting through a committee, propose to select nine artists to make preliminary studies of given parts of three of the cartoons. Artists will first be required to complete an accurate copy either in water-colours, tempera, or oil, of a photograph, full size, of a head selected from the Beautiful Gate. These will be sent in to the Secretary of the Science and Art Department by the 31st of July, 1872. From the candidates so competing, nine may be selected to make accurate coloured copies from the cartoons themselves of portions set out by the committee as a final test.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, May 28, and unacknowledged elsewhere:—

T. T. Greg.—Stephen Reay.—J. P.—Arthur Monckton.—G. A. W.—J. A. R.—Guillaume.—James Best.—The Harmonious Blacksmith.—H. Franklin Parsons.—P. Santalinus.—Well-wisher.—James Gillingham.—John Wilkins.—S. Deacon and Co.—Jabez Francis.—Wm. Bowles.—Robt. W. Armstrong.—F. R. A. S.—Amateur.—Fitzgerald Kenny.—W. J. P.—Plumbago.—B. C.—Mechanic's Wife.—A Subscriber.—One in Need.—A. A. A.—A Silversmith.—Rev. H. C. Key.—Monte Cristo.—R. O. Berry.—Emily Jane.—R. A. B.—Philo.—T. A. A.—Maugh.—M. Paris.—S. M. Drach.—John Parsons.—Caloric.—J. H. Schucht.—G. C.—J. W. Fennell.—F. J. M. Evans.—X. Y. Z.—Cymro Glân.—John.—H. W. J.—W. R.—"Sir Roger."—Louisa.—Hautboy.—J. Barwick.—M. Y.—An Engine Driver.—A., Liverpool.—Lovatt.—T. Smith.—Thos. Fletcher.—Ashley Dakin.—J. Jeffcock.—J. E. Anderton.—H. W. Cartes.—J. Sheldon.—E. W. Braithwaite.—N. Jocelyn.—W. H. Neal.—Rev. C. R. Holmes.—W. H. Skelton.—W. M.—Gwastad.—M. Carter.—Points and Crossaways.—Joe.—M. A. Simmonds.—Outside Labourer.—Bed of Stone.—Beacon Lough.—Ko Jo.—H. B.—G. E. L.—G. J. C.—T. A.—George Richardson.—Joseph Arrowsmith.—E. W. S.—En Avant.—Hope.—J. H. L.—P. H. Holland.—Separator.—P. H. D.—J. T. Oakley.—E. N. Piers.—T. L.—B. F.—Sarah Lewis.—Jacques.—Erick.—J. W. Abbott.

J. BARWICK.—The errors in your letter on the alcohol question are your own. We cannot spare the space you require to correct them.

B. THOMPSON.—Yours on "Electricity" next week.

MINERVA.—Consult the *Times* advertisement sheet.

J. W. HAYWARD.—Forwarded to "Jack of All Trades."

E. L. G.—Your "More Proofs of the Deluge" next week.

A. BULL.—See "Philo's" letter on "Jack of All Trades."

W. D. L. writing from Wigan, says: "It is now Monday noon and I have not got Friday's paper. Please attend to it." We have nothing to attend to in such a matter. The ENGLISH MECHANIC is invariably published at ten o'clock on Thursday mornings, and if not delivered to subscribers in time, the fault is not ours.

CHARLES ROCHE.—Yours on "Debility" next week.

AN OLD READER.—If an old reader you are a negligent or forgetful one, or you would have known and remembered that your questions appertaining to chucks have been answered in various ways.

E. B., J. WILLIAMS, AND ELSMORE.—Queries too trivial.

E. L. D., J. JUDSON, and E. D.—The controversy on "How we see a Distant Object" is closed.

G. PINNINGTON.—We have no desire to withdraw our assertion in reference to "perpetual motion and perpetual fools," neither can we consent to a rediscussion of the subject, or any aspect of it, in our pages. You say you have "been working at the problem for thirteen years." We are sorry to hear it, as your time has been wasted. You cannot get more out of your "model machine" than you put into it, if you try till doomsday. We don't know Mr. Dirck's address.

F. J. GODDEN.—See reply by "Berks late Oxon Farmer," on removing bees.

HYDROLOGIST.—Can't you send something more substantial and definite on the question.

J. W. BODWELL.—Try to write on thicker paper and in a plainer hand, and we should probably insert.

W. C. M.—See "Sigma's" letter this week. The one paragraph we have given from the hand-book must suffice.

ISLA, A Pattern Maker, A. Z., Schoolboy, R. B., R. J., J. C., F. Stockwell, and Inquirer, are referred to indices to back vols.

ARTILLERYMAN.—Very often it is the case, but if you have anything really good, *make* the department listen to you.

E. E. DUNN.—Your request could not be complied with, except by a great and useless sacrifice of our space.

PULSE.—Ask your medical man, if you *must* imagine yourself ill.

DÆDALUS.—For information on mounting microscopic objects in damar, see pp. 183, 343, and 380, Vol. XIII.

E. L. G. AND THE POPE.—Mr. J. Birmingham writes:—"I see 'E. L. G.' has transferred his wrath from Lyell to the Pope. It is all very well to laugh at his theories and the literary style in which he tries to set them forth, but I put it to you as a gentleman whether you ought to publish his insults to a large class of your readers and contributors, and to the vast majority of civilised and Christian men." Perhaps "E. L. G." will take the hint.

W. C. M.—You have only sent part of the description of the watch-key. We hardly think its insertion would be worth the space it would occupy.

J. DIXON.—Please do not send us "one or two more communications" unless you treat the question more scientifically that in the present instance, for which we cannot find space.

J. D.—It is impossible to make out the impression of the coin sent.

TROUBLESOME.—None.

A. M.—Incubators have been frequently treated of in our columns, see, for instance, pp. 517, 566, 609, 668, 671, of our last volume, XIV., and a few replies in recent back numbers.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MAY 21, 1872.

1385 O. Schulze, Finsbury-circus, for new and improved modes of using cork. A communication.

1386 T. Morris, Carlton-chambers, Regent-street, for improvements in domestic hydraulics.

1387 J. Clark, Belmont-terrace, North Kensington, for improvements in railway brakes.

1388 L. Engel, Mumford-court, Cheapside, for attaching thermometers to the handles of umbrellas, parasols, sticks, whips, and fans.

1389 W. J. Perkins, Baker-street, Portman-square, for a new or improved portable pneumatic apparatus or bracket for supporting music or books, and for any analogous use.

1390 T. A. Ashton, Sheffield, for an improvement in the manufacture of coal, coke, and other similar baskets or "skips."

1391 F. G. Fleury, Merrick-square, Southwark, and A. Tylor, Newgate-street, City, for improvements in apparatus for measuring and recording the flow of liquids or fluids.

1392 F. J. Hamel, Avenue road, Regent's Park, for improvements in machinery for the compression or consolidation of blocks of fuel or other material.

1393 I. Brown, Edinburgh, for improvements in utilising the substance or material known as the green sand of the lias formation, such as that found in coprolite beds.

1394 F. L. H. Danchell, Horwich, Lancashire, for an improved filtering medium.

1395 A. Slater, Liverpool, for improvements in printing from photography.

1396 H. Turner, Sheffield, for improvements in the application of wire to building and other purposes.

1397 B. Looker, Kingston-upon-Thames, for improvements in hollow ventilating bricks or slabs, and in arrangements to be used for ventilating horticultural and other structures.

1398 E. Watteen, Middlesbro'-on Tees, or improvements in machinery or apparatus for driving holes or drift-ways in rocks. A communication.

1399 E. Brook, Huddersfield, for improved machinery for facilitating the application of labels to bobbins and other articles.

1400 H. D. Plimsoll, Gordon-square, Middlesex, for improvements in miners' safety lamps.

1401 W. Loy and J. Pinker, Liverpool, for an improved packing for steam and other motive-power engines.

1402 S. P. Longman and E. C. Alderman, Islington, for registering the issue of tickets in public conveyances and elsewhere.

1403 H. H. Mawhinney, Massachusetts, for new and useful improvements in eyeletting machines. A communication.

1404 J. Arnold, West Smithfield, for improvements in "enemas" or injection apparatus.

1405 J. Howard and E. T. Bousfield, Bedfordshire, for improvements in the construction of ploughs and other tilling implements.

1406 A. Wilbaux, Paris, for improvements in the manufacture of paper hangings, and printing on stuffs or other similar materials.

1407 G. Newsome, Rochdale, for improvements in emery rollers for grinding cards.

1408 W. R. Lake, Southampton-buildings, for improvements in apparatus for producing compression upon metallic articles. A communication.

1409 J. H. Johnson, Lincoln's Inn-fields, for improvements in the treatment or ores, more particularly iron ore, for the manufacture of cast iron, wrought iron, and steel therefrom, and in the apparatus to be employed therein. A communication.

1410 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of artificial manure. A communication.

1411 F. Trotman, Zoological Gardens, Regent's Park, for improvements in reflecting apparatus or fittings for use in lighting up theatres and other buildings.

1412 M. H. Larmuth, Salford, and F. Norton, Manchester, for improvements in standards or supports for telegraph-wires.

1413 S. Swain, Bradford, for improvements in gas fittings.

1414 W. Ross, Glasgow, for improvements in water-closets.

1415 B. French, Rochester, U.S., for improvements in lubricating compounds.

1416 S. Crabtree, T. Crabtree, and J. Crabtree, Manchester, for improvements in apparatus for singeing or firing cotton or other fabrics.

1417 J. H. Johnson, Lincoln's Inn-fields, for improvements in traction engines or road steamers, and other vehicles. A communication.

1418 W. R. Lake, Southampton-buildings, for improvements in mules for spinning. A communication.

1419 J. C. Browne, The Cedars, Hampton-wick, for improvements in the construction and in the form of vessels and boats.

1420 K. H. Cornish, Market-street, Mayfair, for improvements in apparatus used for the manufacture of gas, applicable also to that employed for the distillation of paraffin and other volatile fluids.

1421 J. Robey, Manchester, for a new or improved filtering medium, suitable also as a disinfectant and deodoriser.

1422 G. T. Bousfield, Loughborough Park, Brixton, for a new and useful improvement in apparatus for puddling and melting iron. A communication.

1423 P. Jensen, Chancery-lane, for improvements in the construction of coke ovens, in the utilisation of the waste heat therefrom, and in apparatus connected therewith. A communication.

1424 W. F. Henson, Cavendish-street, and H. Poole, Princes-street, Cavendish-square, for an improved manufacture of certain textile fabrics.

1425 W. R. Lake, Southampton-buildings, for an improved clamp for joining and securing ropes and for other like purposes. A communication.

1426 W. Glover, St. James'-road, Old Kent-road, and H. Sykes, Bankside, Southwark, for improvements in governors for motive-power engines.

1427 H. B. Fox, Oxton, Cheshire, for improvements in jugs for filtering and cooling liquids.

1428 K. Highton, M.A., Putney, for improvements in electric telegraphs.

1429 J. G. Briggs, Gracechurch-street, City, for improvements in the manufacture of stereotypes, and in apparatus for use therein.

1430 E. Grinerd, jun., Bernard-street, Russell-square, for an improvement in portmanteaus.

1431 A. Dereguancourt, Lansdowne-road, Hackney, for an improved method of manufacturing "cutters" for cutting out leather, cardboard, paper, textile fabrics, metal, and other materials, applicable also to the manufacture of spades, shovels, picks, hoes, pitchforks, and similar articles, and also to the manufacture of handles for such tools.

1432 J. Sutherland, Glasgow, for improvements in furnaces for puddling and re-heating iron.

1433 J. G. Hughes, Sunderland, for improvements in propelling steam ships.

1434 J. Carter and J. E. Carter, Halifax, Yorkshire, for an improved means or apparatus for moulding and casting lead, siphon-pipes, or stench traps, or other bent pipes or tubes.

1435 J. Sheffield, Glasgow, for improvements in furnaces for melting glass.

1436 T. Maynard, Dawley, Middlesex, for improvements in the manufacture of bricks and in the kilns employed therefor.

1437 J. V. P. Lagrange, Paris, for improvements in the treatment of saccharine juices and syrups.

1438 F. P. Preston, J. T. Prestige, E. J. Preston, and W. A. Prestige, High-street, Deptford, for improvements in apparatus for regulating the supply of water to water-closets and other places.

1439 A. Ray, Guildford, for the instantaneous transmission of telegraphic signals by the employment of two currents. A communication.

1440 Sir F. Blackwood, Marlborough Club, Pall Mall, for improvements in signal lanterns.

1441 A. Stewart, J. Stewart, and J. Wotherspoon, Coatbridge, Lanarkshire, for improvements in steam boilers.

1442 W. Gossage, Widnes, Lancashire, for improvements in the manufacture of certain alkaline carbonates for the purpose of obtaining carbonic-acid gas therefrom.

1443 G. Davey, New Cavendish-street, Portland-place, for improvements in the manufacture or artificial or imitation ivory, bone, horn, coral, malachite, and tortoise shell, applicable also to the production of a variety of substitutes for ornamental and decorative objects.

1444 J. Oldroyd, M. Olyroyd, jun., and E. Johnson, Dewsbury, Yorkshire, for a new or improved textile fabric, and the means or method of producing the same.

1445 J. Hall, Chancery-lane, for improvements in window-sash fasteners.

1446 G. J. Cross, New Cross, and A. Macgillwray, Camberwell, for improvements in means and in apparatus or appliances for clearing or cleaning tramway rails and the groves therein.

1447 J. A. Désgoffe, Paris, for improvements in the construction of telegraph posts and in the apparatus in connection therewith.

1448 E. Lofts, Cambridge, for a new or improved apparatus or arrangement for washing and rinsing bottles.

1449 G. B. Lewis and W. M. Ward, East Boston, U.S., for improvements in machinery for the manufacture of fishing and other nets.

1450 J. J. Kern, Oxford-street, for an improved combined cot and carriage or perambulator.

1451 J. C. Ellis, Piccadilly, for a convertible day and night railway carriage.

1452 W. R. Lake, Southampton-buildings, for improvements in pneumatic signal telegraph apparatus, chiefly designed for use in steam ships. A communication.

1453 T. A. Edison, Newark, U.S., for improvements in printing telegraphs.

1454 T. Sheehan, Dunkirk, U.S., for an improved process for steelifying iron.

1455 D. Johnson, Wrexham, Denbighshire, for an improved process and apparatus for washing, drying, decolorising and deodorising wheat and other grain or seed.

1456 W. Clark, Chancery-lane, for extracting the whole (or nearly the whole) of the anthracene contained in coal tar, and the pitch accruing therefrom, without either carbonising or decomposing the pitch. A communication.

1457 W. Morris, Deptford, for an improved mode or method of and means for establishing a communication with water or gas mains.

1458 W. R. Lake, Southampton-buildings, for an improved vehicle for painting. A communication.

1459 W. R. Lake, Southampton-buildings, for improvements in pianofortes. A communication.

1460 E. H. C. Menckton, Fineshade, Wansford, for improvements in the construction and arrangement of furnaces suited for smelting and fusing every description of ores and metals and glass, for heating gas and other retorts, and for other useful purposes, and in the means and appliances necessary thereto.

1461 W. G. Fearnley, Eardley-crescent, West Brompton, for improvements in apparatus for making illuminating gas, heating apartments or chambers, and other purposes.

1462 J. H. Weibel, Geneva, Switzerland, for improvements in apparatus for warming railway carriages.

1463 I. Liebich, Church-street, Camberwell-green, for an apparatus adapted to pianofortes for the purpose of varying the tones produced in playing.

1464 L. A. E. MacKinnon, Great St. Helens, London, for improvements in means or apparatus for use in extinguishing fire by the aid of carbonic acid gas.

1465 B. T. Newnham, Bath, for improvements in carriages and parts connected therewith.

1466 E. G. Brewer, Chancery-lane, for improvements in the manufacture of steel, steely iron, and homogeneous metal. A communication.

1467 A. Jaynor, Clapham-road, and M. Low, Lee, for improvements in steam boilers and furnaces for consuming smoke and gases.

1468 J. Spratt, Camberwell, for a new or improved food for cats.

1469 G. Bedson, Manchester, for improvements in puddling furnaces.

1470 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of shoes, and in machinery and apparatus connected therewith. A communication.

1471 W. A. Hubbard, Ramsgate, for an improved level.

1472 C. G. Wilson, C.E., Royal Exchange-buildings, City, for an improved ordure road cleaner.

1473 C. H. Siemens, Great George-street, Westminster, for improvements in the supports, fastenings, and joints of underground telegraph wires.

1474 P. Jensen, Chancery-lane, for improvements in the construction of bridge piers, wharves, docks, and other hydraulic structures, and in apparatus therefor. A communication.

1475 R. Allan, Glasgow, for improvements in reflectors for gas and other lights. A communication.

1476 R. C. Menzies, Valleyfield, Scotland, and A. E. Davies, Worcester, for improvements in the manufacture of pulp for paper-making.

1477 A. Fryer, Manchester, for improvements in the treatment of cane sugar, and in machinery or apparatus to be employed in connection therewith.

1478 H. A. Bonneville, Piccadilly, for improvements in the production of motive power, and in the apparatus connected therewith. A communication.

1479 H. A. Bonneville, Piccadilly, for improvements in the construction of two-wheeled vehicles for the conveyance of passengers or goods on common roads. A communication.

1480 W. E. Gedge, Wellington-street, Strand, for an improved vertical hammer. A communication.

1481 A. V. de Mignot and J. Ganter, Bordeaux, France, for an improved generator of expanded gasses, intended to replace steam generators, and applicable to all kinds of engines.

1482 C. M. Lloyd, South Lambeth, for new or combined machine for sawing, moulding, planing, tenoning, and cutting out various forms of wood.

1483 C. Anderson, Bradford, for an improved apparatus for indicating the time or period at which passenger tramway cars or "busses" are due at various stages, or the route from starting point to terminus, and vice versa, and for indicating the clearing of pillar letter-boxes.

1484 J. Waddington and W. Garside, Halifax, for an improved grate-bar.

1485 S. Russell, Bayswater, for improvements in means and apparatus for stoppering bottles containing aerated and other liquids.

1486 W. Ashcroft, Wolverhampton, for improvements in presses and in "bale ties" relating thereto.

1487 J. Goodfellow, Blackburn, for improvements in metallic pistons.

1488 C. Richardson, Gracechurch-street, City, for improvements in looms for weaving.

1489 J. Imray, Southampton-buildings, for improvements in means of transit across rivers, estuaries, and other waters, and apparatus therefor. A communication.

1490 J. W. Whinyates, Liverpool, for improvements in propelling and steering ships and other vessels, and in machinery or apparatus therefor.

1491 W. Laidlaw and T. Fairgrieve, Galashiels, N.B., for improvements in carding and carding machinery.

1492 T. Christy, jun., and A. Bobrownicki, Fenchurch-street, City, for improvements in the treatment of ammoniacal liquors of gasworks, in order to obtain valuable products therefrom.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 7, 1872.

ARTICLES.

MR. PROCTOR'S ESSAYS ON ASTRONOMY.*

MR. PROCTOR is a puzzle to us. Scarcely are the sheets of one of his books dry from the press than he is again before us with another. *Uno avulso non deficit alter.* Each of his works appears contemporaneously with the announcement of its successor, and "the cry is still, they come." Our difficulty would be decreased did our author exhibit any signs of having overwritten himself, or of being guilty of mere bookmaking; but, assuredly, none such are apparent, each essay in the volume now under review bearing marks of the same careful study and deliberate preparation which have characterised all his former productions. Emphatically it may be affirmed of Mr. Proctor that his utterances are those of a man who has something to say, and not merely of one who has to say something. For, after all, the chief charm and merit of his writing lies in the evidence which it contains of earnest and original thought on the subjects which he discusses; it being as refreshing as it is novel, in these days of compiled scientific "Handbooks," "Manuals," &c., to find a writer to whom paste is as an occult compound, and scissors as unknown as they were to our progenitors in the Flint Age.

The ostensible object of the author of the volume now before us is to collect in it those essays to which he has had most frequently to refer in his "Sun," "Other Worlds," &c.; but it would be doing him an injustice to suffer it to be imagined that the present work is of interest only to the readers of his previous ones. Viewed merely as an independent contribution to astronomy, there are very few pages in it from which the student will not derive both pleasure and instruction; and, collected, as its contents are, from widely diverse sources, much in it must necessarily be perfectly new to any reader. The advantage of obtaining many valuable contributions to the proceedings of the Royal Astronomical Society—otherwise practically inaccessible to him—is one which many a young astronomer, especially, will appreciate.

The first three essays have reference to the life and work of that great astronomical philosopher who has but recently passed from among us, Sir John Herschel; and it is not uninteresting to us to note, in passing (implying, as we conceive it does, a tacit compliment), that the one with which the book opens is the *éloge* which first appeared in our own columns (ENGLISH MECHANIC, Vol. XIII., p. 195). On the whole, we may regard these three essays as conveying a very fair notion of Sir John Herschel's distinctive intellectual peculiarities, and of the kind and nature of the work which he did so bravely and honestly. More merely flattering notices of his labours may have appeared, but certainly no more impartial one has yet been given to the public. But, in saying this, we must not be held to subscribe wholly and unreservedly to all Mr. Proctor's dicta; for, to take a simple (even if it may appear a trivial) instance from pp. 36 and 37, it does seem to us somewhat "hypercritical" on our author's part to object to the very harmless pieces of pleasantry which he there quotes. Granting, which we do at once, that they would have been wholly out of place in formal papers, intended to be read before any of the learned societies, we really must take exception to the assumption that trivialities must, *ex necessitate*, be excluded from popular exposition; since we believe that, to a certain order of minds, these homely illustrations bring conceptions with an amount of force and vividness that no merely rigid enunciation of facts ever succeeds in doing. That "*Dulce est desipere in loco*" is as true now as it was when Horace wrote it, 1900 years ago; and it is a little hard upon the man of science to deprive him of an instrument which is wielded with effect in the Senate, at the Bar, and even in the Pulpit. Before dismissing the particular papers which we are now discussing, we would invite the especial attention of astronomical amateurs to the remarks and protest made on pp. 43 and 44. It would be well if these could be reprinted on a large card and hung up in every telescope-room in the kingdom. Notably would we recommend the Observing Astronomical Society to reproduce them in a pamphlet form, and circulate them among its members. Real service might, in that way, be done to science.

The fourth essay is on Mars; one of the subjects which Mr. Proctor has made peculiarly his own. This gives a mass of detail as to the physical structure of the planet's surface; and the means adopted by the author to determine, with very refined accuracy, his precise rotation period. In connection with this essay we would point to the diagram of the orbits of the Earth and Mars, in the plate facing p. 51, as an example of the *thoroughness* of all Mr. Proctor's work. If there be one thing rather than another which is executed in a perfunctory manner in popular works on astronomy, it is the drawing of diagrams; a series of concentric circles, with the most absolutely hap-hazard proportion subsisting between their radii, mostly doing duty for delineations of the various planetary orbits. The particular diagram of which we are now speaking presents an extraordinary contrast to this slipshod kind of work, being most carefully and elaborately drawn to scale; and, the nodes being marked and the inclination of the orbit of Mars to the ecliptic given, we would suggest to the student that it would be a profitable exercise to obtain a couple of sheets of cardboard and reproduce the plate under discussion in, as it were, a solid form. He would hence gain a more vivid idea of the relations subsisting between us and our neighbour in space than he could derive from almost any amount of reading.

The three succeeding essays relate to the planet Saturn. With reference to these, it will be sufficient to note that they are by the author of "Saturn and its System;" the frontispiece of which grand monograph, by the way, decorates the present work also.

The next four papers, on the November shooting stars, and on meteors generally, will be read now with considerable interest in connection with Schiaparelli's extraordinary discovery (for which the Royal Astronomical Society granted him its gold medal in February last) of the correlation of these marvellous luminous streams and comets.

From meteors to the zodiacal light, and hence to the solar corona, the transition is natural, and these subjects are treated in the sequence indicated. How thoroughly Mr. Proctor crushes the hypothesis of the terrestrial origin of the corona, the reader must go to his book itself to learn; and it must, we think, be a source of some gratification to him to have found how absolutely and entirely the recent Indian eclipse observations settled the question of the character of this stupendous solar appendage, and justified the views which he advanced, on theoretical grounds, so, relatively, long ago. Surely this power of vaticination is the glory, as it is the crucial test, of true science; the future is opened to him who will read it aright, and the prophet and the philosopher are one!

"The Sun's Journey through Space" deals with a problem which has successively engaged the attention of Sir William Herschel, Otto Struve, and the present Astronomer Royal; of which, however, all that can be fairly said is that that existence and direction of such motion is demonstrated. "Coloured Suns" has reference to those exquisitely tinted gems which spangle our night sky; and "News from Sirius" to a subject which was treated in a popular form in our eleventh volume (p. 361) by one of our own correspondents.

The succeeding essay on "Equal-surface Projections of the Globe," is but a quasi-astronomical one; but it appears as a necessary introduction to its successors, which contain the author's speculations on the physical structure of the sidereal heaven. Every word of these will repay perusal. There are, further, three appendices, two having reference to subjects discussed in the main body of the work, and the third treating of the approaching transit of Venus in 1874. Here, again, we have some of Mr. Proctor's exquisite and admirably accurate delineations of the aspect of our own world, as viewed from the Sun during the passage of Venus across his face.

Regarding the work as a whole, it is impossible to speak of it otherwise than in terms of very high commendation; but we here and there come upon statements, or modes of expression, to which it is difficult, unhesitatingly, to subscribe. As examples to illustrate this assertion we would refer to a foot-note on p. 181, in which the hypothesis is advanced that the earth, as viewed from Venus or Mercury, must sometimes look green, and sometimes "dun or fawn coloured;" this opinion being founded on the assumption that the ocean would appear bluish green, and the land on the average of a brownish tint. Now, excluding altogether the mass of cloud, which covering as it does no inconsiderable portion of the earth's visible hemisphere, would reflect a brilliant faintly yellowish white light, we would merely observe that the larger oceans are of a black-blue tint, rather than of a bluish-green one; and that, considering the enormous area of land covered with vegetation, it is very improbable that it should (save over relatively minute areas) exhibit a *brown* hue. Portions of the earth's surface, like the African deserts, would no doubt look buff or dun coloured, *assuming the superincumbent atmosphere to be free from cloud;* but it surely cannot have escaped our author's recollection, that during the very eclipse (the one of 1870) with reference to which he calls in his conjectural terrestrial tints to account for an observed greenness of the Moon's dark body, a very large proportion of the visible hemisphere was covered with cloud, and that to an extent which was very nearly rendering all observation nugatory. Certainly the African continent seems to have been shrouded in an impenetrable pall. *Mutatis mutandis*, the same observations would apply to the eclipse of 1860; since, if we have reason to expect any continent to look green, as viewed from external space, it would be that of America, with its virgin forests and millions of acres of prairie and savannah. Yet we are told that during the eclipse of 1860 the Moon "presented a brown hue," she then being mainly illuminated by earth-shine from America. Again, on p. 280, we find a reference to Mädler's theory of the orbital motion of our system round Alcyone, a motion which we conceived had long been held to have had its only warrant in that astronomer's imagination. And further, in the essay on "A Novel Way of Studying the Stars," on pp. 308 and 309, we find our author using the words "higher" and "lower," as applied to star magnitudes, in a way which we think open to question. In ordinary parlance we should call 2 a *low* number, and 520,000 a *high* one. Why, then, a star of the first magnitude should be spoken of as of high magnitude, and one of the tenth as of a low magnitude, is not, at first sight very apparent. Even admitting that reasons may be advanced in justification of this nomenclature, we cannot but regard it as decidedly perplexing to the student.

Five misprints, and as far as our somewhat careful examination has extended, five only, disfigure the present volume. The first is on p. 72, where "line of light" appears for line of sight. The next on p. 89, where the compositor has spoken of examining Saturn "with a powerful microscope!" the third, on p. 91, where "Handibook" stands for Handbook; and the fourth is in a foot-note on p. 185, where "superior conjunction" is printed for inferior conjunction. The blackness of Venus's disc in contrast with the surrounding sky during her *superior* conjunction, would, we are tempted to think, astonish observers very much indeed. The last we have noted is on p. 256, where the northern horizon is called the "southern horizon."

We can only, in conclusion, express a hope that our rapid survey of the leading features of this, Mr. Proctor's latest work, and our curt summary of its contents, will induce the earnest astronomical student to go direct to its pages for trustworthy information concerning the most recent results of cosmical investigation. From them he may learn, in a popular and most attractive form, what has been accomplished towards the solution of some of the very grandest problems which the human intellect has ever attacked.

We have reproduced on another page one of the essays, as a sample of the interesting contents of the book.

* *Essays on Astronomy.* By RICHARD A. PROCTOR, B.A. Camb. (Honorary Secretary of the Royal Astronomical Society). London: Longmans, Green, and Co., 1872.

TELESCOPIC WORK FOR MOONLIGHT EVENINGS.

BY W. R. BIRT, F.R.A.S., F.M.S.

THE GREAT SIRSALIS CLEFT.

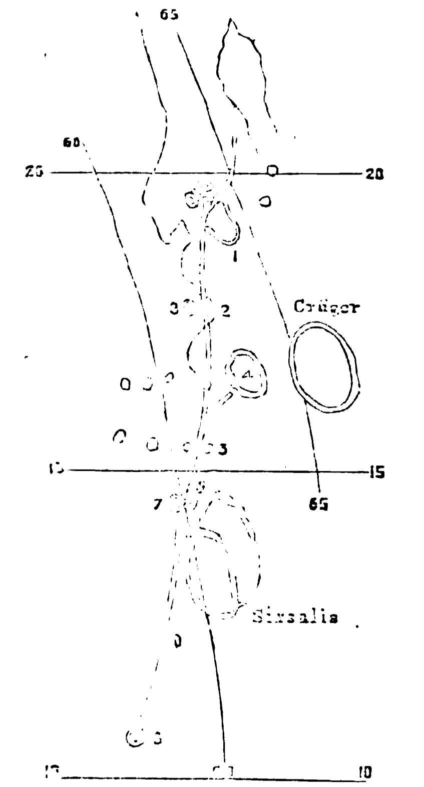
THE study of lunar clefts is increasing in interest, and, embracing as it does, a cl[illegible] of objects that differ so exceedingly from [illegible] broader features of the moon's surface, too [illegible] attention cannot be bestowed upon it. A cleft may be described as a narrow channel running through every variety of surface, sometimes penetrating and dividing mountain ranges or cutting down cliffs and headlands, at others traversing plains or existing in the interiors of craters, having tunnelled beneath the surrounding wall or pierced it to its foundation with a deep ravine. The appearance of such an object as viewed with a powerful telescope is not easily forgotten, the sharp linear character which it exhibits among the surrounding diverse forms rivets the attention and creates a desire to know what purpose so singular a feature subserves in the lunar economy. Often commencing and terminating with a small craterlet, clefts have been supposed in some way to connect distant openings. Our business, however, is not with conjecture, but with facts.

In No. 311, March 10, 1871, p. 577, we presented to our readers an account of a system of *ramifying* clefts which appeared to originate in the Crater Triesnecker. We have now the pleasure to notice a *single* cleft situated in a region of a different character to that in the neighbourhood of Triesnecker; it is known as the *Great Sirsalis Cleft*. The earliest notice of this cleft which we have been able to find is of the date 1824, by Lohrmann, who gives on his map, constructed from observations made in 1822 to 1836, a cleft commencing at the parallel of 20° S., passing northward partly through the crater 204, and thence to a small crater (No. 7 on the sketch accompanying this article), on the S.W. of the double crater 205 (Sirsalis). With the exception of an interruption by the crater 204 the cleft is *continuous* on Lohrmann's map. In the year 1832, October 8, Beer and Mädler observed and figured in their map the southern part of the cleft of a curved form *not figured by Lohrmann*, which they treated as a separate cleft, designating it Eichstadt γ. It is No. 64 in their catalogue. On October 26, 1833, they detected a portion of the northern part, terminating near Sirsalis, which they termed Crüger ε. It is No. 49 in their catalogue. It is likely the instrument which Mädler was then using was inadequate to show the intermediate portion figured by Lohrmann. In 1866 Julius Schmidt published his "Rillen auf dem Mond," in which he refers to Lohrmann's notice of 1824, and Mädler's of October, 1832; but he does not mention No. 64 Eichstadt γ, except as the strong southerly curved γ, having, as he says, seen the *whole* in 1850 and 1851. The length he gives is 45 German miles, or 207 English miles.

We are in possession of three unpublished series of observations of the *Great Sirsalis Cleft*. One by Messrs. Knott and Birt, made with Mr. Knott's Alvan Clark refractor of 7·3 inches aperture, on October 2 and 3, 1865. One by M. Gaudibert, with his silvered glass reflector of about 8in. aperture, on Nov. 6, 1870; and one by Mr. Knobel, with his 8½in. speculum, on May 21, 1872. As the study of this cleft is interesting on more accounts than one, and it can be well observed from thirteen to fourteen days of the moon's age, we shall give the observations principally as recorded by the several observers, illustrated by a drawing, in which each object specially referred to is numbered; the scale is that of Beer and Mädler's large map, the positions of the larger objects being taken from it.

The cleft is designated in the symbolic nomenclature III C ϖ^1, III Cσ^9, and III C μ^5, according to the areas in which its portions are situated. On October 2, 1865, it was observed to take its rise from the N.W. rim of the crater III C σ^1 (No. 1 in the drawing), the rim of which it cut through. On Lohrmann's map it is seen as extending S.S.E. from the S.E. rim of No. 1, a portion of it being figured as on the S.E. floor of this crater; according to Lohrmann it is *interrupted* by the S.E. rim. Beer and Mädler do not figure No. 1 *as a crater*, but as two nearly parallel mountain ranges with an oblique range between them on the north and nearly open on the south, and they bring the cleft *through the S.E. rim across the floor* to the W. rim, which is not disturbed. In M. Gaudibert's sketch of November 6, 1870, the cleft is shown as given by Lohrmann, the rim interrupting it, and it is described as passing *under* the wall. In Mr. Knobel's drawing of May 21, 1872, it is shown and described as cutting clean through the *walls* and floor of the crater. This is a point of no ordinary interest. Lohrmann and Gaudibert agree in its *not* cutting through the S.E. rim, Beer and Mädler and Knobel in the rim being separated by it. As regards the N.W. rim, Lohrmann and Mädler show it entire. Knott and Birt and Knobel speak of it as separated by the cleft, and Knobel alone shows both rims separated. In the earlier observations the rim appeared to be unaffected by the cleft, but in 1865, 1870, and 1872 it appeared as cut through. This sequence does not, however, characterise the S.E. rim at the epoch of Lohrmann, 1824, and in 1870 the rim was seen entire, but separated at the time of Beer and Mädler, and also in May, 1872. The alternation of the two appearances precludes the idea of the rim having existed in two different states, and it would be an interesting matter for inquiry as to whether Libration will account for these appearances, but the small number of observations will not allow of a solution. No. 1 has two craterlets on the S.W., they are both in Lohrmann and in Beer and Mädler. Mr. Knobel's N.W. crater is *double*, M. Gaudibert gives neither of them.

From the crater No. 1 the cleft was traced on October 2, 1865, through a depressed portion of the moon's surface, III C σ^2, cutting a headland III C σ^3 (No. 2 in drawing), which projected into the depression. In cutting through the headland the cleft grazed the east side of a somewhat conspicuous but small crater III C σ^4 (No. 3 on drawing). The depression, headland, and crater are shown by Lohrmann, but not by Beer and Mädler, and the crater is shown by Gaudibert and Knobel exactly as described above. The course



of the cleft was noticed in 1865 to be west of a crater III Cσ^5 (No. 4 in drawing) marked *a* by Beer and Mädler: it is in a line with Crüger and Fontana. On May 21, 1872, Mr. Knobel found a small craterlet *on the cleft* opposite to No. 4. From a point a little north of this craterlet Mr. Knobel observed a delicate offshoot from the main cleft towards No. 4. Returning to the observations of 1865 the cleft was seen to pass through a cliff III C σ^6, which is shown by Lohrmann, with the cleft to the east of it; Beer and Mädler also show the cliff. North of the cliff the appearance of the cleft was exceedingly distinct, as it crossed an elevated plateau, III C σ^7 to the west of a craterlet, III C σ^8 (No. 5 on the drawing), where it is terminated on Beer and Mädler's map. This craterlet is given by Lohrmann, who gives another close to and west of the cleft, which is given by Beer and Mädler, the E. craterlet being omitted by them. The W. craterlet was not seen by Gaudibert and Knobel in 1870 and 1872. From the point at which Beer and Mädler mark its termination its continuation was observed in 1865 along the N.W. slope of the plateau, III C σ^7, to near the south edge of the craterlet, III C μ^3 (*f* of Beer and Mädler, and No. 6 on the drawing) where it disappeared. It reappeared at the north-western border of the crater, III C μ^3 (I of Beer and Madler, and No. 7 on the drawing) descended, the slope was continued on the south-west of a ridge of mountains, III C μ^4, and finally terminated at the crater III C μ^1 (No. 8 on the drawing).

The craters Nos. 6 and 7 are shown by Lohrmann, and given by Gaudibert and Knobel, and in connection with them we have a repetition of the phenomena presented in the case of No. 1. Lohrmann, in 1824, showed the cleft as terminating at No. 7. Knott and Birt, in 1865, speak of its disappearance at No. 6, and reappearance at the north-western side of No. 7. Gaudibert, in 1870, delineated and describing it as crossing No. 7, and in Knobel's drawing of May 21, 1872, it is shown as interrupted by the east side of No. 7; indeed, its appearance is much as described by Knott and Birt. A careful determination of the circumstances of Libration, under which these different appearances are presented will go far to make us acquainted with hypsometrical and other relations.

On the 3rd of October, 1865, some further observations on this cleft were made by Messrs. Knott and Birt, the portion south-east of the crater No. 1, and designated III Cϖ^1, was seen to run along the foot of the cliff III Cϖ^4, the cliff forming the west side of the cleft which then *crossed* the crater No. 1, its course being diverted by the crater III C σ^{10} on the south-western part of the floor. It does not appear that either M. Gaudibert or Mr. Knobel saw this crater on the floor of No. 1 at the epochs of the later observations. It is desirable to include in the study of the clefts the search for craterlets on the lines of fracture, if such they be, and also to ascertain if in *any* instance a cleft really partakes of the nature of a tunnel.

BEDDING-OUT.

THE time for planting out the flowers which it is now the fashion to employ for ornamenting our gardens during the summer and autumn months having arrived, it may be as well if we say a few words on the subject, for many of our readers are amateur gardeners, and the present plan of "bedding-out," as it is called, is so much the rage that one of our daily contemporaries has actually devoted a column to the important question. Time was when our gardens, while presenting just as pleasing an appearance in summer as they now do, were not the blank deserted patches of black mould which is their chronic state under the fashionable régime during the most cheerless part of the year. Then we had flowers of some sort nearly all the year round, and, at least our parierres looked green, and gladdened the eye with vegetation if they did not exhibit the exuberant rejuvenescence of the genial and growing spring. Now all this is altered, and our public and private gardens are bare of bloom from October to May. It is true that our changeable climate is the cause in a great measure of this state of things, for the inclement springs of the last few years have done much to retard the "bedding-out" time even under the present system. But this shortening of our flower season is not entirely due to the treacherous weather of May, which was formerly the chief planting-out month; but is in a great measure occasioned by the vicious system of "coddling" in vogue with gardeners, amateur and professional. Geraniums, calceolarias, verbenas, and heliotropes are now forced along at such a pace that slight frosts in May, and even in June, affect their weak frames and unconsolidated tissues to an extent that a month of warm weather almost fails to repair. Instead of strong, healthy, autumn-struck cuttings, the market is glutted with cheap plants that a few months previously were merely shoots on the parent stem; and the consequence is that a cold, wet spring makes such wretched objects of them that the purchaser is disappointed, while no credit and, ultimately, no gain accrue to the producer. The present system is the most expensive style of gardening that can be adopted, and if the result is worth the candle it is worth while to insure obtaining it after the candle is burnt. The *Daily News* essays to prove that English gardeners are not masters of their profession, and that a considerable reduction in the first cost might be effected by the plan of propagating bedding-out stuff it recommends. "Ask an ordinary English gardener," says our contemporary, "to turn you out at the end of every May (say) three thousand plants, and he will be sure to ask you where is your greenhouse. Failing that, in his eyes, absolutely indispensable appendage, he will not be ashamed to own himself absolutely powerless to meet your wishes. In vain will you point to three or four large stout frames, solid at the sides and well-glazed, and inform him that he has at his disposal any amount of rotted leaves and stable manure. He will tell you that he can do nothing with them. They are cucumber frames in his eyes, and nothing more. Yet no better appliances, nine times out of ten, are at the command of the gardeners who decorate the beautiful villas that surround Paris with floral beauty from May till November, as they can testify who saw them deserted, but in all their beauty, when the Germans invested the great capital. If an Englishman wishes to attain the same results by the same small means, he must either become his own gardener, or he must break his gardener's will to his own. Given such a frame as we have spoken of, and four or five hundred of the hardier geraniums—such as Tom Thumb, Tom Thumb's Master, Lady Constance Grosvenor, and the Duchess of Sutherland—may with care be carried through the coldest and, even what is far more trying, the wettest winter. What are termed the foliaged pelargoniums, such as Mrs. Pollock, Bijou, and Star of Spring, will not, it is true, or but rarely, endure this simple treatment; but if the bright and flowering geraniums are preserved, the exquisite charm and variety that are given by foliaged plants can be still more easily obtained by other means. Abundance of white is a *sine-quâ-non* in the bedding-out style of gardening; and white may be secured to an unlimited extent without the aid of so much as a pane of glass. *Cerastium Tomentosum*, with its beautiful silver-gray leaves, is as hardy as common grass, and can be propagated by division either in the late autumn or the early spring. It is to be seen in almost every cottage garden, only there it is allowed to flower, as it must not be when intended to serve the purpose of which we are speaking. Another most useful and lovely white plant is the *Cineraria Maritima*, which has only to be sown under a south wall, from seed, in September, to be left out all the winter, and to be potted in spring, to make a famous show by the end of May. After white in importance comes blue; and the best, indeed the only good blue, unfortunately, the Lobelia, can be grown by any one who can make a hotbed of stable-manure in February. By its side, in the same manner, may be raised the Oxalis, that lovely bronze-coloured clover; the tall Perilla; and last, but anything but least, the Pyrethrum, or Golden Feather. Only, in all these instances, care has to supply the place of extravagant outlay; whereas extravagant outlay is just the one thing that delights the English gardener most."

Now, as a matter of fact, a greenhouse will cost no more to construct than the requisite frames to preserve and propagate an equal number of plants; while it is immeasurably more convenient for the gardener, requiring less labour and time for the due performance of the various attentions necessary for the health and welfare of his patients. Besides, frames with their fermenting masses of leaves and stable manure can be made to yield a more profitable return from early vegetables than "bedding-out" stuff would give—doing this, moreover, while the latter is in "winter quarters," and then coming in handy for the "hardening-off" process.

So much for the expense of the system. There is another side to the question as to the advantage of the present arrangement of flowering and brilliant foliaged plants. The gorgeous masses of colour are, no doubt, pleasing when set out in a harmonious manner, but they require to be surrounded with large masses of green, as much to exhibit their full beauty as to relieve the eye, which is apt to be dazzled by the glaring lines of yellow and scarlet—the *heat*, in fact, of the "painted carpet" produced by "solid planting." For this reason the "solid" style is utterly unsuited to small gardens where grass is conspicuous by its absence; and the plants should therefore be so placed that they may develop their foliage and permit the earth to be seen between them. Independently of all this, the aspect of the subject which we are most inclined to look at is left out in the cold—the individuality of the plants is utterly destroyed, and the mental pleasure which might be derived from a study of their physiology and life-history is lost in the mere sensual gratification of harmoniously arranged colours. The principal value of a garden to our readers consists in the facility which it affords for the study of vegetable physiology and the refining influence which a contemplation of the works of Nature must always exercise upon the mind. How this may best be carried out, with the further advantage of having flowers all the year round, we shall probably explain at some future time.

ELECTRICITY: WHAT IS IT?—II.

By B. Thompson.

ELECTRICITY A MODIFICATION OF THE MOTION OF HEAT.—In the second part of this communication it is my object to try and show that the motion which I think has been proved to constitute a current of electricity is only a modification of that of heat. Let us follow out the experiment touched on in the latter part of the former paper. When the current of electricity is increased, of course more electricity passes in a given time, but if no more matter be given for the electricity to be conducted by, the rapidity of polarisation must be increased, which, if it be motion, will show itself, as we have found it does, by increase of heat. Increasing the current still more we obtain further evidence of the increase of motion, for if the radiation from the wire be submitted to the action of a prism (of rock salt, because of the absorbing power of glass), we get no visible spectrum, but heat is found to exist greatest where it would had there been a visible spectrum—viz., just beyond where the red becomes visible, when the current, and therefore the heat, is still further increased. The fact of the spectrum becoming visible and extending is very significant, for it shows that more rapid vibrations have been compelled by the increased current, and it may be increased until the spectrum includes the actinic rays only shown by the phenomenon of fluorescence.

This similarity in nature between heat and electricity which we are discussing affords a ready explanation of the fact that a good conductor of heat is also a good conductor of electricity, and a good insulator of electricity a good insulator of heat: the same substance which stops the motion of heat stops that of electricity.

The phenomena of electrolysis, too, have an important bearing on this part of the subject, inasmuch as they present tangible evidence of the changes electricity works in compound bodies: so we will now consider them.

We know that no other forces, save heat and electricity, can effect the decomposition of any compound by apparently destroying the affinities of its elements for each other; we likewise know that electricity will decompose substances that defy any other means of analysis; and that electricity is convertible into the most intense artificial heat and light known. Can we fail to see the significance of this fact, which distinctly points to their similarity of nature? Even the simple evidence of their being convertible into each other is sufficient to show that they have a common origin, and beyond this we find they act in the same way, and have a connection so close that it is impossible to produce the one without the other.

Heat destroys the affinities between the constituents of compound bodies, or at least suspends them, by removing the atoms beyond the sphere of each other's attraction; and taking any example we may, the heat required to decompose a compound body is exactly the same in amount that was given off in its composition. For example, take the gases, oxygen, (O) and hydrogen (H); like all gases, they contain a large amount of latent heat. When they combine to form water OH_2, the greater part of this is given off, because the latent heat of water, and indeed all liquids and solids, is considerably lower than that of a gaseous body; but it will be seen at once that to again pass into the gaseous state, the oxygen (O) and hydrogen (H_2) must be supplied with the same amount of heat that they gave up when forming water, and with less than this amount they will not be decomposed, *except* when electricity is employed; that the electricity has given them a different force to that which they possessed before cannot be admitted, for they will yield just the same heat on again forming water as in the first case.

Again, if a current of electricity which produces the greatest heat and light known to us can also decompose substances which no other agent will touch, and that this decomposition can only be effected by an amount of heat being supplied to the molecules sufficient for their constituents to exist in an uncombined state—so far as we are able to discover—would it not be a remarkable thing if electricity suspended the affinities of an electrolyte by other means than that of heat (or motion) which it can supply of such great intensity?

I believe I am right in stating that when the temperature of water is raised to about 200° C. it is decomposed; this being the case, we may with reason conclude that virtually a heat of 200° C. is given out in the combination of oxygen and hydrogen, and forms water, and therefore that a motion corresponding to this heat must be supplied by the electric current when it effects the decomposition of water, and this supposition is perfectly consistent with fact, for a very powerful current is required to decompose water alone; and the heat developed in a bad conductor, such as water is, increases enormously with the augmentation of battery power. Here, then, I think, we can approach nearer to the theory I am trying to explain than we have hitherto done; for, besides having the conditions necessary to produce the required heat for the decomposition of OH_2 (water)—a powerful current and poor conductor, itself a proof almost of the agency by which the water is decomposed—we can (retaining the same arrangement of decomposing cell) apply heat direct, instead of the electric current, with exactly the same result. Thus, if the platinum electrodes of the voltameter or decomposing cell be heated by the oxy-hydrogen flame, the water is decomposed the same as with a battery; showing, again, how intimately connected the two modes of motion, of heat and electricity, are.

The influence of pressure in the decomposing cell also tends to confirm this theory, for, if an electrolyte in a decomposing cell be submitted to pressure, the decomposition is entirely suspended. The expansion consequent upon increased temperature and ultimate decomposition being prevented, the current manifests itself as heat, instead of being rendered latent; observing exactly analogous laws to those of heat in relation to constant pressure and constant volume.

Following the above course of reasoning, I think we shall be able to comprehend more clearly what occurs in a decomposing cell or ordinary voltaic battery. The first effect of the voltaic current is to polarise the molecules of the electrolyte, which, I think we have proved, is accompanied by a motion of them; this motion represents, or is virtually, a certain amount of heat; indeed, a great part is manifest to us as heat; and if the rapidity of vibration is sufficient, the heat is supplied requisite for the constituents of the compound to exist separately; of course, this amount varies with the compound being decomposed. In the case of water, as we have before shown, the heat required is very great. When, however, a small quantity of sulphuric acid (SO_3HO_2) is added, the water is decomposed readily by two or three batteries, on account of a secondary action. O being liberated at one pole and H_2 at the other, the SO_3 (sulphuric anhydride) combines with another molecule of H_2O (water) to form again SO_2HO_2 or H_2SO_4, and so the action is continued.

I have taken all along water as the example to work with, but any other compound will answer just as well, and the same reasoning apply to it; for instance, take $CuSO_4$ (sulphate of copper), where we have a compound in which the base Cu (copper) gives out very little heat in combining with H_2SO_4 (sulphuric acid): indeed, it does not combine very powerfully at all, but is easily displaced by other metals; in this example of weak affinity we might reasonably suppose that a weak current would effect their decomposition; such is the case, $CuSO_4$ is even decomposed by one cell of a battery.

Going a step further to the voltaic cell itself. I think it is very generally admitted now by scientific men, that "chemical affinity" is identical with "electrical attraction;" indeed, modern chemistry divides the elements into chlorous and basylous, or + and —; and it will be admitted that all bodies vary in their susceptibility to electrical action; or, if we may use the term, in their affinity for it. Friction is the readiest method of developing it, and when developed in this way is called statical electricity.

The theory to account for this which finds most general acceptance is, that the development of electricity is the result of the separation and renewal of contact between dissimilar bodies, and electricity is distributed amongst them in quantities proportional to their affinity for it (or may we not say to their power in rendering it latent?). Now, let the affinity of glass for it be represented by 4, and the affinity of a rubber of silk by 6, making together 10. When these bodies are brought together, this relative affinity may be supposed to be charged, the electricity being nearly equally distributed over the two bodies; the affinity of the glass, then, in this case, would be increased from 4 to 5, the affinity of the rubber decreased from 6 to 5, the total, 10, remaining the same; when we separate the rubber from the glass, or break the contact, the original affinities, 4 and 6, are restored, whilst the new distribution, 5 and 5, remains; the quantity of electricity in the glass, therefore, has been increased by 1, and hence is positively electrified and the rubber negatively.

The same kind of reasoning must be employed to explain the effect of contact between the dissimilar metals in a voltaic battery. It was this behaviour, probably, that led so many of the earlier electricians to believe that contact alone was necessary to generate a *current* of electricity.

Now, taking one of the simplest voltaic batteries—a plate of amalgamated zinc and a plate of copper immersed in dilute sulphuric acid—so long as the plates remain unconnected no current circulates, nor does any decomposition occur, at least, very small in amount, if any, due to the ordinary affinities of the plates for the elements of the compound; but when the two metals, zinc and copper, are connected by a conductor, powerful chemical action ensues, accompanied by a current of electricity, which, indeed, it has generated. The strength of the current, too, is always proportional to the amount of zinc dissolved in a given time, and it is one of the important points which should be noticed, as will be seen afterwards.

The amalgamated zinc has little power of itself to separate the constituents of the liquid in which it is immersed, but on receiving additional assistance from its connection with the copper by the new distribution it has its affinity or electrical attraction increased sufficiently to overcome the existing affinities between the elements of the solution in which it is placed, and thereby decompose it. But we have said that the same amount of heat or motion is required to decompose a compound that was given off in its composition; applying this to the point in question, I should say that the affinity of the zinc now represents an amount of heat or force equal to that required by the elements of the electrolyte to exist in a separate state—*i.e.*, the H_2 has an amount of heat given to it, *must have*, to enable it to take the gaseous state as it does; and so must the O, or the O and H_2 would not part company. Indeed, any body in passing from the solid or liquid state to the gaseous absorbs large quantities of heat. From whence does this heat come? We are obliged to refer it to the new affinity obtained by the contact of the two dissimilar metals.

If now it be admitted that chemical affinity—the affinity we have to do with here—is only electrical attraction, and that attraction can only exist where there is an excess of electricity, we have a ready explanation as to how the decomposition occurs when the metals are connected; that is, when the new distribution takes place, for it has been shown that electricity, if not a form of heat, represents in its effects this heat.

The oxygen, however, liberated in the battery we have been speaking about, does not continue in the gaseous state, as the H_2 liberated at the copper plate does, but combines with the zinc, forming oxide of zinc (ZnO), and in doing so, of course, gives up again, more or less, the force which it absorbed when parting with the hydrogen. What is this force? Where does it go? I think we cannot fail to see that it is this force which, when supplied with suitable conditions to circulate through a conductor, is called the electric current, though, of course, it must have undergone some modification from the true form of heat. If the suitable arrangement is not supplied, no sign of electricity is present, but the chemical action manifests itself as heat. It must be remembered that part of the current must return to the zinc to again render it electro-positive, otherwise all action ceases.

This theory, if I may call it such, I think we shall find applicable to all the phenomena observed in a battery, for the strength of a current produced by a given expenditure of zinc is always proportional to the amount of work it does in overcoming the resistance of its conductors, and if the current loses strength by the interposition of work its equivalent is always found in the work done, whatever that may be, whether to induce magnetism in iron, work machinery, or circulate through a long conducting wire; just as there is with heat, so is there with electricity a true mechanical value.

Another important thing for us to notice here is, that if there is not sufficient work for the battery to do, the surplus force turns directly into heat, the behaviour being exactly analogous to that observed in machines where heat is the motive power. If the machine is made to work, an amount of force or heat is lost proportional to the work done; but if the machine is not working, the force or heat is found to be distributed over all the parts of it.

(*To be concluded in another paper.*)

SMELL.

THE *Moniteur Scientifique* contains a paper by M. Papillon on this subject, having reference to recent discoveries in chemistry and physiology. We extract from it the following:—

The seat of the sense of smell is, as we know, in the lining membrane of the nostrils. This membrane has a mucous and irregular surface, over which spread a number of nerves, with delicate terminations. It secretes a lubricating liquid. By means of muscles, the apparatus of smell is dilated or contracted, like that of sight.

The mechanics of smell are, simply, the contact of odorous particles and the olfactory nerve. These particles are carried by the air into the nostrils. If, on the one hand, the nerve is injured, or even compressed; if, on the other, the air is prevented from passing into the nostrils, there is an absence of smell. The upper part of the nostrils is the most sensitive as regards odour. The sense of smell varies much in different people. Some are entirely without it. Others are quite insensible to certain odours: a case similar to that of Daltonism, in which some eyes fail to perceive certain colours. It is recorded of a certain priest that he perceived no odours but those of smoke and decayed cabbage, and to another person vanilla seemed quite inodorous. Blumenbach speaks of an Englishman who could not perceive the fragrance of mignonette.

Smell is sometimes voluntary, sometimes involuntary. In the former case, to obtain a lively sensation, we close the mouth, and make a long inspiration, or a series of short and jerking ones. The muscles contract the orifice of the nostrils, and thus increase the intensity of the current of air. On the other hand, when we wish *not* to smell, we *expire* through the nose, so as to drive away the odorous air, and inspire by the opened mouth.

Smell and odours are closely connected with the phenomena of taste or gustation. Most savours perceived by us arise from a combination of sensations of smell with those of taste. There are, indeed, only four primitive and radical kinds of taste—acid, sweet, salt, and bitter. This may be shown by experiment. If we close our nostrils on tasting any sapid substance, the perceived taste will come under one or other of these four heads. Thus, when the olfactory membrane is diseased, the savour of food is altered.

How do odorous substances act with reference to the matter which separates them from the organ of smell? Prevost, in 1799, showed that if an odorous body were put in a saucer full of water, the emanations from it agitated the molecules of the water visibly. These motions, of which camphor gives a very good example, have been recently studied by M. Liegeois.

He found that some substances caused movements of gyration and translation over the water surface, similar to those of camphor. Of this class are benzoic acid, succinic acid, and orange bark. In the case of others, this motion ceases very soon, as they become encased in an oily layer over their surface.

He thinks these motions are due, not to a disengagement of gas, causing something like recoil, but to the separation and rapid diffusion of the odorous particles in the water. The fluid shows affinity for these. Similarly, a drop of oil falling on water sends out an infinite number of very small globules, which spread through the liquid, while the volume of the drop is not sensibly diminished. So with aromatic essences. Though insoluble in water, the small odorous particles tend to disperse themselves in it. A small quantity of odorous powder will thus impart perfume to a large body of water.

It is these same odorous molecules which are carried to our nostrils. And the action of water is thought by M. Liegeois to assist in the formation of them. In the morning, when the ground is moist, and the flowers are covered with dew-drops, there is a large exhalation of perfume. Similarly, after a shower of rain. In gustation we have something analogous: the saliva is fitted to diffuse the odorant principle; by the motion of the tongue in the cavity of the mouth, this diffusion is promoted, for the surface of evaporation is enlarged. Now, in the same way as the small particles diffuse themselves in water, do they diffuse themselves in air, which then becomes the vehicle carrying them to our nostrils.

Some odorous substances have a very great diffusibility. Ambergris, newly cast on the shore, is smelt a long way off. Bertholin states that the odour of rosemary off the Spanish coast is perceptible long before the land comes in sight. The degree of division of the particles is in some cases marvellous. A grain of musk will perfume an apartment for a whole year, without sensibly losing weight. Haller mentions having kept for forty years some pieces of paper perfumed with a grain of ambergris, and at the end of that time they still retained their odour.

It is to be noted that the odorous particles are *sent out*, and the body emitting them does not act as a centre of agitation, giving rise to vibrations. It is thus a different case from those of light and heat. The odour is the odorous molecule itself; whereas light, as perceived, is not the luminous body.

We cannot tell whether oxygen has some chemical influence on the particles; nor what kind of action takes place on contact of the particle with the nerve, whether a mechanical agitation or a chemical decomposition. But the distinction of the senses into *physical* (sight, touch, and hearing) and *chemical* (taste and smell) is a just one. In the latter, contact is always implied.

An able writer has recently tried to prove a kind of music in odours. That is, different odours, according to him, affect the olfactory nerve in various degrees, corresponding to those in which sound affects the auditory nerve. Thus we may have octaves of odours. He enumerates various substances that produce the same impression, but in different degrees; *e.g.*, these four, almond, heliotrope, vanilla, and clematis. By combination he obtains semi-odours, corresponding to semitones; *e.g.*, a rose with a geranium. He points out principles of harmony in perfumes corresponding to those in colours, and thinks it possible to produce a desired perfume from a mixture of others.

The theory is ingenious and worthy of attention, but it is open to grave objections. For the harmony in colours and sounds depends on exact numerical relations, which may be accurately determined; whereas, in the case of smell, the criterion is capricious and uncertain, and it is not possible to reduce to formula what our sense reveals.

There are many cases of hallucination as regards smell; united, generally, with insanity on other points. Lunatics have been met with who constantly complained of a fetid odour; others rejoiced in the most delicious, though imaginary, perfumes. M. Lelut tells of a patient in the Salpetrière, who was continually troubled with the smell of dead bodies, which she thought to have been buried in the establishment.

Capellini mentions the case of a lady who could not bear the smell of a rose, and fainted one day when a friend came in with one that was artificial in her hand. Many other instances could be given. It seems to be well authenticated, that in lunatic asylums these delusions as to smell are very frequent.

The intensity and delicacy of the sense of smell vary in different individuals and races. In some it is wonderfully sensitive. Woodwart tells of a woman who predicted storms several hours in advance, from the sulphurous odour (due to ozone probably) which she perceived in the air. A young American who was deaf, dumb, and blind, became a good botanist, simply by the sense of smell. It is, however, in some of the lower animals that we find the sense most highly developed: ruminants, pachydermous animals, and, above all, carnivorous mammifers. Smell is, with some of them, like an eye, which sees objects, not only where they are, but where they have been. The keen scent of the dog is well known.

Humboldt mentions that when, in his travels in South America, it was desired to attract condors, all they had to do was to slaughter an ox or a horse, and in a short time the odour attracted a number of these birds, though none were visible previously. Of birds, waders have the largest olfactory nerves, and their sense of smell is most highly developed.

The olfactory organ in reptiles is large. Fishes also have an olfactory membrane; and fishermen have observed that they are driven away when certain odorous substances are thrown into the water. Sharks and other voracious fishes often gather from great distances when a carcase is thrown into the sea. Crustaceans are not insensible to emanations which come in contact with their olfactory fibres.

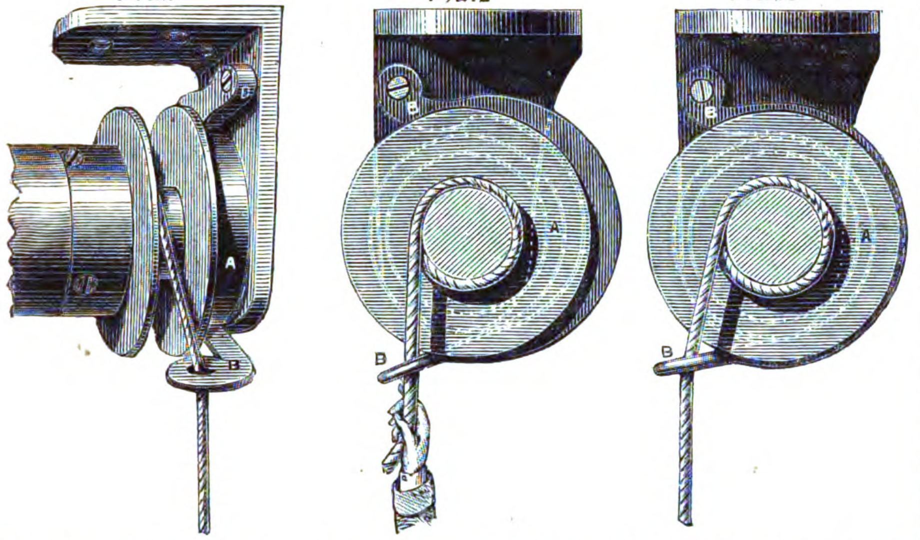
Entomologists say that the sense of smell in insects is very subtle, but it is difficult to determine the seat of it. When meat is exposed in the air, flies soon appear in great numbers, though none were seen before. The carcases of animals left on the ground attract hosts of insects, which find nourishment in them, and deposit their eggs. This will often happen when the object is concealed, so that their search cannot be guided by sight.

The flower of the cuckoo fruit gives forth a fetid odour, and a number of flies and other insects are often seen moving about on the corolla, in search, it is said, of decayed matter, from which, they imagine, the odour proceeds.

SELF-ACTING BLIND ROLLER.

A SIMPLE form of self-acting blind roller has been recently patented by Messrs. J. Manuel & Son, which will be readily understood from the engraving and the following description. The principal feature of the invention consists in the application of a friction brake, which prevents the roller turning except when released by the single cord which is found sufficient for moving the blind to the different positions required. On an ordinary blind roller, between the drum or pulley on which the cord is wound and the bearing bracket, a washer, consisting of a ring of rubber, guttapercha, leather, cork, or any substance capable of causing friction, is fixed. On the window frame or jamb, at a point above the washer, a lever brake, consisting of a curvilinear pendant, is secured by a pin or screw in the frame, bracket, or jamb, so as to bear against a portion of the circumference of the washer. This friction lever may be made of metal or wood or other combination of materials, and may be lined internally to enable it to exercise speedy friction on the washer, by its own gravity and contact always tending to cause it to press on the side periphery of the washer. The pendant lever or brake when in position rests with its lower extremity (through which the cord is passed (projecting forwards from the vertical line drawn from the centre of its pivot, and consequently the cord from the drum or pulley is held forward at a tangent, as shown in Fig. 3; consequently when the cord is pulled by the operator it becomes vertical by tension, and thus throws back the projecting under-point and prevents the friction brake bearing against the roller washer. The cord can then be pulled to raise the blind wholly or partly, and immediately the cord is released the swinging lever hangs forward and holds the roller exactly in the position required. When it is desired to lower the blind it is only necessary to slightly depress the cord, so as to throw the brake out of friction and to let the cord slip through the hand till the blind has wholly or partly descended, the release of the cord allowing the brake to act without the use of any rack or spring or other equivalent. Fig. 1 represents an elevation of the blind roller; Fig. 2 an end view with brake released; and Fig. 3 an end view showing the blind at rest, the hand having left the cord. In each figure A is the washer ring and B the brake.

FIG. 1 FIG. 2 FIG. 3



THE WESTINGHOUSE ATMOSPHERIC RAILWAY BRAKE.

THE railway brake invented by Mr. Westinghouse, which has during a period of three years proved itself to be the best mechanism for the purpose in use in the United States, has at length been tried by two railway companies in this country, with a result very gratifying, though not, we imagine, unexpected by its ingenious inventor. The principle of the brake consists in the application of the elastic force of compressed air to actuate the ordinary brake blocks, the control of which throughout the train is left entirely in the hands of the driver. The remarkably short distances in which long trains can be stopped by its means was made apparent on its introduction to the American railways, and the results there regularly obtained in practice have been reproduced here. In the trials recently made on the Caledonian line near Glasgow, with a train consisting of twelve carriages and two vans drawn by one of the powerful fast four-coupled engines belonging to the company, stoppages were made in 19 seconds and in 264 yards on the level, when previously going at the speed of 50 miles per hour. While travelling at the same speed, and running down an incline of 1 in 130, a dead stop was come to in 20 seconds and in a space of 268 yards; and when running down a gradient of 1 in 68 at 60 miles an hour (29⅓ yards a second) the train was brought to a standstill within 308 yards in 23 seconds. These results are amply sufficient to show the value of the new (as far as this country is concerned) brake, even when examined solely in the light of the figures thus obtained, but there is another point of view which appears to have been overlooked by the chroniclers of the experiments. Under the present system, as our readers are aware, the driver or the stoker has the immediate control only of the brake attached to the tender. In order that the other brakes on the train may be applied he is obliged to whistle to call the attention of, and signal to, the guards, who, it is to be hoped, always pay prompt attention to the commands of the driver thus conveyed. As many of our readers will not require to be told, however, long acquaintance with danger renders those callous who have to face it; and although we are inclined to be reticent in insinuating that guards do not always pay that attention to the whistle of the driver they are supposed to do, there cannot be the slightest doubt that far too much is left to their care; in other words, that the command of the train is taken out of the hands of the man best capable of governing it, to an extent which should not be allowed when a remedy is pointed out. But granting that the guards are always on the *qui vive*, with their hands on the brake wheel, ready at the first intimation of danger to apply the means of stopping the train under their control, it must be acknowledged that with trains travelling at 50 miles per hour even fractions of a second are valuable amounts of time, and it is only too true, having been proved in numerous instances, that the waste of these fractions of time in whistling and in getting the brakes put down, has often resulted in accident, or rather has failed to prevent what would have been, under a better arranged system, preventible. With the Westinghouse air-brake, on the contrary, the application of every brake on the train may be almost simultaneous with the intimation of danger, depending solely on the quickness or smartness with which the driver puts in operation the means at his disposal. Under the present arrangement the time occupied in whistling and getting the brakes on often means just the difference between a collision and its avoidance, for although the time thus occupied may seem almost inappreciable, it is frequently of sufficiently lengthy duration to be a trifle too long.

It is time, however, that we proceeded to describe what experience has shown to be the best arrangement for stopping trains yet put into practice. The most important part of the Westinghouse system is the method of compressing the air and storing it up for use when required. This is accomplished by an ingeniously contrived engine and pump secured to the outside of the locomotive, between the driving-wheel and the trailer; in fact, on one side of the fire-box in a similar position to that frequently occupied by the Giffard's injector. The piston of the little cylinder and that of the pump are connected together by a rod of a somewhat peculiar section, obtained by cutting or filing down the ordinary circular rod on four sides. The object of this is to prevent the turning of the pistons, which, owing to the peculiar arrangement of the steam-valve, and the absence of guides, &c., would otherwise be free to rotate. The arrangements for the admission and regulation of the steam to the pump engine are of a very ingenious character, and we shall probably illustrate them at a future time; suffice it to say, that the steam-valve is contained in a cylindrical chamber, and is made to rotate to admit and exhaust the steam. This rotatory movement is obtained from a very small piston actuated by steam, situated on the top of the cylinder and working at right angles to its axis. The main piston-rod is hollow for more than half its length, so as to permit the insertion of a rod connected with a valve which admits steam to the small piston employed to rotate the valve-rod. Thus the motion of the piston-rod actuates this valve-rod, and the steam being caused to act upon the same piston, the valve is rotated to the required positions. The air-pump is double-acting, takes its air through a strainer, and also draws in a supply of the lubricator at each stroke—mineral oils being used for the purpose, owing to the great heat developed by the forcible compression carbonising all other lubricating materials. The compressed air is forced from the pump to a strong cylindrical receptacle carried under the foot-plate of the engine, and it is found in practice that the pump is self-governing, working when the air chamber is full at just sufficient speed to supply the small leakage which unavoidably takes place, but when the pressure which thus opposes its movements is reduced on applying the concentrated force to the brakes, it immediately springs into rapid action and restores the normal pressure. The small engine and pump is capable of a speed of 100 double strokes per minute in the event of any extraordinary leakage, less than one-third of that speed being found amply sufficient, however, under ordinary circumstance. The reservoir is provided with a small safety-valve, so that whatever the pressure of the steam in the boiler of the locomotive may be, the pump may be allowed to work as fast as it can against the pressure of the air in the reservoir, generally from 60lb. to 70lb. per sq. in. The compressed air is led by a pipe from the reservoir to a three-way cock placed conveniently to the hand of the driver, which communicates by one pipe with a three-way cock situated beneath the foot-plate, and by the other pipe with the atmosphere. In connection with this second three-way cock are inch iron gas-pipes, fixed beneath each carriage one on each side, the joints between the carriages being made with stout specially prepared indiarubber tubing and an ingenious coupling, the air-tight fit of which is secured by means of the compressed air itself. The object of having two sets of pipes is partly to insure against mishap to one set of tubes, in which case the other would be sufficient for all the purposes required, and partly to facilitate the connection of the different carriages; for the couplings, being provided with male and female screws respectively, and all the carriages being fitted alike, it is obvious whichever end of the carriage it is desired to couple will present the pipes in the required position, which could not be the case if only one pipe was employed. The coupling is fitted with two valves, which, when the connection is perfect, are both open and allow of the passage of the compressed air, but in the event of rupture of any of the couplings by accident, or if the connection through carelessness has not been made, the valves close the end of the pipe and prevent the escape of the air. Besides this self-acting arrangement the driver can, by means of the three-way cock beneath the foot-plate, shut off the compressed air from either or both of the pipes.

The air being thus led throughout the whole length of the train is conveyed by branch pipes to an air cylinder under each carriage. This cylinder contains a piston packed by a cup-leather, and connected with a rod, to the outer end of which is attached a conical cup, which receives the thrust rods employed to actuate the brake-shaft. A small pipe is inserted in the front cover of the cylinder to permit the escape of air when the piston is going forward, and to admit it when the piston is going back. Thus the whole operation is readily understood. The driver by means of the three-way cock placed near his right hand admits the compressed air to the pipes and the cylinders, where it moves the pistons, and by means of the thrust-rods and gear forces the brake-blocks against the wheels with a degree of pressure entirely under the control of the driver, who can thus by a mere turn of the wrist lock every wheel in the train, or bring just sufficient friction into play to check the speed and retard a train when running down an incline or through a station where numerous points and dangerous crossings render 50 miles an hour a hazardous speed. By another turn of the wrist the compressed air which has done its work is permitted to escape into the atmosphere, and spiral springs immediately draw away the brake-blocks and push back the pistons in the air cylinders. The existing brake-gear can be made available for the application of compressed air, but where new gear has to be provided Mr. Westinghouse prefers to adopt an arrangement of swing brake which possesses the valuable properties of equalising the pressure on the blocks, however unequally they may be worn, and of preventing all jar and vibration, none being perceptible, it is said, in the first-class carriage to which it has been applied on the Caledonian Railway.

Mr. Westinghouse has also devised a simple system of signalling between passengers, guards, and driver, which depends on the adoption of the atmospheric brake, however. It consists in fitting each carriage with a small reservoir, which is supplied with compressed air every time the brakes are applied. Wires lead from the different compartments to a lever in connection with a valve in this reservoir, which lever also works a kind of semaphore indicating the part of the carriage whence the signal was made. The valve being opened, the air rushes along the pipes and sounds whistles near the driver and in the guards' vans. These whistles are also unavoidably blown when the brakes are put on, and to prevent the continuance of the sound longer than is required, a peculiar form of whistle is adopted, consisting of a cylindrical pipe containing a loosely-fitting piston, which permits sufficient air to pass to sound the alarm, but which is driven up so as to close the outlet as the volume of air increases. All the details of the mechanism seem to have been well and carefully thought out, as regards both the brake and the signalling apparatus, each of which answers its purpose in an admirable manner. When we further consider that the cost of application cannot amount to a very great sum, that the coupling of the pipes occupies but a few seconds, and that the power of the driver over his train is considerably increased (which means, as we take it, increased safety for the passengers), we are curious to see what action will be taken by railway companies, who have some regard for the money they pay away in damages if they have no respect for the lives of the public.

THE PRODUCTION OF CHLORINE AND HYPOCHLORITES.

ANY improvements in the manufacture of chlorine must be, as the majority of our readers are perfectly well aware, of considerable importance to sundry industries of the United Kingdom. We gave an account of an improved process on p. 55 of Vol. XII., and we are now enabled to give the details of the method recently patented by M. Tessié du Motay. According to that distinguished chemist, the processes hitherto employed to produce chlorine continuously by means of oxygen or of air and hydrochloric acid in the presence of certain metallic peroxides or dehydrating salts have never given practically valuable results, because the excess of oxygen or air and nitrogen mixed with the chlorine generated partly prevents the condensation of this chlorine or its combination with the alkalies and alkaline-earthy bodies intended to produce hypochlorites suitable for practical use in bleaching. The object of M. Tessié du Motay's process is while wholly or partially utilising the hydrochloric acid employed, to generate pure chlorine in an isolated state which can combine without waste with the alkaline or alkalino-terrous bodies in the form of bleaching chlorides; and to accomplish this the inventor has discovered two methods.

1. Into a retort heated to a deep red, containing peroxide of manganese or a mixture of peroxide of manganese and lime, a current of hydrochloric acid is caused to pass; chlorine and steam are produced and disengaged, and there remain in the retort non-decomposed peroxide of manganese and chloride of manganese, or a mixture of peroxide of manganese, chloride of manganese, and chloride of calcium. The chlorine is collected in the water or led away into a chamber for the production of dry hypochlorites. Over the mixture remaining in the retort a current of air or oxygen of the same temperature is caused to pass, which, in the presence of peroxide of manganese decomposes at once the chloride of manganese alone or the chlorides of manganese and calcium regenerated from the sesquioxide of manganese alone into sesquioxide of manganese mixed with lime, and sets at liberty the chlorine contained in the chlorides. This chlorine mixed with air and azote or oxygen is led into vats containing a mixture of lime and protoxide of manganese which has been previously produced by the decomposition of chloride of manganese by an excess of lime, the soluble chloride of calcium produced in this reaction having been previously run off. In presence of the oxygen of the air and of the chlorine it produces immediately sesquioxide of manganese and hypochlorite of lime, which in reacting upon the sesquioxide produces finally the hydrate of peroxide of manganese and chloride of calcium. The excess of lime remaining having no longer to act upon the sesquioxide remains in the state of hypochlorite of lime. Upon this mixture composed of hydrate of peroxide of manganese, chloride of calcium, and hypochlorite of lime, liquid hydrochloric acid is made to react in the ordinary manner. Chlorine is at once disengaged by the reaction of this acid on the one hand upon the hydrate of peroxide of manganese and on the other upon the hypochlorite of lime. This chlorine is led into the chamber for the production of hypochlorites. After this reaction it remains in the vats of the chlorides of manganese and calcium. Upon the chlorides of manganese and calcium an excess of lime is again caused to act, which reproduces the mixture of protoxide of manganese, chloride of calcium, and lime already referred to. The soluble chloride of calcium is then run off, and there remains in the insoluble state a mixture of protoxide of manganese and lime, which will serve for other similar operations by repassing under the action of chlorine and air to the state of hydrate of peroxide of manganese, chloride of calcium, and hypochlorite of liquid lime.

It therefore follows, first, that by the reaction of gaseous hydrochloric acid upon air and oxygen in retorts heated to redness containing peroxide of manganese or a mixture of peroxide of manganese and lime, a first quantity of pure chlorine is produced, which is led away into condensing chambers, and for the production of dry hypochlorites; secondly, that by the decomposition by means of air or oxygen of the chloride of manganese alone, or the chlorides of manganese and lime contained in the said retorts, gaseous compounds are produced containing at once oxygen and chlorine. These compounds in their passage across the vats containing the protoxide of manganese and liquid hypochlorites of lime produce pure chlorine by the action of liquid hydrochloric acid, the chlorine in its turn being led into the chambers for the production of dry hypochlorites. Instead of the mixture of protoxide of manganese and lime in excess, over which the chlorine mixed with air and oxygen is caused to pass just as it comes from the retorts, a milk of lime may be employed, which is transformed into hypochlorite of lime. This hypochlorite as well as the mixture of hydrate of peroxide of manganese and hypochlorite of lime treated by liquid hydrochloric acid regenerates pure chlorine suitable to be taken to the chambers for the production of dry hypochlorites.

The chloride of calcium remaining from the operation is collected in vessels wherein carbonate of magnesia, or magnesia and carbonic acid, are caused to react simultaneously, carbonate of lime and chloride of magnesium being produced. This distilled chloride of magnesium regenerates the hydrochloric acid, which is again employed for the production of a fresh quantity of chlorine. The magnesia remaining serves again for another operation. Thus the reactions which constitute the process are shortly as follows:—1, the oxides of manganese serving for the production of chlorine are ceaselessly regenerated; 2, the hydrochloric acid is utilised completely for the production of chlorine; 3, all the chlorine generated is in a pure state, and consequently suitable for the production of dry hypochlorites.

2. The second method only differs from the one just described in the substitution of magnesia for lime, the chlorides of magnesium produced being without transformation, and capable of re-engendering hydrochloric acid by simple distillation.

COLOURED SUNS.*

IF a brilliant star be observed when near the horizon, it will be seen to present the beautiful phenomenon of "coloured scintillation." The colours thus exhibited exceed in purity even those seen in the solar spectrum or in the rainbow. By comparison with them the light which flashes from the ruby, the emerald, the sapphire, or the topaz, appears dull and almost earthy. There are four or five stars which present this phenomenon with charming distinctness. The brilliant Vega in the constellation Lyra, which rarely sets in our latitude, is one of these. At midnight in winter, and earlier with the approach of spring, this splendid steel-blue star may be seen as it skirts the southern horizon, scintillating with red, and blue, and emerald light. Arcturus twinkles yet more brilliantly low down towards the north-east in our spring evenings. Capella is another notable scintillator, seen low down towards the north during the summer nights. But these, though they are the most brilliant northern stars, yet shine with a splendour far inferior to that of Sirius, the famous dog-star. No one can mistake this noble orb as it rises above the southern horizon in our winter months. The vivid colours exhibited by Sirius as it scintillates have afforded a favourite image to the poets. Homer compares the celestial light which gleamed from the shield and helmet of Diomed to the rays of "Sirius, the star of autumn," which "shines with a peculiar brilliancy when laved by ocean's waves;" and, to pass at once from the father of poetry to our greatest modern poet, we find in Tennyson's "Princess" the same image, where he says of Arac and his brothers, that—

> As the fiery Sirius alters hue,
> And bickers into red and emerald, shone
> Their morions, washed with morning, as they came.

It is difficult to persuade oneself that these ever-changing tints do not really belong to the stars. But there is now no doubt that they are caused by our own atmosphere. Unequally warm, unequally dense, and unequally moist in its various strata, the air transmits irregularly those coloured rays which together produce the light of a star. Now one colour prevails over the rest, and now another, so that the star appears to change colour. But it is only low down towards the horizon that these changes take place to their full extent. In the tropics, where the air is more uniform in texture, so to speak, the stars do not scintillate unless they are quite close to the horizon, "a circumstance," says Humboldt, "which gives a peculiarly calm and serene character to the celestial depths in those countries."

But the stars are not wanting in real colours, caused by peculiarities in the quality of the light which they emit towards us. In tropical countries the colours of the stars form a very obvious and a very beautiful phenomenon. The whole heaven seems set with variously coloured gems. In our latitudes, none but the brightest stars exhibit distinctly marked colours to the naked eye. Sirius, Regulus, and Spica are white stars; Betelgeux, Aldebaran, Arcturus, and Antares are red; Procyon, Capella, and the Pole-star are yellow; Castor exhibits a slightly green tint; while Vega and Altair are bluish. Antares, which we have described as a red star, presents, when carefully watched, a greenish scintillation so peculiar as to have early attracted the notice of astronomers. The green tint of Castor had been found to arise from the fact that the star is double, and one of the components green. But, for a long while, powerful instruments failed to exhibit a companion to Antares. At length General Mitchell, with the great refractor of the Cincinnati Observatory, detected a minute green companion to this brilliant red star—the Sirius of red stars, as it has been termed.

But, as we have said, the stars which present distinctly marked colours to the naked eye in our latitudes are few and far between. It is in the telescope that our observers have to seek for a full

* From "Essays on Astronomy," reviewed on p. 291. The essay on "Coloured Suns" appeared originally in *Frazer's Magazine*.

view of the delicate phenomenon of coloured stars. When a survey is made of the heavens with a powerful telescope, peculiarities well worthy of careful attention are revealed to the observer. We have seen that there are no stars visible to the naked eye which are *decidedly* blue or green. The ancients, also, recognised only red and white stars. In the telescope, this peculiarity is still observable when single stars only are looked at. We meet with some telescopic stars, the depth of whose red colour is remarkable. There are stars of a fiery red, of a deep blood-red, and of a full orange colour. There is a well-known star entitled the "garnet star." And, in fact, every variety of colour, from white through yellow and orange to a deep, almost dusky red, is met with among the single fixed stars. But there is no instance throughout the whole heavens of a single green, blue, or violet star.

The case is altered when we come to examine those double, triple, and multiple stars, the observation of which is one of the most pleasing employments of the amateur telescopist. Amongst these systems we meet with all the tints of the rainbow, and with many colours which are not seen in the rainbow, such as fawn-colour, lilac, gray, and so on. "The attentive observation of the double stars," writes the celebrated Struve (who detected 3,000 of these objects) "teaches us that, besides those that are white, all the colours of the spectrum are to be met with." "Here we have a green star with a deep blood-red companion, there an orange primary accompanied by a purple or indigo-blue satellite. White is found mixed with light or dark red, purple, ruby, or vermilion." Sometimes a single system offers at one view many different colours. Such is the case with the remarkable group detected by Sir John Herschel within the Southern Cross. It is composed of no less than 110 stars, which, seen in a telescope of sufficient size, appear, Herschel tells us, like "a casket of variously coloured precious stones."

It will be well to examine some of the collocations of colour, that we may trace the presence of a law of distribution, if such exist.

We have said that blue stars are not met with singly in the heavens. Among double stars they are common enough. But they are generally small. When the larger star or primary is not white, it is usually either red or yellow; then the smaller star —or satellite, as we may term it—is frequently blue or green. But this is so far from being a law without exception that the more common case is to find both stars similarly tinted. Amongst 596 bright "doubles," Struve found 375 whose components were similarly coloured, 101 whose components presented colours belonging to the same end of the spectrum, and only 120 in which the colours were totally different.

Amongst double stars whose components are similarly tinted, by far the greater number are white, yellow, or red. But there are some instances of double blue stars; and in the southern heavens there is a group containing a multitude of stars, *all blue*.

It is impossible, therefore, to suppose that the blue colours seen in multiple systems are due to the mere effect of contrast. In some cases this may happen, however; or at any rate the effect of contrast may intensify the colours of each component of a "complementary double." There is one very charming instance of complementary colours in a double star which may be separated with a telescope of very low power. We refer to the star Albireo on the beak of the Swan. The components of this star are orange and blue, the tints being well pronounced. It has been found that when one of the components is hidden, the other still preserves its colour, though not quite so distinctly as when both are seen together. Another "complementary double" is the star γ Andromedæ. The primary is red, the smaller star green. In very powerful telescopes the smaller component is found to be itself double, and doubts exist among astronomers whether the two minute components of the lesser star are both green, or one blue and the other yellow. There is another double star very beautiful in a powerful telescope. This is the star ϵ Boötis, on the Herdsman's belt; it is called also Mirach, and, on account of its extreme beauty, Pulcherrima. The components are nearly equal—one orange, the other a delicate emerald green.

One of the most startling facts revealed by the careful observation of the fixed stars is that their colour is not unchangeable.

We may begin at once with the brightest of the fixed stars—Sirius. This star was known to the ancients as a red star. To its fiery hue may doubtless be ascribed the peculiar influence assigned to it by ancient astronomers. At present Sirius is brilliantly and unmistakeably white.

We have not such decisive evidence in the case of any other noted star. But among telescopic stars, there have been some very remarkable changes. There are two double stars, described by the elder Herschel as white, which now exhibit golden-yellow primaries and greenish satellites. That careful observer, Admiral Smyth, records also that one of the components of a double star in Hercules changed, in twelve years, from "yellow, through gray, cherry-red, and egregious red, to yellow again."

The questions may well be asked: Whence do the stars derive their distinctions of colour, and by what processes do their colours change? To these questions modern discoveries have supplied answers which, if not complete, are well worth listening to.

It had long been suspected that the stars are in reality suns. It had been shown that their distance from us must be so enormous as to enable us to assign to them an intrinsic brilliancy fully equal, in some instances, and in others far superior, to that of our own sun. Nothing remained but that we should have some evidence that the kind of light they emit is similar to that which we receive from the sun. This evidence has been supplied, though only of late years.

We cannot here enter at length into an account of the important discoveries of Kirchhoff and Bunsen, which have enabled astronomers to analyse the light emitted from the celestial bodies. It will be sufficient to remark that in the solar spectrum there are observed fine dark lines breaking the continuity of the streak of light, and that these lines have been proved to be due to the presence of the vapours of certain elements in the solar atmosphere. The proof depends on the exact correspondence of numbers of these lines, grouped in a complex manner (so as entirely to eliminate the possibility of a mere chance accordance) with the bright lines seen in the spectra of light from the vapours of those elements. When once Kirchhoff and Bunsen had proved the possibility of exhibiting the same set of lines either as bright lines on a dark ground or as dark lines on a brilliant spectrum, all doubt as to their meaning in the solar spectrum disappeared at once.

It has been found that in the sun's atmosphere there are present the vapours of iron, copper, zinc, and nickel, besides calcium, magnesium, sodium, and other metals. But the vapours of tin, lead, silver, and gold do not appear to be present in the solar atmosphere. One of the most remarkable dark lines is due to the presence of hydrogen.

But it has been found possible to extend these researches to the fixed stars. Drs. Huggins and Miller have done this successfully, and their discoveries afford a means of assigning very sufficient reasons for the colours of the brighter stars. By analogy also we may extend a similar interpretation to the colours of stars not bright enough to give a spectrum which can be satisfactorily examined.

Let us take first the brilliant Sirius. This star belongs to the southern half of the celestial sphere, and although it becomes visible at certain seasons in our latitude, it never rises very high above the horizon. In fact, at its highest—that is, when due south—it is only twenty-two degrees above the horizon, or less than one-fourth of the way from the horizon to the point immediately overhead. This peculiarity somewhat interferes with the observation of the star by a method so delicate as that applied by the celebrated physicists we have named. On the other hand the exceeding brilliancy of Sirius makes some amends for the effects of atmospheric disturbances. By selecting very favourable opportunities, Huggins and Miller were able to analyse the star's spectrum, with the following result:—

The atmosphere around Sirius contains sodium, magnesium, hydrogen, and probably iron.

The whole spectrum is covered by a very large number of faint and fine lines, indicating a corresponding variety in the substances vapourised in the star's atmosphere.

The hydrogen lines are abnormally strong as compared with the solar spectrum, all the metallic lines being remarkably faint.

This last circumstance is well worthy of notice, since it is *a peculiarity characteristic of white stars* —so that we begin already to find a hint respecting the source of colour or of the absence of colour in stars.

Take next an orange-red star, the brilliant Betelgeux. The spectrum of this star was very carefully analysed by Huggins and Miller. They marked down the places of two or three hundred lines, and measured the position of no less than eighty. They found that sodium, magnesium, calcium, iron, and bismuth are present in the star's atmosphere, but the two strong lines which note the presence of hydrogen are wanting.

Take next the yellow star, Pollux. The observers were not able to obtain very satisfactory measures of this star; but they established the presence of sodium and magnesium in the star's atmosphere; and again the strong lines of hydrogen were found to be missing.

But we are not entitled to assume that red and yellow stars are characterised by the absence of hydrogen from their atmospheres. On the contrary, the noted red star Aldebaran, the spectrum of which was very carefully analysed by Huggins and Miller, was found to exhibit the two lines of hydrogen with perfect distinctness. This star exhibited a richness in the construction of its atmosphere not presented by any other. The elements proved to be present are sodium, magnesium, calcium, iron, bismuth, tellurium, antimony, and mercury. It must not be supposed, in this or any other case, that other elements might not by a sufficiently laborious scrutiny be proved to exist in the star's atmosphere. The observations required, says Dr. Huggins, "are extremely fatiguing to the eye, and necessarily limited to the stronger lines of each spectrum."

It is clear, however, from the above short list of examples, that a considerable variety exists in the physical constitution of the fixed stars. This of itself affords a suggestive hint respecting the true explanation of the variety of colour which we have described. And the peculiarity that in the white stars the hydrogen lines are singularly strong, while the metallic lines are as singularly weak, is yet more to the point. Sirius *was* a red star. Was it at that time unlike present red stars? Does it not seem more probable that, if there had existed in those days a Huggins or a Miller, and the instruments used so successfully by these observers had been invented, it would have been found that Sirius did not—when a red star—present peculiarities now observed only in white stars?

We recognise, then, the influence of time upon the spectrum of this celebrated star, as probably tending to render the lines of hydrogen more distinct than of yore, and the lines of the metallic elements less distinct. But what is the meaning of such a change? Suppose a chemist, for example, observing the spectrum of the flame produced by the combustion of a compound body, should notice that the lines of some elements slowly increased in distinctness, while the lines of others grew fainter, how would he interpret such a phenomenon? If we remembered only that the dark lines are due to the absorptive effect of the vapour they correspond to, on light which is trying, so to speak, to pass through the vapour, we might readily jump at a conclusion, and answer that the extent of absorptive vapour is increasing when the lines are growing more distinct, and *vice versa*. But we must also consider that these lines are partly the effect of contrast. The limelight held before the sun's disc appears *black*, though so dazzling when seen alone. It may be, therefore—or rather we may say it certainly is the case—that those parts of the spectral streak which seem dark are in reality luminous; or—which is merely another way of saying the same thing—that the vapours which absorb light from the solar beams, send us light of their own. And so with stars. Therefore, we have this difficulty to contend against—that there is no power of determining whether a change in the intensity of a line, or of a set of lines, is due to a variation in the light-giving power of the corresponding vapour, or to a variation in the quantity of vapour whose absorptive effects produce the lines.

But, inasmuch as it resulted from Dr. Huggins' examination of a temporary star which appeared last year, that the increase of light—for it was only the abnormal brilliancy of the star which was really temporary—was due to a sudden outburst of inflamed hydrogen, it seems on the whole more probable that the incandescent vapours of stars burn with variable brilliancy, than that they vary in quantitative distribution.

As regards the constant colours of different stars, we are enabled at any rate to deduce negative results.

For instance, we may dismiss at once the theory started some years ago by the French astronomer M. Doppler. He supposed that the colours of a star are due to the proper motions of the star, acting so as—in effect—to lengthen or shorten the waves of light proceeding from the star to the earth, just as the apparent breadth of sea-waves would be greater or less to a swimmer according as he swam with or against their course. It is quite clear that the effects of a motion rapid enough to produce such a change would be to shift the position of the whole spectrum,—and this change would be readily detected by a reference to the spectral lines.* Apart from this, the colour of a star would not be changed by such motion, the spectrum being merely displaced, not affected in its characteristics of colour. (See p. 275.)

Another theory—that the orange and red tints indicate a lower degree of temperature—must also be dismissed. For we have seen that the spectra of red stars indicate the presence of the vapour of iron and other metals, and nothing but an exceedingly high temperature could vapourise these.

It seems clear that the difference of tint is due to the different arrangement of the dark lines—in other words, to an absolute difference of physical constitution. "There is a striking difference," remarks Huggins, "between the effect on the colour of a star of such closely grouped and very dark lines in the green and blue part of the spectrum of Betelgeux, and of the corresponding part of the spectrum of Sirius, in which the dark lines are faint, and wholly unequal to produce any noticeable subduing of the blue and green rays."

But we have still to consider the peculiarities presented by the double stars. We have seen that

* I may be permitted to notice that this was among the earliest *published* references to the possibility of determining motions of recess or approach by the displacement of the spectral lines. Very shortly afterwards, Dr. Huggins had succeeded in applying the method, which he had been endeavouring to do for some months before. I was, however, quite unaware of this when I wrote the above lines. I believe, in fact, his researches were carried on altogether privately.

amongst the components of these there are observed some which present a distinct blue colour. It has been found possible to analyse some of these with the spectroscope. We have spoken of the charming double star Albireo, the components of which are orange and blue. Both have been analysed—with this result, that the spectrum of the orange component is remarkable for the great strength of the lines in the green, blue, and violet, while the spectrum of the blue component is equally remarkable for the great number of groups of fine lines in the orange and yellow.

It would seem, then, that the complementary colours observed in certain double stars indicate a sort of complementary distribution of elements which in our own sun are associated equably and intimately.

And we must note here, in passing, that it is not absolutely necessary, as some have supposed, that, if there are systems of worlds circulating around such double suns, there should be any remarkable difference in the quality of light distributed to the planets, as compared with that which we receive from the Sun. Sir John Herschel has spoken of "the charming contrasts and grateful vicissitudes —a red or a green day, for instance, alternating with a white one or with darkness, according as one or other or both of the stars should be above the horizon." But if the dependent orbs swept in very wide circuits about their double sun, they would receive white light during nearly the whole of each of their days, since it would only be during a brief interval that either sun would be visible *alone* above the horizon.

Of the deeply coloured stars which are visible with the telescope, none have been found sufficiently brilliant to admit of exact analysis.

A peculiarity has been remarked by a distinguished modern observer which is worthy of careful attention. Many of the regularly variable stars, when passing into their phase of minimum brightness, exhibit a ruddy tinge which is very conspicuous in instruments of adequate power. It does not seem easy to explain this as due to any change in the vaporous constitution of a variable star—since it seems difficult to show why such changes should occur at regular intervals. Yet this would appear to be more probable than that these changes are due, either to the rotation of the star itself and the presentation in a cyclic order of the different parts of an unequally illuminated globe, or to the revolution round the star of an extensive vaporous mass whose interposition cuts off from us at regular intervals a portion of the star's light.

It is remarkable that a large number of the known variable stars are red or orange. There is one notable exception, however, for Algol—the celebrated variable in Medusa's head—is a white star.

It is probable that a careful examination of the stars with any efficient "colour-tester" would lead to the discovery of many cases of variation in colour. Admiral Smyth adopted a chromatic scale of colour—but a test of this sort is not very satisfactory. Opaque colours generally vary with time, so that it is impossible to say that two observers, even if they have used the same strip of coloured discs, have really made observations fairly comparable *inter se*. And it is further to be noted that there are many persons who find a difficulty and uncertainty in the comparison of stars, or brilliants, with opaque colour-scales. An ingenious student of science has suggested the use of chemical solutions, which can always be reproduced with certainty; and he has described a method for forming an artificial star in the field of view of a telescope, and for gradually varying the colour of the star until it should coincide with that of a fixed star whose colour we may desire to determine. The great objection to the plan is its complexity. Coloured glasses, through which a small white disc within the telescope might be illuminated (just as the wires are illuminated in the ordinary transit telescope), would serve the same purpose much more simply.* The inquiry is an exceedingly interesting one, and Sir John Herschel has expressed the opinion that there is no field of labour open to the amateur telescopist which affords a better promise of original discoveries than the search for such variations as we have described.

WOOD VENEERS FOR COVERING WALLS.

THE following particulars of the method of preparing veneers of wood for use in place of paper-hangings, are sent by a correspondent to the *Gardeners' Chronicle* :—

Some time since, Dr. Asa Gray presented to the Museum at Kew a series of thin veneers, or rather sheets of wood, such as had been introduced into America for covering the walls of rooms instead of paper. These wood papers, if we may so call them, are exhibited amongst the American woods in the timber museum (No. 3), and though the specimens there shown are not more than from 2ft. to 3ft. long, and 18in. wide, they are, we understand, to be had in America in lengths of 10ft. and of the entire width of the trunk from which they are taken. They are of a uniform thickness throughout, and scarcely, if at all, thicker than ordinary wall paper. They are produced by a kind of gigantic planing-machine, the papers being simply huge shavings. In most of them the grain runs longitudinally, the trunk of the tree being fed against the plane, or the plane being worked along the trunk in that direction, but by a further development of this wood machine much wider veneers are obtained. A wider blade is, of course, necessary, and the trunk of the tree being cut to the required length, it is made to revolve like a cylinder, and by a very even and uniform pressure against the edge of the plane, a continuous shaving or veneer, of any desired thickness or length, is produced by what might be likened to a kind of unrolling of the vegetable tissues. Though these wood papers are of comparatively recent introduction in America, it appears the patent for their production is only a development of a French patent obtained so long ago as 1826, by which the patentee covered a piano with sheets of ivory so produced. For the veneering of small objects, such as telescope tubes, sword canes, &c., the wood shavings are usually backed with thin papers; the backing or lining is applied by means of a machine very similar to that usually employed for making cardboard, by which two sheets, supplied from rollers, after being brought into contact with a revolving brush, dipping in liquid paste or size, are passed together between compressing rollers, and then taken up on the receiving roller. At first the wood sheets were used for walls without any lining or backing, but before being applied they were thoroughly soaked in water to make them pliable; when lined with paper, however, they are much stronger, and are used exactly as ordinary wall papers by pasting the sheets, or if preferred the wall itself. The sheets are so thin that the edges can be lapped over each other as readily and neatly as actual paper. After being properly fixed the walls can be either left untouched, rubbed down with oil, or varnished, and in either case look well. Amongst the woods cut for this purpose, and exhibited at Kew, are bird's-eye maple (*Acer saccharinum*), red maple (*A. rubrum*), swamp curly maple (*A. rubrum*), mahogany (*Swietenia Mahagoni*), black walnut (*Juglans nigra*), button wood (*Platanus occidentalis*), hornbeam (*Carpinus Americanus*), &c.

* This plan was proposed by me in the *Quarterly Journal of Science*, for October 1867, in the "Chronicle of Astronomy.' An instrument of some such sort had been constructed earlier by Mr. Birt, who called it the *homochromatoscope*.

NATURE PRINTS BY PHOTOGRAPHY.

THERE are probably but few of our readers who have never seen the beautiful pictures produced by skilful manipulators of the ordinary nature-printing processes. Probably the best method of producing these elegant pictures of leaves, ferns, and grasses is the most neglected of any, although it is possibly the most simple of all. We allude to the utilisation of photography in this connection, and extract some interesting details of the process from the *Photographic News*.

Our contemporary has more than once called attention to the very interesting, but singularly neglected, branch of photography, the production of copies of ferns, leaves, grasses, and other botanical specimens, by printing direct from the freshly gathered plant without the intervention of a negative. The production of these "leaf prints," as our American neighbours have styled them, is an occupation at once simple, elegant, and interesting, and may be adopted either for the purpose of securing pretty floral pictures and decorative designs, or for the more important purpose of aiding botanical studies. Where decorative results only are required there is abundant opportunity for the exercise of taste in arranging the leaves, stems, and blossoms of various plants in pictorial bouquets in graceful wreaths; ferns, and the leaves of various creeping plants, such as the ivy, the linaria, various grasses, the graceful plumous foliaged milfoil, and a hundred other of the most common wild plants growing by the hedge side, will yield endless varieties of effect. Where aid to study is the aim, the plan in question is not less full of interest and value. One of the first objects of the botanical student is to acquire a distinctive knowledge of the appearance of plants and their likeness to, or difference from, each other, which can only be acquired by constant comparison. When the student turns to the dried specimens in his flora, he finds that he has lost much of the characteristic of the fresh plant. By skilfully using the plant, or portions of it at a time, as a negative, he can retain many qualities utterly lost in the dried plant, however carefully preserved. Where the student, besides securing self-prints of the leaves and other portions of the plant admitting such treatment, will also take the trouble to photograph the whole plant, either the size of nature or in some definite relation to the size of nature, he will gain an enormous advantage in his studies. A set of such photographs accompanying his preserved specimens would give a flora more perfect than any other we know.

Treating of the subject for decorative purposes, Mr. Gaffield, of Boston, gives the following hints :—

1. The leaves and ferns should not be dried, as the dried leaves do not permit the light to delineate their beautiful and delicate venation. They should be freshly gathered and pressed between the leaves of a book, just enough to extract the excess of moisture, and then used before the delicate veins have become dry and opaque to light. The finest impressions are those from the fresh leaves and ferns.

2. They are not placed on sensitive paper, but fastened by mucilage to a sheet of glass in the form of the design required. This glass is then placed in a pressure-frame, and used as a negative from which to print. The sensitive paper placed upon this negative must be exposed to sunlight from ten minutes to half an hour, according to the season of the year, or the intensity of the chemical rays. The pictures can then be toned, fixed, and mounted like other photographic prints.

3. It is not true "that it requires but little skill to arrange the leaves and sprigs of fern, and none to print them." As the chief part of my work has been done by other and gentler hands than my own, I can, without a charge of immodesty, assure you that the work requires great taste and skill, and the expenditure of much time, labour, and patience.

Again, great care is necessary in printing not in injure or start off the delicate ferns from the glass. After the print is made, a sheet of white letter-paper should always be placed over the ferns, and the back-board put in position again to protect them from injury, and to keep them from drying and coming off the glass.

For the help of those who may desire to adopt this method as an aid to botanical studies, we reprint a few hints from Professor Hime's excellent work on the subject :—

In gathering leaves for photographic purposes, some care should be taken to procure perfect and characteristic specimens. The margins should be kept as free from overlapping as possible when the leaves are placed in the printing frame or pressed. Some are more easily managed if very slightly wilted, but generally the sooner they are subjected to a slight pressure the better. A portfolio or ordinary atlas, supplied with sheets of printing-paper, should be taken to the woods, in which the most delicate one—as the maiden-hair, fine-haired mountain fern, &c.—can be placed as soon as plucked. Many leaves can be printed from without pressing or drying—as forest leaves, many ferns, columbine, anemone, black currant, &c., but when the pines of the leaf may be expressed by the pressure used in printing, and stain the sensitive paper, it will be necessary to subject them to some pressure between the folds of bibulous paper. They should not, however, be dried as for an herbarium.

The ribs and veins in prints made from undried leaves appear as sharply-defined dark lines, and the whole appearance of the prints is superior to those made from dried leaves, in which the ribs and veins are represented by comparatively ill-defined white lines.

The reason of the difference alluded to lies in the fact that the ribs and veins, whilst filled with the fluids which they convey, are transparent, and allow the light to pass through and make a record of them in dark lines. When dry and empty they are opaque, and, by preventing the action of light, produce white lines.

Dried leaves may be made to give prints in all respects equal to, and sometimes even superior to, those obtained from freshly-gathered ones, by soaking them for several hours in water until the veins become expanded and filled. They must then be pressed between the folds of bibulous paper until dry enough superficially to print from. After this treatment they will only remain in good photographic condition several days, but the operation can be repeated as often as desired. A little glycerine added to the water will cause the veins to remain transparent longer, and a little hydrochloric acid will facilitate the filling of the veins in some cases.

When it is desired to print from several leaves upon the same piece of paper at the same time, it will be found convenient to fasten them to the glass by means of dilute gum-water. Immediately after being fastened to the glass in this way, they should be subjected to the pressure of the clothes-clip as in printing from them. In some cases it is best to place the leaves—especially dried ones—between folds of writing-paper, and subject them to as great a degree of pressure as can be obtained by means of an ordinary letter-press, before fastening them on the glass. If the leaves are not of the same intensity, the most intense—those that require the longest time to print—may be bleached as much as necessary by means of Labarraque's solution, or those least intense may be stained light yellow by means of turmeric. Small plants with flowers that preserve their shape somewhat in pressing—as violets—can be photographed entire.

As all prints taken from the leaves themselves must consist of a light image on a dark background, Professor Himes suggests that for many purposes an improved effect will be produced by using the print first obtained as a negative, first treating it with wax to render it transparent. The following is the method recommended ;—

Melt some pure white wax by placing it in a shallow dish placed in a pan of boiling water. Immerse in the melted wax sheets of blotting-paper. As these sheets will absorb much more wax than is required, a pile is to be made of (say) half-a-dozen of these with half-a-dozen clean sheets of blotting-paper, placing alternately waxed paper and clean blotting-paper, a few extra sheets of the latter being placed at top and bottom. The whole pile is then pressed with a flat iron heated to about the temperature of boiling water. By this treatment a series of uniformly waxed sheets of blotting-paper will be obtained. When a print is to be waxed for use as a negative, it is placed upon a sheet of blotting-paper, and then upon its face is laid a sheet of the waxed paper; this is then covered with two or three sheets of blotting-paper, and the whole pressed with the hot iron. The negative is thus uniformly waxed, and made sufficiently transparent for printing purposes.

Silver prints will, of course, be found to answer every purpose, and carbon prints, in suitable colours, still better. Blue and brown prints may be obtained as follows:—Prepare—

Ferridcyanide of potassium (red prussiate of potash)	100 grains
Water	1 ounce

Apply the solution with a tuft of cotton to a piece of Saxe paper pinned to a board. This will give paper of a uniform yellow tint. This, on exposure to light, becomes blue; the only fixing process necessary being copious washing in water until all trace of yellowness is removed. A saturated solution of bichromate of potash produces brown images by similar treatment, excess of washing having a tendency to decompose the image of brown oxide of chromium, and leave a pale green image of sesquioxide of chromium.

FLUID MEAT.

A SOLUBLE preparation, under the above title, has been perfected by Mr. Stephen Darby, F.C.S., which is likely to become of some economic as well as medical importance, says *Food, Water, and Air*. Mr. Darby recently gave some interesting particulars respecting this article to the Food Committee of the Society of Arts, from which we glean the following:—

"Fluid meat contains all the constituents of lean meat, including fibrine, gelatine, and coagulable albumen. By the process pursued these are all brought into a condition in which they are soluble in water and are not any longer coagulable on heating—in which state they have been designated peptones. This change is effected, as in ordinary digestion, by means of pepsin and hydrochloric acid. Lean meat, finely sliced, is digested with the pepsin in water previously acidulated with hydrochloric acid, at a temperature of 96° to 100° Fahr., until the whole of the fibrine of the meat has disappeared. The liquor is then filtered, separating small portions of fat, cartilage, or other insoluble matters, and neutralised by means of carbonate of soda, and finally carefully evaporated to the consistence of a soft extract. But this process, whatever care may be taken, leaves the fluid meat with a strong bitter taste. This bitterness attaches always to meat digested with pepsin; and this, in the opinion of medical men, would wholly preclude its acceptance and adoption as an article of food. In order to remove this bitter taste, and to obviate the objection to fluid meats on that ground, I have made many experimental researches, and have at length discovered that the purpose is completely and satisfactorily effected by the addition, in a certain part of the process, of a small proportion of fresh pancreas. The fluid meat so prepared is entirely free from any bitter flavour."

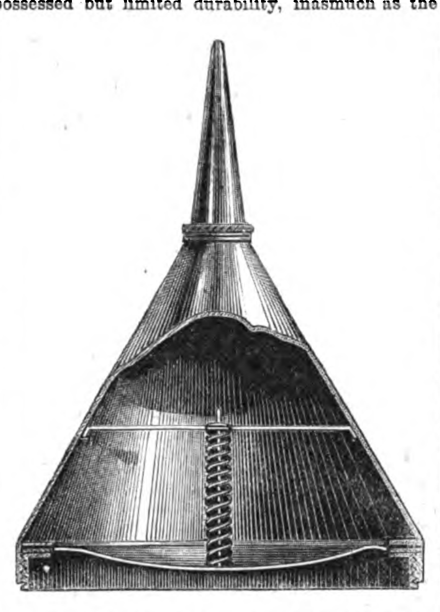
Mr. Darby regards these changes as exactly analogous to the action of the pepsin and pancreas on food in the body. 1lb. of soluble extract is obtained from 20lb. of lean meat, and he considers that even by using English beef economy is effected in certain cases, while, of course, the employment of the process in places where meat is much more plentiful would be attended with an equivalent increase of profit.

A NEW ANILINE VIOLET.

M. CLAVEL, of Basle, Switzerland, has published an account of the preparation of a new violet, obtained by heating magenta and iodide of ethyl without pressure. He calls it the "night violet," and obtains it by means of a condenser connected to the apparatus with a glass tube, in which the iodide of methyl, as fast as it is volatilised by the heat, is recondensed and falls back as a liquid. The apparatus is a common cast iron boiler heated by means of a steam jacket. The cover has two openings for two glass tubes in connection with a worm for condensation. The vapours rising out of the boilers pass into the worm, are there condensed, and from thence run as a liquid into the second glass tube which leads back the iodide of ethyl in a regular stream. For the preparation, he takes magenta crystals, solid caustic soda, and iodide of ethyl, with a suitable quantity of wood spirit; or the iodide of methyl can be used, and alcohol used as a solvent. The magenta and the soda are put into the boiler together, and well stirred till the mixture becomes uniform. Half of the iodide of ethyl is then added, the lid closed, and the condenser connected. Heat is now applied for six hours. The apparatus is then cooled, the remaining half of the iodide of ethyl added, and heating resumed for six hours more. After this time the connection between the condenser and the second or return glass tube is closed by means of a tap, and another tap is opened to allow the condensed iodide of ethyl to run off into a receiver. Heat is again applied, and maintained until all the iodide of ethyl and wood spirit are distilled over and preserved for use on another occasion. The mass which is left behind in the boiler is then taken out, and boiled for a considerable time with a strong lye of caustic potash. This removes all the iodine in the form of iodide of potassium, while the "night violet," is deposited as a cake. This is now in the state of an insoluble base. To render it soluble in water, it must be combined with an acid. For this purpose, the cake is dissolved in dilute sulphuric acid. When this has been done, the colour is thrown down by neutralising with a solution of soda. It is then washed in cold water, dissolved in boiling water, and finally reprecipitated by the addition of common salt. Unlike the ordinary aniline violets, which, when seen by artificial light, seem of a reddish brown colour, this dye retains its beautiful blue tone. A variety of shades may be obtained by varying the proportions of magenta, soda, and iodide of ethyl.

IMPROVED PATTERN OIL-CAN.

AN improvement in mechanics' oil-cans recently patented in the United States relates to that class of oil-cans in which the oil is ejected by pressure on a piston or a portion of the can made elastic for the purpose. Such cans have hitherto possessed but limited durability, inasmuch as the



bottom generally became worn out before the body; and as it formed an integral part of the latter, the destruction of the bottom caused the loss of the whole; the necessary repair not warranting the expense. This is obviated in the improved can by making the bottom readily detachable, so that when necessary or desirable it can be replaced by another, and as several bottoms are sold with the can the cost of repair is reduced to the minimum. The can is of the usual form, but provided at its base with an annular piece of brass or other metal securely soldered in place, and furnished with a screw thread on its interior surface; at the upper edge of this fixed ring or base-piece is an internal flange, *a*, on which a washer of leather or like material is laid; the flexible bottom is then placed with its edge on the washer just mentioned, and a second washer is laid upon the edge of the opposite side of the bottom. The annular nut shown, being provided with a screw-thread on its outer surface corresponding to that on the ring forming the base, is then screwed home, and firmly clamping the edge portions of the bottom, together with the washers, tightly fixes the bottom in position. The annular nut, is, in practice, fitted with internal projections in order that it may be easily turned. The bottom has the usual swelled or bulging contour, and may be fitted with a spring, as shown in the figure, arranged between it and the fixed transverse bar, but this can of course be dispensed with when desired, without impairing the advantages secured by the essential feature of the invention.

BITUMEN AS A PHOTOGRAPHIC MATERIAL.

A FRENCH photographer, M. Despaquis, recently exhibited to the Société Photographique of France, specimens of a new photographic agent which is likely to yield valuable results for photo-engraving and photo-lithographic purposes. This is bitumen of Judæa, which is used for sensitising either sheets of paper or mica. In calling attention to this new process, M. Despaquis said that the paper may be preserved for an indefinite period, if screened from light and protected from the effects of moisture. The manipulations necessary to its employment are of the most simple character, and are confined to placing the paper under a negative in the ordinary manner, exposing to light (a very long exposure is necessary) and washing subsequently in essence of turpentine.

The samples of paper are of various kinds. No. 1 is as transparent as glass, and is covered with a sensitive film of bitumen; it serves for the production of transparent positives, and for reproducing clichés, which may be put into the frame reversed if desired, according as the image is required for photo-engraving or carbon printing.

No. 2 is also transparent, but possesses more the appearance of ground glass. It is suitable for making transparent prints for stereoscopes, transparencies, &c., at a low price. With prints of this kind, the stereoscope needs no glass, and is, therefore, very light and portable. This same material answers well for the preparation of so-called photo-miniatures, which are produced by means of two prints superposed, the lower one being vigorously coloured; the tints, when viewed by transparency through the upper print, possess very fine gradations. The upper print is produced upon this No. 2 paper, which will doubtless be found to answer the purpose much better than albumenised silver paper rendered transparent by varnish.

No. 3 has a matt or opal white surface, formed by means of oxide of zinc and starch. It serves very well for the production of the second or lower print required for the object previously mentioned, and is also suitable for the preparation of transparencies.

All three papers may be attached or mounted upon cardboard like ordinary prints. To do this, the print is put upon a glass plate and covered with thin card slightly moistened; the two surfaces are then passed through a rolling press, and complete adhesion takes place.

The fourth material, which is likewise sensitised by means of bitumen, is, however, capable of more important applications. It is prepared specially for the transfer of photographic prints, with all their half tones, to stone or zinc, for working up with fatty inks, and printing upon wood, glass, enamel, painter's canvas paper, &c.

In this last named material, a film of gum is placed between the gelatine film and the film of bitumen, and as no washing in water is required for developing and fixing, it is attached while still wet with essence. If already washed and dried, the print is again treated with the essence upon the stone, zinc, wood, &c.; then by the aid of a sheet of thick and moist blotting paper, which is placed upon it and pressed down to chase away air bubbles, the print is allowed to dry under a slight pressure, as in carbon printing. The blotting-paper should somewhat overlap the print. One or two dry sheets of the same kind are placed over the wet paper, and these are then covered with a few glass plates. After the lapse of a few hours, the dried sheets are removed by means of a sponge and water applied to the last sheet of blotting-paper, and the gelatine being softened the gum is dissolved; the blotting-pad is then lifted off, carrying with it the gelatine, and leaving the bitumen upon the glass or metal surface. The image is thus transported to the block, and nothing is then necessary but to etch the same in the usual manner with acid.

The preparation of bitumen paper is, of course, no novelty, but it is the special employment of gelatine that is new. This renders the application of water unnecessary in development, and the film does not cockle or roll in washing; by the addition of starch, carbonate of baryta, oxide of zinc, and various colours, it is possible to impart to the film any degree of transparency desirable. The two principal points of importance are the application of bitumen of Judæa to a support of gelatine, which, not being dissolved in the liquids used as solvents for the bitumen, is not modified or changed in any way during the process of washing; and the special preparation of the bitumen, whereby it is very adherent to its basis, and of so solid a nature that it will allow of the application of a layer of printer's ink by means of a roller. Acid for etching may be employed with impunity.

This is a very important matter for photo-engraving or photo-lithographic purposes. Maps and drawings have been prepared upon glass by M. Despaquis in the manner indicated, and in these cases not only is the etching of extraordinary depth, but the fineness of detail is perfect, proving beyond doubt that the hydrofluoric acid which had been employed for etching had in no way attacked the film. These same qualities are only to be seen upon metal engravings; and although M. Despaquis is himself but an indifferent operator, he has been enabled to obtain these results very easily.

As to the transparent pictures produced by means of this material, they are certainly very beautiful when mounted between two plates of glass, forming very charming illuminated designs. The manipulations are exceedingly simple: there is no sensitising, no fixing, and no toning, inasmuch as the whole operation consists in placing the prepared material under a cliché, in exposing to light, and washing it in essence of turpentine.

SCIENTIFIC SOCIETIES.

CHEMICAL SOCIETY.

The Atomic Theory.

AT a recent meeting of this Society a paper was read by Mr. Atkinson, entitled "An Examination of a recent Attack upon the Atomic Theory," having reference to a paper by Dr. Wright "On the Relations between the Atomic Hypothesis and the Condensed Symbolic Expressions of Chemical Facts and Changes known as Dissected (structural) Formula," recently read before the Society, and published in the April number of the *Philosophical Magazine*, which led to an animated discussion. Mr. Atkinson said that Dr. Wright, notwithstanding his having asserted that the atomic theory is unnecessary, invariably uses it, arguing that we must either accept the atomic theory, in order to revise the approximate results obtained in any given analysis, or adopt the actual number obtained, instancing Roscoe's analysis and determination of the vapour density of tungsten oxy-chloride and other tungsten compounds. Dr. Wright refers to the law of multiple proportions as one of the facts of chemistry, but experiment does not lead to numbers which are multiples of his combining numbers, that is, the law of multiple proportions is not an experimental fact; thus, the vapour density of ferric chloride would lead to the atomic weight 112 for iron, and that of aluminium chloride to 55 for aluminium. Dr. Wright's analysis of hydrobromate of bromocodide would lead him to the formula

$$C_{18}\frac{1}{7}, H_{22}\frac{1}{6}, Br1\frac{15}{16}, No._{2};$$

instead of $C_{18}H_{21}Br_2$ No. $_2$, the one he had adopted; instead, however, of accepting the numbers obtained by analysis, he rejects them, and takes the nearest numbers which yield a formula containing only integral multiples of atomic weights. He also said that Dr. Wright had not attempted to explain the cause of isomerism, which can be readily done by the notion of the existence of atoms associated in different relative positions.

Dr. Wright said it was somewhat difficult to reply to a large number of objections which he had only just heard for the first time. He was afraid Mr. Atkinson had failed to understand the object of his paper, which was to distinguish between the employment of certain symbols to express certain facts, and the adoption of the atomic hypothesis to explain these facts. One of the charges was that of denying the atomic theory, and yet of employing that theory; the instance adduced being that the approximate results obtained by his analysis of hydrobromate of bromocodide would lead to the formula—

$$C_{18}\frac{1}{7}, H_{22}\frac{1}{6}, Br1\frac{15}{16}, No._{2}.$$

He need only say, that taking into account the errors of experiment, such as the presence of water, &c., the nearest whole numbers which represent his results lead to the formula $C_{18}H_{21}Br_2$ No_2; and that in assigning this as the formula, he did so quite independently of the atomic theory. With regard to his observations that the determination of the vapour density of ferric chloride and aluminium chloride would lead to the numbers Fe = 112 and Al = 55 he seems to have forgotten that the speaker had especially stated that compounds that dissociate, or are believed to do so, must be excluded in the determination of the combining number of the element. It is quite possible to express symbolically the difference between isomeric compounds without reference to any theory whatever: the two isomeric propylic alcohols, for instance, when treated with reagents, give rise to different products, and these facts can be recalled by the employment of symbols apart from all theoretical considerations. The speaker could scarcely see what great advantage was gained by the discussion of such a purely theoretical question as the constitution of matter, the important point being to express symbolically the facts with which we are acquainted. At present sufficient distinction was not made between Dalton's proposal to represent the results of his quantitative analyses by symbols, and the theory founded on these results—namely, that matter is built up of small particles or atoms, and these again are united to form molecules. The latter was a subject which admitted of much discussion. The use of symbols to represent facts quite apart from any theory gave us a power similar to that which the symbols in algebra gives to the mathematician.

Mr. J. Newlands remarked that it was very important to distinguish between the two proposals of Dalton—namely, the law of multiple proportions and the theory of the existence of atoms founded on it. Dr. Divers said there was one point he would like to refer to, and that was whether in sodium chloride, for instance, the sodium and the chlorine existed as such. On bringing together chlorine and sodium, the two united with production of intense heat, and formed a compound as different from either sodium or chlorine as these were from one another. True, we could obtain these elements from the compound, but we could not say they exist in it as such. We know nothing of the structure of coupled substances except that by certain reactions they yield certain products. It is quite possible, therefore, that although we get out the same elements from two isomeric bodies, these may differ in the amount of force they contain.

Dr. Williamson said that although it was a question of very great difficulty to decide upon facts so remote from our senses as these minute particles of which matter was built up, yet it was no more unreasonable to do so than with the enormous masses in the remote regions of our planetary system. He must say that those who consider it simply the part of science to record the results of observations, and not to endeavour to connect them with one another, know not what science is. A theory different from the atomic theory would be very valuable by reason of its giving us another point of view from which we might behold the facts with which we are acquainted. He would hail such a theory with delight.

Mr. Atkinson said it would be unnecessary for him to reply, as most of the points raised had been refuted by subsequent speakers.

The Chairman, Dr. Debus, was inclined to think that the representation of facts by symbols, without connection with some theory, was very like a body without a soul; the human mind could never rest satisfied simply with the outside representation of things, but would look for the causes which connect them. From about 1808 to 1820, in Germany, the dynamical theory advanced by Karl was generally employed, and it is remarkable that no great discoveries were made there, and that no eminent chemist existed during that period; whilst in England and in France, where the atomic theory was adopted, science advanced rapidly; when, however, Germany adopted the atomic theory, chemistry at once began to improve. These things spoke for themselves.

USEFUL AND SCIENTIFIC NOTES.

Force and Energy.—By "force" in rigid signification is understood the power of producing "energy;" by "energy," the power of performing work. To give an illustration: powder has force, the cannon-ball energy; but to speak of the force of the cannon-ball is inexact. It may also be remarked that the words "actual" and "potential" are in frequent use to qualify the state in which energy is met with. By actual energy is meant energy in an active state, energy which is doing work. By potential energy, energy at rest—energy capable of doing work, but not doing it. In a bent cross-bow there is potential energy—energy in a state of rest, but ready to become actual or to manifest itself, when the trigger is pulled. Again, actual energy is evolved from the sun. By vegetable life this is made potential in the organic compounds formed. In these organic compounds the energy is stored up in a latent condition; potential energy is reconverted into actual energy when they undergo oxidation during combustion, or in their utilisation in the animal economy.

Meerschaum. — At the Berlin Geographical Society's December meeting, M. Ziegler described the sources whence the considerable annual supply of meerschaum for meerschaum pipes is derived. Large quantities of this mineral, so highly esteemed by smokers, come from Hrubschitz and Oslawan in Austrian Moravia, where it is found imbedded between thick strata of serpentine rock. It is also found in Spain at Esconche, Vallecos, and Toledo; the best, however, comes from Asia Minor. The chief places are the celebrated meerschaum mines from six to eight miles south-east of Eskischehr, on the river Pursak, chief tributary to the river Sagarius. They were known to Xenophon, and they are now worked principally by Armenian Christians, who sink narrow pits to the beds of this mineral, and work the sides out until water or imminent danger drives them away to try another place. Some meerschaum comes from Brussa, and in 1869 over 3,000 boxes of raw material were imported from Asia Minor at Trieste, worth 345,000 florins. The pipe manufacture and carving is principally carried on in Vienna and in Ruhla, Duchy of Saxe-Coburg-Gotha. The commercial value of meerschaum carvings at these places may be estimated at £100,000 annually. However, very large quantities of them are not made from genuine but from artificial material. The waste from these carvings is ground to very fine powder, and then boiled with linseed oil and alum. When this mixture has sufficient cohesion, it is cast in moulds and carefully dried and carved, as if these blocks of mineral had been natural. It is said that about one-half of all pipes now sold are made from artificial meerschaum.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

THE UNDULATORY THEORY OF LIGHT—FOCUS OF A LENS—AND CEMENTED OBJECT-GLASSES.

[4276.]—MR. HOPKINS (let. 4259, p. 280) has either taken singularly little pains to acquaint himself with the undulatory theory of light, or he is indebted to his own imagination for what he puts forth as such. It is simply ridiculous, to say nothing of its being untrue, that "the undulatory theory of light assumes" that what "is called luminiferous ether . . . in a state of rest is darkness, and in a state of undulatory motion is light!" The function of the ether is *to transmit vibrations* from the source of what we call light to the human retina, which is then itself set into a state of inconceivably rapid vibration. *It is this vibration of the retina which affects us as light.* It is mere nonsense to talk of the medium which transmits it "becoming visible." Perhaps a rough illustration may help to show Mr. Hopkins the error into which he has fallen. I assume that he is familiar with the fact that the scratch of a pin made at one end of a long beam of wood, or felled tree, is quite audible to any one who will put his ear against the other. Evidently, then, what happens in this case is that the vibrations caused by the scratching of the pin are transmitted along the fibres of the wood, that they set up corresponding vibrations in the tympanum of the ear, and that, in common parlance, we thus *hear* the sound. No writer on acoustics, however, that I have ever heard of, has yet attempted to enunciate the theory of this action by saying that the *wood* in a state of rest is *silence*, and in a state of undulatory motion is *sound*; and yet I fancy that even your correspondent must admit that this is no caricature of his own mode of exposition of the undulatory theory of light.

"Anon." puts a query (11991, p. 288) which he might have answered from, or found answered in, any fourpenny catechism on "Optics;" and I really must crave your indulgence, sir, for wasting the space necessary for a reply to so ridiculous a question. The focal length of a lens, then, is the distance from it at which the image of a distant object, like the sun, is formed. It "is ascertained" by holding the glass up in the sun and moving a sheet of cardboard to and fro until his image is perfectly sharp and well-defined upon it. A divided rule will then measure the distance between the lens and the card. It is "necessary to know it" (among other trifling reasons) because the eyepieces in a telescope and the plate-holder in a photographic camera have to be placed in this focus. In this reply I have dealt wholly with the principal focus of a lens, and said nothing about conjugate foci. I, moreover, expressly disclaim any attempt to give a scientific answer to such a query.

"C. B." (query 12029, p. 289) will find that, as a rule, terrestrial telescopes only, have their object-glasses cemented with balsam. I fancy that the makers do it to prevent that internal decomposition which will take place with lenses exposed to much damp or (especially) sulphurous vapour; and I think that they claim a slight increase of light from this arrangement. The sun ought not to melt the balsam, as it transmits heat rays pretty freely.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

DISTANCES OF THE STARS.

[4277.]—IF there be one man in England who knows more of the sidereal depths than another, indubitably that man is Mr. Proctor; but even he, I am afraid, will find "Dorset" (query 12018, p. 289) a trifle too much for him. If our querist will turn to p. 35 of your last volume (XIV.) he will find the parallax of nearly every star whose distance has yet been determined (there are about a dozen of them) in a letter by the present writer. In perusing this list "Dorset" will be struck by the curious fact that *the smallest stars are some of the nearest*; as, from the way in which his question is framed, he would appear to be under the impression that the smaller stars are, the further they are off. Your correspondent must forthwith obtain, read, mark, learn, and inwardly digest Mr. Proctor's last work, the "Essays on Astronomy." Its perusal will enlighten him most astonishingly as to the structure of the sidereal universe.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

PRACTICAL METHODS OF INCREASING THE LOUDNESS OF PIANOFORTE TREBLES.

[4278.]—FOR the purpose of increasing the loudness of the treble sounds of pianos only the subjoined means seem applicable.

1. The carrying out of any improvement in the soundboard, which is, or may become, known. I fear there is but little to be hoped for in this line, when I see that very little change or alteration has been made, for more than a quarter of a century, in pianoforte soundboards.

2. Increasing the force with which the hammer strikes the strings. This seems much more promising, for it is universally admitted that no piano with a weak action can yield powerful sounds, however large it may be, or however thick its strings are. The force of the blow may be increased by two methods. We may make the hammers heavier, or we may impel them with greater velocity. A hammer double the weight of another, which moves with the same velocity, must strike the strings with double the force the lighter hammer can strike them; but this (although a very great improvement in the bass) is unsuitable for the treble, because it is found to be impracticable to cause a very heavy hammer to rebound from the strings quickly enough after striking them to prevent it from partially damping their vibrations, and thereby (besides preventing the full power of sound from being developed) producing what is termed a "blocky" quality of tone. When a light hammer is impelled with great velocity, we obtain a sufficiently powerful blow without inducing "blockyness," because it rebounds from the strings instantly after striking them; in a word, it don't sensibly "damp" their vibrations, and suffers their full power of sound to become developed. Considering that there is no practical limit to the force with which a comparatively light hammer may be made to strike—except inducing objectionable weight of touch, also that sufficient force for any practical requirement may be obtained long before the touch becomes unpleasantly heavy—I think there can be no doubt that this method (which produces sounds of the greatest power and clearest quality) ought to be preferred.

3. Another method, which may be employed in conjunction with the above, is reducing the thickness of the covering of the hammers, or, what is preferable, covering them with harder material. Probably, there is not much further to be done in this way. I think it is already carried out pretty nigh as far as it well can be to advantage in ordinary English-made pianos, so long as their strings be not increased in thickness and length, in which case the hammers may be much harder than any we can employ to strike ordinary strings without inducing a disagreeable quality of tone. In this respect, many pianos of foreign make differ much from those of home production. Instead of, like most of the latter, having their hammers too hard, they are usually much too soft—at least in the treble—and most of them would be greatly improved by re-covering their treble hammers with thinner and harder felt, or even with doeskin leather, the tones produced by which I prefer to any I have yet heard produced by felt-covered hammers, but which material requires renewal too frequently to be suitable for general use. I may remark, however, the weakness of the trebles of foreign-made pianos—like the same defect in many of those home produced—is often caused by defects in the soundboard and in the action, as well as by the treble hammers being too soft.

Having thus pretty well exhausted every means which seems likely to be adopted in practice—excepting an improvement in the scale, for, I believe, extending the soundboard beyond, or, as in an upright piano, above the hammer line, as carried out by Godwin, Nosworthy, Alfred Wornum, and others—does not sensibly augment the loudness, however much it may improve the timbre or quality of the treble sounds of a piano, also dismissing Mr. Jenkinson's plan, on the ground that it must be too costly to execute and keep in order to be adopted for general use, not to mention that it can hardly be termed an improvement on the ordinary treble (it being, in truth, constructing two treble pianos with one action common to both, and placing them in the same case with one tenor and one bass piano), I now proceed to state what may be effected by altering the scale—*i.e.*, the lengths and thickness of the strings employed to produce sounds of given pitches.

Thalberg once said that, *cæteris paribus*, "the loudness of a pianoforte must be in proportion to the mass of matter we can put in motion to produce sound; doubtless, this is quite true within the limit "to produce sound," also that in practice that mass is only limited by the amount of force our fingers are able to impart to the keys of the instrument. Could pianists play on instruments with "tuppenny and threepenny touches" (see my article on harpsichord touches, p. 176, No. 371), which tuppenny and threepenny touches became sixpenny and ninepenny, *alias* six and nine ounces touches when the jacks plucked all the strings, simultaneously, they might put a very much greater mass of matter into sonorous vibration; but, I suppose, our fingers are not so strong as those of our forefathers, or even those of little Fanny Burney—the race is said to degenerate—so we can effect no useful purpose by augmenting the mass of the vibrating parts indefinitely. The force of a modern pianist's fingers is a limited quantity, which fact practically limits the mass they can put into sonorous vibration; and this, combined with the mechanical difficulties of executing modern pianoforte music, prevents us from making our piano-touches much heavier than the threepenny touch formerly employed on one harpsichord jack; in other words, we are limited to about 3oz.; nay, 2¾oz., or even 2½oz. touches, are generally preferred to 3oz., even in strong-handed Great Britain, and most continental pianists complain if the weight of touch exceeds 2oz., or 2½oz. at most.

This necessity for comparatively light touches also partly limits the number and thickness of unisonous strings which may be advantageously employed for a single note. The force of the blow being limited by the admissible weight of touch, it is, of course, quite useless to employ a mass of material in the form of strings greater than the blow can vibrate properly; consequently, even if pianoforte makers were not limited, as they practically are, by considerations of commercial requirement and practical convenience, from increasing the number of the strings for one note beyond three or four at most—I believe very few instruments have so many as four, even if made in France—they would soon arrive at the condition of failing to obtain any increase in the loudness of the sounds produced, because of the failure of the hammer's blow to vibrate so many strings properly.

So long as the number of strings be limited to three, there is no danger of being unable to strike them with sufficient force, both the actions engraved in No. 368 being quite able to do this, however long and thick we can make the strings. Indeed, long before the force of the blow could become too weak, relatively to the mass of three strings, the want of tensile strength of their material compels us to limit their length, and I fear the quite unavoidable consequent production of sounds of very unpleasant quality prevents us from very greatly increasing their thickness. Probably, wires from two to four sizes larger than those usually employed is quite as great an increase of thickness as can be allowed for treble strings; besides which, it should not be forgotten that every increase of length and thickness must be attended by a proportionate increase of rigidity, which soon more than compensates for any advantages increased length and thickness afford if the latter be carried to excess.

At first sight M. Thalberg's dictum might suggest increasing the superficial area of the soundboard in the treble, as well as increasing the length and thickness of the strings, and if *cæteris paribus* could in practice be maintained, it would be perfectly legitimate and probably successful, for our purpose to do this; but, alas! *cæteris paribus* cannot be maintained. Thalberg said "maintained in vibration," which a larger soundboard hardly can be if it cannot first be put into vibration, and that is just the thing very short strings cannot do. It is very easy to make your treble soundboard larger, at least beyond the bridge; but *cui bono*, if you cannot even make it vibrate (much less "maintain its vibrations"), at least not sufficiently for those vibrations to generate audible sounds; I fear we never shall be able to cause the necessarily short strings in the treble of a piano to induce the sonorous vibrations of its belly for any distance much farther than double the length of each string beyond each side of the bridge which supports them, or above and below that bridge in upright instruments; and, as any extension of the soundboard beyond that distance which the strings can (audibly) vibrate must be quite incapable of increasing the loudness, however much it may affect the timbre or quality of the sounds produced, we are soon practically estopped from increasing the superficial area of our soundboards in the treble by the utter inutility of doing it, consequently for the purpose of increasing the loudness of the treble sounds of pianos we seem to have no other resources than increasing the number, the thickness, and the length of their strings, and the force with which we impel the hammers which strike them. Practically, as commercial considerations prevent any increase in their number, we are reduced to the three latter methods.

How to carry out those methods I have given very full—perhaps it might truly be said very prolix—instructions in my articles on pianoforte actions in Nos. 338, 339, 367, 368, and 370, especially in those printed in Nos. 368, 369, and 370, illustrated by the engravings in No. 368, also in the illustrated article on an improved scale for the lengths of piano strings printed in No. 372. Regarding the latter I may, *en passant*, remark that the lengths shown in the figure are only two-thirds the full lengths of the strings from C above the lines to E, 30 semitones, so a workman, when making his gauges, will have to make each note exactly half as long again (both above and below the hammer line) as it is represented in the figure, which need not be a difficulty to the "skilled labourer." In that paper I purposely omitted specifying the thickness of the strings, because this must, in practice, be determined by the quality of the tone you desire to produce, and in this matter individual tastes differ greatly. For the same reason I omitted to specify the distance from the bridge at which I should prefer to make the hammers strike the strings; for this, again, ought to be varied according to the thickness of the strings (of any given length) employed to produce a sound of given pitch; also, perhaps, according to the number of unisonous strings struck by one hammer, for it is obvious the thicker and more in number the strings be, the more they must resist the blow a hammer of given weight, moving at a given velocity, can strike. That three strings whose total mass is fifty per cent. greater than the mass of two strings, must resist the same hammer's blow half as much again as two strings possibly can, is indisputable. Now, I see no possible method of even partly compensating for this increase of resistance—so long as the force of the blow be not augmented—but causing that blow to be delivered on a portion of the string which is less rigid, in other words, somewhat farther from the bridge.

Probably few persons who manufacture pianofortes for sale will be induced to string them so heavily as I prefer doing. I think they would prefer employing No. 17 wire for C above the lines, No. 18 for pitch C, No. 19 or 20 for middle C, and No. 20, 22, or 23 for tenor C, in which case, supposing the lengths of the strings of those notes to remain unaltered, it might be preferable, instead of causing the hammers to strike them at the same distances from the bridge, as I have specified below, that they should be struck at ⅞in., 1¼in., 1⅞in., 4¼in., and 7½in., therefrom.

For strings of the thickness I prefer using I have already stated the distance from the bridge I should cause the hammers to strike them, but to save the trouble of reference to back numbers—some of them rather far back—I again specify the sizes of the wires and the striking distances for the G and C's below the longest note in the scale printed in No. 372. Commencing at the top note E, I should employ wire of the sizes specified below:—

6 notes of No. 15		6 notes of No. 21
7 „ 16		5 „ 22
8 „ 17		4 „ 23
8 „ 18		3 „ 24
7 „ 19		2 „ 25
7 „ 20		2 „ 26

Assuming the instrument thus strung to be trichord down to fiddle G, I should strike its strings at the distances from the bridge specified below:—

C 8in. long, 1in. from the bridge.
(As shown in diagram p. 202, No. 372.)
G $10^3/_4$ in. long, $1^1/_4$ in. from the bridge.
C 15in. long, 2in. from the bridge.
G 19in. long, $2^7/_8$ in. from the bridge.
C 26in. long, $5^3/_{10}$ in. from the bridge.
G $35^1/_4$ in. long, $6^1/_2$ in. from the bridge.
C 50in. long, 8in. from the bridge.

Probably, it would be preferable to strike the strings of F♯ immediately below fiddle G, a trifle nearer the bridge than the distance this scale would afford, because that note having but two strings, each of which is only one size larger than those of fiddle G, might be a trifle deficient in firmness if struck so far from the bridge by an equally heavy hammer. Personally, I should much prefer that note to be strung with wire one size larger, say with No. 25, instead of No. 24, in which case it might be desirable to string the two lowest notes, C and C♯, with No. 27, also D and D♯, with No. 26 wire. If this be done, the striking distances for those notes may very safely remain unaltered, and, provided the hardness of the hammers be carefully regulated—in other words, the instrument's hammers be well "toned"—no offensive break in the loudness or quality of its sounds will be distinguishable where three strings are succeeded by two.

I rather think, Mr. Editor, that on the subject of pianofortes I have pretty nearly written myself out. Excepting the article on bracing and soundboard making which you have, and one on the various methods of tuning which have been employed, I don't think I have much more to say on this subject, so I intend to rest, and trust that yourself and my fellow readers will be thankful that these long-winded epistles which have extended over more than two years have nearly reached their terminus. Sooth to say, the subject of pianoforte improvement seems to the writer to be well nigh exhausted. However, should any fellow reader find a difficulty in understanding what I am but too conscious is very imperfectly expressed, I can only add I shall be most happy to afford them any assistance in the way of explanation—either through the columns of "our" journal or privately—which my small brains may enable me to give; also to reply to any questions, addressed either specially to myself or generally to my fellow readers, which my very limited experience will enable me to answer. A reply to the last of these, addressed to me by "H. D. W." (No. 11766), I have already written and will send soon.

THE HARMONIOUS BLACKSMITH.

INTERNAL RESISTANCE.—MANCE'S METHOD.

[4279.]—I HAVE to thank "Pi," p. 276, for describing this process, which I had overlooked, if even I had seen it. The process is good, particularly as it is applicable to other purposes; but for its special purpose it is scarcely so simple and convenient as the plan with a shunt given by Mr. Fitz-Gerald, which I should always use myself, if for no other reason than for this, that no calculation is required, and that the apparatus, once prepared, a single operation is all that is necessary at any after time, and the resistance of a single cell or battery is read off at once from the resistance instrument. Besides, in single cells it is important to have as small resistances as possible in the circuit, as the resistance sought must hold proportions to this, and the closer they approach in relative quantity, the greater the accuracy attainable.

SIGMA.

MEERSCHAUM.

[4280.]—IN answer to let. 4261, for meerschaum repairs, take a shank bone and make small tubes. Bore your pipe out with a twisted drill, and file your tube a nice fit; make that hot and cover with white wax or beeswax that all the oil has been pressed out of, and, heating the pipe, pass it through. This is the best and only way I have found to make a job of them, and if the joint is kept clean it will scarcely be seen. I have used this method for years. The pipes being treated to a bath of wax when manufactured, there is no way of cementing that ever I have found.

JACK OF ALL TRADES.

A SIMPLE METHOD OF HEALING WOUNDS.

[4281.]—I SEND, for the benefit of your numerous readers, many of whom often find some trouble in healing wounds from cuts, burns, &c., the following simple plan recommended by Dr. James Braithwaite, of Leeds, in the current number of the *British Medical Journal*. The plan is especially applicable to ulcers or festered wounds which have failed to heal by first intent through the entrance of dirt or some foreign substance. Dr. Braithwaite says: The application of an aqueous solution of carbolic acid (one drachm to eight ounces of water) to an ill-conditioned ulcer cleans it from all purulent matter, and causes it to assume a healthy red appearance, with each granulation distinctly visible. If a wound in this state be freely exposed to warm dry air for some hours, it becomes glazed and dried on the surface. It becomes covered by what is practically an impervious transparent membrane, closely applied to the surface of the granulations, and exercising a certain amount of mechanical pressure upon them. In many cases, no matter forms underneath this membrane, and cicatrisation goes on underneath it with great rapidity. In time, the membrane assumes the appearance of a thin dry scab, and drops off. If matter form under the membrane, it is at once visible through it; the lotion should then be reapplied, and the wound dried by exposure, as before. Immediately this is done, the inflamed edges of the ulcer commence to pale in colour, and in twenty-four to thirty-four hours have nearly the tint of natural skin. This treatment is especially of value in the cure of ulcers on the leg, as no confinement to bed is necessary; and what is required in the application of the lotion and subsequent drying can be done in the evening, after the conclusion of the day's work.

Disinfectant.—From the same authority I learn that Mr. T. L. Phipson, F.C.S., says: "The simplest, most effective, and most agreeable" method of disinfecting houses consists in spreading a little chloride of lime along the ledges at the top of every door in the house, outside the rooms. This, he says, should be done in the evening, and the next morning the whole atmosphere of the house will be found to have an odour resembling that of the sea. He says, when this odour is slightly perceptible it indicates that the disinfectant has been used in sufficient quantity. The reason for placing this substance upon the ledges over the doors is that the chlorine gas given off is a heavy gas, and falls to the ground.

I doubt, however, whether chlorine gas is given off unless the chloride of lime is treated with an acid. Some of our chemical contributors will perhaps say.

L. T. F.

AMATEUR ORGAN BUILDING.

[4282.]—WILL you find space for the following questions on amateur organ building. First, I want information to enable me to progress with my own organ; and, secondly, I am anxious to see whether it is not possible to make an altogether cheaper instrument than many of those advocated in the columns of the ENGLISH MECHANIC. I am half-way through a large organ—that is to say, for such a class of amateur as myself; my ideas being so enlarged by reading of the pedal bases, two rows of keys, swell box, &c., that it did not occur to me at the onset that a swell box really meant a case, say 6ft. × 3ft., × 4ft. 6in. high, of 1¼in. stuff, or that the mere fact of uniting principal as a stop instead of uniting coupler, meant the cutting of paper patterns for a week, and about 1cwt. of metal extra. I agree with Dr. Usher, now too late, that for the majority of amateurs a 4-stopped organ is quite enough. If the letter is too long, please omit it and insert the queries only.

Stockboards, or upper board, for an organ of C stops, soundboard 6ft. 1in. by 2ft. 8in.—I propose to make it in three parts, of 1¼in. pine or deal (mahogany cannot be afforded), as by so doing two stops can be placed upon each. How can I avoid the boards curling, as if braced with cross-wood, screws and glue they will perhaps curl? And a shifting brace like a drawing board I do not think will act upon a width of 11½in. Is it better to make it in three parts, with rack to each, or to make one board full size of soundboard to take all the pipes?

Will some of "our" readers send a few hints with a view of cheapening an organ, substituting (say) pine for mahogany. What can be the use of specifying 1in. or 1¼in. mahogany for a wind-chest, and covering that part of the soundboard not covered by the wind-chest with parchment? As both are subject to the same pressure, provided construction can be carried out, I conceive that the scantlings could be reduced to the strength of the parchment. Provided the middle board of the bellows is made strong and firm, say 1in. or ¾in. stuff, the bottom, top board, and frame of ¼in. stuff, why not make the ribs as light as possible, say ¼in. or ½in. pine, and covered with paper, or rag and glue, or perhaps of millboard, the object being to reduce the necessity for fine woodwork and expense? Is not the reservoir only an air-tight bag? I am a worker in metals and a draughtsman, but not a worker in woods, and thereby can be conceived the necessity to reduce the woodwork as much as possible.

Having got all the metal pipes to theoretical scale, what is the next operation before placing in the organ for voicing and tuning, and what are the lengths in practice? "J. D." gives 1in. shorter than the scale for a stopped wood pipe. If I so understand, this will give about 3in. or 4in. shorter on account of length of plug for the 12 basses CC to C. Is it the practice to voice and time the octives, and from these lengths to strike a new curve to cut the rest to?

DRAUGHTSMAN.

ELECTRICITY.—WHAT IS IT?

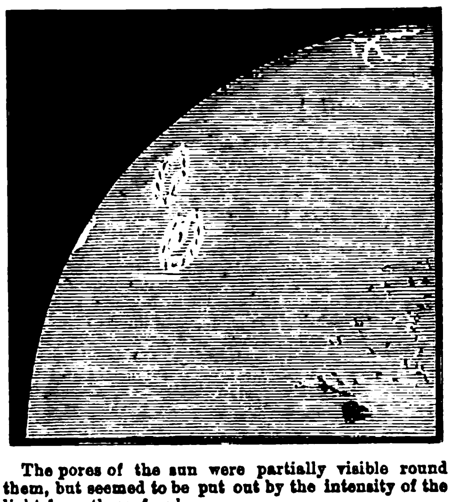
[4283.]—IN reply to Mr. Fitz-Gerald (let. 4251), I think he is peculiarly sharp on those who hold opinions contrary to his own with regard to electricity, for if I remember right, a similar letter to the one he referred to appeared in the ENGLISH MECHANIC when "Sigma" began his papers on electricity. I forget (if I ever knew) what theory Mr. Fitz-Gerald proposes to replace those which he claims to have upset, but if it had been a satisfactory one, and generally accepted, I cannot imagine that I should have been ignorant of it for so long.

The desultory nature of the first paper which Mr. F. complains of will, I am afraid, be shared by them all, though by the others, perhaps, to a less extent than the first; indeed, I could see no way out of it without increasing their length considerably.

Besides being very premature in his comments, I think Mr. F. is very much out of place in calling the paper ludicrous because contrary to his belief; for, in spite of his exhaustive investigations, which I have never seen and only once before heard of, many eminent philosophers still regard electricity as a force—indeed, the things he claims to have proved are directly opposed to the belief of some of our first philosophers (see "Tyndall on Heat," page 198), so that I certainly need not be *petitio principii*. B. THOMPSON.

SOLAR FACULÆ.

[4284.]—WHILE observing the sun at 6 p.m., on the afternoon of the 27th, I noticed two large and brilliant faculæ at the south-eastern part of the disc. They were then close to the edge, and consequently considerably foreshortened. The one farthest away from the edge was rather the larger of the two, but not so intensely brilliant as the second. I was at this time observing with a glass of 2¾in. aperture, and power of 80. On changing the latter for one of 200 I was instantly enabled to see further details. The upper one was composed of three masses, a larger one, and two much smaller, which were contained, as it were, by it. The second presented somewhat the appearance of a lunar crater, and the interior gave a fair idea of its floor. Both the faculæ were composed of small flakes, not unlike the feathers of a bird's wing. There was no spot in the immediate neighbourhood, and not one of any considerable size within 50,000 miles distance.



The pores of the sun were partially visible round them, but seemed to be put out by the intensity of the light from these faculæ.

It is worthy of notice that the shape of both of them was decidedly round, and there were no waves running sharply out from either, as is usually the case in large outbursts. I may mention that on the 26th, I had noticed a small patch of light in exactly the position these would have occupied had they followed the usual rotation. The annexed drawing will probably render the explanation clearer. PAUL W. WYATT.

Harpur-place, Bedford, May 30.

"THE HARMONIOUS BLACKSMITH'S" FUNNY FIRST FIDDLE.—To "F.R.A.S."

[4285.]—I BEG to assure "F.R.A.S." that he is totally mistaken regarding our relative positions—I was going to write in the scientific world; but, alas! instead of position I have not even the entrée. So far from I being head partner soliciting forgiveness, or rather advice from the Co., it is he who is certainly, at least, one of the heads of our scientific Co.—I mean cooperative for mutual instruction—journal. Hence, it is not at all surprising that the 'umble blacksmith desireth to "sit at the feet" of so scientific a Gamaliel as the "F.R.A.S.," who, although much the "Blacksmith's" junior, was, as the writer well remembers, devoted to the pursuit of science at that early period of "F.R.A.S.'s" life when it was my misfortune to be "earning my bread"—a thing "F.R.A.S." never had to do—by manufacturing and commercial enterprise, which, by the way, seldom sow the "seeds" of science.

I fear my rather long article on this fiddle is hardly clear; in fact, it can't well be if anything like a bridge is deducible. I never had any intention of employing a bridge proper, using that word to denote something on which strings rest, and which connects them with the soundboard. The piece of hard wood, 4½in. × 1in., which I proposed should be glued on the under surface of the soundboard, can hardly be termed a bridge, for it simply reinforces soundboard No. 1, and prevents it from becoming split between the holes bored in it for the reception of the strings, which I distinctly stated were attached to soundboard No. 1 just like those of a harp. Considering that, for facilitating performance, the strings cannot be far apart, it follows the holes for the strings must be bored pretty near each other, say as near or a trifle nearer than the strings of an ordinary violin are to each other on its bridge; consequently, if No. 1 soundboard be not reinforced, it would almost certainly be split by the tension of the strings.

The reason why I prefer placing the strings a trifle closer than usual is simply to bring the first string more conveniently within reach; were it not that there must be five instead of three strings behind it, closer spacing would be unnecessary. It will be noted that the first four strings are the same length (say 13in.) as those of the ordinary violin; consequently, the stopping will be as easy on my fiddle as on "any other man's fiddle," barring that to reach them we must reach over the two C strings, by which its compass is extended.

In regard to the length of the latter—to borrow the language *Punch* alleges Mr. Gladstone applied to Cerberus—I might have treated them "under three heads," more properly in three different ways. I could have made tenor C string, say, 14in. long, which is about its length in the viola. This would have required it to be "stopped" in planes differing from those of the violin to the same extent the "stops" are further apart in the tenor than they are in the violin. I might also have designed it the same length as the strings of a violoncello, thus making the CC string its usual length. Probably, doing this would produce the most powerful sounds of the finest timbre or quality; but as I didn't hope to rival Dragonetti or Bottesini, Lindley or Piatti, nor even to surpass my late friend J. A. Turner on the tenor C string, from which I have often heard him elicit sounds of great power, rivalling even those of the French horn in purity, I, like a true Englishman, chose a middle course; in a word, like all practical politicians, I accepted a compromise, and designed both the C strings only 2ft. long, which, assuming they be properly loaded so as to induce sufficient tension, will, I little doubt, afford sounds quite powerful enough for ordinary chamber music performed in the domiciles of her Majesty's subjects, who are oddly termed by Mr. Gladstone the upper middles; also in those of who might, quite as appropriately, be termed the "great middle middle class," for not many of their residences have rooms whose cubic capacity exceeds 10,000ft.

Why the holes in soundboard No. 1, which receive one end of each string, should be disposed on the segment of a circle of unusually small radius I cannot conceive. For anything I can see to the contrary, the radius of that circle may be quite as long as that of which the bridge of an ordinary violin is a segment. Provided the finger-board be posited somewhat nearer to the strings than usual, the radius of the arc might even be lengthened, because, so long as there be no danger of the bow touching other strings than those we desire it to act on, it would seem to be of little practical importance how flat the finger-board may be made, or how long the radius of the circle, on a portion of which the strings are disposed, may be. This appears to be a mere matter of practical convenience, and these considerations seem to me to dispose of the objection that my funny first fiddle would "necessitate a peculiar style of bowing." Were that objection well founded it would, in my opinion, be a very grave one. Although myself one of the "peculiar people"—I don't mean the religious (?) sect so-called, but merely an odd fellow—I yet, being also a rigid Conservative, deem all unnecessary departures from ordinary practice exceedingly unwise. Now, such a departure as necessitated the bowing of only one string at a time instead of (what we can now accomplish) the bowing of two strings together, would, I opine, be extremely objectionable, because it would deprive us of one of the greatest charms of good solo performance—to wit, the duet—although, perhaps, calling a duet rendered by one performer a solo seems rather Hybernian nomenclature. This deprivation would, however, be an abomination, which deserves to be accursed with bell, book, and candle, or even some yet stronger anathema, if such "great medicine" can (with clerical assistance, for priests are the principal manufacturers of curses, although lay assistance is often rendered) be prescribed and dispensed.

Probably, the fingering might, for a time, be "a bit of a puzzle." Any variation in the lengths of fiddle strings must be "a bit of a puzzle" to performers accustomed to their ordinary lengths. To render this puzzle as little complex as possible, I avoided designing the one or two thickest strings of the violin portion of my fiddle any longer than usual, although strongly tempted to do so by considerations of superior tone. Were the G and D strings made 2ft. long they would doubtless yield more powerful sounds of finer quality than they can do if limited to 13in. of length, even were they both loaded by wire wrapped round them—which, according to my experience, greatly improves both the power and the timbre of the sounds of the D string. Had I made them 2ft. long I fear my friend "Fiddler" and most of his fellow fiddlers would find their performances stopped by the "stops" on those strings becoming so much wider apart than usual and in different transverse planes to the stops on the A and E strings. It would, indeed, be very inconvenient to perform on an instrument which has two different scales within the compass of an ordinary violin. Of course, the same objection must apply, although with much less force, to making the two C strings longer than the G string; but I thought it preferable to encounter this evil—although it is far from an inconsiderable one—than the, perhaps, unavoidable consequence of bad tone, which, I fear, must necessarily result from the employment of C strings no longer than the G string. In this instance, as before, that true conservatism Disraeli has taught myself and the rest of the great Conservative party is "compromise."

THE HARMONIOUS BLACKSMITH.

SUN SCREENS.

[4286.]—WILL "A Fellow of the Royal Astronomical Society" allow me to point out that his suggestion (let. 4228, p. 278) in reference to smoking instead of silvering the field lens is not theoretically so perfect: indeed, the principle can hardly been said to be the same. They are both dependent on the effect of "minute solid particles, in the one case of carbon, in the other of silver," it is true, but the former act by absorption, the latter by reflection. The field lens would consequently be much warmed in the first case, and hardly at all in the second. With a large aperture, the heating of the field lens from this cause might be considerable, although the actual focus is formed some little distance beyond it. But there is another consideration—viz., that though a sufficient thickness of lampblack will undoubtedly absorb all light and much heat, yet a considerable portion of the heat is transmitted through it, as much, I think, as 38 per cent. for a film of ordinary thickness. The carbon particles are not by any means so athermanous as they are opaque, and I need not say that transmitted heat is unpleasant to the eye of the observer. In the case of a bright silver surface everything, heat as well as light, is reflected back and away up the tube again. I hope "F.R.A.S." will excuse my calling to the attention of his readers these to him well-known, though possibly overlooked, facts.

By the way, I remember that a short time ago one of your correspondents raised an objection to Mr. Berthon's plan of silvering the lens, on the ground that the reflected rays would converge and form a hot focus on the object side of the lens, which might produce a disturbance from convection currents. Eliminate the word hot, and the closing clause dependent thereon, and the sentence is correct; the focus is undoubtedly formed, but it is not hot. In the intense focus of an electric light, the air might be actually at a freezing temperature, while a piece of blackened platinum placed in it would be instantly rendered incandescent. If a substance does not absorb heat, it cannot be warmed by any quantity passing through it. Pure air is almost perfectly diathermanous, and consequently is quite unaffected by the passage of radiant heat, however intense.

A very striking experiment in proof, or rather illustration, of this is the following, devised by Dr. Tyndall. Take an air thermometer with a single large clear thin bulb, so sensitive that momentary contact with the finger will notably depress the column of liquid (I say *depress*, because in these instruments the bulb is at the *summit* of the stem). Place this in the rays of the electric light converged with glass lenses, so that the intense focus may be formed in the centre of its bulb. Although the glare is intolerable, not a motion of the liquid ensues, the rays pass through the air without communicating any warmth to it. As Tyndall observes, "A person on first seeing this can hardly believe his eyes." Of course, if the glass be slightly lampblacked, or even if a little tobacco smoke be introduced into the bulb, a most violent depression of the column is instantly produced.

SIRIUS.

IS LIGHT INVISIBLE?

[4287.]—JOHN HOPKINS (let. 4259) some time since saw an experiment described "to prove the invisibility of light." I presume it was the beautiful experiment shown by Professor Tyndall in his lecture on "Atmospheric Dust;" but our correspondent is not satisfied with the deduction therefrom that light is invisible, and proceeds very neatly to state the dilemma or "fix;" but I think he will find that the dilemma arises, as in most other cases, from an ambiguous meaning attached to one of the terms employed—in this case I think the ambiguity is in the word visible. If the visibility of light only meant that light proceeding from incandescent or reflecting bodies in the direct line of vision of the spectator excites the optic nerve and produces in the brain the sensation of light, then the visibility might be admitted. But visibility means more than this.

Before light can be pronounced to be visible, it must be shown that it can be seen in whatever line it is proceeding, even though that line should be vertical or at right angles to the line of vision. For instance, let the spectator stand in a square chamber, his back to the wall. In the wall on his right hand is an opening admitting the sunlight, which falls upon the wall on his left. He is conscious that the wall on his left is illuminated, because the light is reflected to his eye, and excites the optic nerve accordingly; but the light passing through the chamber from right to left is invisible. He may, perhaps, perceive a faint pathway of apparent light; but this would be only illuminated atmospheric dust. He cannot see the sunbeam, but only "the gay motes that people the sunbeam." Now, if a spray of water, or a jet of steam, or a cloud of smoke were passing from right to left, it would be visible, and would obscure the view of the wall of the chamber immediately in front of the spectator; but light in its transit is invisible, and the wall opposite is distinctly discerned, which it would not be if the light were visible; and it is well for us that light is not visible, if it were we might almost as well be blind, for we should see nothing else distinctly. I think we must conclude that although light is the exciting cause of vision, it is in itself invisible.

BOBO.

MAGNETO-ELECTRIC MACHINE.

[4288.]—IT has been asked from time to time through the medium of the ENGLISH MECHANIC how a magneto-electric machine can be constructed: although there are many contributors better able than myself to answer this question, I venture in a humble way to do so. The Figs. 1, 2, and 3, will assist me to describe its various parts. There are many kinds of magneto-electric machines, but the principle is the same in them all. Fig. 1 is a representation of one most commonly in use; A is a powerful horse-shoe magnet; B B are reels which are generally made of boxwood, on to which is coiled a quantity of moderately fine, insulated wire; in the centre of each reel is placed round soft iron, joined to C C, which is also soft iron; but as this part of the machine is the most difficult to understand, I will go more into details directly. D is the armature of the magnet A, made of soft iron, which can be moved to regulate the current. E represents a grooved wheel for the use of a gut band, communicating motion to another grooved wheel seen in Fig. 2, E. F is a toothed wheel running in another wheel attached to E, to increase

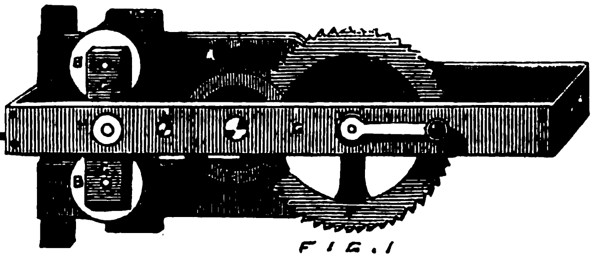


FIG. 1

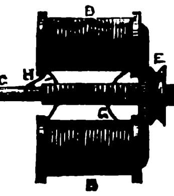


FIG. 2

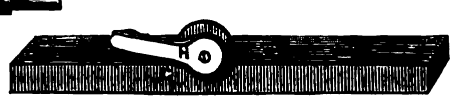


FIG. 3

its speed; a handle is screwed on the axis of F. G represents the framework made of brass to suit the requirements of the machine. I will direct attention now to Fig. 2; the secret of these machines depends materially upon the construction of the spindle which carries the reels of wire. D is a round piece of iron, filed flat on two sides at F, but not at the end beyond F. One part of the spindle is electrically insulated from the other, which may be done in the following manner:—Let a moderately-sized hole be drilled into D horizontally, and insert a piece of ivory or vulcanite; a hole is then to be drilled into the ivory to admit the thin part of the spindle C; care must be taken not to drill the hole in the ivory deep enough to allow C to touch D. The wire must be wound on the reels as follows: Each reel is filled separately, a length of wire must be left to come outside of each; let the wire in the first reel be wound on from right to left under the reel, and of course left to right above, but the second reel in an opposite direction; the two ends from the inside of the reels are soldered together not to touch D, then one of the free ends is soldered to D, shown at G; the other end to C at H which must not touch D. The reels when fixed in the machine are shown in Fig. 1. The C end of the spindle runs in a hole in a plate parallel with the magnet; the end F comes through H, which is a bit of box-wood fixed in plate G to insulate F from the other part of the machine. This leads me to explain Fig. 3, which shows the top and behind of plate G. H is a stiff spring screwed to the projection at the top of G, and made to bend to the back, that it may press on the spindle at F, Fig. 2, but the spring must not touch the flat sides. The machine complete is put into a suitable box, a binding screw goes through one end and into I, Fig. 1, another through the other end, but a spring must be attached to this, and not touch the machine except the F end of the spindle D, against H, Fig. 1. I think a little attention to the diagrams, &c., will give some idea how these machines are constructed, but it must be understood who ever constructs one should use judgment at every stage of his progress, as success depends upon exactness in every part.

J. THOMPSON.

"E. L. G.'s" COMET.

[4289.]—"HAVING no case, abuse the plaintiff's solicitor." "E. L. G." is getting out of temper, and therefore out of judgment, or he would not have written the first paragraph of let. 4239, p. 276, in which he ignores some of my arguments as though they were mere unsupported assertions, as is the case with too many of his own. He must remember, however, that if I replied to one of his extraordinary fallacies, "This is absurd," I did not do so as an *ex cathedrâ* condemnation, but gave the reason why it was absurd, a reason to which he has given no reply.

So also as to my argument as to the pressures resulting from the supposed fall of 10ft. per minute of water; he actually goes so far as to falsify my argument by saying that I "invent some unknown law whereby water that fell on land would not remain thereon long enough to press it." I did nothing even resembling this, but pointed out the self-evident fact that if the earth is coated with a mere elastic film, which "E. L. G." asserts would be disturbed by this pressure, then the water falling all over the surface would press *equally* on sea and land, and therefore not produce the result stated, but would produce the opposite as soon as the water ran off the land. Nor is it at all reasonable that "E. L. G." should foist his responsibilities upon me by asking how I got the water back from the sea. I never put it there, I do not believe it ever was there, but as "E. L. G." asserts that it was, and in quantity sufficient to cover sea and land, it is for him to show how the drainage was effected. I see how he means to do this; he proposes to lower the sea bed, and so make a cavity, and to raise the Andes, Himalayas, Alps, and other great ranges, so making space for water. But, as he tells us he is the "defender of natural law versus miracles," he must show where the force came from to effect this. He has brought the water in a comet, and so arranged things that the whole earth is submerged; it is, therefore, on his showing a mass of fused minerals covered with a film of solidified materials, and again by a stratum more or less deep of water, of course in the form of a spheroid of rotation. Now, what new force disturbed this condition of equilibrium, depressing one portion and elevating others of the covering film? Ordinary earthquakes and volcanoes may be accounted for by gradual cooling and contraction of the mass, but not this sudden and enormous change.

Again, "E. L. G." permits his wrath to overmaster the most ordinary courtesy, when he ventures to say he "does not believe" Roscoe or Huggins made a remark I quoted, and the source of which I named, copying and giving it as a verbatim extract. The words will be found on p. 253 of the first edition of Roscoe's "Spectrum Analysis;" nor can I see that, whether Roscoe was playing the buffoon or no in making the statement, I was doing so in quoting it in reply to the ridiculous assertions and baseless assumptions with which "E. L. G." fills page after page.

One would really suppose that those who object to this cometic dogma were a mere ignorant minority; that no one who really knows "the chief points yet discovered respecting comets, the earth, and the properties of fluids," can possibly require any evidence in support of it, for with charming *naiveté* "E. L. G." remarks, "No one so acquainted *would*, I conceive, ask for proof of anything so obvious." But as "E. L. G." also says he stands "alone, unless Mr. Gosse or some other physicist likes to help" him, therefore, it is evident that "E. L. G." is alone acquainted with these discovered laws. That *is* the case; the comet is his own discovery, unless he got it as a legacy from Whiston.

Now, "E. L. G." commenced this discussion at p. 91, with a characteristic threat of demolition to every one not inclined to adopt his views, and with a distinct promise to "show that every kind of evidence that could be fancied on this point exists. There is no conflict of evidence; all is harmonious." I have just measured the space he has taken up—just 11½ columns; and having given us one evidence (as he considers it, but no one else)—viz., the rounded form of hills and "sweep vales;" he again tells us "there is abundant evidence of a *steam* comet-fall 50 centuries ago, but not one of gas, for at least many thousands." Now, if there is *any* evidence either of the occurrence or the period, let us have it, in as few words and as plain a statement as "E. L. G.'s" peculiarities will permit—but let us have nothing else. I protest against page after page being filled up with magniloquent phrases meaning nothing. It is almost impossible to discuss the subject at all without shocking many people's feelings, and possibly injuring some people's faith in matters of first importance, but it is quite impossible to discuss it in the absence of a single particle of evidence; and, for my own part, these are my last words upon it, at all events till some evidence is forthcoming, as I have no wish to have a mere sparring-match with "E. L. G.," which is very much like fighting a cloud.

SIGMA.

"E. L. G." AND THE PROOF OF THE DELUGE.

[4290.]—I TOO would wish heartily to thank "E. L. G." for his excellent letters on this subject, though I feel my doing so may expose me to our "F. R. A. S.'s" sneer, and to our friend "Sigma's" scorn. But I am one of those old-fashioned people who have not yet been so far "educated" as to have come to regard the Deluge as a "myth," a "grand old legend," and its recorder, though "learned in all the knowledge of the Egyptians," as no more than "a semi-barbarous Hebrew." But, then, I am only an Irishman, trained in the Irish University of good Queen Bess, where the professors, as a rule, do not swallow all Lyell. This may be my misfortune; but, be that as it may, I have not given up "the tales of my childhood," and though I do not go with everything

"E L. G." says, I think there is a great deal in what he has brought forward which no one has as yet proved false, or shown to be less likely than what they would themselves substitute.

"E. L. G." is right well able to cope with either "Sigma" or "F R. A. S.," who, I regret to think, consider all who differ from their dicta as regards a flood 5000 years ago to be "playing deliberately into the hands of the infidel and scoffer." I cannot see how this need be, and, therefore, I venture to point out one or two weak points in "Sigma's" answers, as it appears to me, and trust he may reconsider what he has written, or found his objections on something else.

In "Sigma's" letter (4086, p. 196), he finds objection to "E. L. G.'s" illustration of the effect of rain in forming "furrow vales" in the earth, and says that its effect on a heap of clay is not at all applicable to the form, past or present, of the earth's surface—for that if any thing is certain it is this, "that the original condition of the earth was not that of a mass of clay, mud, or sand," that "clay, mud, and sand are the products of the wearing away of old solid rocks, and are again passing into solid rock."

Now, from this one would suppose that "E. L. G.'s" theory was based on the supposition that at the time of the flood which he contends for there were no rocks, that the earth was only a lump of clay, sand, and gravel. Starting, then, with this unfounded supposition, which he seems to wish to father on "E. L. G.," he proceeds to smash it to bits, and tells us that the effect of "E. L. G.'s," comet on this earth (which he "Sigma" has made for himself) "would be to reduce it to a true spheroid of rotation covered with water over its whole surface."

Now I have read very carefully all that "E. L. G." has written on this subject, and it seems to me he has never once given ground for such an unfounded supposition to be attributed to him, and has in more than one place stated that it is the "drift gravel," or "boulder clay" (let. 4157, p. 226), the then loose earth or disintegrated rock, which he believed the Deluge had formed and alone could form into "sweep vales."

A flood could not in a few days or hours smooth down a hard jagged rock, and make it into a gentle sweep, but it might gather around it and over it a mass of mud, sand, and gravel, and thus form a gentle slope. If any one doubts this let him walk along the bank of a river where there has lately been a flood, and he will see so many instances of its effects in forming of mud, sand, and gravel, sweep vales and sloping hills in miniature, that I will venture to say he will not regard a flood which once covered the whole earth at the same time as a mythical event, but rather as the most natural way of explaining the numberless facts he cannot shut his eyes to.

"Sigma" seems to think it a more rational explanation to believe that there were a number of local floods—which to produce the effects must have been greater than any recorded in profane history or in the memory or experience of later times, and these great local floods "constantly happening" (let. 4086, p. 196)—than to believe possible the one great flood recorded in a book which some still regard as divine, and of which one flood there is traditional record more or less distinct found amongst all nations even the most barbarous, and not amongst the merely "semi-barbarous Hebrews."

"Sigma" (let. 4193, p. 252) says a mass of water falling over the whole surface would do the reverse of what "E. L. G." states—*i.e.*, the sinking of the highlands, and rising of the sea beds, or as records call it, the breaking up of all "the fountains or foundations of the abyss."

Does "Sigma" forget the little but important fact, that the general surface of the land is somewhat above the sea level, and therefore, though the water might run into the sea, it could only do so if the land did not sink under the weight of water, which, because of the difference of level would first fall on it? The question, then, is, would there not have accumulated on the land and into the hollows a weight of water sufficient to entirely overturn the balance before a single drop had fallen on the sea. I think there is no doubt "E. L. G.'s" comet would effect what he contends for, and not the reverse.

Now, does "Sigma" think that he is arguing honestly for the truth when he says "the 10ft. on the area of the land would be balanced by the 10ft. per minute on the sea"? Is he so poor a mathematician as to think that the water will run as quickly off an inclined plane, and at the same time do the work of transporting mud, sand, and gravel, uprooting trees, shrubs, and everything, and carrying them along a winding course, and yet only take the same time as it takes to fall through the height of the inclined plane—*i.e.*, in other words, does he believe that there would be accumulated on the land no more than 10ft. water, by the same time there was 10ft. on the sea? How else could the 10ft. on sea balance the 10ft. on land? It would have to balance many times 10ft. on the land.

"Sigma" has only to look again at his reasoning in letter 4193, and he will see he is all wrong, and that a mass of water falling over the whole surface would certainly increase the pressure on the land more than it would on the sea, and first on the land.

Let us take "E. L. G.'s" rainfall of 10ft. per minute; there are, I imagine, many inland plains or valleys, call them what you like, and of large extent, whose level is some thousand feet above the sea. Now the rain which fell on the highest mountains would run down into these valleys and then form lakes, and thus there might be concentrated at one point on the land a pressure many hundred times greater than it had to bear but a minute before, and this might and would in certain places be the case before a drop of rain had fallen on the sea. Of course, till the land began to sink, the water would tend to run off; but still it would be retarded sufficiently to form the elevated lakes I have spoken of. But further, even let us suppose that the rain began to fall on the sea at the same time as on the land, or at a period of time so shortly after as to be inappreciable; and so if it were possible to have 10ft. on sea balancing the 10ft. on land, it would not have the effect "Sigma" supposes, for 10ft. on the sea surface would be equal to the pressure of a column of water 10ft. high distributed equally over all the bottom of the sea, and this it could bear without any sinking. Now, in the second minute, 10ft. more would be added to the pressure on sea's bottom, but it would be equally distributed—it would not be 20ft. at one place and 60ft. or 100ft. at another; it would be 20ft. plus whatever in the second minute might have run down off the land, which would not be more than a foot over the whole sea, if it would be so much. But what state of things would obtain on the land at end of the same second minute? In many places there would be an increased pressure of many hundred times greater than it had to bear but a moment before, and under this it might begin to yield, and if it once began it would take some time to stop it and set it going in the opposite direction. "Sigma" may know this from his chemical balance—if he puts too much in one scale and it begins to descend, a greater weight in the opposite scale will not at once make it commence to rise again. Thus the land would first sink, and could only do so by raising the bottom of the sea, whose waters would rush in on the lands, and thus help to flood and sink them. Derf Errac.

P.S.—I trust "E. L. G." will give us some more proofs. He has many a one who sympathises with him in his desire, in this and other matters, to have the truth known and acted on. Let him manfully, yet humbly, fight, and the victory will not be uncertain, though, perhaps, delayed. If he were not so well able to hold his own against all comers, more friends would speak out. Till help is wanted, it is oftentimes better withheld. D. E.

THE DELUGE.

[4291.]—While endeavouring to avoid infringing the law laid down for the exclusion of theological discussions (a law which, however, I much regret, as I long to break a lance with several of your correspondents), I wish to address a few words to "E. L. G." on the subject of his recent letters on the Deluge. Why does he give himself the trouble of trying to explain such an impossible phenomenon as a universal Deluge, deep enough to submerge the hills all over the earth, when there is at hand a far easier solution of the question? There had not been time enough since the Creation for men to have spread themselves very far from their first dwelling place, and, in all probability, their wanderings were confined to the level valleys, where the existence of themselves and their herds could be maintained with little or no exertion; therefore, what is more natural than to suppose that the Deluge, which was really universal as regards man and his possessions, should have been only partial as regards the whole earth? Provided that it accomplished the destruction of every human being, this awful instrument of the Divine wrath had done its work, and further ravage was unnecessary. God's wisdom in adapting means to an end will not allow us to suppose that in order to destroy man, He drowned the whole earth, where man had never yet come. We may, therefore, conclude, until it is proved to the contrary, that the Deluge was not universal, but partial, and confined to those regions inhabited by man.

Apologising for having occupied so much of your valuable space with these notions of mine, I leave "E. L. G." to explain to us what became of the water from his comet, and when that is satisfactorily done, how specimens of all the creatures of the earth could have been got into the Ark and preserved from destruction. If he cannot do this his theory falls to the ground. Vertumnus.

MORE PROOFS OF THE DELUGE.—II.

[4292.]—"As lakes and river systems," says Darwin, in his famous work on "Natural Selection," chap. xii., "as lakes and river systems are separated from each other by barriers of land, it might have been thought that fresh-water productions would not have ranged widely within the same country; and, as the sea is apparently a still more formidable barrier, that they would never have extended to distant countries." Certainly that seems, on any Lyellist view of Geology, very obvious. Of the three mansions of terrestrial creatures, land, sea, and fresh-water, the second alone has free connection round the globe, or over most of its face, having but a few detached outliers, as the Caspian and minor salt lakes. The first, the land, is mainly in two masses, but neither exceeding its half, and the outliers (of which our Britain is only about the twelfth largest) vastly more numerous than those of salt water. But the fresh-water mansion, widely different in plan from either, is in countless thousands of separate chambers, the largest barely holding a fraction of a tithe of it, and all of them as separate and permanently inaccessible now to their inhabitants, each from each, even when as near as the Thames and Medway, as are the earth and moon. Assuredly, few things could be plainer than that as long as "causes now in action" were uninterrupted, the mansion most uniformly stocked must be the sea; next to it the continents, and possibly some or many islands to which their land creatures and plants (or eggs and seeds of them) might be occasionally carried on driftwood, by birds, or even on ice; but that the fresh water, in its myriad isolated systems, each locked up in its own valley, must have the diverse, localised and peculiar stocks. Now hear Darwin proceed:—"But the case is exactly the reverse. (!!!) Not only have many fresh-water species, belonging to quite different classes, an enormous range, but allied species prevail in a remarkable manner throughout the world. I well remember, when first collecting in the fresh waters of Brazil, feeling much surprised at the *similarity* of the fresh-water insects, shells, &c., and at the *dissimilarity* of the surrounding terrestrial beings, compared with those of Britain."

"With respect to plants," he adds, "it has long been known what enormous ranges many fresh water and even marsh species have, both over continents and the most remote oceanic islands. This is strikingly shown, as remarked by Alph. de Candolle, in large groups of terrestrial plants, which have only a very few aquatic members; for these latter seem immediately to acquire, as if in consequence, a very wide range." That is, in such a group or family the majority of the members, those of *dry* habitat, with their free run of all their continent's uplands and connected frame, these are all *localised*; but the *fewer* branches of the family that need marsh or even constant water, and so are locked in by hills, each to its particular vale or basin, "these latter seem immediately to acquire, as if in consequence (!), a very wide range," or "enormous ranges, both over continents and the most remote oceanic islands"! !

Now, surely, if "the distribution of living beings" is to prove anything at all (as "Santalinus" and your other correspondents tell us it must, though I have demolished any connection between their facts and their dogma about deluges), here is a startling world-wide class of facts, according to Darwin and De Candolle, than whom I know of no higher "authorities" on this distribution, that must go to prove *something!* The trouble taken by Darwin, as detailed in the rest of that chapter, is truly worth reading. Nothing less could impress on minds like our "F.R.A.S.," M. Paris, "Osa," &c., the transcendent irreconcileableness of the above general facts with his baseless Lyellian dogmas All these elaborate experiments with duck's feet, &c., to prove what? Only barely to make out a *possibility* of some *occasional* transfer of fresh-water seeds or ova from one country to another over sea, or over hills (though the latter, indeed, the commoner problem, is not solved at all)—a bare chance of *some* fresh-water organisms happening now and then to obtain diffusions approaching or distantly imitating what is general to most of the sea and dry land ones. This is the utmost the experiments establish (if so much), when, by Darwin's own account, as you see above, the thing to be explained is not a diffusion of *some*, nay, not even of all or the generality of fresh water species, partly, or even quite *as well* as most sea or land species; but a diffusion of them as a *general rule*, *wider* and over *more* "enormous ranges" than the sea and land ones!

In short, if such things are evidence at all, while there is absolutely *no* evidence of all or the generality of *land* having ever, in any geologic period, been connected, or even the whole of the salt waters having been so, it is quite otherwise with the fresh. There is just *all* the evidence the nature of the case would seem to admit of, that the *fresh* waters have been connected, and this in quite the modern geologic period, that of the existing (not extinct) plants and animals. No shadow of evidence, indeed, for any of the many "partial deluges" of "F. R. A. S.," and others—(can none of the geologers, by the way, tell us the limits of even the very last? I do not even ask for the last but one of these deluges)—no single fact for any one of these uncaused and, as far as they have shown, sheerly *miraculous* deluges, baseless myths of their imaginations; but, on the other hand, *all* the evidence that could well be imagined (consistently with known laws) that once, in recent ages, a layer of fresh water has covered both our continents and oceans at once.

And so, if it be known, as M. Paris tells us, p. 255 (but it is still unknown to me), that mere freshets of Indian rivers kill "millions of sea fish," then, probably, their mourner has to mourn the death, at that deluge (the sole traceable one), of still more of his marine friends; unless there be reasons (as there may be plenty neither known nor knowable) for a vertical accession of fresh water killing fewer than a lateral. But whether more or fewer, billions or tens, I fail to trace any connection of their deaths with our argument.

Now, being in this twelfth chapter of Darwin, we may as well quote his other grand puzzle, that of the beings on "oceanic islands." First, he tells us, "The species of all kinds which inhabit oceanic islands are few in number compared with those on equal continental areas. Alph. de Candolle admits this for plants, and Wollaston for insects." Of this he proceeds to give very striking examples; all New Zealand, for instance (equal in extent and climates to Italy and Sicily together), having fewer species than a bit of most continents of a hundredth its size and but one uniform climate—nay, than a civilised isle as small and uniform as Anglesea! This *fewness* of species (in either kingdom) on each single pelagic island, and, moreover, their *separateness* on islands even within sight of each other (which astonishes Lyell in the case of Madeira and Porto Santo, two very ancient isles, long, long ante-Noachian)—these two facts, especially coupled, as he says, with great *similarity* in their fossil extinct species, are two quite general facts, for which neither he nor any of his school have suggested the slightest explanation; indeed, have tacitly quite given it up; though, of course, there *is* a theory, that of the "semi-barbarous Hebrews," that so obviously fits pat into both, that it would be an insult to the common sense of your readers to give its explanation of either.

The same, of course, applies to the following of Darwin's *facts*—"Oceanic islands are sometimes deficient in animals of certain whole classes. . . All such differences in number, and the absence of certain whole groups of animals and plants on islands are generally accounted for" (*i.e.*, said in other books to be so) "by supposed differences in their physical conditions; but this explanation is not a little doubtful. With respect to the absence of whole orders of animals on oceanic islands, Bory de St. Vincent long ago remarked that Batrachians (frogs, toads, newts) are never found on any of the many islands with which the great oceans are studded. . . . This general absence of frogs, toads, and newts, on so many oceanic islands cannot be accounted for by their physical conditions. Indeed, it seems that islands are peculiarly well fitted for these animals; for frogs have been introduced into Madeira, the Azores, and Mauritius, and have so multiplied as to become a nuisance. . . . But why, on the theory of creation, they should not have been created there, it would be difficult to explain." Certainly, I agree with the eminent naturalist, very difficult indeed! especially as it seems plenty of fossil extinct species of such absent orders *did* exist even on islands!

"Mammals," he proceeds, "offer another and a similar case. I have carefully searched the oldest voyages, and as yet I have not found a single instance free from doubt, of a terrestrial mammal (excluding domesticated animals kept by the natives) inhabiting an island situated above 300 miles from a continent or great continental island; and many islands situated at a much less distance are equally barren. . . Yet it cannot be said that small islands will not support at least small mammals, for they occur in many parts of the world on very small islands, when lying close to a continent; and hardly an island can be named on which our smaller quadrupeds have not become naturalised and greatly multiplied. It cannot be said on the ordinary view of creation" (what on earth is the ordinary view of creation?—I am at a loss to conjecture) "that there has not been time for the creation of mammals; many volcanic islands are sufficiently ancient." (! ! !) What precise antiquity this requires, I cannot find the learned creationist to have anywhere told us. According to Milton, the only other authority at hand, not a great period:—

> The grassy clods then calved; then half appear'd
> The tawny lion, pawing to get free
> His hinder parts.

But Darwin proceeds: "Although *terrestrial* mammals do not occur on oceanic islands, *aërial* mammals *do* occur on almost every island. Why, it may be asked, has the creative force produced bats, and *no other* mammals on remote islands? On my view this can be easily answered, for no terrestrial mammal can be transported across a wide space of sea, but bats can fly across." Certainly, that is a ready explanation on *one* view, but I was not aware Darwin's view was the one to yield it. "No terrestrial mammal can be transported across a wide space of sea"! But what need, O Darwin, on *your* view, to be *transported* to the island any more than bats? Why not be *developed* there? Since *you* say, "it cannot be said there has not been time," and "many volcanic islands are sufficiently ancient, as shown by the stupendous degradation which they have suffered, and by their tertiary strata." You explain indeed "easily" (and by nothing peculiarly Darwinian) the presence of the bats, but not the larger fact, the absence of all the other mammals!

But we have not exhausted, we have not yet come to the climax of, Darwin's diluvian proofs. "He who admits the doctrine of the creation of each separate species will have to admit that a sufficient number of the best adapted plants and animals have not been [later edition, "were not"] created on oceanic islands, for man has unintentionally stocked them far more fully and perfectly than has Nature" (later edition, "than did Nature"). Assuredly! Then you see, Nature, or Creation, or natural Selection (which ever of the three terms you prefer), if acting in regard to islands, has been a stupendous blunderer indeed! Widely different from what it has done on continents, and in seas, and even the now infinitely separated bits of fresh water, more numerous and even smaller than islands on the whole! Just observe! In one or two centuries only, our ships merely happen, by blind chance, to carry into most islands, plants or animals so vastly fitter to their physical conditions than the native species that have been there, according to Darwin's present faith—faith in the Lyellian priesthood—for thousands of centuries at least, as to starve out, crowd out, and exterminate, in a single century, these ancient, million-year-settled possessors of the soil! Oh, blundering natural process! With all this unlimited bank of "Time, time, time" (as Scrope hath it), to draw upon, natural selection is unable (according to the very prophet thereof), unable in all these million ages, either to develop *in*, or get *into* these islands, a stock half so fitted to them as man unintentionally (*i.e.*, man's ships, by pure chance) happens to introduce in one short century!

And this same process observe, infallible, as all admit, in stocking regions where it once *operates*, even for a generation or two! A crux indeed for Darwin, under Lyellian bonds, all this insular misdistribution! But taken in connection with all else, with the uniform age of deltas, and waterfalls, and peat-bogs, the universal diluviation, the flood-scoured surface, the boulder-drift, swept and lodged in every isle and every river-vale alike, the iceberg-dropped trains of "grey wethers," and other erratic blocks—what can be plainer? Between land and land, *no* such cause as natural selection, no *regular* or *continuing* cause, *has operated* at all in the present distribution of life. It is found, as regards islands, to be mere *mis*-distribution; therefore, the work of nothing regular or long continued, but of sheer *accident*, the sudden accidents of some quick, sharp, sudden catastrophe.

E. L. G.

A BATCH FROM MR. BOTTONE.

[4293.]—(4265.)—SULPHUR AS A BLEACHING AGENT. —Sulphurous acid and its congeners are powerful reducing agents, but they require certain favourable circumstances to bring their deoxidising powers into play. Sulphurous anhydride *cannot* of itself absorb oxygen from the air, but in contact with steam and an oxide of nitrogen it does so readily. A strong solution of sulphurous acid in water is tolerably permanent, *if air be excluded*, but after the lapse of some weeks part of the water is decomposed, hydrogen is set free, and sulphuric acid is formed, thus:—

$$H_2SO_3 + H_2O = H_2SO_4 + H_2.$$

The presence of organic matter seems particularly favourable to the production of this effect, and in many cases the organic matter absorbs the hydrogen liberated. Cases however occur in which the hydrogen is *not* absorbed. It by no means follows, however, that the result of the deoxidation is *insoluble*, as "A. E. S." seems to infer. The following equations may be acceptable, as illustrative of the effect of sulphurous acid in several cases:—

$$\overbrace{2C_8H_5NO}^{\text{Blue Indigo.}} + \overbrace{H_2SO_3}^{\text{Sulphurous Acid.}} + \overbrace{H_2O}^{\text{Water.}} = \overbrace{H_2SO_4}^{\text{Sulphuric Acid.}} + \overbrace{C_{16}H_{12}N_2O_2}^{\text{White Indigo.}}$$

$$\overbrace{C_{20}H_{19}O_3}^{\text{Rosaniline.}} + \overbrace{H_2SO_3}^{\text{Sulphurous Acid.}} + \overbrace{H_2O}^{\text{Water.}} = \overbrace{H_2SO_4}^{\text{Sulphuric Acid.}} + \overbrace{C_{20}H_{21}O_3}^{\text{Leucanaline.}}$$

$$\overbrace{2C_4H_2N_2O_4}^{\text{Alloxan.}} + \overbrace{H_2SO_3}^{\text{Sulphurous Acid.}} = \overbrace{H_2SO_4}^{\text{Sulphuric Acid.}} + \overbrace{C_8H_4N_4O_7}^{\text{Alloxantine.}}$$

NEW METHOD OF OBTAINING POTASSIUM (p. 273).—This is by no means a novelty. In 1865, while at Novara, I prepared both potassium and sodium by the action of iron filings on the respective sulphides. The mode of operation quoted last week is, however, far from being the best. I found that a straight gun-barrel, with the nipple plugged, and inclosed in fire-clay, is the best retort to be got. This is charged with the alkaline sulphide and iron filings, laid transversely in a furnace, while a short U-shaped tube, carrying a globule of mercury, and fitted with a cork, is kept in readiness. More than three-quarters of the gun-barrel must project from the furnace, and be kept cool by artificial means. When the body of the gun-barrel has attained a cherry red heat, the bent tube and cork is to be inserted into the cold end of the barrel. The heat must now be increased and kept up for about an hour. The glass tube may now be corked and the gun-barrel allowed to cool. When *quite* cold the mercury tube is to be removed, and the potassium, which will be found condensed at the cool end of the gun-barrel, quickly removed by a bent scraper, and preserved under naphtha. If the heat be sufficiently high all the potassium will be expelled from the sulphide.

S. BOTTONE.

ANALYSES FROM GEORGE E. DAVIS.

[4294.]—I DARE say "S. S.," who inserted a query in the ENGLISH MECHANIC some time since, must have thought I did not mean to reply, seeing that I had let such a long time slip over without taking any apparent notice. I promised to perform the analyses when I had sufficient leisure, and now that time has arrived, I hasten to publish the results, so that "S. S." may publish the analyses he has received from the "leader" already spoken of.

A qualitative analysis only has been made, and therefore to say how the bases and acids are combined would be simply an absurdity. I give them separately; but if "S. S." particularly requires a qualitative analysis made, I will do so for a consideration, which, in the present instance, will be rather high.

To proceed with the bottle marked "No. 1 Liquid," I found as follows:—*Acid Radicles*: Chlorine, phosphoric, sulphuric, carbonic. *Basyls*: Aluminium, sodium, trace of iron. *Neutral Substances*: Water, with a very small quantity of a fatty acid.

The following is the analysis of the liquid contained in the bottle marked "No. 2 Liquid:"—*Acid Radicles*: Chlorine, hyposulphurous, sulphuric, carbonic, phosphoric, silicic. *Basyls*: Aluminium, sodium, potassium, traces of iron. *Neutral Substance*: Water.

The tin canister containing a paste, and labelled "Composition Paste for Analysis," gave, on examining the contents, the following result:—Partly decomposed organised substance, sodium humate, with traces of copper sulphate.

Having now given the results of the qualitative examination, I should like to know what my friend "W. R." has done. I should like him to write me personally, especially if "W. R." should happen to be "R. W." GEORGE E. DAVIS.

Radcliffe, near Manchester, May 30.

AN IMPROVED BEEHIVE.

[4295.]—THOUGH "Bee-Keeper," in his interesting letter (4187, p. 251) does not expressly say so, no doubt one reason for making the sides of his hive so thick and durable is to protect his bees from cold, which is advantageous not only to save them from danger, but for economy of food. Mr. Pagden, of Alfriston, in his clever little book, called "£70 a year: How I Made it by my Bees," says at p. 29 that he has proved by weighing hives containing few and many bees that nearly as much honey is consumed in winter by a small as by a large number, a fact mentioned by many writers, though "no one," he says, "has been able satisfactorily to explain how this mysterious fact is to be accounted for."

Though it is unsafe to conclude that a general rule is established by one experiment, however apparently satisfactory, I believe that it is true that many bees in a hive do require much less honey in proportion to their numbers than few, and that the explanation is that when many are together they keep each other warm with less proportionate consumption of food as fuel (which honey chiefly is) when not used up in the secretion of wax. It is well known that all animals eat less whenever they are less exposed to cold, and bees when warm and not needing wax require but little heat-producing food. If this be the correct explanation, it follows that hives should be very well protected from cold in winter, and fortunately the same means will be effectual in protecting them from heat in summer if sufficient ventilation be provided for, but they will at all times need a great deal more air than "E. L. G." queerly thinks enough for us—namely, "just as much as is breathed, neither more nor less," and if they do not get far more, they will soon want none at all, neither should we if silly enough to confine ourselves to his allowance.

I do not know whether the experiment has ever been tried, but it is, I think, worth trying, if it would not pay to reduce the consumption of honey by bees in winter, by very gently warming their hives, or the air entering them artificially. It would have to be done very cautiously, lest warmth should stimulate them to unnatural activity. Possibly some of your correspondents may know if the experiment has been tried, and with what result. I know that hives are sometimes warmed to remove damp, but can heat be used to save food? PHILO.

REVOLVING PUDDLING FURNACE.

[4296.]—THE question as to Mr. Danks being the original inventor of the revolving puddling furnace will from present appearances have to be decided in a court of law; but as to who has the credit of perfecting the invention there is no doubt Mr. Danks is entitled to it. A similar manner of puddling was tried years ago at Dowlais and failed; since then Mr. Danks informs the trade that he has succeeded in what the Dowlais Company failed in, which in a great measure he has done by using a new description of "fettling." This has been proved by the commission sent out by the Iron and Steel Institute (of which "G. S." seems inclined to speak disparagingly), one of the leaders of the commission being from the very place where the invention was originally tried. If Mr. Danks's invention is adopted generally, and the economical working which is claimed for it proved to satisfaction, then the Steel Institute has performed a service for this country, which, perhaps, "G. S." may probable in the future acknowledge. Trevithick invented and patented the first locomotive made, but George Stephenson made the locomotive a success.

The remarks of "G. S." about the new Institute are very undeserved; they are doing a good work, which is acknowledged by foreigners of the highest distinction in the iron trade, such as M. Schneider and others; and as to his remarks about "gushing votes of thanks from lordly lips," when "G. S." can benefit mankind by writing such an inaugural address as the late noble President did at the first meeting of the Institute, he will be listened to as an authority. "G. S." must remember he belongs to an honourable profession, which deservedly boasts of an institute in connection with it similar to the Iron and Steel Institute to the iron trade.

A MEMBER OF THE IRON AND STEEL INSTITUTE.

ENTOMOLOGICAL.—(II.)—ON LARVÆ.

[4297.]—THE apparatus required in collecting larvæ is a metal larva-box, a large cotton umbrella, a strong wire ring-net, a stick, and a box to put food in to bring it home. Some collectors prefer chip boxes to metal ones, but they are liable to break in and kill the larvæ.

Thus equipped, the collector may set out. When a suitable locality is reached, he should proceed to beat the trees and bushes, holding the umbrella underneath to catch the larvæ that fall, which may then be boxed with some of their food plant. Many larvæ will contrive to elude observation by being quite still, and others, such as that of the Brimstone Moth, look more like pieces of stick than anything else.

Another method of collecting larvæ is to sweep over the herbage with the net, and so obtain many larvæ which could be found in no other way.

Concerning the best time of the year for collecting larvæ, I think all seasons are good, but early in the spring, in February or March, many otherwise unobtainable larvæ may be found on grassy banks. The next best season is about the end of May or beginning of June, when the trees have been in leaf some time. Lastly, many hybernating larvæ may be found just before the leaves drop off. Just before a just after sunset are the best times, though the collector will meet with success all day long. Some larvæ are great wood borers, such as *Cossus ligniperda* (Goat), but the collector may be deceived by the borings of beetles, when he expects a good lepidopterous larva; the different appearance of the holes must, of course, be learnt by experience. Other larvæ, such as that of *Catocala nupta* (Red Underwing), rest during the day on the bark of their food tree (willow), artfully concealed from general observation by the similarity in their colour to the bark of the tree, and by their filling up the hollows in it.

Lastly, the presence of birds, such as tits and creepers, shows that larvæ—which are their food—are close at hand, and this ought to make the collector even more active in his search. Ento.

BONES AS MANURE.

[4298.]—Some of your correspondents appearing interested in the question of manures, especially artificial and dissolved bones, I forward a clipping which may be found useful.

The complaint of fraud in the manufacture of commercial manures gives rise to many questions concerning the manufacture of bones into some available form by the farmer himself. Bones and coprolites are almost the only reliable sources of supply to replace the phosphates; but bones broken into fragments of not more than an ounce in weight each will, under ordinary circumstances, remain in the soil undecomposed for half a century, and consequently but little benefit will be derived from their use. Bones, to be of immediate value, must be ground fine; but this with "raw bones" is a very difficult process. When subjected to the action of high steam they lose all their oil and a large portion of the gelatine, thus becoming brittle, and easily ground in a common mill. The same end can be reached more directly by burning the bones, the waste being merely the animal matter contained in them. The phosphate of lime is unaffected by either steaming or burning. The mineral part of the bones thus separated, will be found to consist substantially of 45 per cent. of phosphoric acid and 55 of lime. This compound is insoluble in pure water, and but very sparingly soluble in rain water charged with carbonic acid. If we take this "bone phosphate" and add to it a little more than half its weight of sulphuric acid (commercial oil of vitriol), we shall in a few days produce a new compound, in which the sulphuric acid has removed two-thirds of the lime from the bones, combining with it to form gypsum, supplying the place of the lime thus removed with water. This is a true soluble superphosphate. Its elements are:—Phosphoric acid, 60·69; lime (calcium), 23·93; water, 15·38.

This mass will be found very tenacious, and somewhat difficult to handle. To remedy this it should be mixed, in sufficient quantities to render it dry, with some good absorbent, such as dry swamp muck reduced to a powder, or with ground charcoal, or even with road dust. Lime or ashes should never be used for this purpose.

Several farmers might co-operate in the construction of a mill, and thus produce the bone meal which they use at prime cost. From this, they can make their own superphosphate, and use it either by itself or mixed with composted manure.

But bones may be reduced to a very fine state of division by the use of strong wood ashes, and thus, presenting a large surface to the solvent action of water and carbonic acid in the soil, may be of great value in maintaining fertility. The following formula has been suggested for using bones with ashes:—

	Pounds.
Ground bones	100
Strong wood ashes	400
Soda nitrate	70
Epsom salts	10

Dissolve the soda nitrate and Epsom salts in sufficient water to thoroughly moisten the ashes and bone meal. Mix well, and let it stand ten days, stirring it daily. Use some absorbent, such as dry muck pulverised, to dry the mass and reduce it to powder. Kainite may be substituted for the ashes, in whole or in part. This amount used on an acre will have a marked effect on the crop.

In some parts a difficulty will be found in obtaining the quantity of wood ashes here mentioned, but it should be remembered that almost any vegetable refuse will answer the purpose—the haulm of potatoes and the clippings of hedges and trees being possibly more serviceable than the ashes of burnt wood.

Many persons who have studied the question are firmly convinced that the stimulating manures, such as contain ammonia are rarely required, that plants will obtain all of this that is absolutely necessary from the atmosphere, and the rain which brings it down into the soil; and all that the farmer need do is to supply phosphoric acid, and the special salts, which an analysis of the soil may show to be necessary—*e.g.*, potash for potatoes. B. T. R.

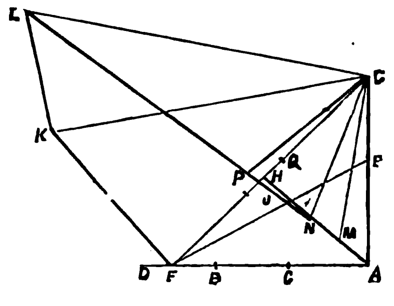
PURE GEOMETRY OF 113 : 355.

[4299.]—Since in this approximation to circumference $355 = 15^2 + 9^2 + 7^2$, and $113 = 8^2 + 7^2$, I find this permits of a geometric result excluding arithmetical divisions, *e.g.*, $MN = 11\,PQ = \frac{1}{7}RS$, &c.

On diameter A B of a circle, radius A C = 1, extended to B D = B C, erect perpendicular A E G, A E = E G = side inscribed square = $\sqrt{2}$. From E, radius A D = 3, cut A D in F $\therefore AF^2 = EF^2 - AE^2 = 9 - 2 = 7$, $AG^2 = 4 . 2 = 8$, hence G F is cut by perpendicular A H in ratio 8 : 7 :: G H : F H = G Q on G F, whereon H J = Q H gives C J = 9.

Next, on H A make H M = H F, G M = $\sqrt{113}$ in same units: then F K ⊥ G P = G J gives G K = $\sqrt{306 = 15^2 + 9^2}$; K L ⊥ G K = F H gives G L = $\sqrt{306 + 49} = 355$; G N ⊥ G L = G M; G P ⊥ L N, whence N P ; P L :: 113 : 355.

Further, $\frac{AH}{AC} = 2\sqrt{\frac{7 \times 8}{15}}$, $FH = \sqrt{\frac{7 \times 7}{15}} = HM$, $\therefore$ M falls between A and H.



I append some appropriate fractions, devised by my late friend, C. J. Willich (*Philosophical Magazine*, May, 1863), and resolved by me. Note specially the cube root of $\frac{1}{6}$ of π.

$$\pi = \frac{355}{113} - 0·000002 = \frac{5 \times 71}{64 + 49 + 72}$$

$$\frac{\pi}{360} = \frac{7}{802} - 0·000001,6 = \frac{7}{784 + 18}$$

$$\pi^2 = \frac{227}{23} + 0·000039 = \frac{441 + 9 + 4}{36 + 9 + 1}$$

$$\pi^3 = \frac{23200}{763} - 0·000022 = \frac{200}{7} \times \frac{100 + 16}{100 + 9}$$

$$\sqrt{\pi} = \frac{296}{167} + 0·000001 = \frac{100 + 196}{100 + 49 + 18}$$

$$\sqrt[3]{\pi} = \frac{331}{226} - 0·000010 = \frac{225 + 81 + 25}{2(113)}$$

$$\sqrt{\frac{1}{\pi}} = \frac{145}{257} - 0·000012 = \frac{144 + 1}{256 + 1}$$

$$\sqrt[3]{\frac{\pi}{6}} = \frac{457}{567} - 0·000000,5 = \frac{441 + 16^*}{21 . 27}$$

$$\text{Hp. log. } \pi = \frac{87}{76} - 0·000007 = \frac{3}{4} . \frac{29}{19}$$

$$\text{Mod. log.} = \frac{195}{449} + 0·000004 = \frac{15 . 13}{400 + 49}$$

$$\text{Base h. l.} = \frac{1264}{465} + 0·000002 = \frac{16 . 79}{15 . 31}$$

*Hence $(8 - 3)(8 + 4) : 8^3 :: 1 - \sqrt[3]{\frac{\pi}{6}} : 1 : + \sqrt[3]{\frac{\pi}{6}}$ nearly.

I find number of times every digit of π occurs in the first six hundred decimals of Mr. Shanks' value to be as follows:—

To dec.	0	1	2	3	4	5	6	7	8	9
100th	8	8	12	11	10	8	9	8	12	14
Add	11	12	12	8	12	12	7	4	13	9
200th	19	20	24	19	22	20	16	12	25	23
Add	7	10	11	12	15	7	15	7	9	7
300th	26	30	35	31	37	27	31	19	34	30
Add	11	13	9	8	10	12	11	7	10	9
400th	37	43	44	39	47	39	42	26	44	39
Add	6	16	9	12	7	11	5	12	10	10
500th	43	59	53	51	54	50	47	38	54	51
Add	13	4	11	13	10	6	15	8	5	15
600th	56	63	64	64	64	56	62	46	59	66

Here the same number is repeated as follows:—

No.	4	repeated	2 times	8
„	5	„	2 „	10
„	6	„	2 „	12
„	7	„	7 „	49
„	8	„	7 „	56
„	9	„	6 „	54
„	10	„	6 „	60
„	11	„	7 „	77
„	12	„	11 „	132
„	13	„	4 „	52
„	14	„	1 „	14
„	15	„	4 „	60
„	16	„	1 „	16
		Sum	60	609

For 500th, repeat 1 . 1 . 1 . 7 . 6 . 6 . 5 . 6 . 11 . 2 . 1 . 2 . 1 times. S. M. Drach.

DETERMINING THE SPECIFIC GRAVITY OF POROUS SUBSTANCES.

[4300.]—The plan suggested by Dr. G. E. Morse, described at p. 220, appears to be well suited for the purpose; but not better, I think, than the old one—proposed, I believe, by Sir John Leslie—of inclosing in the upper part of a glass tube a known weight of the substance whose bulk has to be determined, so that its specific gravity may be calculated. The tube, which must be more than 15in. long, is placed in a larger tube filled with mercury till the surface of the liquid metal corresponds with a mark on the inner tube; the top of this is then closed air-tight, and the tube raised until the mercury in it stands half the height at which the barometer is standing at the time; of course, the air in the tube being thus relieved of half the compressing force of the atmosphere, expands to twice its original volume. As half of the expanded air occupies the part of the space above the mark which is not occupied by the solid matter, and half the space between that mark and the top of the mercury. the space occupied by the mercury, which stands in the tube higher than it would do if no solid matter were contained in it, is equal to the space occupied by such solid matter, less any air or other elastic fluid that may be united with it mechanically. This volume may be estimated with very small error by weighing the mercury, its weight being great in proportion to the bulk it occupies. There may, however, be some objection to the use of this simple instrument not known to me. Philo.

DR. CARPENTER AND PERSPECTIVE.

[4301.]—The reason, I think, why a picture does not embrace so many degrees vertically as horizontally is because it represents a scene more or less defined, viewed by an eye directed to one point. The natural shape of a picture is, therefore, an ellipse, of which the major is to the minor axis as 3 to 2. "B. D. T." (let. 4190, p. 252), whose previous letter I was not so uncourteous as to reply to without reading, will see that our tower need not be made up of parallel lines to suit a rectangular representation of the scene. "E. L. G." (let. 4189) gives the better reason, but as he adds that pictures are not always viewed from the point of sight, it is unnecessary for me to say more than this, that as they are to be the best representations possible, under all circumstances we may be surer of the real truth by following what must be depicted on the glass plane of projection—namely, convergency. I do not quite agree about the correction of the eye, although quite aware that we really see not by the eye, but by the brain. A plane of projection being an entirely artificial matter is changed by the slightest movement of the eye. I have never seen the book referred to by "E. H." (let. 4191). To him, as to "E. L. G.," I reply, a picture is not mathematically arranged, but is a compromise, and is painted for effect. Architectural photographs are simply horrible. M. Paris.

PAINE'S MAGNETIC ENGINE, &c.

[4302.]—On p. 611 of your last volume "Sigma" asked in a very pointed way, "*Where's* the peck of pepper Peter Piper picked?" I have just come across a piece of "intelligence" which will supply him with the not unexpected information. According to the New York *Telegrapher*, the "peck of pepper" cannot be found; for it seems the Electro-magnetic-wood-sawing-and-driving-men-of-war-across-the-Atlantic-for-nothing Company has "gone up"; that Peter Piper himself has "left for the East, where the wise men came from," and that the stockholders have experienced an electric shock in the shape of a total loss of their money—3,000,000 dollars.

In other words, Mr. Paine has failed to do what he publicly stated, with much show of offended dignity and injured innocence, he had done and could do, and has retired from the country to "perfect the details" of his machine in quiet. So far Mr. Paine. What has become of Mr. Slater's engine, of which at one time we heard so much from Mr. Highton? The latter gentleman appears to have given up attempting to perfect its details, as his attention is now devoted to telegraphing through uninsulated sub-marine wires, which of course would be much cheaper than the rather costly cables found necessary in practice. Mr. Highton surely owes it to science to make as full a report of his failure as he did of the "facts" by which he thought to overthrow the experiments of Joule. I would also ask Dr. Packman how he is progressing with his steam-engine, mentioned on p. 253 of Vol. XIV., and when the promised description is likely to delight the hearts of "our" readers. Saul Rymea.

SUPPORT OF SPINNING TOP.—UPWARD DEFLECTION OF BULLET.

[4303.]—It is a misfortune that many men of great talent waste their time and energies in attempting to prove why some particular effect is produced, without in the first place ascertaining what the fact really is. Many of us have heard of the glass globe puzzle, the question being, "How is it that a live fish added to a globe partly filled with water does not increase its weight?" The learned of the time entered freely into the discussion, which came to an untimely end by a cynic requiring the globe to be weighed before and after the addition of the fish. Mr. Taylor says he "shall be much surprised to hear that a spinning-top will stand in vacuo for a moment." Would he be very much surprised to hear that Faraday kept a top spinning in vacuo for one hour and forty minutes?

Amidst all the plausible theories and speculations to account for the movements of the top and gyroscope, none as yet appear to afford any satisfactory solution of the problem.

With regard to the bullet rising from the gun, this again is a popular fallacy, of which it is easy to trace the origin. When a gun is fired from the shoulder the point of resistance not being in a straight line with the force exerted by the ignited powder, but several inches below, the muzzle naturally rises. It has been well ascertained from the experiments of Whitworth and others, that if a gun-barrel be firmly fixed to a slide-rest in such a manner that it can only recoil in a direction parallel to itself, the bullet will not rise. To give a more homely illustration, every one accustomed to pistol practice knows that pistols throw very high as a rule, but if the hand be turned sideways, the bullets will not rise, but the deviation will be horizontal instead of vertical. A BARRISTER.

SPINNING TOP.

[4304.]—I CANNOT just now lay my hands on the number "E. H." (let. 4191, p. 252) refers to. It appears to me, a perfect top in a perfect vacuum, and the peg being unaffected by friction, would spin for ever, being equally on all sides affected by gravity; let there be friction, rotation sooner or later stops, and the top falls. Let "E. H."—not resorting to any dodge *à la* Columbus—set up a top on its peg, and tell us what, if not gravity, causes it to fall. Let him then spin it; the top remains upright because its motion counteracts its tendency to find a position of rest. Perhaps I do not understand "E. H." The particles are moving in a plane, and cannot get out of that plane by themselves; gravitation, however, unequally affects them, as the top is not a theoretical top, and at last is too strong for the other force. M. PARIS.

[4305.]—I CANNOT refer to the MECHANIC of January, 1870, consequently know not what the "old fallacy" is, which M. Paris and myself are accused of reviving by "E. H.," let. 4191, p. 252, but I have a strong notion if "E. H." tries the following experiment, that he will withdraw his authoritative fiat as to which is right. Take a weight suspended to a cord; let it go, and it falls to the ground from the effect of the attraction of gravitation; pick it up and cause it to revolve rapidly and vertically, then let it go as it passes the highest or lowest part of its circuit. It will not then fall to the ground, but will travel in a tangent to the centre of gyration as long as the velocity is maintained, and if the "force of gravity" is not overcome then write me down an ——.

As it seems that I have not conveyed my meaning clearly upon the point to J. M. Taylor, I will endeavour to do so thus:—When any body is made to revolve, its centre of gravity is not, mathematically speaking, in a vertical line with the point of rotation. As a consequence, there is an unequal attraction, which is greatest at the lowest side of the circle, but is instantly conveyed to the highest part, which has the effect of raising the one side and lowering the other until the attraction of gravitation is equal all round; he will plainly see this by using a teetotum, as the motion becomes so slow as to cause his air-cushion to "fade like the baseless fabric of a vision." He will observe the heavier side dip, but being immediately whisked to the higher side counteracts the attraction until the velocity becomes too slow. Does he compare a bicycle rider who keeps erect, although going at merely a foot pace, to a bullet from a gun? Surely he is poking fun at us. I would like to know particulars as to how he satisfied himself that a ball fired horizontally always rises. I don't say that it does not, but I have not seen it proved, although often asserted.

Liverpool. A.

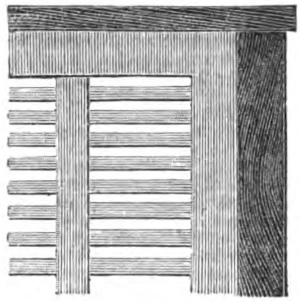
[4306.]—I CAN assure your correspondent J. M. Taylor that I have seen a top spin for one hour and ten minutes in vacuo. This was a top made, I believe, by Troughton, of black glass, with a steel point in a sapphire cup, now at the observatory at Armagh, in Ireland, and assuredly it did not wobble. It was made as an attempt to afford an artificial horizon at sea, which failed. The rising of a top and the gradual steadying of its motion depend upon the spherical shape of the so-called point. There is a good diagram of the forces, I think, in the *Saturday Magazine*, but I have it not. Let Mr. Taylor spin a seal ring on a table with the seal sideways: the seal, or the heaviest part of a ring when made symmetrical, but of different materials, will rise to the summit. VIS.

CABINET FOR MICROSCOPIC OBJECTS.

[4307.]—THE following is a description of a strong, light, and commodious cabinet for microscopical objects. Let a case be made having a door back and front measuring inside 10in. high, 8in. wide, and 6½in. from door to door, and let a vertical partition ⅛in. thick divide the case into two compartments; each will be 10in. high, 8in. wide, and 3¼in. deep. At ¼in. from both sides of partition fix a zinc plate of the same dimensions as inside of case, perforated as shown in sketch, and 2in. from each of these a second plate, perforated in precisely the same manner. Each pair of plates, instead of being fixed, may be in one sheet, doubled over so as to be 2in. apart, and soldered at the bottom; they could then be drawn in and out if necessary.

The perforations are to be made thus: Draw ½in. margin all round each plate, and let the middle space thus inclosed be divided into five vertical columns, nine-eighths of an inch wide, having a space between each of ⅜in. Each column is to have lines ¼in. apart, ruled from top to bottom, and the space inclosed by every other two cut away.

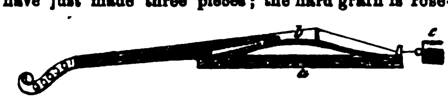
The mode of arrangement is as follows: The glass slides are to be passed through the slits in the front plate into the corresponding slits in the back plate, as far as the partition allows. This will leave about ¼in. of each slide projecting in front quite sufficient to admit of their being easily withdrawn. In the space between the slides the name of the object may be written, or a number may be placed at the side through which easy reference could be made to a list. The doors must be glazed with rather thick glass, and made to fit nearly close to the slips, to prevent them falling out should the cabinet become tilted; or the doors might be of wood, padded inside.



A cabinet this size would hold five slides horizontally and thirty-six vertically, equal to 180 in each division, equal to 360 in all. Every slide would lie flat, and be perfectly easy of access without disturbing any other. Some of the slits might be left farther apart than others (for deep cells), having the front aperture cut to correspond with size of cell. These cabinets can, of course, be made larger or smaller than the above, and as there is not much work in them need not be very expensive, nothing like 50s. or 60s.—the price the makers charge for a case to hold this number of slides. I have said nothing about outside ornamentation, which may be left to individual taste. The front plate might be electro-gilt, and would then present a handsome appearance. LOVATT.

HOW THE TONES OF A VIOLIN MAY BE INCREASED.

[4308.]—"FIDDLER" (let. 4197, p. 253) says, "I thought at first (and do now in part believe) that the pressure of the strings on the bridge interfered with the vibrations of the breast." I have made the experiment, and come to the conclusion that in a good violin the up-pressure of the breast is just so much more against the strings—say 8 to 7—as the down pressure, so that the pressure of the fingers and the bow on the strings make it nearly equal. However, "Fiddler" may try the experiment himself by hinging a neck of a violin on a piece of wood *a*, and centreing seven or eight pieces together, *b* representing the breast, which must be centred with one end on the neck, and with the other on the piece of wood. Then passing a string over the bridge as usual, putting it through a loop, and fastening it to a weight *c*, he will find that the pressure of the breast is not only more against the strings near the middle where the bridge is, but also on every centred piece, which he has to keep down separately. Besides this, in the violin, after the breast and strings are in what I may call proper tension, they act as a support against the neck, and from this support or breast the neck forms a lever connected with the back of the violin; this lever is pulling the back (if arched) straight, or a small portion towards it, and forces the soundpost against the breast also. Whether the law of vibration was known to the first makers of violins, or whether it was found out bit by bit, I cannot answer; but the fact is, the instrument constructed strictly in accordance with it, and if I may say so, just reversed from instruments which ring after the action ceases on the strings, for it is bound and compressed where ringing instruments must be free, except the strings. The only way I can see to get a little more tone out of such a small breast (for it is less than a square foot, and we cannot make it larger) is to construct the breast of pieces of wood (I have just made three pieces; the hard grain is rose-



wood, beach, and Virginia pine respectively, and barkwood in each of them, representing the soft grain. Trying them with the tuning-fork they are certainly much louder than Swiss pine), prevent the sound parts from "paulking" out on either side, which they do at present, and consequently the wood is rarefied sideways. And then not a cut must be done without strictly observing the law of vibration, which includes specific gravity, inertia, tension, leverage, and in this respect the form also. I think this a fitting place to say a few words on "The Harmonious Blacksmith's" ingenious invention (let. and diagram 4201, p. 254). Whatever merits that instrument may have when finished after the diagram, it cannot produce the tone of a violin, because the strings pulling on the soundboards and frame tend to rarefy instead of compressing the soundboards.

J. H. SCHUCHT.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[9440.]—**Mathematical Question (U.Q.)**.—This is answered in No. 370, with diagram. To find K, the simplest construction is to sweep a circle from E as centre with ED radius, making the chord EK equal to ED (the versed sine of arc AE). The demonstration makes a good exercise in geometry.—CORRESPONDENT.

[10478.] — **Pork Diet.** — While admitting the advisability of being extremely careful in the selection of pork, owing to the ease with which parasitic insects, trichinæ, ascarides, &c., may be introduced into the human system by the use of diseased animals, I am by no means prepared to go the "whole hog" with a "Mother" and "Sarah" in the universal condemnation of Piggy, Esq. Pork is really extremely well adapted to the nourishment of those inhabiting cold countries, as the large amount of carbon it supplies is a great aid in maintaining animal heat. Poor bunny has been very harshly treated, and I am confident from experience without any just cause. As to oysters, &c., they are certainly highly nutritive, and it is greatly to be regretted that our supply is so limited. The annexed table of the amount per cent. of water, starch, fat, gluten, and fibrine, present in beef, pork, rabbit, and oysters, may perhaps interest Sarah and Co.:—

	Water.	Starch & fat.	Gelatine, gluten, and fibrine.
Lean beef	78·0	8·0	19·0
Lean pork	76·0	5·0	19·0
Fat beef	63·0	27·0	10·0
Fat pork	60·0	30·0	10·0
Rabbit	88·0	2·0	10·0
Oyster	79·0	0·0	21·0

—S. BOTTONE.

[10664.] — **Angle of Reflection and Incidence.**—Many thanks for "F. N.'s" suggestion, but with a true stroke the ball will not rotate on a vertical axis at the moment of contact, nor during any portion of its course. If, however, the ball be struck a little to the right or left of the centre, this will take place, and the ball will form a parabolic curve after impact. With regard to the ball taking a direction parallel to the top cushion, this is at variance to the notions I have hitherto imbibed of motion and forces. "F. N.'s" diagram leads me to suppose he is under the impression that in each case the red is struck so that it returns from the top cushion at right angles. If so played, "strength" would not be required; both strokes should be played a half ball, and if the harder stroke be played from the left-hand side of the table, the red returning from the bottom cushion will come to rest near the left top corner pocket. If the ball from the first position be played with strength, the ball will strike the side cushion instead of going into the pocket, and if from the second position, with a gentle stroke the ball will strike the top cushion.—BILLIARDIST.

[11196.]—**Turning Perpendicular Shaft.**—The various replies to this query have all omitted the fundamental rule to be observed strictly, that is, that one shaft may be driven by a belt from another lying at all angles with each other from 0° to 90°, provided that their centres are in parallel planes, without which the belt will not keep on.—SEPARATOR.

[11386.]—**Crystals in Gas Tar.**—Let "Ethyl" refer to his Schützenberger, and he will find that naphthazarine is the artificial alizarine, in contradistinction to the real alizarine, however obtained.—S. BOTTONE.

[11423.]—**Surgery.**—Some years since a servant girl in my family ran a needle into her foot, just below the ankle. The doctor could do nothing, especially at a venture so close upon a joint. In this dilemma the girl was ordered to bed, and a large linseed poultice applied. Removing this in a few hours, a careful search discovered one-third of the needle. In twelve hours a second poultice was applied, the result being the recovery of the middle portion. A third application, and the remaining third, the point, was, after a most patient search, found. Fitted together, the needle was entire. Four heaped tablespoonfuls of meal put into a saucepan with a small quantity of heated lard, and mixed well when on the fire with cold water, rapidly, and well stirred till quite hot all through, makes the best form of poultice for the purpose, stiff and firm. Months of suffering may be spared by remembering the saying, "A stitch in time saves nine."—H. B.

[11564.]—**Blackberry and Strawberry (U. Q.)**.—I have read and re-read this query without being able to make out which of the fruits the first two sentences relate to, or what M. Paris wishes to ask about the blackberry, which he does not name after the above heading. I never heard of its cultivation, though it is brought to market both in England and France. It requires to be very fully ripe before developing its peculiar flavour, and seems to be nearly always, when gathered at all, gathered too soon. This flavour exceeds in richness that of its two cognate varieties, the red and white raspberry, as much as the black currant exceeds the red or white. I know not whether botanists have in these cases made the black fruit another species from the red and white, but its flavour would seem to entitle it to that distinction; and there are other differences, as the black currant, having a much larger "snuff" (or remains of the flower), and the blackberry, growing in greater bunches than either of the cultivated rubi, and having stouter thorns. I once read in a newspaper of some seeds found in the stomach of a skeleton in a Wiltshire barrow being sown, and producing the red raspberry! This was supposed to show that the red, as well as the black fruit, had been indigenous in ancient Britain, and had since become extinct. Some botanical reader may perhaps tell us where the raspberry is now indigenous, and how we obtained it.—E. L. G.

[11572.]—**Compressing Water.**—May I venture to point out to "Saul Rymea" that in replying to this question (p. 284) a detail has escaped his memory, which, although, of little importance, probably, so far as concerns Mr. Westwood's query, may as well be mentioned here. The compression produced by each additional pressure of one atmosphere in one million parts of water *freed from air* was found by Colladon and Sturm to be 51·3 millionths. This result is almost identical with "Saul Rymea's," as given at p. 284, save that the italicised words are omitted in his reply. I hope "Saul Rymea" will not deem me guilty of needless and carping criticism in directing attention to the *lapsus*. I merely do so, because in compressing water containing air, the result obtained by Colladon and Sturm was 49·5 millionths. The latter result approximates more nearly to Regnault's 47 millionths. In fact, Regnault's result may be taken, I think, as the mean compression of water, if we call Colladon and Sturm's 49·5 millionths the maximum, and Oersted's 46·1 millionths the minimum result.—A. J. V. G.

[11589.]—**Dry Steam.**—I am afraid "A., Liverpool," is still rather at fault in his attempt to explain what dry steam really is. Every one knows that each increment of heat increases the pressure of steam, but action and reaction must be reciprocal, and therefore the pressure of the superheated steam must be as great towards the boiler as towards the other end of the pipe; and, indeed, if the resistance was not greater at the boiler end than at the other, the steam would evidently rush as readily back into the boiler as into the atmosphere; the pressure of the steam, therefore, after all the additional heat it has required by passing through the furnace coil, cannot possibly exceed the 3lb. pressure in the boiler. Still, this is a long way from accounting for what dry steam really is; and, I suspect, if chemistry — which "A." seems to ignore — cannot give a satisfactory explanation, still less can pneumatics.—CALORIC.

[11589.]—**Dry Steam.**—In my reply, p. 284, for 250° C. read 2500° C.—F. T.

[11589.]—**Dry Steam.**—This very easy query has been singularly ill-treated; not one reply without some ludicrous error! First, "A., Liverpool" (p. 157), says "You may place your hand in high pressure steam," which is absurdly impossible. The only way to *touch* high pressure steam would be to have your hand bound to an aperture in a boiler, so as to form a valve confining the steam. That which has once left the boiler, be it only a barleycorn from the outlet, is no longer high, but "low pressure" steam, and the reason it will not scald you like the lower pressure steam of a tea-kettle is its cooling by sudden expansion. I cannot see (with deference to "Caloric," p. 232) how the term "dry" steam can be otherwise applied than as a synonym with "overheated" or "subsaturated steam" that which will dry bodies, or take up additional water. Atmospheric steam is dry, except in a rain-cloud; dry even in falling rain, and may have its dryness expressed by the number of degrees it has to be cooled to reach its "dew point," or become "steam of saturation." The comet of the Deluge, however low in temperature, was, I have no doubt, dry steam; and need not during its whole fall render the air anywhere a wetting air, though a mile of water should fall through it as rain in a day or two—of course, the steam that "Caloric" says (p. 106) was incondensable by cold, was no longer steam at all, but decomposed, as all steam is when passed over iron, zinc, coal, or other combustibles at a temperature "to kindle timber,"—but not decomposed "into oxygen and hydrogen," after "J. L." (p. 181). The oxygen remains with the iron or zinc, or carbon, and in the latter case forming carbonic acid, will, by its mixture with the hydrogen, make it uninflammable. This would even be the result of passing through tubes of red-hot cast iron, but with wrought iron the steam may be made inflammable hydrogen, and balloons have been thus filled. Of course, a certain remnant of undecomposed steam would also mark its inflammability.—E. L. G.

[11630.]—**Compendious Perpetual Calendar (U.Q.).**—The querist should refer to "The Perpetual Cross Calendar," by C. J. Recordon, B.A. London: Trubner and Co. This little work was noticed not long ago in the ENGLISH MECHANIC, and in the introduction to it, the querist will see how he could construct such a calendar as he desires, say in metal, by rendering the position of certain pieces of the apparatus there described yearly interchangeable.—B. A.

[11632.]—**Debility.**—I may, perhaps, be permitted to make a few remarks with reference to the discussion between "Amateur" and "Saul Rymea." The latter thinks there is no occasion to defend either allopaths or homœopaths against the charges of the former. Now, as one desirous to learn, I should be very glad if "Saul Rymea" would state what the principles of allopathy really are, and what is their rationale. Till lately the sheet anchor of the medical profession was the lancet, which was used indiscriminately in diseases of every class. Take the instance of typhoid fever. Here, as far as modern science has been able to ascertain, the blood is poisoned. As a remedy allopathy dictated the withdrawal of a part of the blood in the hope of purifying the remainder. Is not this just as logical as if we, in order to disinfect a river suffering from the influx of sewage, should pump out and throw away a few gallons of the water, hoping that such a step would in some "occult" manner render the residue limpid and wholesome? If "Saul Rymea" is acquainted with the history of medicine, he must be perfectly aware that what are called "feverish symptoms" were deemed especially to indicate copious blood-letting. Yet, he ought also to know that those very symptoms are brought on by loss of blood, as every army surgeon who has had experience on the battlefield can testify. It may be said that blood-letting has now fallen into comparative disuse. Granted: thanks to the pressure from without, which the *Anti-Lancet* has contributed to create. But has the irrationality of the practice ever been formally admitted? And what shall we say of a system which can thus repudiate its grand procedure, and yet claim the adhesion—I will not say of scientific men—but of a community not void of common sense? Equally prevalent with blood-letting, and almost equally ruinous, was the sweeping use of drastic purgatives. But a short time ago, if an allopathic practitioner was called in, one of his first steps was, quite irrespective of circumstances, to administer a brisk dose of what is still popularly and inclusively called "medicine." This error, though on the wane, as the diminished consumption of Epsom salts can prove, survives still in the "theories of quacks," who appear to treasure up what the allopaths have gradually and quietly repudiated. But I cannot help reminding "Saul Rymea" that the allopaths have by their practice created that very faith in "Solidway's pills" which he now deplores and wonders at. "Saul Rymea" may, again, urge that random purgation is now less frequently employed than it was half a century ago. True, allopathy is gradually changing its nature, though not its name; its practice, though not its principles, and is approaching the altera-tonic system. Your correspondent thinks that nervous debility is certainly not the cause of cholera. Will he kindly explain how it is that, of three men, living in the same house, and exposed to the same influences during the epidemic of cholera, one shall entirely escape the disease, another shall take it, but recover, whilst the third shall die? Heart-disease seems also to your correspondent something inconceivable as a result of nervous debility. Is he not aware that it increases almost *pari passu* with disease of the brain, and that it is found most widely prevalent among the very class who are most subject to the latter? The fact is that allopathy, at least in the days when it was young and bold, conceived of disease as a positive entity—as a something which could be drawn out by blood-letting; driven out by purgatives and sudorifics, or poisoned by "drugs and counter drugs." The only difficulty was that sometimes the patient was poisoned instead of the disease. There is deep truth in the story of the French physician who undertook the treatment of a desperate case of cutaneous disease. The eruption gradually vanished under his treatment, but just as the last trace had disappeared the man died. The physician, carefully examining the corpse of his patient, remarked with an air of self-complacency, "Il est pourtant guerri." This is scarcely a caricature of allopathy. I will only add that I shall be very glad to answer, through the ENGLISH MECHANIC, any questions which may be put to me on this important subject.—CHARLES ROOKE.

[11650.]—**Annealing Steel.**—It is what are called pins—viz., fine hard places—in the steel that spoil your cutters. They will sometimes defy a file to touch them; you can make your steel beautifully soft by putting it into a box made for the purpose, filled with dust charcoal, closed air-tight, heated thoroughly through to a red heat, and then allowed to get cold. A piece of stout gas-pipe, with one end welded and the other plugged, makes a very good box for a small quantity of steel. For large quantities make a charcoal fire, heat the steel to a red heat, and let the whole get cold together.—KYRLE.

[11656.]—**Boiler for Small Steamboat.**—In reference to the above query would "P. W. H. J." please inform me if the boiler and engine, as shown on p. 259, would be powerful enough to drive a boat 21ft. long by 7ft. beam? And would there be a governor required, as I think it would not work without one or a fly-wheel? The engine is stated to be 7in. by 3½in. stroke: am I to understand that 3½in. is the diameter of the cylinder and 7in. the length of stroke? Are the double eccentrics for reversing gear? If so, how are they joined where the two ends meet? An answer to the above will much oblige.—W. H. SHEPHERD.

[11674.]—**Stretched Indiarubber.**—I do not suppose that any of your readers can give "Philanthropist" the information he requires. It appears to me that the power required to stretch the rubber would be more than that given out by the rubber in returning to its normal state.—E. M.

[11687.]—**Speeding Machinery.**—ERRATUM.—The last two lines or so of my reply belong to reply 11869, Zinc *v.* Coal.—PHILANTHROPIST.

[11711.]—**Time at our Antipodes.**—Is "Kelby" quite sure that every particle of fog has cleared away from his own mind with regard to this question? He tells us that the announcement of the destruction of a building in Paris by fire at 12 o'clock can be made in New York the same evening, a similar case to the publication in London of the eclipse telegrams from India on the afternoon of the day on which the event occurred. He also tells us that telegraphic messages from New York are found on our breakfast tables. Surely he does not mean the news of the previous evening, in which there would be nothing extraordinary. At the time we were acquainted with a message flashed the same morning we should have finished our breakfasts long ago. I may still be enveloped in a fog, but to me the two statements do not seem to be accordant. I may have been in error in assuming the diagram No. 1, on p. 234, to represent the simultaneous existence of Tuesday all over the world, and even if this be so the principle will nevertheless remain, as is manifest from the following statement:—A day of twenty-four hours — Tuesday, for example — can only exist simultaneously over the world for a single moment; previous to this moment some portion of Monday remains to some of the inhabitants of the earth. At and after this moment a portion of Wednesday comes into existence. The Monday is separated from the Wednesday by its being Tuesday in every part of the world. After Monday is gathered to its predecessors Tuesday is separated from Wednesday by a single meridian on the hemisphere turned away from the sun. As this meridian approaches the sun, more and more of Wednesday comes into existence, and less and less of Tuesday remains. When this meridian has passed over an arc of 15° one hour of Wednesday exists, leaving twenty-three hours of Tuesday. The time east of this particular meridian is reckoned as of Tuesday, the time west of it as of Wednesday. Will "Kelby" have the kindness to determine which of the 360 meridians it is? Perhaps it may assist "Kelby" if he can really devote sufficient thought to the subject, to call attention to the increase, fall establishment, and decrease of the absolute, as distinguished from the local day on the earth. Diagram No. 1, on p. 234, assuming it to be Tuesday over the whole world, gives the commencement of the absolute Wednesday on the meridian 270°. Twelve hours afterwards the meridian 270° comes up to the sun, diagram 3. During these twelve hours Wednesday has been increasing, but as yet its noon has not occurred. Bearing in mind that twenty-four meridians mark the successive hours, twenty-four noons of Wednesday must transpire before the departure of Wednesday from the earth, and when the twenty-fourth has passed the decreasing portion of Wednesday has still to run out. We have consequently four periods of twelve hours each. When the meridian 270° is turned away from the sun it is Tuesday everywhere. During the first period the twelve morning hours of Wednesday occur to places west of the upper solar meridian, diagram 3. During the second period twelve noons occur, and Wednesday is established over the whole globe, diagram 5. During the third period the remaining twelve noons transpire, and one half of Wednesday has departed, one half of Thursday having taken its place, and during the last period the afternoon hours of Wednesday leave the globe at places east of the upper solar meridian, and Thursday is fully established. As, according to "Kelby," I am in a state of fog it is not unlikely that I have imagined the above described diurnal progression, if so, I beg my readers to regard it as an instance of the use of the imagination in scientific inquiry.—W. R. BIRT.

[11711.]—**Time at our Antipodes.**—Some of your correspondents appear to have got into a maze on this subject, and by diagrams have only made confusion worse confounded. I shall endeavour to answer the very sensible question put by "T. S." Fortunately, there is no great amount of inhabited or inhabitable land at our antipodes, or as "T. S." justly remarks, there would be great confusion, because immediately to the east of the meridian of 180° it is Sunday and to the west it is Monday, and any of the small groups of islands situated in the Pacific on either side of this meridian may have Sunday on one island and Saturday on an adjoining one. The only parties at present affected by it are travellers by sea, and it is usual for all navigators on passing the meridian of 180°, if going eastward, say, on a Saturday, to call the next day also Saturday, thus having two Saturdays in the week; but if going to the westward they would skip over the Sunday, and have only six days in that week. I hope these remarks may throw some light on the subject to "T. S."—F. N.

[11711.]—**Time at our Antipodes.**—Replying to "Kelby" on what he considers a very interesting question, I think I can satisfy him, and set the question at rest, having travelled much over the Australian Continent, and also most of the islands in the South Pacific, and spent some considerable time at the Fiji Island named by him, with whose man-eating king, Thackambau, I am personally acquainted. I beg to state that in every island I thus visited they reckon their time in advance of ours, and in no case did I find it, or hear of its being reckoned, otherwise—the reason being, I presume, that by far the greater majority of Europeans have arrived in those islands from the westward, and, therefore, have shortened each day in proportion to the distance travelled due east, until, arriving on the 180° longitude at any given day at twelve noon in England, it will be twelve the previous night, and so in proportion for any shorter distance.—SEPARATOR.

[11711.]—**Time at our Antipodes.**—I have to thank Mr. W. R. Birt for the trouble he has taken in answering my question, and only regret that the knotty point is to my mind still unsolved. In his letter (p. 259) he states that I am wrong in supposing that a message dispatched from London at noon on Tuesday, May 7, would be dropped at New Orleans at 6 a.m. on the same day; and, further on, explains that the difference in time reckoned according to the earth's rotation being 18 hours, the message would really be dropped at New Orleans 18 hours in time later than its despatch, or at 6 a.m. "Wednesday" morning, not on "Tuesday" morning. This, reckoning New Orleans to be 270° East instead of 90° West, seems right enough, but unfortunately totally at variance with daily experience. We have no direct communication with New Orleans by telegraph, but we have with New York, and as the longitudinal difference between these two cities only accounts for about one hour difference in time, either place would answer my purpose quite as well. But to be correct, if the time at New Orleans be 18 hours later than our own, the time at New York should be 19 hours later, but this is not the case. Every afternoon about 4 p.m. we receive in London the opening prices of the New York markets of that very day, the markets opening there at about 11 a.m. Now, applying the argument of Mr. Birt, that the time at New Orleans is 18 hours later than our own, and therefore at New York 19 hours later, Tuesday 4 p.m. in London, ought to be synchronous with Wednesday 11 a.m. in New York, not Tuesday. Referring to his diagram No. 2 in his former letter, p. 234, he says: "If now we take the times for diagram No. 2, we have

90° civil time, Tuesday, May 7, 6 p.m.
270° " " Wednesday, May 8, 6 a.m."

Clear enough as regards the difference of 12 hours, the one being the antipodes of the other, but he also shows

0° civil time, Tuesday, May 7, 12 noon;

and as I have just shown that by our telegraphic despatches that the time at 270° (or 90° West) is 6 a.m. Tuesday, and not Wednesday, I only find myself landed at my original starting point—viz., that the message from London, Tuesday, May 7, 12 noon, by the east, if dropped at Calcutta, would find the time there to be Tuesday 6 p.m. (this is admitted), and that the one by the west, if dropped at New Orleans, would find the time to be Tuesday 6 a.m., and thus meet at the antipodes the first at Tuesday midnight, the second at Tuesday break of day. That every day must have an absolute commencement somewhere on the earth's surface, I do not doubt, and I can only imagine that every country fixes its own time, or adopts that already fixed by some other; but if the two cables could drop a message every 15° equivalent to one hour in time, there must be some point at which they would find themselves entirely out in their reckoning. I would add, that though the Americans reckon their time by the Observatory at Washington instead of Greenwich, their day from San Francisco to New York is precisely the same as ours, therefore we could not have Tuesday 12 noon at London and Wednesday 6 a.m. at New Orleans at the same moment.—T. S.

[11718.]—**Cheap Water Filter.**—The zinc and lead would not improve the water; but would not do more harm than the usual zinc-lined cisterns and lead pipes.—AQUARIUS.

[11721.]—**Assayer's Duties.** — Thanks to J. Roskell for his kindness in bringing under my notice the fact that the method given by me in reply to "G. T. H." is not correct. The rules given would, indeed, be right enough if such a thing existed as a copper ore standard, but there is no such thing, the so-called "standard" being a "sublime humbug." Now, unfortunately, when "G. T. H.'s" query first appeared, I was busily engaged, and could not find time to reply, and when I had the time, I found that I had misplaced the number containing the query, so that it was out of my power to apply myself to the solution of the example given. Had I done so, I would have advised "G. T. H." to see from the last sales the average standard of such low produce ores, and then to apply the rules given, when he would have a fair approximation to the value of his ore; or he might take the price per unit, and from the produce of his ore deduct its value. Indeed, I could show "G. T. H." one other mode of valuation, and explain at length the valuation of the silver and auriferous ores, were it not for the same reason given by J. Roskell—namely, that it would be a betrayal of professional confidence. My rule, without this explanation, would be certainly ridiculous, as even at the present high rate of copper, "G. T. H.'s" ore is only worth about, at the outside, £1 12s. a ton. I need hardly remark how much obliged I am, therefore, to J. Roskell for his kindness in pointing out my error, and I deeply regret that one so capable of contributing to our metallurgical department does not oftener figure among our correspondents.—UN IRLANDAIS.

[11725.] — **Reversing Gear for Oscillating Cylinders**—"Erin" will find the usual plan employed in the steamboats on the Thames described by "Jack of All Trades" on page 91, Vol. XIV. No better system has yet been devised.—E. M.

[11727.] — **Cork-cutting Machine.**—"Balmarino" will find a description of a machine of this kind in Spon's "Dictionary of Engineering," page 1082, but whether that is the best, or what is its price, I cannot inform him.—E. M.

[11741.]—**Boot and Shoemaking.**—First you must get patterns. Some leather-sellers will cut you the shoe or boot out if you take your last; but the surest way is to take an old shoe or boot to pieces. Get one the pattern and size you want it, put the pieces in water to soften them, open them out, and lay them on thick paper, and cut pieces of paper the size of the leather, tack these pieces of leather together with small steel tacks, or paste them with paste (paste made with rye flour is best); then close or stitch them together, holding them between your knees with clamps. Next get the last the size you want your shoe. Procure some insole leather, soak in water, place the last on the smooth side, mark the leather round the size of the last; then cut the pieces off exactly by the mark, place the smooth side on the last, tack on with three or four tacks, press it close to the last, and while wet trim your insole close to the last all round. The shape of your shoe depends on this. Trim the rough off the bottom of your insole. Some shoemakers make two slight nicks round the insole, one about a quarter of an inch from the edge, the other about half an inch. Putting the awl in at one and out at the other of these nicks you sew more level, and the stitches are not so liable to break their hold of the leather. Next place the top level and straight on the last, get the pliers, and pull tight over the toe; drive a tack in the centre of the toe, and one in the heel. Shoemakers generally push some bits of leather betwixt the last and the top leather on the instep, according to the size of the foot round the instep. Next, tack the top all round, then get a piece of top leather about an inch broad that will reach round the heel. You then place the heel of the shoe towards you, holding it on your knee with a strap, which goes under your foot and over the shoe. Sew round the heel first, put your awl in at the insole, but not too deep; sew the narrow piece round the heel, leaving enough to turn over; this done, take a bit off the edge of your welt, and sew round your shoe, putting from four to five stitches to the inch; keep your welt level while sewing. Get a stick, make it flat at one end, work it round your shoe, between the top and the welt; trim your welt round level, cut your leather level round the heel, turn the narrow piece of top leather (some call it a ran) over, and stitch down with a few stitches. Place your shoe on the rough side of your bottom leather, mark round, and cut off. You might save a little leather by putting your sole about half-way along the heel. Then put a bit of inferior leather to finish up the heel, hammer your bottom soles, fill up the middle with small bits, put on your sole, and tack down. Next stitch the sole on; place the awl through the welt, holding the shoe so that you will stitch towards you; place the heel on, put the awl between the top and the narrow piece that is turned over and through the heel pieces; these being sewn on, get the sharp end of your hammer, and hammer round the edge of the sole and welt while they are wet, this will make the edge better to finish. Trim the edges round when dry, being careful not to cut the top leather; scrape round and put ink on, let the ink dry, put your heel-ball on, and heat your iron hot enough to melt the ball, but not to burn the leather; rub up with a bit of old cloth. If Mr. Lonsdale wants to make the bottom smooth, and put a polish on, he must cut a nick in the bottom sole to let the stitches in; then scrape the bottom, and file it and rub with sand-paper (he must do this with the edges, if he wants a first-class polish). He can colour the bottom if he thinks proper. He can buy the tools at the leather-seller's—a shoemaker's kit contains but few. I will answer any questions that he asks for information on shoemaking to the best of my ability, either on sewing, riveting, or pegging.—S. H. L.

[11756.]—**Power of Water-wheel.**—It is a pity the pipe is so long, as the water loses "head" from fluid friction. I cannot say exactly how much, as I have not access to tables. 6ft. fall in pipes, 14ft. 9in. fall at wheel. Suppose the effective fall to be 19ft., and the buckets three parts full; if filled too full the water runs out too soon; 48 × 5 = 240 gallons, or 2400lb. of water delivered to wheel, 2400 × ¾ = 1800lb. contained with the buckets three parts full; 1800 by 6 = 10,800lb. of water delivered to wheel per minute, 10,800 × 19 = 205,200 units of work; take the *modulus* as ·6 or 3-5ths, we get 123,120 units of work per minute, or about 3¾ horse-power. The overshot water-wheel utilises the velocity of the water as well as its fall, but the weight of water on the wheel increasing the pressure on the axis augments the friction.—PHILANTHROPIST.

[11799.]—**Botany of Cornwall.**—The Christian Knowledge Society publish "The Flowering Plants of Great Britain," by Anne Pratt, in three vols., which are ten shillings each. There is a plain practical account of every flower, and a coloured picture of each also. I have used the book for years, and have seldom failed to identify a flower with its aid. There are companion volumes of mosses and ferns.—E. M. P.

[11801.]—**Question in Trignometry.**—Finding that the answers by "H. H." and "Theodolite" to this query did not exactly correspond, I worked it out myself, and found A P = 700·033, B P = 600·028, and C P = 499·927. I also worked it backwards, using "Theodolite's" 500, 600, and 700, and "Numa's" three angles of 120° each, and found the side A B = 1126·95, the side A C = 1044·03, and the side B C = 954·47; instead of 1127, 1044, and 953·9, as given by "Numa." As no two of us agree, will "Numa" kindly say, in the ENGLISH MECHANIC, which calculation he considers nearest the truth? And I shall also be obliged to "H. H." to say whether his method of constructing the diagram is applicable to any triangle. Would it do, supposing the angles from the station P within the triangle A B C had been 100°, 130°, and 130°?—TRIANGLE.

[11801.]—**Question in Trigonometry.** — The following is one solution of this question, without calculating any angles: Let A = area of the triangle, and S = sum of lines drawn from angle to point, P = $u + v + w$

$$S = u + v + w = \left\{ \tfrac{1}{2}(a^2 + b^2 + c^2) + 2 \cdot 3^{\frac{1}{2}} A \right\}^{\frac{1}{2}} = 1799 \cdot 9884$$

$$u = \frac{S}{3} + \frac{b^2 + c^2 - 2a}{3\,S} = 700 \cdot 0364$$

$$v = \frac{S}{3} + \frac{a^2 + c^2 - 2b}{3\,S} = 600 \cdot 0301$$

$$w = \frac{S}{3} + \frac{a^2 + b^2 - 2c}{3\,S} = 499 \cdot 9219$$

—F. M. 1799·9884

[11801.]—**Question in Trigonometry.** — Your correspondent "H. H." has embellished his reply to this query with a more elaborate diagram than is usually employed to illustrate the problem which is the subject of it, and I wish to be informed, through the ENGLISH MECHANIC, whether "H. H.'s" directions and diagram will apply to all triangles having the station P within them, or whether they will serve for one description of triangle only? Suppose, for instance, the station P had been at D, half-way between A and P in "H. H.'s" diagram, how would the intersection of the circles described from the centres of the equilateral triangles have fixed the position of this point? I shall be glad to be corrected if I am wrong, but it appears to me that "H. H.'s" method of finding P will serve for such triangles only as have the angles subtended by their sides from P = 120° each.—THEODOLITE.

[11811.]—**Lime-juice and Glycerine.**—Thanks to "Auld Reekie," and will he kindly inform me how to prepare the lime-water, and the tincture of cantharides?—COUNTRY BARBER.

[11818.]—**Aerated Water.**—Gazogene too expensive for my private use; is there anything cheaper that would answer same purpose.—COUNTRY BARBER.

[11825.]—**Testing Bleaching Powder.**—The mode proposed by "Aughrim" and "Ethyl" is certainly much more accurate in skilful hands than the one I gave. Will "Ethyl" kindly inform me where he obtained samples of chloride of lime containing 35 per cent. of available chlorine? This exceeds the theoretic amount of available chlorine contained in the compound $Ca\begin{cases}Cl\\ O\,Cl\end{cases}$, while in the commercial product I have never found it to pass 20 per cent.—S. BOTTONE.

[11826.]—**Tinning and Soldering.**—"W.T.M.D.," if he refers to my communication, will find that I state distinctly that resin is only to be used in soldering lead or zinc, that being the flux suitable for those metals, or candle grease will do for lead. If he ever spent a day in soldering with spirits of salts, he would not clean his hands either with "clear water," or even with soap without a deal of trouble. I have to call in the aid of washing-powder.—A., Liverpool.

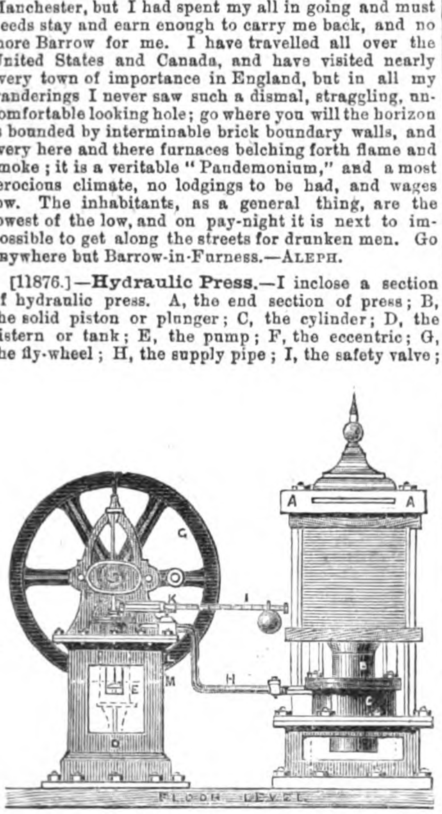
[11835.]—**Arsenic in Wall Papers.**—The plans for detecting arsenic, described at p. 262, by F. Greenway, and "E. B. H.," are very good, and unless the quantity be extremely small, will answer. There is, however, the possibility of a very small quantity of arsenic being carried away in the gas allowed to escape to avoid risk of explosion, and, if the whole quantity be very small, it may thus escape detection. This is not probable, but possible, and may be avoided by a slight modification of the apparatus proposed. Instead of using a common bottle or test tube, if one be used with a little hole at the bottom, and the bottle quite immersed in water contained in a larger vessel, the bottle may be completely filled with acidulated water, containing also the zinc and the substance suspected to contain arsenic in some form. The hydrogen generated will displace the water, and being unmixed with air, may be burnt without exploding. It is convenient to confine the gas as generated by a small stop-cock. If there be arsenic in the hydrogen, the flame will be more visible than if there be none; it will produce a little smoke, which will condense on glass (or on copper wire gauze, which is better) in the form of metallic arsenic or of white arsenic, most probably some of both. To make certain that this is arsenic, it should be converted into white arsenic, by heating it in a test tube by a small flame of a spirit lamp, dissolving it in a few drops of water, acidulated with hydrochloric acid, and testing with sulphuretted hydrogen, which gives an intense yellow slightly orange precipitate; also with nitrate of silver and bisulphate of copper, adding with each a very small quantity of ammonia. The first will give a bright lemon yellow, the last an intense green precipitate, both soluble in excess of ammonia, precipitated again by acid. Some prefer to the first process precipitating metallic arsenic from an acidulated solution by immersing a slip of bright sheet copper, which becomes leaden coloured if arsenic be present. The slip of copper is then placed in a test tube, and the arsenic driven off, oxidised, and tested as before. I prefer the reduction by nascent hydrogen as first proposed by Mr. Marsh, but some think the other as good and less troublesome. —PHILO.

[11839.]—**Plates Chemically Clean.**—I have for many years taken a deep interest in its chemical bearing in photography, and after very many experiments—Carey Lea's bichromate bath included—have found nothing so effective as the well-known "Diamond Polish," and the later, but, if possible, more praise-deserving, "Tunicare," both to be obtained of most dealers.—CIREB.

[11853.]—**Pedal Harmonium.**—I thank "Pneumatic Lever" for his kind answer to my query, and shall be glad to have his plan for pedals, actions, and soundboard. Should like the pedals to slide under instrument; depth of my case 2ft., length (inside) 38in. The tubes I require are such as are advertised as being in the "Canterbury Model," by Rudd and Co., in which the vibrators are said to be ranged on vertical tubes instead of the horizontal arrangement, thereby giving a more organ-like tone.—G. J. C.

[11863.]—**Barrow-in-Furness.**—I am a joiner, and having heard of the place, and being out of collar, I packed myself away there. It was all that I had heard as to business—plenty of work on hand and in prospect; in fact I got a job before I had been there half an hour. But didn't I wish myself back to Manchester, but I had spent my all in going and must needs stay and earn enough to carry me back, and no more Barrow for me. I have travelled all over the United States and Canada, and have visited nearly every town of importance in England, but in all my wanderings I never saw such a dismal, straggling, uncomfortable looking hole; go where you will the horizon is bounded by interminable brick boundary walls, and every here and there furnaces belching forth flame and smoke; it is a veritable "Pandemonium," and a most ferocious climate, no lodgings to be had, and wages low. The inhabitants, as a general thing, are the lowest of the low, and on pay-night it is next to impossible to get along the streets for drunken men. Go anywhere but Barrow-in-Furness.—ALEPH.

[11876.]—**Hydraulic Press.**—I inclose a section of hydraulic press. A, the end section of press; B, the solid piston or plunger; C, the cylinder; D, the cistern or tank; E, the pump; F, the eccentric; G, the fly-wheel; H, the supply pipe; I, the safety valve;



K, the turning handle; L and M, high and low water marks. As there should be double actions, I need not go into details. Two pumps, two eccentrics, two supply pipes, two safety valves. I cannot show them, both being the end sections. — JOSEPH WILLIAM FENNELL.

[11877.]—**Slide Valve Question.**—Will "Rook" give detail of the action of the slide? also state use of small lever seen on top of slide box, where steam enters, where exhausts, and what size steam and water cylinders would require to be for a fire-engine? boiler being 3ft. high, 18in. diameter, 36 field tubes.—PUMP.

[11878.]—**Photography.**—To retouch negatives, the best plan is to spot the parts requiring attention with asphalte varnish or Bates's black varnish, and after printing, spot the white places in the usual way with water-colour and gum, to match the tone of your print. In reply to your second query, I should say you over-expose your outdoor pictures, which would fully account for the symptoms which you describe. Try half the exposure by way of experiment.—R. M. HATCH.

[11885.]—**Power of Boiler.**—I don't know of any existing rule for the solution of this question, so I have invented the following, which I extract from my notebook. Let N be the number of cubic feet contained in the boiler (plain horizontal cylinder), and z = number of square feet of surface exposed to the action of the air, and x = the number of square feet contained in the sides and bottom (area of bottom to be divided by 2). Then N $\left(z + \frac{x}{10}\right) \div 45$ for small boilers and by 50 for large ones. Applying it to the case stated, let $z = 15 \times 6$, and $\frac{x}{10} = \frac{\frac{90}{2} + 2\ (4 \times 15)}{10} = \frac{165}{10}$

$\therefore$ N = $\left(90 + \frac{165}{10}\right) \div 50$ = say $2\frac{1}{8}$ cubic feet; $\therefore$ a boiler of 12in. diameter, and about 26in. long, will be sufficient; but, as it would require constant attendance, for fear of being short of water, I think that it would be better 15in. diameter, and 3ft. long. I think that it would be advisable to have a float, to let on the water supply besides the ordinary hand-tap, and a fusible plug. With these, the smaller boiler could be worked with as much safety as the larger one. The calculation is made for an uncovered sheet-iron tank, and if made of stone, slate, &c., the equivalent of x will have to be much diminished.—P. W. H. J.

[11887.]—**Hair Dye.**—The best hair dye that can be made is made with a solution of nitrate of silver and gallic acid (separately). If "Gray Beard" will advertise his address he shall have the benefit of an analysis I made some four years since of one of the best hair dyes extant, and much advertised, as well as sold at a high price.—R. M. HATCH.

[11891.]—**Contents of Cistern.**—I think "J. K." must mean the cistern to be like the letter D, placed in this way, ᗜ, if so, the following rule may do:—To three times the square of the cistern's radius, add the square of its height, then multiply the sum by the height (or depth), and the product by ·5236 for solid content, which sum, divided by 277·278, will give the number of imperial gallons.—C. B.

[11898.]—**Tempering Cast-Steel Chisels.**—If "U. V. U." adopts R. Welbank's plan to harden his chisels, he will have nine out of ten of them break off just about where the surface of the water came. The best way to harden chisels of this kind is to get the cutting part only to a red heat, plunge in water slightly chilled till cold, brighten on stone, and bring down to dark purple by putting head into the fire.—KYRLE.

[11903.]—**Quinine.**—(1.) Quinine is rarely adulterated at all, especially the well-known makes. When it is, its adulterants are chiefly quinidia and cinchonia, (2) which may be detected in the following manner:—Take 10 grains, add 10 minims of dilute sulphuric acid, and half an ounce of water, which dissolves the suspected sample perfectly; add ammonia, which throws down a white precipitate. This re-dissolves on agitating the whole with half an ounce of pure ether, and if pure, without producing any crystalline matter floating on the lower of the two strata into which the agitated fluid separates on rest. If either of the two other salts be present, they become very visible there. The upper stratum of fluid, if entirely removed and evaporated in the air without heat, must weigh 8·6 grains, and is pure quinia. Salicine has been known to be used to adulterate quinine, but on account of its property of turning red on the addition of strong sulphuric acid, is, I should say, extremely improbable now a days. If soluble organic impurities are suspected, the salt will blacken with strong sulphuric acid, and when the quinia has been separated by ammonia as described above, these will be found by evaporation of the solution. (3.) I do not think it has ever been known to salivate; such is not its supposed therapeutical action. (4.) Amorphous quinine may be prepared by dissolving purified quinoidine in pure sulphuric ether, decanting the etherial solution, and evaporating it with a very gentle heat. Amorphous quinine remains.—R. M. HATCH.

[11903.]—**Quinine.**—I suppose that the question put by William Hamilton Hey refers to sulphate of quinine, and that what he calls amorphous quinine is the alkaloid itself derived from the bark. Sulphate of quinine is commonly adulterated by one or more of the following substances: Calcium sulphate, boracic acid, mannite, sugar, starch, salicin, stearic acid, and cinchona sulphate, or quinidine sulphate. Pure quinine sulphate, when incinerated, does not produce any ashes. When it does, it is a clear indication that it it has been adulterated with mineral matters. If quinine sulphate is pure, two grammes of this compound will dissolve in 120 grammes of alcohol without leaving any residue. The residue, if there is any, consists chiefly of starch, or magnesia, or mineral salts. Salicin is easily detected by the deep red colouration imparted to the suspected compound by the addition of pure concentrated sulphuric acid. Stearic acid is easily detected by dissolving quinine sulphate in water acidulated with some sulphuric acid, as stearic acid does not dissolve. In order to detect mannite or sugar, dissolve quinine sulphate in water acidulated with sulphuric acid, then precipitate by a slight excess of the solution of baric hydrate. Filter carefully the liquor, and pass through it a stream of carbonic anhydride, and boil for a few minutes, and filter again. The solution, when evaporated, will leave no residue if the suspected salt was free of sugar or mannite. As concerns the cinchonine sulphate, the purest quinine sulphate contains always two or three parts per cent. of it; a larger proportion may be detected in the following manner: Put in a test-tube 1 gramme of the salt, and 12 grammes of ether, and then 2 grammes of liquor ammoniæ. If there is any cinchonine it will form a precipitate at the surface of the water, as the quinine will be entirely dissolved in the ether which occupies the upper part of the test-tube. Quinidine may be detected, as it does not precipitate by ammonium oxalate, whilst quinine does. Oxalate of quinidine is afterwards removed from the solution by adding some liquor ammoniæ. Does quinine cause salivation? This question will be better answered by a physician. How is amorphous quinine prepared? Consult any manual on organic chemistry.—F. T.

[11904.]—**Suitable Spectacles.**—"A." has apparently arrived at that time of life that he must do as the writer does, use the weakest power that answers his purpose by day, and if such power is too weak at night use spectacles of greater power.—S. J.

[11906.]—**Spectroscope.**—It is difficult to say which is the better, to have a micro-spectroscope or a simple one, because they are both useful in different ways. A very simple one can be adapted to the microscope or used as a pocket spectroscope for a cost of £2 2s.; but a really good instrument that will separate the D lines cannot be had under £5 5s. to £6 6s.—R. M. HATCH.

[11912.]—**Chemical.**—I should say you will get all the information you need from the last edition of Fowne's "Chemistry" (Churchill).—R. M. HATCH.

[11912.]—**Chemical.**—One fundamental alteration has been in regarding the atomic weight or combining proportion of oxygen as 16 instead of 8; thus, hydrogen being 1, water was formerly considered as $\frac{H}{1} + \frac{O}{8}$, or HO in symbolical language. It is now indicated by symbol H_2O, which expresses two parts of hydrogen by weight (not atoms) to 16 of oxygen. Many of our other formulæ are changed in consequence. Roscoe's is a very good elementary chemistry, but I do not know if it gives much information on the atomic theory.—PHILANTHROPIST.

[11914.]—**Expansion Joints in Steam Pipes.**—I prefer the old fashioned stuffing-box and gland properly fitted up, and packed with good indiarubber rings lapped with spun yarn. I also cast four brackets, two on each pipe, a convenient distance from joint, to receive a couple of tie rods for preventing pipes from being forced out. If pipes are already cast, fix a couple of clasps, they will answer the same purpose.—CLEAN FINGERS.

[11914.]—**Expansion Joints in Steam Pipes.**—The joint used is a stuffing-box packed with indiarubber core, surrounded with hemp strands. To save expense, it would be as well to have an ordinary stuffing-box with packing wedged very tightly in it; but instead of having the ordinary stuffing-box gland, to have just a round plate with a hole cut in it. This would be a consideration when there are many required.—P. W. H. J.

[11915.]—**Corn Screen.**—Dell's Complete Wheat-cleaner is the best I have ever met with.—H. M. S.

[11915.]—**Corn Screen.**—If "A Young Tyke" has a barley mill on his establishment he will find it answer his purpose admirably.—S. J.

[11920.]—**"Jack of All Trades."**—This gentleman would seem to be in a queer way, though I have no doubt but that the symptoms are mainly the result of debility following his recent illness, and will eventually wear away. But should he wish to physic himself, let him take bromide of potassium, 5 grains; tincture of nux vomica, 8 drops in 1oz. of water, three times a day; live as well as he can; have one glass of port wine daily; no malt liquors, and relax his studies, especially at night, for a time.—T. I. PRESTON.

[11921.]—**Curing Sprats.**—I hope this article is not to be prepared for general consumption. Having chosen some fine large fish, decapitate, and wash them. To one pint of pure olive oil add six bay leaves and six cloves, place the vessel containing the mixture on the fire and raise to boiling point. Pack the fish in tin cases, pour in sufficient hot oil to cover them, and solder down immediately. Keep for one month before using.—T. I. PRESTON.

[11923.]—**Potatoes.**—Cutting off the tops necessarily injures the potatoes to a certain extent, but as far as my experience goes the remedy, in this case, is preferable to the disease. As to the size of potatoes, that is a matter of taste, and on my table I always like to see fine specimens of everything. The saving of labour in digging the crop, in sorting, storing, and cooking, as well as the fine sample for the market, are my reasons for preferring size. I have never found any hollows in mine, and I cannot say I have as yet discovered that the smallest potatoes are the best.—INQUIRING MIND.

[11924.]—**To Millers.**—I should advise "M. C." not to have a 4ft. 6in. French stone for grinding wheat upon any consideration; 4ft. stones are the best size he can possibly have, they take less driving, are quicker dressed, and not so liable to "kill" the flour. All the millers that ever I came in contact with like the 4ft. stone the best of any.—H. M. S.

[11924.]—**To Millers.**—Where a number of stones are employed the 4ft. size is generally preferred, as it is more manageable, and does not heat the flour so much in grinding as the other. However, in small mills where two or three pairs of stones are at the most employed, a little time can be devoted to grinding; the larger size is mostly employed, as more work can be performed by it. The speed at which each is driven ought to be about the same, the chief difference between the two sizes being that the larger requires less "face" than the other.—TEVIOTDALE.

[11924.]—**To Millers.**—A 4ft. millstone has the greatest power, and is much easier driven than a 4ft. 6in. one. Dressing has a good deal to do with the power and speed of a stone. I would recommend "M. C." to have 7in. of face upon the stones, and keep the eye slack, as it not only allows the stone to run easier, but also makes the flour much sharper and better. This is on the supposition that "M. C." is a flour miller.—BED OF STONE.

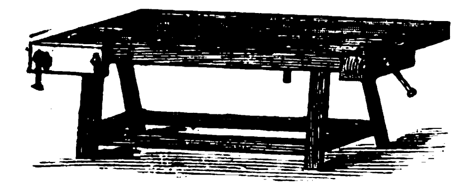
[11927.]—**Ants.**—In Spain, I cleared my bedroom, sitting-room, and verandah by dropping a few drops of tincture of iodine down a hole in the bedroom, where, amongst other places, they used to come up. I tried nearly every other photographic chemical previously. I never saw another ant after this application. I think it would be worth trying for white ants, or preserving timber from them.—R. Y. T.

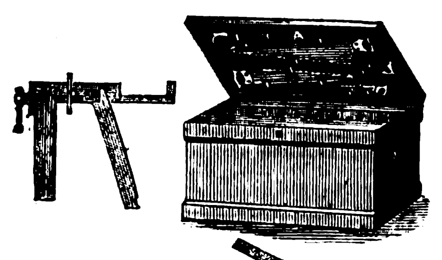
[11927.]—**Ants.**—Has "A. N. T." tried squirting solution of carbolic acid into the tube occupied by his namesakes? I think it will either drive them out or keep them in for good. Boiling water is bad for them if it reaches them before it gets cool, which is not always easy to manage.—PHILO.

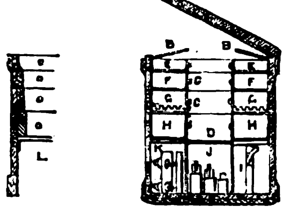
[11928.]—**Microscopes.**—These instruments are often advertised according to magnifying power; this is by no means the sole criterion; two microscopes of the same power may differ greatly in excellence in other respects, such as field of view, brightness of image, achromatism, and clearness of definition, also in the steadiness of the mounting and apparatus. The old fashioned sort, having a vertical sliding tube, has the defect of requiring a somewhat constrained position for observation, and the eye, in such a position, is not so evenly lubricated with its secretion.—PHILANTHROPIST.

[11937.]—**Filtering Water.**—Ordinary filtration has little useful effect in eliminating the impalpable sedimentary matter in waters derived from clay lands; whilst natural subsidence requires several weeks to secure clarification. The flood waters of the Nile I have filtered through charcoal repeatedly with no effect. I bottled flood water from a local stream weeks ago, nevertheless, complete subsidence is not even yet attained. "Jannifred" will find that with potable water the most useful remedy is precipitation by calcic hydrate, being the late Dr. Clark's process, already described in these columns under several heads of queries, amongst others, I believe, the Prevention of Boiler Incrustation, for which see indices to last two or three vols. Cost: a penny or so per thousand gallons of water, and time a few hours.—W. R.

[11938.]—**Carpenter's Bench and Tool Chest.**—The saws are buttoned to the top as A; the hinged lid of the upper till B is polished mahogany, as also the fronts of the tills C, and divided in length to represent drawers; D is a mahogany slide to run from front to back, and acts as a cover to plane box; E E, partitioned off for files and gimblets, &c.; F F, for plough bits and brace bits, to fit in racks; G G, for chisels and gouges in racks; H H, spokeshaves, levels,

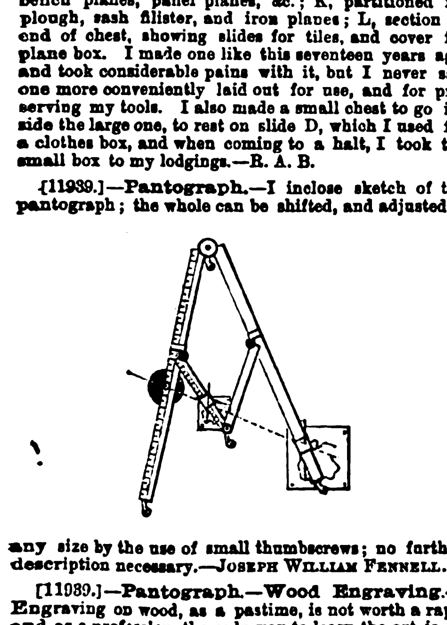






squares, &c.; I, hollows and rounds, for heads; J, bench planes, panel planes, &c.; K, partitioned for plough, sash filister, and iron planes; L, section of end of chest, showing slides for tiles, and cover for plane box. I made one like this seventeen years ago, and took considerable pains with it, but I never saw one more conveniently laid out for use, and for preserving my tools. I also made a small chest to go inside the large one, to rest on slide D, which I used for a clothes box, and when coming to a halt, I took the small box to my lodgings.—R. A. B.

[11939.]—**Pantograph.**—I inclose sketch of the pantograph; the whole can be shifted, and adjusted to



any size by the use of small thumbscrews; no further description necessary.—JOSEPH WILLIAM FENNELL.

[11939.]—**Pantograph.—Wood Engraving.**—Engraving on wood, as a pastime, is not worth a rap; and as a profession, the only way to learn the art is to be with an engraver for five or six years (to some people even six years is not time enough). Engraving cannot be learnt from a book, because there are hundreds of little things that refine the work that are not mentioned, but which you learn by experience. To draw on wood, it is best to know something about engraving, or at least what sort of drawings are the best to cut. When you are about to draw on the block, you must prepare it by spreading a wash of flake white on the surface. When this is dry, sketch in the outline, and then put on what are technically called the washes or tints (which are composed of Indian ink and water in different shades) with a brush. This requires care, to avoid rubbing off the ground of white. To do this, you must put it on at once, and not go over it again till it is perfectly dry. When the washes are on, you touch it up with pencil, ink, and white, if requisite. In what is called a *fac simile* drawing, no washes are used, and it is all done with pencil or ink.—XYLOGRAPHER.

[11943.] — **Worms for Fishing.**—Having only lately become a subscriber to the ENGLISH MECHANIC, I cannot tell you where to find the way given to prepare worms for baiting, but I think I can give you a few hints on the subject which may prove useful to you and others. Your expression "preparing worms for baiting" may have a twofold sense: it may mean either preparing them for the hook, or for ground bait, and to prevent any mistake, I will answer both. Isaac Walton, in his "Complete Angler," says that "camphor put in your bag with your moss and worms gives them a strong and so tempting a smell that the fish fare the worse, and you the better for it," but I don't believe that. The means I use are simple, and, from experience, I can recommend them. Procure a large earthen mug (say) 1ft. 6in. deep, and 1ft. 6in. across; fill it half full of moss, well washed, dried in the sun, and damped before use; put your worms (maiden-dew worms are the best for all fish) on the top of the moss, and let them work their way down to the bottom; turn them over every day; thus treated, they will scour in about a week. To give them a red, healthy, appearance, I mix bole Armenian (a red earth procurable at any chemist's shop) amongst the moss. This is, certainly, the best and simplest method for preparing worms for the hook. To prepare them for ground bait, I make use of three different ways, according to the water I fish in, and the fish I want to catch. If the stream be rapid and rather deep, I procure a ball of clay, about the size of a large turnip; I beat it out until it is a quarter of an inch thick, and then roll up the worms in it, not chopped up, but whole. The stream wears away the clay in the course of a few hours, and the worms crawl out. If the water be deep, but the stream not rapid, I chop up the worms in a basin with a pair of scissors, and put them into a large paper bag, in which I have already placed a stone, heavy enough to sink it to the bottom. I tie the mouth of the bag up, and attach a string to it long enough to reach to the bottom. I then lower the bag, and, after allowing it to remain in the water long enough to make the paper soft, I give the string a sudden jerk, which breaks the top off the bag, and the worms are washed out. If the water be dead, or sluggish, I simply chop them up, and throw them in with my hand.—PISCATOR.

[11945.]—**Leaky Tap.**—When a tap becomes leaky in a short time it may be due to dirty water, or to its having been ground with emery, which should never be used upon anything which is to move afterwards, as it is impossible to get rid of it again as it imbeds itself in the work, and continues to cut when its action should cease. The plug ought always to be re-turned. I find the dust scratched off a good setstone the best to use.—A., Liverpool.

[11947.]—**Power of Water-wheel.**—It will be necessary to know the head and velocity of the water before the first part of your query can be answered. As regards the second part, two pipes of the diameter of 6·77in. will discharge the same quantity of water as your weir, the velocities being the same.—EXCELSIOR.

[11948.]—**A Bad Sleeper.**—"N. K. R." no doubt is troubled with a sluggish action of the liver. I would recommend a very light diet, with a medicine I adopt myself. Senna leaves, powdered rhubarb, jalap; of each a pennyworth. Ground ginger and cream of tartar one teaspoonful. Boil the senna in a pint and a half of water; add the other ingredients, and sweeten with syrup of orange or sugar; shake it up before taking; three doses for adult.—JOSEPH WILLIAM FENNELL.

[11949.]—**Doctors' Commons.**—It is certainly not necessary to employ a professional man. Any person can procure a copy on payment according to the length of it. If "Auspicious" will advertise his address in the MECHANIC, I will procure it and send it to him.—G. C.

[11949.]—**Doctors' Commons.**—Any person (male or female) may search for a will, and if found, obtain a copy. The applicant should know the Christian as well as the surname of the deceased, and the year of death from whence to begin the search. A shilling search stamp must be obtained from one of the stationers opposite the Probate Office, and applicant, having passed into the office, will, on inquiry, be directed how to proceed. The cost of copy will be stated to applicant, who will be required to pay an amount on account, and the balance when the copy is ready. No money is taken in the office, all payments being in stamps, to be obtained at the stationers.—S. J. M.

[11950.] — **Sewing Machine Difficulty.** — "Lovatt" must first set the needle in the bar to its proper height, making the set-screw fast; then lower the needle to its lowest position, by turning the handle in the direction the machine is worked. He will have noticed that in the formation of the stitch, the needle after leaving its lowest point, rises from an eighth to three-sixteenths of an inch to form the loop; let him so raise the needle, still by turning the wheel or handle as before, and when the loop is well formed, the shuttle point must be just entered in the loop, and about the eighth of an inch above the eye of the needle. I forgot to mention that he must thread the needle first. In adjusting the feed he must notice that the teeth rise as the needle rises, but do not move horizontally till the needle is quite clear of the cloth, and that as the needle descends the teeth descend also. Should the above shuttle adjustment not work quite satisfactorily, it may be in consequence of the shuttle being a little too late. "Lovatt" will easily ascertain by trying it a little sooner if necessary.—HONE KO JO.

[11950.]—**Sewing Machine Difficulty.**—If it has a rest motion, let the needle descend below the shuttle-race and return upon a level with it just before the shuttle start; if it has no rest in the needle-bar, to allow the shuttle to enter the loop set it that the shuttle just enters the loop as it comes up.—JACK OF ALL TRADES.

[11950.] — **Sewing Machine Difficulty.** — "Lovatt" should adjust his "Defiance" sewing-machine as follows:—Replace the large wheel, leaving the small wheels loose on their shafts. Place a bit of stuff under the presser and make one stroke (with the hand) of the threaded needle. When the needle just begins to rise, and a small loop is made in the thread, clamp the small wheel on the needle-bar tight with its screw. Then, holding the large wheel tight, move round the shaft, actuating the shuttle in its loose pinion until the point of the shuttle enters a little way into the loop, and pinch the small wheel tight. If a finer adjustment should be necessary it may be effected by the needle itself; anyhow, it is necessary that the point of the shuttle should just enter the loop as the needle is beginning to rise. The same adjustment holds good in all shuttle machines.—GEO. FOX.

[11951.]—**Photography.**—If "Camera" gets a tub and puts a false bottom about 3in. from the real bottom, and conducts a siphon from underneath the false bottom, he will be able to work as follows:—Fill the tub with water, put the prints in for ten minutes; then draw the water off with the siphon. Repeat the operation several times; let them remain in water for twenty-four hours. The false bottom must be perforated.—W. BRIGHT.

[11951.]—**Photography.**—I was once in the same fix as "Camera," and this is the way I got out of it. I got a piece of 9in. by 1in. board and planed smooth, and down each side I screwed a number of wood buttons (such as used for fastening cupboards), then laying on the prints in the same manner as you would lay slates on to a house, fastening them at the joints by turning the buttons. Then I got an old pail, and knocking a small hole in the bottom close to the edge, I hung it on to the spout of the pump, then pumped until full, and fixed the board with the prints at an angle, so that the water fell an inch or so above the top print; it then ran down, and I thus had a running stream, which books on photography so strongly recommend. Of course you require to pump your pail full again, say three or four times. If I wanted to get them washed quickly I used a little warm water at first.—LICTOR.

[11953.]—**Chemistry.**—It would far exceed the limits of a reasonable reply to give even a short explanation of the recent changes in this science; and I do not at all wonder that "Paterfamilias" fails to recognise his old friends in the complex notation now in vogue. If he wishes to go in for what is termed the rational notation, he cannot do better than read the "Introduction to the Study of Inorganic Chemistry" (price 3s. 6d.), by W. A. Miller, a short review of which work he will find at p. 341, Vol. XII.; or he would find Roscoe's "Lessons on Chemistry" very useful (price 4s. 6d.). If, however, he wishes to study the theory of atomicity, and the constitutional formulæ advocated by Dr. Frankland, he may get the first volume of the "Lecture Notes for Chemical Students" (published by J. Van Voorst, Paternoster-row, price 4s.), and he can follow this up with the "Textbook of Practical Chemistry," by W. G. Valentin (price 10s. 6d.). I may add that I recommend him to obtain the last-named works, for they present by far the most satisfactory view of chemical science. — BEACON LOUGH.

[11954.]—**Harmonium Stops.**—"B Sharp" will find the information he requires in ENGLISH MECHANIC, Nos. 109 and 116. All the stops might be added, but the result was compared some time ago in our paper to "powdered footmen behind a one-horse chaise."—G. J. C.

[11954.]—**Harmonium Stops.**—"B Sharp" can introduce the expression stop into his instrument by making a small slide or shutter for the opening on the top of the reservoir bellows, below the soundboard. It can be opened and shut by means of a wire attached to it, and working through a small hole in the side of the soundboard, the hole being stuffed round about with chamois leather to prevent escape of wind. The expression stop consists simply in shutting off the reservoir bellows; but as it is very troublesome to wind the harmonium when using it, I would advise "B Sharp" to try another plan which I tried, and found it to work well. Remove the spiral springs below the reservoir bellows at the back of the instrument, and see what height they rise to when at their freedom. They will, perhaps, rise to twelve or fifteen inches. In that case there is too little variation in their pressure upon the bellows, and you will require to get two sofa springs that will only rise till about nine inches, and put them in the place of the ones you took out. With them there will be little pressure when the bellows is nearly shut, but a great deal when it is open the length of the safety-valve; consequently, with any rate of pressure, you can get any strength of tone. You could not introduce a tremulo stop without constructing a separate wind-chest between the soundboard and bellows, which is a good deal of trouble.—J. SMITH.

[11958.]—**Level of Railway Curve.**—Where W = width of gauge in feet, V = velocity in miles per hour, and R = radius of curve in feet, the following formula will suffice:— $W \frac{V^2}{1 \cdot 25\ R}$. Substituting the values W, V, and R in the above formula, we have $4\frac{3}{4} \times \frac{40^2}{1 \cdot 25 \times 1680} = 3\frac{13}{21}$ inches, the difference of level or cant of the rails. Half of the cant should be given by raising the outer rail above the level of the centre line, and half by depressing the inner rail. It is not necessary to take into consideration the weight of the engine.—W. AIREY.

[11958.] — **Level of Railway Curve.** — Let "Pupil" strain a line, 22 yards long, holding each end against the top flange of the rail, inside of curve, then measure in centre from rail to line, and whatever curve he has in the chain, put one-third of the same in "cant"—as we term it—on the curve. Let "Pupil" remember that too much "cant" is worse than too little. "Pupil" should be very careful in running his "cant" into the straight line, and run it far enough, so that the engine may enter upon and leave the curve as easy as possible, for if the engine has a tendency to leave the rails on a curve, she will almost certainly do so on entering upon it, if not properly "run out." If "Pupil" should require more information, I shall be glad to oblige him.—POINTS AND CROSSINGS.

[11958.]—**Level of Railway Curve.**—According to the formula $W \frac{V^2}{1 \cdot 25\ R}$ = elevation of outer rail in inches, the letters in the formula expressing as follows: W = width of gauge in feet, V = velocity in miles per hour, R = radius of curve in feet. I find in your case the required elevation of outer rail to be 3·6190in.—EXCELSIOR.

[11963.]—**Brass Springs.**—You are using soft brass, which is unsuitable for springs, but can be hardened only by hammering. In making some tongues for concertinas I fell into this mistake, and they did not retain their elasticity. I then procured hard-rolled brass; but found eventually that there is a sort of gray steel coloured brass, of which English concertina notes are manufactured, and which would make admirable springs if strong enough.—A., Liverpool.

[11964.]—**To Prevent Paper Sticking to Silk after being Printed with Metal Leaf.**—Rub your paper with a piece of hard curd soap, and you will have what you require.—JACK OF ALL TRADES.

[11965.]—**To Blacken Brass.**—Warm it over clean gas flame or spirit lamp, and plunge it while hot into nitric acid for two or three seconds. Then return it to the flame, and heat it till it blackens, brush off blisters, and lacquer.—J. F. E.

[11965.]—**To Blacken Brass.**—Brass may be stained black by means of a liquid containing two parts of arsenious acid, four parts of hydrochloric acid, and one part of sulphuric acid in eighty parts of water. Zinc may also be given a fine black colour by cleaning the surface with sand and sulphuric acid, and immersing for an instant in a solution composed of four parts of sulphate of nickel and ammonia in forty of water, acidulated with one part of sulphuric acid, washing and drying. The black coating adheres firmly, and takes a bronze colour under the burnisher.—HONI KO IO.

[11966.]—**Dandelion Roots.**—The best time to get the dandelion is from March till September; its best properties are in the root.—JOHN.

[11967.]—**Emigration to San Francisco.**—In answer to the inquiries made I can reply as follows:—(1) Yes! if he lets mining stocks alone. (2) Living is nearly as cheap in San Francisco as in London, and about 50 per cent. cheaper than in New York. (3) Take only what is necessary. Thin summer clothing is never wanted. Clothing is dearer in San Francisco than in London, but not over 15 per cent. dearer. (4) Nearly 3,000 miles. Seven days trip by rail from New York, or twenty-two to twenty-five days by steamer, *via* Panama. (5) Can stop three times each day, long enough to get meals at the stations. Some trains have dining-room cars attached. Breakfasts cost from 60 cents. to 75 cents., and dinners from one dollar to one dollar fifty cents; that is, 4s. to 6s. (6) Trübner and Co., Paternoster-row, or information can be had of Bowles Bros. and Co., 449, Strand. (7) Very! for persons who have not weak lungs. (8) As a large commercial town, no! As an agricultural or mining centre, yes! (9 and 10) The American bankers, Bowles Bros. and Co., 449, Strand, can probably give you the desired information.—A RETURNED CALIFORNIAN.

[11968.]—**Dog with Weak Sight.**—If the dog never closes its eyelids to protect its eyes from a sudden light, or a cold blast of wind, and if "Libra" is in the habit of striking it on the head, the dog is suffering from gutta serena. Let the dog have a new bed, wholesome food, but no flesh, a cold bath or swim daily, good running exercise, and brush the dog's body well with a hair-brush that will reach the skin. Do not meddle with its eyes, or give it any opening medicine.—MONTE CRISTO.

[11972.]—**Hot Soldering Iron.**—An 8-jet cassene lamp, or an ordinary triple burner benzoline lamp, would, I think, keep a small iron hot enough for light jobs.—W. T. M. D.

[11981.]—**Science Examination.**—A candidate informed me to-day that the result was expected towards the end of June.—EXCELSIOR.

[11982.]—**Thrush.**—I refer "A. C. L." to page 645, No. 863; the proper food is there stated. Feed the birds regularly with moist food, fresh made every day, in the shape of elongated pills. Leave some stuck on edge of cage, and feed over that, to teach them to peck for themselves. Keep them clean, dry, and free from all draught; nestlings should be covered at night with a cloth over the cage. A good cage is easily made out of an old tea box with wickers or osiers. As they grow up and begin to be able to perch, separate them. And when the cocks begin to chirrup, kindly let the hens regain their liberty, and oblige—JOE.

[11988.]—**Dyeing and Fixing.**—I have used Judson's dyes for many years, and find that a very little starch in the dye-bath fixes the colour. With the exception of blue, green, and black, all of the colours will dye wool, silk, and feathers, without any other preparation than their being first cleansed from dirt and grease in soap and water.—OLD HAND.

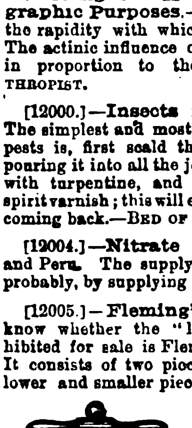
[11993.]—**Photographic Process.** — The following, perfected by Major Russell, is extremely good and reliable:—(1) *Bromised Collodion:*—Pyroxyline, 5 grains; cadmium bromide, 8 grains; alcohol (specific gravity: ·805), 4 drachms; ether (specific gravity ·725), 4 drachms. (2) *Nitrate Bath:*—Distilled water, 1 oz.; nitrate of silver, 60 grains; acetic acid, 1 minim. (3) *Preservative Fluid:*—Tannin, 12 grains; distilled water, 1 oz.; alcohol, 1 drachm. (4) *Alkaline Developer:*—Aqueous concentrated solution of bicarbonate of soda, 30 minims; water, 4 drachms; pyrogallic acid, 1-5th grain; alcohol (absolute), 10 minims. To be mixed just before using. Having thoroughly cleaned the glass or mica plate, coat it with a solution of guttapercha in chloroform, two grains to the ounce. Dry the plate before the fire. When quite cold coat with collodion. Let it "set" well. Immerse in nitrate bath, where it must remain fifteen minutes. Remove from bath, and wash in several waters, until every trace of free nitrate is eliminated. Now coat with the preservative solution by immersing in a bath containing the tannin solution. The plate is to be drained and reared upon end to dry. When dry it will keep good several months (away from light and dust, &c.) Expose as for an ordinary wet collodion. To develop.—Wet the film thoroughly by immersion in a bath of pure distilled water. Then pour on the developer and develop until all details are well out, but of a faint red colour. Now wash away thoroughly the developant, and having flooded the plate with an extremely dilute solution of acetic acid, the image may be intensified by using the usual wet collodion developer. The picture is to be fixed and varnished as usual.—S. BOTTONE.

[11994.] — **Instrument for Measuring and Recording the Amount of Light for Photographic Purposes.**—I think there is. It depends on the rapidity with which sensitive paper is darkened. The actinic influence of different days is not always in proportion to the amount of light.—PHILANTHROPIST.

[12000.]—**Insects in Tables and Chairs.**—The simplest and most effectual way to get rid of these pests is, first scald the furniture with boiling water, pouring it into all the joints and cracks, then rub over with turpentine, and when it is dry, give a coat of spirit varnish; this will effectually cure and prevent them coming back.—BED OF STONE.

[12004.]—**Nitrate of Soda.**—Comes from Chili and Peru. The supply appears inexhaustible. Acts, probably, by supplying nitrogen.—S. BOTTONE.

[12005.]—**Fleming's Locking Corks.**—I do not know whether the "lock" cork now extensively exhibited for sale is Fleming's, but this is a description. It consists of two pieces of box wood preferably, the lower and smaller piece being firmly secured to a pin having a screw thread on its upper part. Three small india-rubber rings are placed between the junction of the two parts of the "cork," and a key being applied to the square portion of the pin or to a square nut at the top, the two pieces of box-wood are brought forcibly together, consequently expanding the rubber rings till they fit the bottle neck tightly. The key is, of course, removable; the square nut on the head of the screw is protected from the action of all but a suitable sized key by being sunk into the top of the "cork." The annexed figure will, I think, make all plain. A non-locking "cork" on a similar principle has been in the market for some time. It consists of two pieces of wood, with a pin carrying a screw-thread projecting at the top. Indiarubber rings are placed between the two portions of the "cork," and a wing nut turned by the finger and thumb causes them to expand till they tightly fit the neck of the bottle.—SAUL RYMEA.



[12009.]—**Photographic Lens.**—It is possible to take a picture (?) with a single bi-convex lens, but the result is not at all satisfactory, in consequence of the indistinctness arising from the spherical and chromatic aberrations inseparable from such a lens. To cover a plate $3\frac{1}{4}$in. by $4\frac{1}{4}$in. the length of focus must be about 6in., the diameter $1\frac{1}{2}$in. to 2in., stopped down to $\frac{1}{2}$in. But "A Beginner" can get a very decent unmounted achromatic lens, of the above focus, for about 5s. Should he not be inclined to speculate that sum, let him invest 2s. in a deep meniscus (single lens) of the same focus. This will give a picture free from distortion, and by a few trials to find the exact difference between the visual and actinic foci, will prove far superior to the bi-convex.—S. BOTTONE.

[12012.]—**Water Power.**—Area of pipe, $3^2 = 9$, $9 \times \cdot 7854 = 7$ square inches. Substituting in the formula $v^2 = 2\,g\,h$, we get $v^2 = 2 \times 32 \times 6 = 384$, extracting the square root $v = 19\frac{1}{2}$ nearly; but from the effects of fluid friction and the well-known phenomenon of the contracted vein, the practical velocity will not be so much (I have no books of reference on this subject here), say 10ft. per second, and, besides, I do not know the length of the pipe. $10 \times \frac{7}{12} = 6$ cubic feet nearly per second = 360lb. of water about per second = 21,600lb. of water per minute falling 6ft. = 129,600 units of work per minute, or about 4 horse-power. I may remark here that in calculations there is little use in aiming at greater accuracy than we have in the data presented to us, as the latter circumstances preclude a very accurate solution being obtained, and we experience this difficulty in most physical problems.—PHILANTHROPIST.

[12012.]—**Water Power.**—"Ignoramus" follows in the same course of other of your correspondents requiring information on "Water Power," but in the absence of specific details of velocity of water and length of pipe, I may give him some idea of the power he can obtain by adopting either a water wheel or turbine. By adopting an open conduit instead of a 3in. pipe, the flow of water per minute would be about 85 cubic feet.

Consequently, $85 \times 62 \cdot 5 = 5312 \cdot 5$lb.

Hence $\frac{5312 \cdot 5 \times 6\text{ft.} = 31875 \cdot 0}{33 \cdot 000} = 0 \cdot 9659$ H.-P.

$0 \cdot 9659 + \cdot 60 = \cdot 579540$ H.-P. water wheel.

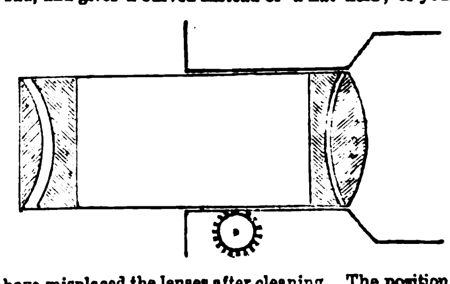
$0 \cdot 9659 + \cdot 75 = \cdot 726425$ H.-P. turbine.

So that, to adopt the best form of water wheel (overshot) would give out a little over half horse-power, and using a turbine would only slightly increase the power; but in either case the machine or motor would be of such a size as to render it practically useless.—J. GILLARD.

[12014.]—**Organ.**—"E. C." will find every information already supplied by "Adept" and "J. D.," and fully shown in section of organ supplied by me in the last number of Vol. XIV. (Consult indices.)—JOSEPH WILLIAM FENNELL.

[12019.]—**Damp Walls.**—The process is similar to one used for waterproofing cloth, as in the "shower-proof overcoats." I have not tested the matter, but have no doubt that the result of the action of the alum on the soap, &c., is the production of an insoluble soap of alumina, which is deposited within the pores, and (from the non-adherence of water to it) exerts a sort of repellant action upon the water. A similar effect may be observed in a wash-hand basin with hard water, when a film of lime soap forms on the surfaces.—SIGMA.

[12024.]—**Photographic.** — Your "fix" depends on one of two causes. Either your lens is radically bad, and gives a curved instead of a flat field; or you



have misplaced the lenses after cleaning. The position they ought to occupy is represented in the adjoining sketch.—S. BOTTONE.

[12024.]—**Photographic.**—The objective may be faulty, and not capable of covering the proper size plate; in that case try a smaller stop. It is possible the lenses may be out of place. The front lens of a portrait combination is generally composed of a double convex lens and a plano-concave lens cemented together, the convex side towards the object. The back lens is also double, but although held in the same brass cell, the two glasses are not cemented together. The one nearest the front is a meniscus, or concavo-convex, the convex side towards the object to be photographed; the lens next the camera being a double convex. I would make a sketch of the position, but it is not fair to ask the editor to have such a thing engraved.—A BARRISTER.

[12025.]—**Chiding Stone.** — There is one in Squire Streatfield's Park, close behind the village of Chiddingstone, Kent.—W. A. G.

[12026.]—**Greenheart Timber.**—The fact that "Khoda Bux" bought a considerable quantity of this valuable timber at a surplus sale of Government stores would seem to indicate that the majority of the buyers at the sale could have had but little knowledge of its qualities, for I presume he got it cheap, or he would scarcely use it for flooring even a granary. As some slight instalment of the information he requires, I send the following particulars:—Greenheart is one of the "first-class" woods acknowledged by Lloyd's surveyors as excellent for shipbuilding—no indifferent character to begin with, but besides this it is one of the very best woods of which to make fishing-rods. In many of the celebrated Irish fishing-rods, such as the "Castle Connell" for salmon, it is the one material used. It is, however, peculiarly suited to the manufacture of "tops," being, in fact, the only wood which is sufficiently stiff and at the same time elastic to admit of being used in single pieces of small bulk. It may often be seen in light fly-rods, in pieces about 8ft. long, tapering off to the thickness of a knitting needle. But it is chiefly from its power of resisting the attacks of sea-worms that it is so valuable to a maritime nation; for in its natural state it is proof against both the *Teredo navalis* and the *Limnoria terebrans*, while it is only second to teak in resisting the attacks of the white ant. There are, I believe, two kinds of greenheart, one being considerably darker than the other; the more abundant variety having the sap-wood of a pale yellow and the heart-wood a deep brown. Greenheart comes from British Guiana, is the wood of a tree known as the Sipiru in that country, but called *Nectandra rodiœi* by Tredgold, and *Laurus chlorozylon* by Ure in his Dictionary. It is a difficult wood to work, as "Khoda Bux" has found; according to Tredgold, the log requires tightly binding while being sawn to prevent it splitting up into splinters. The timber is admirably adapted for shipbuilding, for bridge piles, and for facing wharfs. My attention was first drawn to it some years ago by noticing the high character awarded in Lloyd's Register to vessels built of greenheart, and I have but little doubt that "Khoda Bux" has got a bargain, as the wood has probably been thoroughly seasoned. I do not know, but I should think it would be a very serviceable material for the purposes he mentions. He will be able to supply his friends with the very best material for making fishing rods, for although rather heavy for butts its extraordinary strength enables a sharp taper to be taken from the lower end of the rod. The Santa Maria timber, mentioned by "Khoda Bux," I do not know—by that name at least.—SAUL RYMEA.

[12028.] — **Dimensions of Balloon.** — W = weight to be raised, including the weight of the balloon itself; A = weight of cubic foot of air—G = weight of cubic foot of the gas; D = diameter of the balloon.

$$D = \sqrt[3]{\frac{W}{\cdot 5236\ (A - G)}}$$

$$W = \cdot 5236\ D^3\ (A - G)$$

Approximately with hydrogen gas, but varying with the state of the atmosphere—

$$D = \sqrt[3]{25\cdot 5\ W}$$

$$W = \cdot 0392\ D^3.$$

The buoyancy of hydrogen is about 13·3 feet to 1lb. From Molesworth's "Pocket-book."—WILLIAM C.

[12031.]—**Hot Peas.**—Parched peas, lentils, and paddy, are articles of general consumption throughout India. The mode in which they are prepared is as follows:—A flat thin iron pan, filled with sharp gritty clean sand, is put on the fire, forming a sand bath; with this the grain to be parched is put; when sufficiently done, the grain is whisked out by a broom made of split bamboo, the sand falling to the bottom. "Poor Teeth," I have no doubt, can do the same in a large frying-pan three parts filled with sand. If he wants his peas or Indian corn soft, he had better soak them in water for six or seven hours previous to cooking. I am surprised that parched grain is not more used than it is. It is portable and clean, and with a little salt, very tasty. On one occasion parched rice and peas, washed down with a little brandy and water, formed my breakfast, dinner, and supper, for nearly a fortnight. I was never in better condition in my life at the end of my tether.—KHODA BUX.

[12034.]—**Ordnance Map of London and Environs.**—At a given spot in the Regent's Park, London, the altitudes are these:—Above mean level of the sea at Liverpool, 126ft.; above Thames high water, 117ft.; thus the difference 9ft.—LEVEL.

[12035.]—**The University of Turin.**—I will obtain all information for "Silex" that I possibly can, with regard to the Turin University, and send it in next week.—S. BOTTONE.

[12038.]—**Atmospheric Electricity and Magnetism.**—It would require a treatise to answer this question to advantage. Peltier's electrometer is commonly used for observing atmospheric electricity, but requires special fittings for the purpose. There are also apparatus made for measuring the intensity of the earth's magnetism. Ordinary scientific instrument dealers would be unlikely to have the instruments in stock, but Negretti and Zambra, of Holborn Viaduct, give special attention to this department, and a visit there would, probably, give "R. C." more information than I could put in a column or two, particularly as I have not given any great attention to this department of electricity.—SIGMA.

[12040.]—**Navigation.**—Procure Norie's "Epitome of Navigation."—A., Liverpool.

[12040.]—**Navigation.**—As an ex-mate of ships, and, once upon a time, reckoned a good navigator, I should recommend "A.B C." to study Norie's "Epitome" (many of the examples for one edition of which were calculated by myself); but as this is an expensive book, I may say that I believe there is a small but useful work on the subject in Weale's Series, which could be obtained through any bookseller.—SIGMA.

[12041.]—**Burnishers for Brass-work.**—Either good silver steel or agate. Never used after lacquering. —JACK OF ALL TRADES.

[12046.]—**Endorsing Ink.**—If "F. V. H." will see indices he will there find it given by—JACK OF ALL TRADES.

[12047.]—**Radius of Sector.**—I am free to confess I do not understand "T. E. G.'s" question. What does he mean by the measurement being given "as chords" or "as curves"? If he will kindly word his question a little more definitely, I shall be glad to help him if able.—V. B.

[12051.]—**Fire Engines.**—This appears to be self-evident, as fire-engines generally are used with flexible hose pipes, unless an air chamber were used to exhaust from, the hose pipe would be exhausted for part of its length and would flatten up, thereby preventing the water from flowing along it.—A., Liverpool.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Correspondent" has answered 9440; "E. L. G.," 11564; "B. A.," 11630.

11668 Astronomical, p. 158
11670 Electrical, 158
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11683 Wheatstone's Bridge, 158
11689 Reel for Rotary Sewing Machine, 158
11690 Anchovy and Bloater Paste, 158
11693 Ice Chest and Refrigerator, 158
11700 Ginger Beer Making, p. 159
11705 Small Yachts, 159
11707 Para, 159
11709 Smoking Cap, 159
11717 Removing Gold from Plated Articles, 159
11720 Extracting Zinc from Plumber's Solder, 159
11726 Toughening Cast Metal, 159
11727 Cork-cutting Machine, 159

QUERIES.

[12056.]—**Echo.**—Can any of your readers suggest a remedy for stopping the echo caused by speaking in a large chapel with a high vaulted roof, without any galleries?—J. T. OAKLEY.

[12057.]—**Defective Sewing Machine.**—I have constructed a sewing-machine, the exact counterpart of a Newton Wilson, but, although apparently perfect in every detail, I often find, when working it, I cannot make a single stitch, owing to the needle thread winding itself round the rotating hook, although at other times it works satisfactorily. Could any of your able correspondents inform me of the cause, and remedy for the same?—PLUMBAGO.

[12058.]—**Bees—Swarm or Brood.**—A box hive (15in. square) filled with old black comb, out of which woodlice, a blackbeetle, a slug, and old dead bees were shaken six weeks ago, was replaced in its outer case, and was left on the supposition that it was empty. To-day it is occupied by bees in considerable numbers, who have proceeded to clear the hive of dead bees, broken bits of comb, &c. Room has been added at the top for fresh comb, and food given. Has a swarm taken up its abode in the hive, or has the warm weather hatched brood from the old comb? Information and advice will be gratefully received by—C. R. H.

[12059.]—**Watch Conversion.**—Some information respecting the conversion of vertical watches into levers would be useful to many. I have never seen the subject mentioned in the MECHANIC yet. What new wheels and parts are required, and their probable price? —A. A. A.

[12060.]—**Glass Blowing.**—Would some one kindly give particulars of bending glass tubes to any angle? Also how to blow a bulb on a thin glass tube of ¼in. bore, with the use of a spirit-lamp and mouth blow-pipe?—EMILY JANE.

[12061.]—**Chemical.**—How may chlorate of potash and chloride of potassium be distinguished in testing?—EMILY JANE.

[12062.] — **Induction Coil.** — Would any brother reader give me the following information:—1. Should the secondary wire be coiled the contrary way to the primary? 2. Should the secondary wire be separated by a layer of guttapercha tissue between every coil of wire?—J. B. P.

[12063.]—**Tambour Frame.**—How can I make a common tambour frame?—T. GREENHALGH.

[12064.]—**Diameter of Screw.**—What must be the diameter of a vertical screw about 22ft. long, to act upon the rim of a cast-iron ird x cog-wheel, not exceeding 4cwt., and divided into 22ft.? Also the size of a float to work the screw? The float will be encased in a rectangular cast-iron pipe, perforated and placed against a breakwater. I am designing a simple tidal harbour signal, intended to show the water in harbour at each foot of depth, at flow and ebb.—J. A. ADAMS.

[12065.]—**Paint and Varnish for Portable Engine Boilers.**—Will some subscriber tell me the best kind of paint and varnish for engine boilers? Colour green.—ENGINE DRIVER.

[12066.]—**Washing Baliste.**—Can any of your numerous readers inform me if there is any compound with which a blue material (baliste) may be washed which will cause it to retain its colour? Plain hot water and soap brings it out.—GWASTAD.

[12067.] — **Portable Force Pump.** — Could any fellow reader of our ENGLISH MECHANIC give me any information how I could construct a portable force pump suitable for watering a garden, one that could be fixed in any place required?—W. M.

[12068.]—**Surgical Dentistry.**—Will any fellow reader kindly give me names and publishers of standard works upon above, and profession generally? A really thorough good compendium might suit me best for reference; with plates preferred.—JOE.

[12069.]—**Trip to Australia.**—Would any of your many readers of experienced knowledge be good enough to say if they think a trip to Australia and back would be beneficial to a person who has suffered from congestion of the left lung, but who is now enjoying pretty good health, with the exception of a little weakness if he exerts himself? Also, could they recommend any commission that would help to defray expenses, in the hardware line or agricultural line?—WESTERN.

[12070.]—**Electric Kite.**—Will any one kindly give me particulars as to the materials and construction of an electric kite?—AEDTANNES.

[12071.]—**American Drill Chucks.**—What is the best method for fixing these to a lathe spindle? I have one with only a plain socket, and am at a loss how to fix it. Would heating it a little, and shrinking it on a carefully turned spindle do, without risk? Mine carries only a ⅜in. bit.—JOE.

[12072.]—**Magnetic Moment.**—"The moment of a magnet is the force lodged in one of its poles multiplied by the distance between them." Will "Sigma" give me a little explanation of the above sentence, which is taken from Ferguson, p. 8. For instance, I want to know what units of force and distance have to be employed.—BEACON LOUGH.

[12073.] — **Scarlet Runners.**—Can any of your numerous readers inform me what is the proper treatment of the roots of scarlet runners, to make them grow after the first year?—T. A. SALTER.

[12074.]—**Hollis Observing Seat.**—I am informed its range is from 5in. to 20in. high, and I should feel obliged to hear from any correspondent who may have used the seat how it suits in this respect, as I cannot see how any ordinary tripod or equatorial stand can be of any use on objects below 45° from the horizon with the seat even at its greatest elevation, which is only the height of an ordinary room chair. I understand if the maker is required to construct it higher an extra price is charged.—CROOKED NECK.

[12075.]—**Fruit Syrups.**—How are these, which are sold at one shilling per bottle, manufactured?—COUNTRY BARBER.

[12076.]—**Polishing Slate Clocks, &c.**—I have several slate and marble clocks, which, when new, had a very black and bright appearance, which time has sadly altered. Will some kind reader inform me by what means they can be restored to their original polish?—ALFRED HEALD.

[12077.]—**Pyrethrum Parthenium: the Common Feverfew.**—This plant, which is usually considered as a weed, is said to have occasionally double flowers. I shall be glad if some of "our" readers can inform me of the characteristics of these double flowers, in what respects they differ from the ordinary discs and rays, and how they may be obtained.—W. R. BIRT.

[12078.] — **Cabbage Planting.—Rhubarb.**—Will some one tell me what is the best kind of early cabbage seed? Also which is the best time for planting out, so as to obtain early cabbages? Is it best to manure the ground in the end of the year where they have to grow, or is it best to defer manuring and planting till the spring, and to have good plants for that purpose then? Also, in planting rhubarb roots, when is the time for planting them? Is the end of the year the best time for procuring the plants, or not till the spring? Also which is the largest and best in cultivation? — GEORGE RICHARDSON.

[12079.]—**Detonating Crackers.**—Will some one tell me what the crackers are composed of, which, when dropped on the ground, detonate with a loud noise?—G. E. L.

[12080.]—**Analysis of Manures and Assaying for Certain Metals.**—Would any reader be good enough to give me the names and addresses of some of the most reliable chemists by whom analyses and assays are made at moderate charges?—X. Y. Z.

[12081.]—**Chemistry.**—Can any kind reader inform me of any simple method of detecting arsenic and phosphoric acids, in acid liquors containing various metals in solution?—MOLECULE.

[12082.]—**Turning Tools used for Metals.**—Will S. Smither or any other of "our" readers, inform me the names of the various kind of turning tools used for metals?—BLACKSMITH.

[12083.]—**Polishing the Edges of Glass.**—Will some brother reader kindly give me directions for polishing the edges of glasses for lockets? I generally grind them in with an emery wheel.—TURQUOISE.

[12084.]—**Tools with Swiss Mandril.**—Will some one kindly give me a little idea of the uses of the various tools supplied with a Swiss mandril?—TURQUOISE.

[12085.]—**Cricket Bats.**—Would any reader say what the cricket bat makers use in staining and polishing bats, and what kind of string they use for binding. Small watercord does well, but it comes too expensive.—B. C.

[12086.]—**Velocipedes.**—Can any reader tell me how to put rubber tires on velocipedes when the wheels are iron tired, and which is best, the half round or the flat rubber?—BOB C.

[12087.]—**Violin.**—How are the sides of the violin bent, and set in their proper form? Can any one tell an ancient fiddler?—BOB C.

[12088.] — **Cleaning Jewellery.** — Which is the best and quickest way of cleaning gold. What is it that I have seen shop assistants dip the article in, let dry and polish with a brush, when it looks equal to new?—W. C. B.

[12089.]—**Felt Hats.**—Some of my felt hats got quite white round the band, just where the brim joins. Can any one inform me what causes this whiteness, and what will remove it without damaging the felt?—Bed of Stone.

[12090.]—**Strawberries.**—M. Paris states, in some interesting "Garden Stuff" contributed by him, that the ground about strawberries can hardly be trampled too hard. Does he know this from experience or experiment, or does he report it on hearsay? I should like to know. Also if he is a strawberry fancier. Does he know anything of the kinds, Dr. Hogg, Keen's Seedling, and Myatt's Hautbois? Is Myatt's Hautbois a second cropper?—as I got some plants in the spring of 1871, some few plants of which bore fruit, well tasted but slow ripening very late in the autumn, but the plants seem to have been quite exhausted, in fact, almost killed by the exertion. I gave them a dose of liquid manure (mixture from watercloset and cow byre) about once a week while fruiting, and this may have stimulated them too much.—Derf Errac.

[12091.]—**Plums.**—Why do plums and cherries which have set or formed well now begin to fall off, turning yellow or getting a red pip on the point before they fall off? If it were frost (of which we have had a severe touch here), where the trees were in blossom would it not have altogether prevented the formation of fruit and caused the blossom to fall off or wither up? I know it has had this effect on some of my trees in flower at same time, therefore, I cannot think this is the cause of what I mention. The trees were covered with blossoms, and are covered with half formed fruit, which will all fall off. I should mention that there is, at the same time, on the tree a fair crop of fruit, which will, I trust, ripen; but this part (distinguished by size, now as large as filberts, while the rest, though still green, do not seem to be increasing in size, or only very slowly, and are only as large as barleycorns) is not a third of the fruit which set properly. The tree is about 25 years old and looks quite healthy, but in past years it did not get fair play, suckers having been allowed to grow from its roots, which, however, I have had carefully pruned off. It is well dunged, and in fruit time watered with liquid manure.—Derf Errac.

[12092.]—**Curl in Peach.**—Will some kind horticultural friend prescribe remedy for curl in peach trees? I have heard it is caused by a fly. Some information on its appearance, habits, and mode of life, would be very interesting; the best mode of destroying, or preventing its injurious effects. Mine is a young healthy looking (in other respects) Barrington peach, planted in good ground, on a carefully prepared station on a south wall, in the open air, and carefully attended to, yet I shall have only one peach on it. Do "slaters," the only name I know for them, eat into the stalks of peach blossoms, as many of mine were so destroyed, but by what insect or bird I could never find out?—Derf Errac.

[12093.]—**Budding or Grafting.**—Will some practical man tell me why peaches, plums, and cherries, are generally budded and not grafted (or have I been rightly informed that they are so)? I have got some plum stocks on which I intended to graft scions in March next, but though I have been very successful in grafting apples and pears, I have only succeeded in grafting one plum, though most of those that I budded last year have done well. Is there more difficulty in grafting plums and stone fruit than other kinds, and is this the cause of the adoption of the practice of budding? If budding in the case of stone fruit is more certain than grafting, what should I do with my stocks now? They are good strong ones, but, unfortunately, I did not get them till rather late, and they have gone back a little. They are about 4ft. high, and about ¾in. diameter at bole. If budding is to be adopted, should I cut them down so as to get young shoots for budding on in August? Is there any good book of practical instructions, on the grafting, budding, pruning, and training of hardy fruit trees, and not very costly? The name of such would greatly oblige—Derf Errac.

[12094.]—**Preserving Caterpillars.**—Will some of "our" entomologists kindly tell me how to preserve caterpillars to mount in case, with their respective moths and butterflies?—Chrysalis.

[12095.]—**Hardening Steel Shafts.**—We have an order for a number of steel shafts from 4ft. to 6ft. long, 2in. to 8½in. diameter, with neck or bearings about a foot from the end, 4in. long, 1¼in. diameter. Now, the difficulty is to harden these in the necks, and there only. If I should not be asking too much I should like a rough design of furnace most suitable for heating a number at once, and the best material for hardening.—J. Jones.

[12096.]—**Copying Music.**—A schoolmaster of my acquaintance is in the habit of lithographing the parts of music, and giving them to his boys. Will some one tell me to what extent the practice is illegal?—F. J. Thomas.

[12097.]—**Venetian Blinds.**—Being about to make some for my windows, I should be thankful for a hint as to painting the laths. I am told there is some peculiarity in mixing the paint for this purpose. Any other information on the subject would be acceptable.—F. A. R.

[12098.]—**Dandelion Roots.**—I am greatly obliged to our friend, S. Bottone, for his information (11966). I should esteem it a great favour if he will kindly inform me the simplest and best way to obtain the extracts for medicinal purposes, as I am troubled very much with a sluggish liver. Is it possible to obtain the virtues out of the root so as to keep it by you in case of need? and which is best—a decoction, tonic or aperient, for one troubled as I am? His advice will be thankfully received.—Leicester.

[12099.]—**To Advanced Chemists.**—I have an important question to ask of chemists. I have consulted numbers of doctors—and some of them of European reputation—in vain, and I cannot help thinking that chemistry will assist me; and I trust that none but those well qualified will venture to give advice, as the answer is little less than life or death to me. The query is this: Is there any liquid or solid, or combination of both, capable of being taken internally, that will produce the dissolution—*i. e.*, be a solvent for a stone or calculus, and of which the following is a chemical analysis: Calculus essentially of magnesian character with no trace of uric acid?—Cirer, Brussels.

[12100.]—**Venomous Serpents.**—To Saul Rymea.—How does he (4092, p. 198) account for the well-known "snake stone" of India, and "snake bean" of Africa, acting as an antidote, or at least, preventing all dangerous consequences, as I believe is well authenticated, at any rate, I have seen it used and with full effect on an unknown snake bite, and on a cobra bite?—Cirer, Brussels.

[12101.]—**The Watch.**—I should like to see in the Mechanic a lesson on the watch, how to clean and how to repair it, with the name of the tools used, so that any of the amateurs could refer to it. Could "Yorkshire Pivot," or "West Cornwall," not do this?—S. H. L.

[12102.]—**Lightning.**—Will some one be kind enough to inform me at what rate lightning is supposed to travel? Also, whether lightning is or is not the quickest traveller?—Fred. Moore.

[12103.]—**Staining Glass.**—Could you kindly get me informed, through your columns, how or with what colours or acids glass is stained in the brilliant colours of deep red, pale red, amber, green, &c., and how, or with what, are letters taken out so clearly from the same stained glass?—Geo. Parker.

[12104.]—**Spring Curves.**—Will Mr. Proctor or any of our mathematical friends kindly inform me on the nature of spring (steel) curves when the pressure is at the centre? Does the curve vary in its nature as the pressure is increased? Is it different for different thicknesses? My reason for asking is that I have had some intentions of trying to grind a speculum, and knowing that a spring curve is very near a parabola, I thought it might be very valuable for roughing out.—T. Thorp.

[12105.]—**Equation.** — Will some mathematician kindly solve me the following simultaneous equation, involving a quadratic? It is taken from Todhunter's "Algebra for Beginners." 19th equation—

$$x^2 + xy = 28 \ . \ xy - y^2 = 8.$$

There are two equations—the dot divides them.—C. J. B.

[12106.]—**Organ Building.**—Can any of your numerous correspondents on this subject give me any information, through your columns, on the following? Considering the value of space in constructing chamber organs, and the room pedal (Bourdon) pipes take up, is there any practical difficulty in making one of such pipes do the work of several by means of valves at different intervals along the pipes on the principle of those on flutes, &c.? Seeing that two pedal notes would seldom, if ever, be required to sound at once, no difficulty on that score would arise. I think I have said enough to explain to any one conversant with these matters what I mean; if not, I shall be glad to give further particulars and drawings, but as I am only an amateur, and have never tried the experiment, I ask for information. I believe it is not an original idea; but I have never seen it carried out, so I rather fear it cannot be.—O. V.

[12107.]—**Recipe for Greasy Strapping.**—I am in want of a good recipe for piecing the above kind of strapping, so that I shall be able to work up all spare ends. Can any of the readers of the English Mechanic furnish me with one?—T. W. J.

[12108.]—**Confusion in the Head.**—What does this indicate? I seem always to have noises in my head, ears, &c., and am anxious and desponding. It is not a moral or philosophical defect, but must be a physical one. I wake up in the morning very heavy, and have a disinclination to get up. If I stoop the blood seems to rush to my head; age forty-seven. Bitter taste in mouth frequently. The best remedy I can find is to put myself on half rations. If any correspondent has been similarly afflicted, and knows of a remedy, I should be glad of a hint. Is it possible that it can arise from locality, occupation, &c.? I always fancy I feel more "all there" when I go from home.—Agent.

[12109.]—**Old Locomotive Tubes.**—Having to use old tubes for various purposes, would "Jack of All Trades" or some one else inform me the best method for "bending" them without causing a collapse in the bend?—Young Engineer.

[12110.]—**Silver-Plating.**—Will some one of our correspondents inform me of a simple way of recovering the silver from twelve gallons of cyanide of silver plating solution, or to improve the same, as it deposits the silver of a dark colour inclined to brown? The silver plates or anodes turn of the same colour, and I cannot keep them clean. The solution evolves gas with a very weak battery. What is the cause? Also, what is the best way to remove gold from brass plates, without acting much on the plates, and to recover the gold? I do not want to save the plates, but to remove the gold so as to be able to use it again.—Electro.

[12111.]—**Hothouse Boiler.**—My vineries are heated by a saddle-back boiler, the furnace pit of which fills with water from a spring unless pumped twice a day for about ten minutes each time. I shall be glad if any of your many ingenious correspondents will inform me if there be any other kind of boiler that admits of being placed higher? The present saddle-back cannot be altered in this respect to work efficaciously. A foot and a half would be a great gain to me.—W. F.

[12112.] — **Silvering Mirror for Telescope.**—I should feel much obliged if the Rev. C. Key would answer the following query:—I have just completed a glass speculum 10¼in. aperture, and 65in. focal length, out of a disc of glass an inch and a half thick. On trying it upon a first magnitude star—for example, Arcturus—with the plane mirror silvered, but with the large mirror unsilvered, in order to test its figure, I see the star quite round and small, with two interferences round the disc of the star, but without any rays or appendages. Of course, as the larger mirror was unsilvered, I could not, from want of light, use a high power, the power I used being about sixty linear. Might I consider my mirror sufficiently good so that I might proceed to silver it? To silver so large a mirror is rather an arduous affair, and I should not care to do so, before I was quite satisfied as to its figure. Would Mr. Key also kindly inform me how to make the silver film sufficiently hard to bear a good polish? I am tolerably successful in the process, but my films are always too soft.—T. Godfrey.

[12113.]—**Gold Quartz.**—A specimen of gold quartz weighs 806 grains; and its specific gravity is 3·25. Will some one kindly say what quantity of gold there should be in it, in grains, and also give the rule for estimating?—Augustus.

[12114.]—**Dye for Cricket-Cap.**—I have got a blue velvet cricket-cap with white lines down it and lined with gold braid, and a silk tassel: and after wearing it a little it gets quite worn, and loses its colour. Can any one tell me how to get it into a clean state without spoiling it.—T. T. G.

[12115.]—**To "Sigma."**—About twelve months ago this valued correspondent mentioned that he had a new form of battery in view, and that when he had tried it he would communicate the result. I think many of us would be glad to hear how he is progressing. I, for one, am delaying a long-desired change in my form of battery, awaiting the result of "Sigma's" experiments.—H. H. G.

[12116.]—**Hydrogen Lamp.**—Can any one tell me why it is that frequently a smart explosion ensues when the platinum has been glowing intensely without igniting the jet? It is evidently confined to the outside of the apparatus.—H. H. G.

[12117.]—**Restoring Colour of Watch-Plate.**—Will some friend give me a hint as to restoring the colour of a watch-plate? I want to bring the gilding back to a rich gold colour: it is now too white, though the gilding has not worn off.—F. E.

[12118.]—**Organ Construction.**—Can any reader tell me if I can use a set of harmonium reeds on an organ soundboard? I have made a small organ to have two stops, but having only one at present, I want to use the reeds to carry down the bass octave. Can this be done without cutting the soundboard, and so spoiling it for the other stop? Any information would oblige—Hautboy.

[12119.]—**Pump for Colliery.**—Would any of your scientific readers inform me what would be the cheapest and the most economical kind of pump for a colliery to fetch along the galleries of the mine about 500 gallons of water per day a distance of about 200 yards? I want one to work with the least possible motive power, as the quantity of water is small, and my means small.—One in Need.

[12120.]—**Light.**—I have often thought that light on issuing from the sun may be non-luminous electricity, flowing through empty space (ether being an imaginary substance invented to support the undulatory theory) until it comes in contact with gases such as surround our earth; and in its passage through these gases being converted into light and heat; the deeper the strata of gases, the greater the heat and illumination. For, on ascending a high mountain, the higher you ascend (the depth of the strata of air decreasing), the heat and light decreases. The heat certainly does, and I have heard that the light also does; the sky being of a dull leaden colour. The electricity might become vibratory through contact with different sized atoms of the different gases. Such a theory might lead to the discovery of the size of these atoms by the number of vibrations. Such a theory would satisfactorily account for the tails of comets. If the comets are in a fluid state, and rotated on their axis, they would be greatly flattened at their poles. Electricity in passing through in a polar direction, when illuminated by passing through the gas or gases, would meet in a point giving the conical tail. If the poles were still more flattened, approaching each other until the comet assumed a double concave form, the rays would diverge, giving the fantail. Would Mr. Proctor, or "F. R. A. S.," say if there is a shadow of probability in my theory? Query: Has light been ever seen through only a vacuum?—W. H. S.

[12121.] — **Chemical Preparation of Fruit Essences.**—Could any readers inform me of the method of preparing fruit essences from fusel oil or potato spirit?—H. Billings.

[12122.]—**Driving Bands.**—Will some person of experience say if indiarubber or leather driving bands are the best and most durable for driving steam threshing machines?—J. J. V.

[12123.]—**Worn Waterproof Bands.**—Will some one tell me the best composition to lay on waterproof sheets that are much worn, to make them more durable and waterproof?—J. J. V.

[12124.]—**Voice Weakness.**—I shall feel thankful if any brother reader can kindly inform of the best remedy for weakness of voice. Sometimes my speaking subsides almost to a whisper, which is very detrimental to my business duties.—Jacques Erick.

[12125.] — **Cover Plates.**—Can any correspondent give a practical rule for the length and thickness of cover plates in wrought iron riveted girders?—Excelsior.

Regelation.—The curious phenomenon of regelation can be exhibited by placing a block of ice on a netting of fine wire. The ice will be melted by the wire, and passing down through it will become frozen into a mass again below the wire. A single wire can, in a similar manner, be drawn slowly through a block of ice, the ice uniting again behind the wire and finally showing no sign of having been cut at all.

Nitrogen in Plants.—It has long been known that the quantity of nitrogen contained in cereal crops frequently very far surpasses the amount contained in the manured earth from which they are grown; and the manner in which the additional nitrogen has been acquired is one of the many puzzles of agricultural chemistry. (See p. 400, Vol. XIII.) That it is derived from the air there is no question, but in what manner? Has it been absorbed by the plants directly from the air, or has it been first withdrawn from the atmosphere by some of the constituents of the soil, with which it could form compounds capable of being assimilated by vegetable structures? According to *Les Mondes*, M. Deherian seems to have succeeded in demonstrating that in the presence of organic matter oxygen combines directly with nitrogen, forming a compound analogous to the ulmic or humic acid, produced by neutralising an acid with the potassic solution of garden mould. Into a perfectly dry tube he introduced oxygen, nitrogen, ammonia, and glucose, and on heating the mixture found that a black nitrogenous matter was formed, while at the same time a portion of the nitrogen disappeared from the atmosphere of the tube.

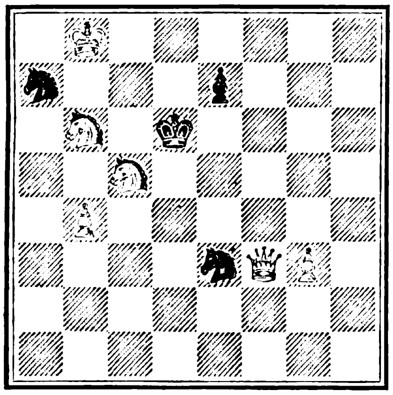
CHESS.

[*Edited by J. W. Abbott.*]

IN compliance with the desire of many of our subscribers, we propose to devote a corner of our publication to the game of chess. The superiority of this game over all others, as an intellectual recreation, has been for centuries acknowledged by philosophers and statesmen, who have praised it not alone for the inexhaustible source of amusement which it affords, but for the educational advantages to be derived from its practice. The popularity which the game of chess has attained in recent times is proved by the number of publications upon the subject; but no student of the chess literature of the last twenty years can fail to perceive that it is in the problem branch of the game rather than in play that modern progress in chess is most clearly demonstrated. He would be a bold man who would, on a comparison of their published games, pronounce Steinitz a better player than Philidor, whilst few people acquainted with the subject require to be argued into a conviction of the superiority of Healey, Bayer, and Loyd over the problem composers of Philidor's time. In fact, the case of Problems *v.* Games may be summed up in the statement that in the present day the genius of the composer has elevated the art of problem construction far above practical play, and that it is in the former that the highest manifestations of contemporary skill and subtlety in chess are to be found. It is unnecessary to enlarge upon the attractions which puzzles and problems have always had for the human mind. With most intellectual people the mere statement that a thing can be done is sufficient to imbue them with a desire to do it, and without taking higher grounds, it is just possible that the interest which the chess fraternity now evince in the construction and solution of problems may be attributed to some such feeling, but whatever the cause the popularity of the chess problem is beyond cavil. We therefore intend to direct attention to problems alone, and we introduce the reader to the latest production of Frank Healey:—

PROBLEM I.—BY FRANK HEALEY.

Black.



White.

White to play and mate in three moves.

All communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

"JACK OF ALL TRADES."

"JACK OF ALL TRADES," whose health has been fearfully shattered, is about to follow the advice offered by Mr. Hayward, as indicated at foot-note of let. 4266, last week. He also accepts, with thanks, the present of £10 10s. which has been transmitted to him. The following correspondents immediately responded to the appeal made:—

	£	s.	d.
J. H. Hayward, Tonnage House, Carrow, Norwich	1	0	0
"Philo"	1	0	0
"J. K. P."	1	0	0
"Sigma"	1	0	0
"Khoda Bux"	2	0	0
"Cireb"	2	0	0
The Editor	2	0	0
"J. C."	0	10	0
	£10	10	0

A "Well-Wisher and Friend," has sent 2s., and B. Marsh, Rochdale, has sent 6d. The two last sums have been added to the Life-boat Fund.

It will be seen that the contributions of other correspondents rendered it unnecessary for the Editor to subscribe more than £2, and that the contemplated amount is made up. Let us hope that "Jack" will soon be himself again, and when he is he will doubtless let us know it.

USEFUL AND SCIENTIFIC NOTES.

Hydraulic Plate-bending Machine. — The largest armour-plate bending machine ever manufactured has just been completed by Messrs. Westwood, Baillie, and Co., and erected by them at her Majesty's Dockyard, Pembroke. The machine has been tested to the enormous pressure of 4,000 tons. The large cylinder and ram are capable of being moved on the bed, so as to apply the pressure at any part between the columns to suit the difference in shape of the plates required to be bent. This movement is effected by means of a small hydraulic cylinder fixed on one end of the main bed casting. By an arrangement of screw valves the water can be applied at either end of the small hydraulic cylinder, or it can be connected with the large cylinder, and the ram made to lift instantaneously. The machine consists of a massive cast-iron block, top and bottom, each weighing upwards of 24 tons. These blocks are connected by four large columns forged from the best scrap iron. The large ram is 40½in. in diameter, and is worked by a set of four pumps contained in one cistern, two being of large and two of small diameter; all four work in concert to lift the ram up to the plate to be bent, and when about 600 tons pressure has been attained, the large pumps, by their own self-action, throw out of gear, and the small pumps continue to work and produce the power necessary for bending the armour-plate. The whole weight of the machine complete is about 83 tons.

Royal Cornwall Polytechnic Society, Falmouth.—The fortieth annual exhibition of this society (instituted 1833) will open on Wednesday, 21st of August, 1872. Medals and prizes in money will be awarded in the following departments:—*Mechanics:* Machinery and models; mechanical and other scientific inventions and improvements; specimens of naval architecture; essays and scientific papers, &c. *Fine Arts:* Pictures and drawings by professional artists and amateurs, sculpture, architectural drawings and models, and specimens of ornamental art. *Photography:* Photographs by professionals and amateurs. *Natural History:* Essays, local observations, collections of specimens, &c. *School Productions:* Mechanical and freehand drawings, specimens of penmanship, &c. *Plain Needlework, &c., British Lace,* and all objects of interest connected with science and the fine and industrial arts, which may be considered deserving by the judges. This exhibition has been established thirty-nine years, and affords an excellent opportunity for making known the merits of inventions, &c., throughout the West of England. The exhibition is held in a spacious hall, and continues open for eight days. No charge is made for space. The society will defray the expense of carriage, to and from the exhibition, of pictures and drawings by professional artists; and photographs by professional photographers. The carriage of all other articles must be paid by the exhibitor; except in special cases, when an exceptional arrangement may be made. Exhibits should be forwarded so as to reach the Polytechnic Hall, Falmouth, not later than Tuesday, August 13th, after which no space can be guaranteed. Lists of prizes and premiums, and all further information, may be obtained from the Secretary.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

	£	s.	d.
Amount previously acknowledged	£335	9	7
A Well-Wisher, and Friend	0	2	0
B. Marsh, Rochdale	0	0	6
	£335	12	1

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, June 4, and unacknowledged elsewhere:—

H. Spink.—V. Buckley.—H. Burridge.—H. Greenwood.—Screw-cutter.—G. A. Adams.—E. H. B.—Wanderer.—G. J. Lough.—J. W. Hood.—Henry Frances.—James Verity.—C. Dening and Co.—W. and H. M. Goulding.—Gillett and Bland.—Payne and Son.—H. A. Rawson.—Frances Blake.—J. D. B.—Evan Davis.—Richard Lloyd.—R. L. Jones.—Soul and Co.—Western.—J. B.—Young Natural Philosopher.—James Beal.—R. A. Proctor.—Fire Engine.—J. G. Parry.—Microscopist.—John Goundry.—E. Sharp.—Jos. Lambart.—J. M. Gorham.—Gilford Mills Reading Society.—Cervus.—F. J. T.—Philo.—Sigma.—F. R. A. S.—Art Student.—M. Reynonds.—J. P. Drake.—F. Paget.—E. M. Peacock.—J. N. Newton.—Chemical.—Saul Rymea.—Jack of All Trades.—Trovatore.—E. L.—Spotsman.—H. C. L.—H. G. W.—Needy.—J. W. Rodwell.—Bee.—Pneumatic Lever.—Lictor.—T. A.—A., Liverpool.—A. B. A.—Thos. Robinson.—C. H. P.—Alfred Waters.—Tourist.—Landsend.—B. N.—E. Anderson.—J. T. Burgess.—Comrade.—E. L. G.—W. S. G.—American Subscriber.—G. P. Coffin.—Thos. Gulliver.—P. W. D.—Robert Johnson.—North-West Yorkshire.—Robert J.—H. W.—A Sufferer.—Constant Subscriber.—Shafto Douglas.—A Would-be Baker.—J. Foster.—Jas. Cunliffe.—J. David Smith.—Xylographer.—Lanca.—J. Barwick.—Great Walker.—H. A. S.—Tripod.—M. J. Dodworth.—W. A.—Philanthropist.—Proven.—Zellus.—Mangle.—T. Perry.—Optical Bricklayer.—F. E. D.—Try Again.—W. Allan.—Experimenter.—Chignen.—J. H. T.—Ben Marsh.—Henry Clarke.—W. C. Hughes.—N. G. Robson.—Cireb.—G. Waterton, Jun.—Stewart Spires.—Ovo.—Assistant Manager.—Try It.—C. S.—Henry Blake.—E. W. James.—F. E.—D. N. E.—Un Irlandais.—Rev. E. L. Berthon.—W. T. Whitaker.—H. B. B.—Old Sub.—Cape Colony.—John Hopkins.—J. X. T.—York.—J. L.—E. W. S.—Leicester.—Monte Cristo.—Before Noon.—Letter Writer.—Horos.

THE DELUGE.—Old King Coal, M. Paris, Derf Errac, J. W. Rodwell, E. L. B., Un Irlandais, and Hill and Vale have sent us letters on this subject.

HOROS.—Why not, instead of finding fault, have assisted to supply deficiencies. Ask for what you want, and no doubt, some one will assist you. You can do no good by growling at what is done. Let us, at all events, part friends.

TOM DAWS.—You want us to repeat much of what many correspondents have from time to time said about photography in our pages, which we cannot do. If you refer to them you will get the information you require.

T. W. J.—"S. W. J." has asked a similar question.

AMATEUR ELECTRICIAN is referred to indices and back numbers. We cannot repeat our information on the construction of galvanic batteries, and you ought not to expect us to do so.

CIREB.—Please answer "Canada" through our pages, so that others may have the benefit as well.

WELL-TO-DO.—Thanks for offer to answer inquirers, but judging from the two answers inclosed, you might do better by *asking* for information on "Fire Engines."

G. E. L.—You may insure insertion by sending something worth inserting, either in the form of query, answer, or letter.

C. H. W.—The fault rests with the Post-office.

A SUBSCRIBER (Lymington).—The Planchette was illustrated and described in Vol. X., p. 280.

J. H. JONES.—Not inserted because not of use to others. You appear to think that the ENGLISH MECHANIC exists exclusively for you, and that, if it does not insert an essentially trade question, it acts unfairly. If we inserted it we should have acted unfairly to other readers, by appropriating space that belongs to them for scientific purposes.

HENRY JOHNSON.—Inform querists through our columns.

KING COAL.—One letter inserted. The other, "A Universal Deluge," contains no specific information not given before.

HONE KO JO.—You can call on employers who want such skilled labour as you have to sell, or you may advertise.

S. SMITHER.—On "Ornamental Turning, &c." next week.

J. T. SPRAGUE.—Your first articles on "Electro-metallurgy" will appear next week.

J. T.—The first *chess problem* appears this week.

UN IRLANDAIS.—Your wish shall be complied with.

B. H. L., Saturn, W. G. S., Australia, J. Barnard, and Steeplehouse.—Your queries and replies are to all intents and purposes advertisements.

WESTWARD HO!—One part of your query is an advertisement, and the other part cannot interest any one but yourself.

J. H. G.—Read the last four volumes of the ENGLISH MECHANIC. Why not ask for "the whole body of physicks" as Montaigne has it?

E. W.—Consult the series of articles on "Plumbing," now appearing in the *Building News.*

E. WHITWELL.—See "Astronomical Notes for June," in last week's ENGLISH MECHANIC, by "F. R. A. S."

E. L., W. M. Edwards, and Peter Piper.—Consult indices.

W. H. SKELTON.—The times given in the *Nautical Almanac* are calculated for Greenwich.

R. B.—Is not your caution somewhat superfluous? When *have* we allowed the insertion of "Infidel attacks on the Truth of Holy Scripture"? We are sorry to notice a half-threat in the latter portion of your letter. We think the ENGLISH MECHANIC would survive your interdict—we are sure all that was good and worth preservation in it would, and we are not at all concerned for the fate of anything else. A general and vague accusation against some of our most able contributors should have been supported by something more than two initials—two initials, moreover, which we do not remember to have seen at the end of any attempt to help us or our readers.

ASTRONOMER.—You need not have wasted our time by writing eight pages to tell us that you possess the knowledge of the true theory of the deluge, and that you mean to publish it somewhere, some time or other.

E. N. PEARS.—Your reply is an advertisement.

T. SMITH.—Consult a medical man.

T. A. (Birmingham.)—Cannot understand your query; write again.

M. A. SIMMONDS.—You had better bind him apprentice to some large shipping firm.

M. CARTER, Mahogany Table, A Subscriber, R. Galloway, G. A., Old Tar, and W. M., are referred to indices to back volumes.

LOUISE.—Never mind your hands, but pay more attention to your spelling.

J. H.—Apply to your local postmaster.

A SUBSCRIBER (Liverpool).—You are apparently suffering from sycosis, and should consult a physician.

Communications which can only appear as advertisements to hand from Cymro Glân, X. Y. Z.

JNO. PARSONS.—If you wish to protect yourself you had better not publish the drawings at all till the invention is patented.

R. O. BERRY.—For soldering without fire, see p. 546, Vol. XII. We gave this reference only last week to another correspondent, who, like yourself, was too lazy to consult his indices to back volumes.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING MAY 28, 1872.

1538 F. R. Gaspary, Berlin, for a self-working threading machine for acting sewing machines.

1539 W. Weldon, The Cedars, Putney, for improvements in the manufacture of soda, potash, hydrochloric acid, and chlorine.

1540 H. Kenyon, H. Kenyon, and I. Swindells, Warrington, Lancashire, for improvements in the manufacture of chlorine and sulphuric acid.

1541 W. H. Dupre, Jersey, for improvements in the construction of wind guards and other ventilators.

1542 G. R. Wood, Wishaw, Lanarkshire, for improvements in steam boilers and furnaces.

1543 R. A. Browne, Richmond-hill, for an improved utensil to be adapted to saucepans, fish kettles, and such like cooking utensils.

1544 J. Holmes, Lincoln's Inn-fields, for improvements applicable to coats and waistcoats.

1545 T. G. Messenger, Loughborough, Leicester, for improvements in the coupling of pipes and in the fittings thereof, and in valves to use in connection therewith and other similar purposes.

1546 E. G. Brewer, Chancery-lane, for a new or improved stocking or hose. A communication.

1547 C. A. C. Eckhold, Green-street, Charing-cross, for improved means of and apparatus for producing and applying motive power.

1548 E. Poulson, Martin-street, Bermondsey, for improvements in apparatus for securing the safety of sailing and other boats.

1549 J. A. Moe, Manchester, for improvements in machinery or apparatus for drawing wire.

1550 J. Worrall, Manchester, for an improved mode of and apparatus for dyeing cloth.

1551 J L. Baker and T. N. Cox, Hargrave, Northamptonshire, for an improvement in ploughs.

1552 H. A. Bonneville, Piccadilly, for improvements in machinery for treating cotton seeds. A communication.

1553 W. R. Lake, Southampton-buildings, for improvements in rolling bearings for plummer-blocks, axle-boxes, and other journal supports. A communication.

1554 G. Havcraft, Faversham, for improvements in the manufacture of pebble gunpowder, and in machinery for the same.

1555 W. Lockwood, Sheffield, for improvements in safety valves for steam boilers.

1556 J. Ricketts, Liverpool, for improvements in stationary and other cases constructed with two or more lids or covers.

1557 S. Cates and W. Swindlehurst, Bedminster, Bristol, for improvements in printing upon metallic or other surfaces by transfer.

1558 M. A. Soul, Southampton-buildings, for a new or improved system of pumping apparatus for compressing atmospheric air or other gases. A communication.

1559 T. Cocks, Gosberton, Lincolnshire, for improved machinery or apparatus for digging and gathering or collecting potatoes, turnips, and other agricultural roots.

1560 T. Cocks, Gosberton, Lincolnshire, for improved machinery or apparatus for planting potatoes.

1561 F. Holloway, New Cross, for improvements in presses for cutting and embossing various substances.

1562 J. Fielding, Liverpool, and W. Duckworth, Manchester, for improvements applicable to breaks for railway trains.

1563 W. B. Woodbury, Greenhithe, for improvements in magic lanterns. A communication.

1564 T. B. De Forest, Southampton-buildings, for an improved machine for making pins.

1565 T. B. De Forest, Southampton-buildings, for an improved machine for sticking pins in paper.

1566 P. Michaelis, Great Winchester-street-buildings, City, for an improved means or apparatus for stoppering bottles. A communication.

1567 P. Michaelis, Great Winchester-street-buildings, City, for an internal capsule for bottles. A communication.

1568 M. M. Harris, Cockspur-street, Westminster, for improvements in hubs or naves for the wheels of vehicles. A communication.

1569 S. Sanderson, Huddersfield, for improved fire-indicating apparatus.

1570 R. Thomas, Shepherd's Bush, for an improvement in tinting or colouring spectacle and other lenses.

1571 T. Brooks, Minerva, U.S., for improvements in the manufacture of steel.

1572 G. Westinghouse, jun., Southampton-buildings, for improvements in slide valves for steam and other engines.

1573 J. E. Rogers, Smethwick, Staffordshire, for an improved differential screw motion applicable to presses, punches, rail benders, shaft straighteners, and other mechanical contrivances of a similar character.

1574 W. R. Lake, Southampton-buildings, for an improved process of manufacturing sheet iron. A communication.

1575 W. R. Lake, Southampton-buildings, for an improved apparatus for removing seeds from raisins and similar fruit. A communication.

1576 W. R. Lake, Southampton-buildings, for improvements in couplings for railway carriages. A communication.

1577 A. J. Murray, Albany-road, Camberwell, for improvements in the treatment of sewage deposits.

1578 R. Rowat, Glasgow, for improvements in and connected with flexible metallic webs, applicable for carrying materials, or as window shutters or otherwise.

1579 J. Knowles, Wolverhampton, J. C. Mayell, Woolwich, for an improved portable cooking apparatus for field or camp use, and an improved formation of trench in connection therewith.

1580 W. Begg, Preston, for an improved feed water heater for steam boilers.

1581 P. F. Connelly, Florence, Italy, for improvements in screw propellers.

1582 J. Maver, Great Portland-street, for improvements in scissors, shears, and forceps.

1583 I. C. Johnson, Newcastle-upon-Tyne, for improvements in the manufacture of Portland and other cements.

1584 W. R. Lake, Southampton-buildings, for improvement in apparatus for propelling ships and other vessels. A communication.

1585 W. R. Lake, Southampton-buildings, for improvements in the manufacture of blocks for paving and other like purposes, and in apparatus employed therefor. A communication.

1586 W. R. Lake, Southampton-buildings, for improved processes and apparatus for the extraction of oil and the production of flour from maize. A communication.

1587 L. V. Simon, Bordeaux, for an improved system of gun, called the "elementary fictitious Chassepot," to be used in the colleges and lyceums.

1588 C. Muratori, Bessborough-gardens, Pimlico, for an improved substitute for iron and steel, chiefly designed to be used in the construction of defensive armour for soldiers, and in the building, lining, and covering of ships.

1589 J. Imray, Southampton-buildings, for improvements in the manufacture of iron and steel, and apparatus therefor. A communication.

1590 J. L. Boone and R. Herman, San Francisco, U.S., for improvements in the construction of the permanent beds of railroads, which improvements also embrace an artificial railroad tie or ...er of a semi-elastic or woody nature, and which block can be ...ted to various similar uses.

1591 G. T. Bousfield, Loughborough-park, Brixton, for a new and improved combination tool for use in mending machinery belts, and for other purposes. A communication.

1592 J. Farquharson, Blairgowrie, Perthshire, for improvements in breech-loading fire-arms.

1593 L. A. da Costa, King-street, Cheapside, and T. Lawrie, jun., Shepherd's Bush, for an improvements in the construction of traps, waste-plugs, or gullies, for baths, sinks, drains, and other conduits of water or other fluids.

1594 W. E. Newton, Chancery-lane, for improvements in caloric engines for obtaining motive power. A communication.

1595 F. Le B. Bedwell, Croydon, for an improved construction of life buoy.

1596 H. Figatner, Finsbury-square, for improvements in voltaic or galvanic batteries.

1597 A. B. Houghton, Birmingham, for an improved apparatus for locking up or securing type or other printing surfaces in frames or "chases," and for locking chases on the beds of presses or machines.

1598 E. T. Hughes, Chancery-lane, for improvements in furnaces for puddling, melting, re-heating, cementing, and for heating boilers. A communication.

1599 J. Shackleton and J. P. Binns, Halifax, for a machine or apparatus for "ticing-in" warps.

1600 F. J. Cheesbrough, Liverpool, for improvements in machinery and apparatus to be used in the process of manufacturing oil from seeds. A communication.

1601 R. Jackson and J. B. Jackson, Sheffield, for improvements in machinery or apparatus for cutting files.

1602 S. Smith, Halesworth, Suffolk, for improvements in the mode of opening and shutting doors of vehicles and in apparatus therefor, which improvements are more particularly applicable to common road carriages.

1603 R. Mather, Fountainbridge, Edinburgh, for improvements in splitting, separating, cleaning, and dressing fibrous materials, more especially rhea or china grass, and in machinery for these purposes.

1604 R. Irvine, Leith, N.B., and J. Mackintosh, Buenos Ayres, for improvements in the manufacture of paper stock.

1605 C. E. Wallis, Albert-street, Peckham, for improvements in repeating or revolving fire-arms.

1606 W. Easterbrook, Finsbury-place South, for improvements in the mechanical contrivances and apparatus employed for locking, and more especially for actuating or setting in motion the locking and interlocking gear for governing railway points and signals.

1607 F. Walton and J. Jones, Staines, for an improved machine or manufacturing nuts for screw bolts.

1608 J. H. Selwyn, Gloucester-crescent, Hyde Park, for a new method of treating refractory ores of silver.

1609 I. B. Harris, Edinburgh, for improvements in and connected with moulds for the production of indiarubber valves and such like articles.

1610 W. H. Davey, Islington, for an improved machine for ironing, calendering, or smoothing linen and other fabrics.

PATENTS SEALED.

3168 R. Wattson, for improvements in stuffing-boxes with metallic packing.
3173 W. E. Gedge, for a novel fabric, being elastic velvet, and improved machinery or apparatus to be used in its manufacture.
3182 J. Johnson, for improvements in the construction of bedsteads, adapted more particularly for invalids.
3198 J. McCool, for improvements in the means or apparatus for stopping holes in ships or other vessels.
3287 A. Gilbertson, for improvements in the manufacture of tin and terne plates, and in machinery therefor.
3290 D. Greig and J. Greig, for an improved rotary lithographic and type-printing machine.
3320 A. Pritchard, for improvements in corks for bottles and other vessels, and in apparatus connected therewith.
3321 A. V. Newton, for an improved mode of preparing for spinning flax, hemp, china grass, and other vegetable fibres.
3336 J. R. Wigham, for improvements in fog and other signals.
3368 J. H. Harrison, for improvements in hydraulic apparatus for raising, hauling, and lowering weights, applicable also for other winding apparatus.
3377 P. Schutzenberger and F. de Lalande, for improvements in employing certain preparations of indigo in printing and dyeing.
3437 J. A. Jaques and L. Sterne, for improvements in the manufacture of bags and pouches.
3455 W. Anderson, for improvements in domestic apparatus for rendering sewage gases innocuous.
83 B. Hunt, for improvements in meters for measuring water or other fluids.
291 E. Barthelmes, for improvements in shuttle sewing machines.
301 C. Wood, for improvements in apparatus for cooling blast furnace or smelting furnace slag or scoria as it runs from the furnace, and loading the same into waggons or trucks in a solid state.
348 E. Jones, for improvements in the manufacture of cartridge cases and in the apparatus to be used in the said manufacture.
466 G. Printz, for improvements in machinery for stamping needles.
511 J. C. Mewburn, for improvements in hackling machines.
582 S. Whitham, for improvements in the manufacturing of pile for bloom for weldless tires made of either iron or steel.
600 J. W. Wood, for a new or improved apparatus or appliance for stopping holes in ships, boilers, and other vessels or objects.
670 F. G. Underhay, for improvements in apparatus for controlling the supply of water to dwelling-houses and other buildings.
761 S. Doards, for an improved apparatus for heating water for warming conservatories and other buildings.
949 H. Y. D. Scott, for improvements in the treatment of sewage water.
63 W. Benson, for improvements in machinery or apparatus for cutting coal.
867 W. A. Lyttle, for improvements in poles for telegraphic and other purposes.
878 P. M. Parsons, for improvements in ordnance and in carriages and projectiles for the same.
879 J. Milroy and J. W. Butler, for improvements in the construction of coffer-dams.
887 E. A. Cowper, for improvements in regenerative hot-blast stoves for heating air, steam, and other gases.
948 J. H. Johnson, for improvements in laying the permanent way of railways and in apparatus employed therein.
974 J. Ashbury, for improvements in apparatus for propelling and steering vessels for inland navigation.
984 J. L. Casartelli, for improvements in pyrometers.
992 W. R. Lake, for an improved subsoil implement chiefly designed for making trenches or ditches for drainage and other purposes.
3192 J. Hargreaves, for improvements in treating dilute chlorine to separate impurities therefrom.
3194 J. W. Harding, for improvements in the method of registering the number of passengers and distance travelled by them in tram cars, "busses," cabs, and other vehicles, and in the apparatus or machinery employed therefor.
3200 E. Gregory, for a new or improved instrument or apparatus to be used in "fining" or improving the condition of ales.
3201 R. B. Starr, for improvements in omnibuses, and improved apparatus in connection therewith, which apparatus is also applicable to other purposes.
3210 M. A. Wier, for improvements in the means of and appliances for fixing buttons, studs, hooks and eyes, and other fastenings in or upon garments, furniture, and other articles.
3214 E. T. Hughes, for improvements in the manufacture of pegged boots and shoes, and in machinery or apparatus connected therewith.
3227 C. Galland, for improvements in the manufacture of leather cloth.
3229 J. D. Gauldie, for an improved apparatus for regulating the speed of steam-engines.
3231 J. Dunbar, for improvements in screwed bushes for the bungholes of casks and in apparatus employed for fixing or withdrawing the same.
3234 J. Wood, for improvements in machinery for polishing yarn or thread.
3243 W. G. Lankester, for improvements in heating and ventilating houses and other buildings.
3248 D. Macfarlane, for improvements in discharging or scattering powdered substances on plants or trees in order to destroy insects or parasites thereon, and in machinery or apparatus employed therefor.
3257 C. Nightingale, for an improved mouthpiece for protecting the wearer against atmospheric influences.
3264 W. R. Lake, for an improved tie or fastening for securing bales of cotton and other merchandise.
3277 A. M. Clark, for improvements in steam-engines for obtaining an efficient steam distribution therein.
3299 T. G. F. Dolby, for an improved means for attaching to the person those watch chains known as "Alberts" and "Victorias."
3392 H. W. Hammond, for a new moveable stamp.
105 R. Brown, for an improved ventilating stove.
339 A. Bauman, for improvements in steam-engines.
525 W. R. Lake, for improvements in cases or vessels for packing caustic alkalies, acids, salts, and other like materials, and in apparatus for forming the same.
571 E. Konigs, for improvements in obtaining sulphate of soda or of potash, and hydrochloric acid or chlorine.
777 E. Edwards, for improvements in dial plates for calendar clocks and watches.
988 G. Westinghouse, jun., for improvements in pneumatic apparatus for working brakes and communicating signals in railway trains.
969 B. Platt, for improvements in purifying turpentine and resin or resinous substances and obtaining the spirit therefrom, and in apparatus employed therein.
1019 W. R. Lake, for improvements in theodolites.
1031 S. Norris, for an improved pavement.
1035 T. Nutting, for improvements in machinery for spinning wool or various other fibrous matters.
3253 F. J. Fahlman, for improved apparatus for disinfecting and collecting fœcal matters, sewage, and manufacturing refuse.
3236 S. Rogers, for improved self-acting couplings for railway carriages, waggons, and other rolling stock.
3249 L. Fortoul, for improvements in treating fatty bodies.
3250 J. Taylor, for improvements in stoves or fire-places.
3261 J. J. Knight, for improvements in the manufacture of caustic soda and potash, carbonates and bicarbonates of soda and potash, phosphates of soda and potash, muriatic acid, and chlorine.
3268 W. Mann, for improvements in the method of purifying gas and in the apparatus employed for that purpose.
3346 L. S. Chichester and C. F. Chichester, for improvements in the preparation of grain for grinding into flour and in apparatus therefor.
3371 E. C. Vickers, for improvements in the preparation of cotton pulp to be used as a substitute for leather.
3490 W. Pawson, for improvements in water-closets.
48 Earl of Caithness, for improvements in cleaning railway rolling stock, and in the machinery or apparatus employed therein.
120 W. R. Lake, for an improved reflector for facilitating the threading of needles.
220 A. M. Clark, for improvements in railway carriage axles and wheels.
319 M. Bayly, for a new or improved combined machine for printing with or without self-inking apparatus, perforating, stamping, copying, and embossing.
450 B. Hunt, for improvements in postal cards and in covers therefor.
586 A. Moore and A. C. Moore, for improvements in roll caps for sheet-metal roofing.
632 E. Kenward, for improvements in ploughs.
649 H. R. Marsden, for improvements in stone-breaking machines.
698 H. Glover, for improvements in local magnetic attraction indicators.
702 A. M. Clark, for improvements in covering top rolls of carding, spinning, and twisting machines.
780 R. H. Patterson, for improvements in the purification of coal gas.
837 R. Monteith, for an improved process for preserving animal and vegetable substances.
851 J. A. Jaques and J. T. Oakley, for improvements applicable to machinery for grinding, surfacing, drilling, or otherwise working articles made of iron or steel.
904 G. Little and T. C. Eastwood, for improvements in machinery for preparing and combing wool, cotton, and other fibrous materials.
910 S. Moorhouse and W. J. Kendall, for improvements in the construction of umbrellas and parasols.
931 T. R. Crampton, for improvements in furnaces.
935 E. Meldrum, for improvements in the purification of paraffin oils and paraffin.
1071 J. Heberlein, for improvements in apparatus for working brakes in railway trains.

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The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 14, 1872.

ARTICLES.

NATIONAL OBSERVATORIES FOR THE STUDY OF THE PHYSICS OF ASTRONOMY.

BY RICHARD A. PROCTOR, B.A.
Honorary Secretary of the Royal Astronomical Society.
AUTHOR OF "THE SUN," "OTHER WORLDS," "ESSAYS ON ASTRONOMY," &c.

IT will be known to the readers of the ENGLISH MECHANIC that Colonel Strange, who has long been earnest in urging that science should receive extensive Government aid, has recently pointed out the insufficiency of existing national observatories. He urges that new observatories should be erected for the special purpose of studying the physics of astronomy. In other words, whereas the national observatories at present in existence are devoted almost entirely to the determination of the position and motions (real, or apparent) of the celestial bodies, Colonel Strange deems it desirable that other observatories should be erected for the study of the aspect and changes of aspect of the sun, moon, and planets; as also, doubtless—though Colonel Strange makes no distinct mention of these objects—for the study of comets, stars, star-clusters, and nebulæ.

It appears to me that no real lover of science can entertain the slightest question, either as to the importance of the general subject which Colonel Strange has been forward, if not foremost, in discussing, or as to the desirability of the establishment of such observatories as he has described. It cannot be too frequently pointed out that the progress of science must be slow, so long as the students of science are compelled, as at present, to make considerable sacrifices, either of money, time, or work. That zeal, indeed, which causes them to be willing to make such sacrifices, is of the utmost value to the cause of science. But it is to be remembered that there are hundreds, as eager to serve that cause as those who are now so engaged, who are absolutely prevented from so doing because unable to make the sacrifices required of them. Those who possess the requisite wealth, or leisure, or both, may sacrifice of that which they possess, and so advance the good cause. But what must happen with those not equally favoured by fortune, who yet are equally anxious to advance the interests of science? What must the man do whose possessions are but barely equal to his own requirements, or who is compelled to employ his whole time and his whole energy in professional avocations? In the present condition of things, he must simply abstain from science. He must refuse himself the luxury of advancing knowledge. At the utmost he must give only his leisure moments to original researches.

Now, it will scarcely be denied that there are hundreds who are thus circumstanced, and that among these hundreds are men as well fitted to carry out important processes of research as those who, being more fortunately placed, have done noble work in interpreting the secrets of nature. It cannot but be admitted that a system which compels hundreds who might advance science, to abstain wholly, or almost wholly, from the study of science, must seriously retard the progress of scientific discovery. Only in one way can the services of these lovers of science be secured—viz., by making of the study of science a profession—in plain words, by paying those who work in the cause of science for their time and labour, and by providing them with suitable means for carrying out their researches. At present there is no suitable provision for this purpose. A few students of astronomy may find a place in our Government observatories, though even in their case the class of work required is such as few students of astronomy can greatly care for. A few students of other branches of science, again, may find in professorships (*pace* Mr. Lowe) and other like positions, such remunerative employment as may in part free them for original research. And a few others may find in scientific bookwriting, at least the means of obtaining a livelihood without *wholly* abandoning science. But these cases are altogether exceptional, nor even in these cases is the want in question supplied. We cannot suppose for a moment that a professorship at one of our universities is the position which a Herschel or a Huggins would desire to occupy, if the want of means or of leisure prevented him from devoting his powers to original research. Nor is the writing of books on science the employment which would be selected—except as a *pis aller*—by one who was anxious to investigate the secrets of nature. And for the most part it is only the fortunate few who can even thus to any degree devote themselves to the advancement of science. The salaried stations in our observatories are eagerly filled; our professorial chairs are not for the many; and ninety-nine out of a hundred who take to scientific writing with the hope of profitable returns, find the expenses of publication greater than the support they receive from the public.*

It is obvious that science must suffer seriously when so many, who might do yeoman's service, are debarred from taking part in scientific work. Let it be remembered that there is here no question of disinterestedness, or the reverse. There is, probably, not one student of science in a hundred who would not be perfectly willing to do scientific work for its own sake and without hope of reward *if free to do so*. But it is one thing to look solely to the profits to be derived from scientific research, and quite another to require before entering on such research that the degree of support commonly called "a livelihood" shall be insured to the worker. I speak plainly, because plain speaking is required. If science is to be the pursuit of the many, it must be followed as a profession, providing, like other professions for, those who enter it and are capable and industrious. At present, science holds no such position. It is only by making important sacrifices, and by running the risk of others much more important, that any person not possessing considerable means can occupy himself with scientific work.

There can be no question, then, that all who desire to see science progress as it should (and as it *can* progress), should give their earnest support to any scheme whereby room may be found for scientific workers at present lost to the good cause. Not in astronomy alone, but in every department of science, the great want is systematic work and an increase in the number of regular workers; and there is only one way in which this desideratum can be supplied. We *must* have national observatories, national laboratories, national scientific salaried offices of many kinds,—and I do not entertain much doubt that before long we *shall* have them.

It is important, however, to notice, that in this matter not merely is it *le premier pas qui coûte*, but that everything will depend on the nature of that first step. Science is strong enough, probably, to secure a first move from Government. But if the consequences of such first move be unfortunate, science will lose much more than she will gain. Now, it cannot be denied that the first move advocated by Colonel Strange is not free from a considerable degree of risk. In the first place, Colonel Strange has associated with it a promise or *quasi* promise of certain practically useful results. This is in itself, I conceive, unfortunate. It cannot be too often insisted upon that science is not bound to answer the question *Cui bono?* so repeatedly asked of her. She is, on the contrary, bound to assert her true dignity by promising nothing. She is high enough—she has done enough—to claim to be served for her own sake. The good will come; of this we need have no fear; but it may not come in the particular way anticipated. In any given case it may be direct, but it may also be indirect; it may come quickly, but it may also be deferred for many years. All that can be predicated with confidence is that it will reward more than amply the efforts through which it has been obtained.

But the particular good suggested by Col. Strange and by Dr. De La Rue, who supported him at the recent meeting of the Royal Astronomical Society, is scarcely such as can be safely promised by astronomers. I venture, for my own part, to express my utter want of confidence in the probability that the systematic study of the sun will throw useful light on meteorological relations. That all weather-changes may be traced to the sun's influence I admit, or rather, the fact is too obvious to require mention. But that man will ever be able by studying the spots, the faculæ, the prominences, or the chromatosphere of the sun, to interpret the phenomena of the weather, appears to me to be an opinion all but demonstrably incorrect. We know that the sun's varying diurnal course accounts for seasonal changes; yet we know, also, that the seasons are not similar in different years, even as respects their general features, while the weather of any single day is almost wholly independent of the general character due to the season. In one region of the earth, again, a season will be exceptionally cold or hot or mild, while in another region precisely opposite characteristics will prevail. And again, whereas one part of a year may be (like last winter in the British Isles) exceptionally warm, another part may be (like the late spring) exceptionally cold, though the sun, "the dominating source of all weather changes," presents throughout the year the same general characteristics. The great eleven-yearly solar spot cycle may be supposed, without improbability, to be accompanied by some corresponding peculiarities of weather or by variations in the total quantity of heat received by the earth. Indeed, Mr. Baxendell has found evidence in favour of the former view, and Professor Piazzi Smyth (followed by Mr. Stone) has found evidence in favour of the latter. But these peculiarities are all but imperceptible, they vary in different places, they are not such as to throw light on the wider features of meteorological change. Now, the circumstances here considered—the sun's varying diurnal path and the great oscillatory change producing the spot-period—are altogether the most striking features of the sun's relation towards the earth. If *they* do not throw useful light on meteorological habitudes, surely none of the minor features which we may hope to detect by prolonged and systematic study of the sun can be expected to do so. And even if the direct action of the sun were more obviously recognisable in its general effects, yet, inasmuch as even in the length and breadth of England—a speck on the earth's globe—the greatest variety of weather is commonly experienced, it is surely hopeless to attempt to predict the conditions which will prevail in any one country when the solar relations exhibit such and such a character. Yet, short of this, what sort of prediction would be of the least use to men? Even if we admit that is the slightest prospect of our being able to do so much as this, of what earthly use would it be to predict that a storm will rage, for instance, on such and such a day, if the storm is as likely to rage in Russia as in England, or in India as in China?

It seems to me, then, unfortunate that Col. Strange's proposal has been accompanied by anticipations so chimerical. It is still more unfortunate that some who have supported it have not hesitated to sneer at the work done by meteorologists with the Government grant of £10,000 per annum. It is certain, in the first place, that whencesoever the means of interpreting meteorological relations are to come (if they ever come), we *must* know what those relations actually are. In other words, we *must* have these long arrays of tabulated figures—thermometric, barometric, wind-recording, cloud-recording, and the rest—if we are to understand the cause or causes of changes in the direction of the wind, in the prevalence of cloud, in temperature, barometric pressure, and so on. Hitherto very little has come of these records, it must be admitted—and, for my own part, I entertain a particularly strong impression that very little ever will come of them—*but if ever the great mysteries of meteorology are solved those tabulations will have fulfilled their purpose. To cease to make them is to admit that these mysteries are inscrutable.*

Moreover, it will scarcely do to approach Government with a request for Government assistance, on the plea that the Government assistance granted to meteorologists has been completely thrown away.

But the chief point to which I would invite attention in Col. Strange's proposal* is this, that he has not indicated with sufficient clearness what he would wish Government to do. If a

* It is, doubtless, due to the present unsatisfactory position of scientific teaching in this country, that what the *general* reading public would take is not that which the student of science would prefer to supply. A volume containing the results of a long process of original research would scarcely have a chance of success as a literary venture. No publisher would accept the risk of such a volume. It should be remembered, in fact, that the scientific author is not free to select his own line or style of writing, unless he can publish at his own expense. He is bound to consider the opinion of the publisher as to what the public is likely to find attractive.

* I refer throughout to the paper read by Col. Stran[illegible] before the Royal Astronomical Society. If there [illegible] been less public utterances on his part, I either ignorant of them or ignore them.

vague resolution, such as his paper seems to promise, were submitted to Governmental consideration, Government might, with the best intentions, proceed to action which would by no means accord with the wishes of true lovers of science. The Royal Astronomical Society, the acknowledged representative of the astronomy of England, knows what sort of man should be placed at the head of a great national observatory; but Government, not knowing, might place there some person without any real regard for science, and with none but borrowed scientific knowledge. If Col. Strange would so bring his proposal before the Astronomical Society, and thus before Government, that none but those who were at once zealous astronomers, trained observers, sound mathematicians, and skilful theorisers, were placed in authority in the proposed observatories, no true lover of science could refuse the proposal his most earnest support. Nothing but good could follow from such a course. But if there were the slightest risk that an appointment of the sort should fall into unworthy hands—and such risk would assuredly be involved if vague resolutions were submitted to Government—it would be the duty of all who wished well to science to oppose the resolution to the utmost of their power.

A point to be most carefully insisted upon is that the head of any national observatory such as has been proposed should be one who would behave in a generous, considerate, and courteous way to all who worked under him.

In conclusion, I must remark, to prevent the possibility of misapprehensions which might mar the effect of what I have been saying, that *personally* I have *no interest whatever* in Col. Strange's proposal. I wish to see science advance as rapidly as possible, and in particular that astronomy may so advance; and I speak out of the interest I thus take in the progress of science. In so far as I advocate the proposal for new national observatories, it is because I believe such observatories to be very much wanted, and that their erection would be followed by important advances in astronomy; in so far as I oppose the proposal for their erection, it is because I fear lest if the project be improperly carried out, it would lead to retrogression instead of advance. I cannot recall any instance, for years past, where it behoved the true lover of science to be so careful as to his action as in the present case.

AIR AND RAIN.*

WE have already (p. 239) examined a few of the facts brought forward by Dr. Angus Smith on the subject which forms the first moiety of the title of this article, and have endeavoured to point out the conclusions to which they lead. We have seen that a very small deficiency in the proportion of oxygen in the air we breathe, when compared with that which is known to exist in notoriously healthy spots is sufficient to call for a rigid sanitary investigation into the causes which produce it, not merely because a deficiency of oxygen is in itself sure evidence of the insalubrious character of the atmosphere in which it occurs, but because there is ample ground for believing that this deficiency of the life-giving gas, found to be the normal condition of the air, is made up by a greater or lesser number of other gases, many of which are known to possess noxious properties, and which are also believed to be the media that afford sustenance to, and assist in the propagation of, the as yet undefined poison-germs of disease. Granting this premise a very little consideration will show us that the rain must exercise a great influence on the number of these germs floating in the air which it traverses, and that it is, therefore, as essential to make a rigid scientific investigation into the peculiarities of the rain of different localities, and the numerous foreign substances brought down by it, as into the air through which it has fallen. We know that after rain the atmosphere contains a larger percentage of oxygen than it did previously, and there is at the same time a diminution of carbonic acid; but although we have not been able to discover the cause of this increase of oxygen in the facts which chemical climatology has as yet presented to view, there can be but little doubt that it is mainly brought about by the removal of "atmospheric dust" and carbonic acid and other gases by the mechanical and chemical actions of the falling water. The analytical examination of the collected rain, indeed, enables us to form a very good idea of the character of the air of the locality in which it has been gathered, and, taken in connection with an examination of the air itself on a fine day, affords a reliable criterion of what may be termed the external salubrity of the place under investigation.

The principal substances found in the rain-waters experimented on by Dr. Angus Smith are chlorides, sulphates, and ammonia. Amongst the most important, as far as quantity is concerned, is undoubtedly common salt, the base of which, sodium, spectrum analysis has shown to be universally present. Common salt is found in abundance in the rain of the sea-coast, to the extent of 1 part in 10,000 parts of rain-water; but it cannot be supposed that any noxious property exists in this compound. In making analyses of the substances found in rain, therefore, allowance must be made for the proportion of hydrochloric acid due to the salt found near the sea and in the neighbourhood of towns, where it is one of the products of coal-burning; but a distinction is easily drawn between the two, from the fact that rain-water near the sea is not acid, while that taken in towns is invariably so, from the fact of its containing sulphur compounds. The compounds of sulphur, too, are found where there is no coal-burning to account for them, and these invariably proceed from decaying animal and vegetable matters, which give off sulphuretted hydrogen and sulphide of ammonium, which, happily for us, are speedily oxidised, and split up. Ammonia, however, is the compound which affords a fair test of the amount of impurity in the atmosphere. When organic substances undergo decomposition, says Dr. Smith, the nitrogen goes off with hydrogen, forming ammonia, unless strong oxidising influences are present. But ammonia itself is not an infection — a small amount, even when constant, may not be hurtful; but the probability is that this small amount is better absent, because its presence indicates objectionable or decaying matter, which may send out worse substances than ammonia. The results obtained by the investigations of Dr. Smith into the constituents of the rain taken in various parts of Great Britain give the amount of chlorides found in London rain-water as 2·6, when compared with Valentia as 100; while for sulphuric acid, taking Valentia as 100, London has 750, and Glasgow 2,571, a fact which Dr. Smith regards as explaining in some degree the great mortality of the last-mentioned place, because sulphuric acid is not merely a measurer of manufacturing industry, but also of decomposition, being a part of the oxidised sewage of the air. The "acidity" of the rain-water is another measure of the impurity of the atmosphere, and in this respect, taking the inland country parts of England as exhibiting 0, Glasgow figures with the high comparative amount of 109, and Manchester and Liverpool with 83, while London has 28. The comparative amounts of combined ammonia are shown by Valentia 1, Glasgow 50, with Liverpool and Manchester following closely with 30 and 36. In the most important table of all, that giving the comparative amounts of albuminoid ammonia —*i.e.*, the measure of unpurified air-sewage—which includes the "germs," Valentia being taken as 1, Glasgow gives nearly 9, while Liverpool (3) is less than London (6), and St. Helen's and Manchester press closely on Glasgow.

The tables containing the averages of the experiments made on the different rain-waters are full of interesting and valuable information, but they must be read in their entirety, with a clear appreciation of the effect of the prevailing wind and other circumstances, before correct notions can be gained; for we find that on one occasion the amount of hydrochloric acid found in rain collected at North Uist was no less than $3\frac{1}{4}$ grains per gallon, while a specimen taken at Kelly, Wemyss Bay, yielded only ·0852 per gallon, a difference which of course can only be accounted for by the elevation of the place, the direction of the wind, and the time of the year. We have said sufficient here to show that an analysis of the rain may be made to determine approximately the healthiness of a given locality, or at least point out the direction which further inquiries should take. For the results of the investigations made at the various places we must refer our readers, as before, to the book itself: so many different localities have furnished the materials for the experiments that a tolerably accurate prevision of the result of analysis can now be made for any spot in the British Isles. Dr. Smith supplies several lithographs of characteristic specimens of the crystals found after evaporating rain-water—those obtained from Newcastle-on-Tyne rain exhibiting beautifully-defined crystals of Glauber's salts (sulphate of soda). These specimens were obtained by boiling down 200 cubic centimetres to the bulk of about one, and allowing one drop of this to evaporate spontaneously on a microscope slide, affording in many cases interesting, and in all, valuable, objects for the study of the sanitarian chemist and microscopist. It is not necessary for the would-be investigator into this subject to wait for a shower of rain in order to obtain an idea of the matters held suspended in, or the gases mixed with the air, for it is quite possible to obtain exactly similar results by taking the air in a bottle containing a little pure water and washing it by agitation. This method has been followed by Dr. Smith in analysing the air of houses and close places; still, he says, that although air-washings enable us to examine air where rain cannot come, and to a great extent must supersede the examination of rain, the latter must not be neglected, since we obtain from it a knowledge of the contents of the atmosphere at a time when we cannot watch it, and we obtain also the mean of a long period. With these air-washings of specimens of metropolitan air, Dr. Smith obtained some curious results, which show how necessary it is to take into account the state of the weather at the time, for in an air-washing from Westminster Abbey Yard, taken on a fine day, he found albuminoid ammonia in the proportion of 37 grains per million cubic feet; in one taken on the embankment in front of the Houses of Parliament 71·8; and in one taken in a field two miles beyond Clapham Junction, no fewer than 118·4; but the second specimen was obtained on a windy day, and the latter during a very strong wind. It is, therefore, necessary to take the mean of a number of experiments before deciding on the amount of impurity in the air of any particular spot; but those at present made by Dr. Smith, though comparatively few in number, are of the first importance in showing the difference between the air of some of our health-resorts, and the vitiated stuff which a large portion of the community are condemned to breathe daily and hourly. Thus, putting the amount of hydrochloric acid found at Blackpool (Lancashire coast) as 100; the comparative amount for London is 320, and on the Underground Railway, 974. The amounts of sulphuric acid (anhydrous) for the same places are Blackpool, 100; London, 352; Underground Railway, 1,554. The quantities of ammonia and albuminoid ammonia are compared with those found at Innellan on the Firth of Clyde, which, being taken at 100, shows London with 117 and 108, Glasgow 150 and 221, and the Underground Railway 138 and 271; so that on these results London has but little more albuminoid ammonia than Innellan—100: 109; while Glasgow and the Underground Railway have atmospheres little better as regards their freedom from what Dr. Smith calls "potential ammonia" than the air obtained over a midden! It is true that while our author points out that the albuminoid ammonia is the most important of the chemical constituents, he cautions us against drawing too many conclusions from its presence. "The organic matter," he says, "is sometimes quite sound, and so far from producing disease it may help to drive it away. All that we can say is that organic nitrogenous matter shows that some organisms of a hurtful kind may be present. If there is no excess of albuminoid ammonia, the hurtful organisms or other matter may be presumed to be absent. If there is an excess, it is well to avoid such air until we know that it is from a source which produces not only that which is wholesome but that which continues to be so."

With regard to the lowest percentage of carbonic acid deemed positively hurtful, scientific men have failed to agree, and even Dr. Smith can give but a hesitating opinion, although he thinks that the "smallest diminution of the oxygen in the air breathed affects animal life, if its place is supplied by carbonic acid." But the question, How can the blood be influenced by a diminution of oxygen in the atmosphere to the extent of ·1 per cent. has met with contradictory answers. Liebig says, "In a closed space 8ft. long, 9ft. high, and 8ft. wide, a man cannot breathe twenty-four hours without uneasiness." The danger to life is not immediate, however, according to Dr. Smith, when the percentage of carbonic acid is less than 4 per cent., provided the person breathing the air so adulterated is healthy; but "the constant lowering of the pulse, even in much less impure air, must have a gradual effect on the

* Air and Rain. By R. Angus Smith, Ph.D., F.R.S., &c. London: Longmans.

vitality." Dr. Smith considers that a certain quantity of oxygen is required to drive out the carbonic acid from the blood, and that this quantity being deficient less carbonic acid is given out, and it is certain that no danger to life and no difficulty of breathing is experienced in situations where the air contains less than the normal amount of oxygen, if carbonic acid is also almost entirely absent. Dr. Smith gives a good rule for ascertaining the amount of carbonic acid in the air of houses:—"Let us keep our rooms so that the air does not give a precipitate when a 10½oz. bottleful is shaken with half an ounce of clear lime-water," a sanitary regulation which can easily be carried out.

This book also contains valuable information on the constituents of smoke, looked at both from the sanitarian's point of view and from the point of view of the consumer of large quantities of coal for heating purposes. We may at some future time call attention to this aspect of the smoke question, which is still imperfectly understood, and in connection with which the teachings of science are strangely neglected. The influence of acids derived from chemical and other works upon vegetation also finds a place in this volume, which, as we intimated before, is a record of work, the full value of which will be recognised at a future time. One of our contemporaries regards the book as useless because ozone finds no place in it; but as Dr. Smith has not yet been able to make the contemplated experiments on the subject we cannot well complain because his "*beginnings* of a chemical climatology" are not so complete as we could wish.

ON A NEW SYSTEM OF CHEMICAL NOMENCLATURE.

BY SELIMO BOTTONI.

MUCH interest has been evinced by several of "our" correspondents with regard to the nomenclature employed in modern chemistry. Though at first sight it might appear that the name applied to any substance would have little to do with the comprehension of its possible properties, and its theoretical relations with other bodies, yet in practice it is found that nothing is so conducive to a clear apprehension of the relation which things hold to one another as a systematic and natural nomenclature. The grouping of plants into natural orders has had a marked influence in the facilitation of the study and the acquirement of a correct knowledge of the science of botany. Thus, for instance, to the botanist, the knowledge that a plant belongs to the order named *Leguminosæ*, immediately gives him an insight into the probable properties, mode of growth, of flowering, &c., possessed by that plant. Again, the nomenclature proposed by Lavoisier, and others, towards the beginning of the present century, has done much towards placing chemistry on the solid basis on which it at present stands. In fact, fresh and more accurate knowledge of the constitution of bodies necessitated novel and more accurate nomenclature; and, as a natural consequence, this more accurate nomenclature pointed to new and hitherto unexpected relations. Let us for a moment turn back 100 years. What possible relation does the mind become cognisant of on hearing the words "water" and "muriatic acid"? How different is the case when we use the modern scientific names "hydrogen oxide" and "hydrogen chloride." We are immediately aware of the similarities and dissimilarities of these two bodies, and are able, within certain limits, to predict the behaviour of the one from a knowledge of that of the other.

But chemistry has taken such vast strides within the last forty years that the present Lavoisierian nomenclature, superior though it be to the old Stahlian, is totally inadequate to furnish us with distinct ideas of the numerous and complex bodies which organic chemistry is daily bringing to light. Let not the student, nor even the professed chemist, for a moment suppose that this inadequacy is imaginary. Let him call to mind the annexed moderately long name, and try whether he can, without reference to some chemical work, give an idea of the composition, properties, &c., of the body named, TETRETHYLPROPYLBUTYLAMYLAMMONIUM HYDRATE. In the hope of awakening an interest in this very necessary branch of chemical science, I propose giving a few extracts from a work published in 1871, at Bologna, by Professor Filopanti, of the Bolognese University, entitled "Alcuni Misteri di Chimica popolarmente spiegati, e nuova Nomenclatura." The system proposed has received favourable notice from the following professors:—P. Piazza, F. Selmi, D. Santagata, G. Fabbi, and G. Carini, and, though novel and strange to the eye, contains, undoubtedly, the germs of a very perfect system of nomenclature. Having thus broached the subject, I shall leave Professor Filopanti to speak for himself.

Atomic Nomenclature.

"The new system of nomenclature, which I propose, is based on a principle, as easy of conception as it is of execution; and yet able to explain all the discoveries of modern chemistry, with even greater perspicacity than the French nomenclature was capable of explaining those which were made at the conclusion of last century. The principle consists in giving in certain determinate cases, an entire ideographic signification to *each* letter of the alphabet; the execution consists in the expression by such letters, of the exact chemical formula of the body to be named. Four elements are present in organic compounds, with such great frequency as to almost exclude the others; and these four are also among the most abundant in minerals. These four elements are at present known under the names of *hydrogen*, *oxygen*, *nitrogen*, and *carbon*. In organic chemistry these occur with greater frequency than all the rest put together. Hence, we will represent them in the simplest and most convenient manner, which (humanly speaking) it is possible to find—that is to say, by means of one vowel for each of the four. But it is by no means indifferent which vowel we choose to assign to each of these very important elements; we wish that our names should aid the student, not only to remember the composition of the bodies named, but also the *reasons* for their having such a composition; we wish that such names should also enable him to foresee the reactions and transformations of which the bodies named are capable. For this reason, a*, the *first* vowel, will be the most appropriate name for *hydrogen*, as hydrogen is *monovalent*—that is to say, has only *one* combining power. e, the *second* vowel, will, for a like reason, be the most adapted to *oxygen*, oxygen being *bivalent*—*id est*, possessed of *two* combining powers. For similar reasons, i will stand for *nitrogen*, as nitrogen acts generally as *trivalent* with *three* combining powers; while o is the best vowel for carbon, as by its *fourth* place in the alphabet of vowels, it reveals the *four* combining powers, or *quadrivalence* of carbon.

All the other elements are to be represented by a combination of four letters; the first of which is invariably to be u, followed by the two most conspicuous consonants in the common name of the element; the ending to be a vowel indicative of the valency of the element. Thus, for example, we shall have *ucra* for *chlorine*; *upsa* for *potassium*; *urga* for *argentum*; as these are all monovalent elements: *ucle*, *calcium*; *upre*, *cuprum*, being bivalent; *uphri*, *phosphorus*; *umri*, *aurum*, which are trivalent; *uslo*, *silicon*; *upto*, *platinum*; these being tetravalent, &c.

We must also agree to assign a numerical value to ten consonants, which, with the new names of the four biogens,† are tabulated below:—

a	*e*	*i*	*o*
Hydrogen.	Oxygen.	Nitrogen.	Carbon.

b	*c*	*d*	*f*	*g*	*l*	*m*	*n*	*p*	*r*
1	2	3	4	5	6	7	8	9	0

The names of compounds are then to be derived from an examination of their chemical composition; placing the new name of the element first, followed by the consonant indicative of the quantity of atoms which exist. Should the number exceed *ten*, it is to be formed by binary combinations of the numerical consonants. The repetition of the same vowel (which may be allowable, for the purpose of facilitating pronunciation) does not alter the value of the other letters. *t* is used to express an indefinite number: *s* to mark the hypothetical nature of the body named. For instance, *splandrafnacti*‡ would be the name of a hypothetical body, composed of 96,830,482 atoms of hydrogen, united to an imaginary number of atoms of nitrogen.

I have coined this fantastic word solely with the object of rendering more palpable the wonderful fecundity of this system as well as its remarkable brevity. In fact, this word can be pronounced five times more rapidly than the corresponding Arabic number, which denotes the number of atoms of hydrogen—viz., ninety-six million, eight hundred thousand, four hundred and eighty-two, contained in the compound.

I must here note, however, that in the names of the non-biogenous elements, such as *upsa*, *ucle*, &c., the two consonants retain their ordinary alphabetic signification, and do not acquire the conventional numeric value. There is no danger of confusion, as these names *invariably* begin with *u*.

Let us now come to the application of this new system, beginning at the commonest and most important of binary compounds, water. Water is composed, as we know, of two atoms of hydrogen, united to one atom of oxygen; therefore, in our atomic nomenclature its name will be:—

B	è	c	a
Two	Hydrogen	one	Oxygen.

I must explain here the use of the accent, which before giving an example, I could not well do. When the accent is placed on the last syllable the body is a *solid*, when placed on the penult it exists as a *liquid*, and, finally, when placed on the antepenult the accent denotes that the body exists as a *gas*. Consequently, we may express the four states of water by the four following words, the position of the syllables being quite immaterial:—

Bèca = Water.
Bèaca = Steam.
Becà = Snow.
Cabè = Ice.

Let us now stop to consider for a moment what the short word bèca teaches us, and what it calls to mind:—(1) it shows that the body contains oxygen, *e*; (2) that it contains hydrogen, *a*; (3) that in every molecule there is only one atom of the former, $b = 1$; (4) and two of the latter, $c = 2$; (5) that it contains no other element, there being no other vowel; (6) multiplying the exponents $b = 1$ and $c = 2$ by the relative atomic weights of oxygen = 16, and hydrogen = 1, we learn that oxygen forms exactly eight-ninths, and hydrogen one-ninth of the total weight of water; (7) that it is a liquid, for the accent is placed on the penult; (8) that the first element is bivalent, being represented by the *second* vowel in the alphabet, that the other element is monovalent, as it is represented by the *first* vowel of the alphabet; (10) that water = bèca must be one of the simplest and most perfectly saturate (chemically) bodies, for we see that the valencies of the two monad atoms of hydrogen = *c a* completely satisfy the two valencies of the dyad atom of oxygen *b e*; (11) that water must, therefore, be one of the most stable and consequently one of the most abundant bodies in all the three kingdoms of nature. Now compare this with the usual nomenclature, and see whether *that* is able to denote so many things, not with four letters only, but even with four of its longest words."

Having given this simple example I can proceed to enlarge upon certain modes of spelling these atomic words, which will enable us to indicate whether the body in question be acid or basic, and whether we view the acidity as dependent on the hydrogen or the oxygen, we can easily point out, not only the *fact* of its being an acid, but also the view we take of the cause of its acidity. Let us agree to place the vowel which stands for the hypothetical acidifier (be it *oxygen* e, or *hydrogen* a) at the *beginning* of the atomic name. After this let us place the numerical consonant, indicating the number of atoms of this element which the compound contains. Lastly, let us repeat the vowel. This repetition does not influence the numeric value of the element, as we have already explained. It is only used to give a distinctive character to the name. We can, therefore, write the following names in two distinct modes, each perfectly intelligible, and each illustrative of different theoretic views.

1. As hydracids:—

H_2SO_4	Sulphuric acid	=	Acabuspèfe.
HNO_3	Nitric acid	=	Ababide.
H_2CO_3	Carbonic acid	=	Acabode.
HCl	Chlorhydric acid	=	Abàbucra.

* In order that the ear may not confound certain names, it is absolutely necessary that these vowels be pronounced as in Italian: viz., A = Ah, E = Eh, I = He, O = awe, U = who.

† Our author calls these four *biogens*, owing to their occurrence in animal and vegetable *life*.

‡ The numerical consonants refer always to the vowels with which they form syllables. Thus: splan-draf nac-ti.

2. As oxyacids:—

Sulphuric acid = Efebuspèca.
Nitric acid = Edebìba.
Carbonic acid = Edebòca.

In a like manner we can express the basicity of a compound by doubling the last vowel, *without* interposing the numeric consonant, thus:—

NH_3 Ammonia = Bìdaa.
KHO Potassium hydroxide = Upsababeè.

I shall now run through a few of these atomic names, leaving my readers to make observations similar to those which I have already made with regard to *water*. Ammonia is an *ai** of the commonest kind, as water is the commonest *ae*†. Each molecule of ammonia is composed of one atom of nitrogen, united to three atoms of hydrogen, hence its simplest atomic name will be *bida*. But, as at ordinary pressure it is a gas, and possesses an alkaline reaction, we will apply the preceding rules, and write and pronounce its name as *bidaa*.

The simplest and commonest of the *ao* (hydrocarbons) is marsh gas, each molecule of which contains one atom of carbon united to four of hydrogen; its name will, therefore, be *bòafa*. We immediately perceive this to be a saturate body, for the four monad atoms of hydrogen, *fa*, satisfy the quadruple affinity of the single atom of carbon *bo*, which is tetravalent, as the vowel *o* (the fourth in the alphabet) indicates."

Professor Filopanti then goes on to give numerous other examples, of which I will only reproduce a few. The first I shall choose is an example of the exactitude with which these atomic names indicate the substitutions which take place during chemical reactions:—" Nitric acid being ababìde, potassium nitrate is bupsabidè; in other words, one atom of hydrogen, *aba*, has been replaced by one atom of potassium, *bupsa*. The accent at the end of the word denotes that the resulting compound is solid; while the absence of doubled vowels, either at the beginning or end of the word, shows that it is neither acid nor alkaline. To illustrate the facility with which this system lends itself to cases in which isomeric bodies are to be named, I give the annexed examples of the essential oil series or terebenes:—

Oil of Turpentine = Bàlbor.
,, Lemons = Balàbor.
,, Bergamot = Boròbal.
,, Neroli = Bòrbal.
,, Lavender = Balàbro.
,, Pepper = Blàbro.
,, Chamomile = Blàbor.
,, Carraway = Ablàbor.
,, Cloves = Ablàbro, &c.

That phenomenon of fifteen syllables which formed the opening of our subject — viz., tetrethylpropylbutylamylammonium hydrate, is in our new language bofbibedàd; and as four of the names composing the fifteen syllables refer to the "monatomic alcohol radical" series, I propose giving the four first terms of six of these series, first with their ordinary names, and again with their atomic names:—

1. Methyl, ethyl, propyl, butyl.
2. Methylene, ethylene, propylene, butylene.
3. Methyl hydride, ethyl hydride, propyl hydride, butyl hydride.
4. Methylic alcohol, ethylic alcohol, propylic alcohol, butylic alcohol.
5. Formic aldehyde, acetic aldehyde, propylic aldehyde, butyric aldehyde.
6. Formic acid, acetic acid, propionic acid, butyric acid.

Now I believe I shall not be doing any injustice to my friends, the chemists, when I say that nine-tenths of them would be very much puzzled to give the exact composition (not to speak of their physical state) of these twenty-four bodies, now so celebrated and important in modern chemistry.

Let the reader now refer to the little explanation I have given of the rules for building up the atomic names, and by so doing he will be able (be he a chemist or not) to give the exact chemical composition, basicity, neutrality, or acidity, liquid, solid, or gaseous state, whether hypothetical or otherwise, by simply reading the names of these bodies, as expressed in the new nomenclature:—

1. Bodas, gacos, domas, pafos.
2. Bòsaca, fàoco, dòala, nàofo.
3. Bòafa, làoco, dòana, bàrafo.
4. Bobèfa, becòla, benàdo, ofbèbar.
5. Bobesca, becofa, belàdo, ofbèna.
6. Acabòce, afacocè, aladocè, anafocè, &c.

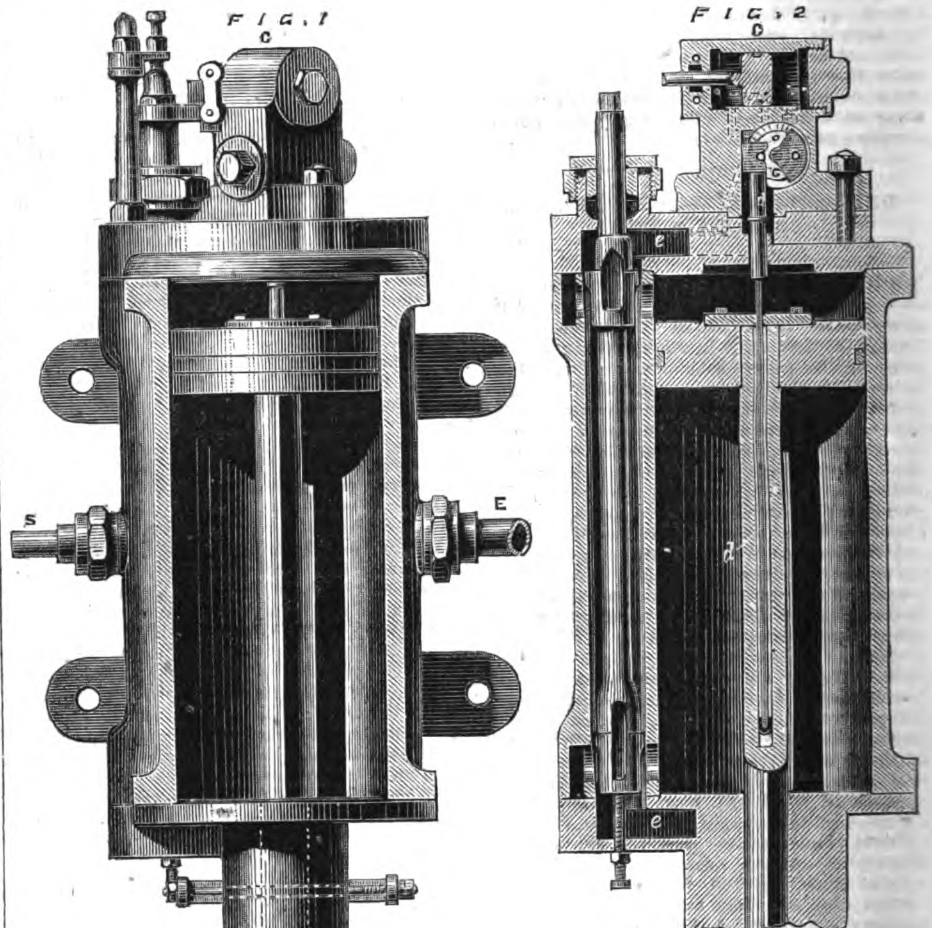
* Compound of hydrogen and nitrogen.
† Compound of hydrogen and oxygen.

'Strike me, but hear me,' said Themistocles. 'Laugh, but reflect,' say I."

Those of my readers who would like to follow Professor Filopanti, in his new ideas will find a fund of information in the pamphlet which I have quoted at the beginning of this paper.

ROTATING VALVE FOR STEAM-ENGINE.

According to a promise made in our article on the Westinghouse air-brake last week, we now illustrate the small engine employed for compressing the air, as the plan may be found useful for other purposes and under different circumstances. One advantage is that the eccentric and its rod are dispensed with, as are also the fly-wheel and the guides—one rod connecting the two pistons in the machine to which it is applied at present. It will be seen from the engravings—Fig. 1 being an elevation with part of the cylinder removed, and Fig. 2 a vertical section taken through the valve-chest—that the valves governing the admission and eduction of the steam are of a conical form, and are cast in one piece with the stem, which passes out through a stuffing-box. The valve-chamber is cylindrical, and is cast on one side of what must be termed the main cylinder to distinguish it from the small cylinder at the top, which is employed to give motion to the valves. This is accomplished by means of a short arm attached to the upper end of the valve-stem, the short arm carrying a pin which works in a transverse slot cut in the head of the piston-rod of the supplementary cylinder C. The latter is supplied with steam from the main valve-chest, the admission and eduction being regulated by a rotating conical valve *c*, actuated by the rod *d*, working in a boring made in the main piston-rod. The diameter of this rod, *d*, is reduced for the greater portion of its length, and collars are formed at each end which strike against a clip-plate secured to the top of the main piston, so that as the latter completes its stroke the clip-plate strikes the upper collar on the rod *d*, driving it up and rotating the conical valve *c*, which then admits steam to one end of the little cylinder C, and by the subsequent movement of the small piston the main valve is rotated so as to admit steam to the top of the main cylinder, and of course simultaneously placing the bottom valve in the position for exhausting. To prevent any noise from the smaller piston the ports are so placed that a small quantity of steam is shut in at the end of each stroke, thus forming a cushion. The main valves can be adjusted by means of set-screws, seen in the figures, so that while steam-tight they may be considered in practice to work without friction. The steam is conveyed to the valve-chest by the pipe S, and the exhaust goes through the passages marked *e* to the pipe E, which conveys it to the chimney of the locomotive. The illustrations will make the arrangement clear, and we need only say here that the engine and the pump in connection with it work very smoothly, even when driven at the rate of 100 double strokes per minute.



PROGRESS OF METEOROLOGY.

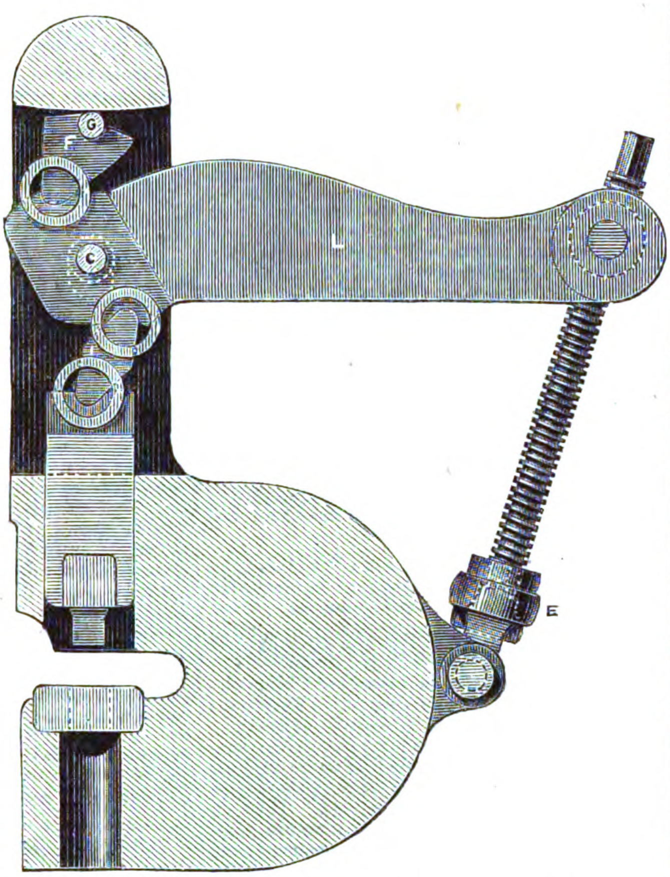
The "Quarterly Journal of the Meteorological Society," just issued, contains two or three important papers. One "On Large and Small Anemometers," by the Rev. Fenwick Stow, is well worthy the attention of meteorologists. In this paper the author gives the results of a series of experiments made at Hawsker with eight cup anemometers of different sizes, ranging from cups of 3in. to 9in. diameter, the arms varying from 4in. to 24in. in length from the cup centres. He finds that in the case of every instrument tried the results are utterly irreconcileable with Dr. Robinson's dictum, that the centre of each cup travels at one-third of the rate at which the wind moves, and that *this law is irrespective of the size of the cups or the length of the arms*. The standard anemometer used in these experiments was an electrical anemometer, with cups and arms similar in size, shape, and construction to those of the anemometers recently erected by the Meteorological Committee of the Royal Society, and so arranged as to make one contact for every mile of wind. The readings were taken by one of Breguets's "Compteurs Electriques." Assuming the indications of the standard to be correct, the cups of most of the small instruments were found to move through a space scarcely more than one *fourth* of that passed over by the wind. Under these circumstances it is important to ascertain the mode in which Dr. Robinson determined the relation of the motion of the cups to that of the wind. It appears that the Doctor's original paper is now very scarce in which he relates the experiment made for the purpose, viz., a small anemometer placed with its axis in a horizontal position at the end of a long arm was caused to revolve by a weight at velocities reading up to, but not exceeding, eleven miles an hour, and which when afterwards fixed in a vertical position was found, by counting its revolutions at a velocity of the wind of eleven miles an hour only, to agree approximately with the large instrument. It is somewhat remarkable that the relation of the instrumental motion to the motion of the wind should for so many years rest upon a *single* experiment, and now that the law obtained by this experiment has been proved not to be applicable to anemometers of *all* sizes, the author considers that the Meteorological Committee of the Royal Society and managers of observatories should investigate the subject for themselves. At first the Rev. F. Stow was disposed to come to the conclusion that small anemometers are not more valuable for the purposes of meteorological science than children's windmills, but on looking at the matter more closely he proposes two sizes—viz., 4in. cups on 9in. or 9¼in. arms, and 5in. cups on 12in. arms, and recommends that experiments be made to ascertain the true relation existing between small and standard instruments. The concluding remarks of the paper appear to be so valuable that we quote them entire. "I cannot avoid," says the author, "expressing the wish that opticians would consult durability more and polish less in the construction of instruments peculiarly exposed to the weather. The weakness of the arms and the want of solidity in the box are sources of mishaps even in a moderate gale. Let the cups be light, the arms both light and strong, the axle strong, and turning on a point, the bearings smooth, and contrived so as to retain the oil for a long time, the wheel work simple, the box large, and the graduations capable of being read to the nearest mile of wind from ten yards distance. A very simple electric contact-marker would be an invaluable addition to most instruments. The great essential is proportion, the next strength, and by attention to other details also, very valuable instruments (I do not mean high-priced) would be turned out."

In a paper by R. H. Scott, Esq., "On a New Form of Cloud," described in *Nature* by Professor Poëy, we are informed that Dr. Clouston and Mr. W. S. Jevons had previously observed similar clouds. Dr. Clouston made a sketch of the cloud on March 5, 1822, the cloud on this occasion being immediately followed by a storm, the barometer falling 1·2in. or from 29·5in. to 28·3in. within 9 hours. The principal characteristic of the cloud consists of a series of dark cumulus-looking clouds hanging like festoons of dark drapery over a considerable portion of the sky, with the lower edges well-defined, as if each festoon or "pock" was filled with something heavy. From this circumstance the cloud has been termed the "pocky cloud."

Speculating on the cause of its formation, Dr. Clouston says, "this cloud may be caused by masses of moist air descending and forcing their way through drier and colder air, for its form suggests air diffusing itself downwards, just as the form of the cumulus, or the steam from the steam-engine, suggests diffusion upwards. If this be so, it shows the moist equatorial currents in greater strength than usual, and an uncommonly quick mingling of air currents, differing in temperature and moisture—the very conditions of a storm. *This cloud is well known and much dreaded by Orkney sailors.*" Mr. Scott introduces a letter from Dr. Moore, of Dublin, who considers that two elements are required for the production of the phenomena characterising the clouds—viz., a rapid condensation of vapour and high *electrical* tension. Mr. Scott adds that the contact of two masses of air at very different temperatures and in very different hygrometrical states is precisely the condition that gives rise to the development of electrical action in the atmosphere, and to thunderstorms, so that a high state of electrical tension would accompany the forcible intermixture of a damp with a dry stratum of air.

IMPROVED PUNCHING MACHINE.

THE improvements in punches recently patented by Mr. du Vallon, of Birmingham, consist in the combination of two knuckles with a single lever, in such a manner that the angle which the lever makes in working is diminished, and the ordinary strain upon it is avoided, while the side strains to which the parts are exposed in ordinary punches are obviated. This is accomplished by connecting the two knuckles to the upper and under side of the lever in such a manner that they are inclined obliquely to the pin of the lever when at the beginning of its stroke, but are brought into a vertical



line with it as the end of the stroke is reached, so that the thrust is exerted in a direct vertical line through the centre of motion. The principal features of this punch will be readily understood from the annexed figure, in which L is the lever, having its fulcrum at C, slotted so as to give the requisite play to accommodate the movements of the lever, the other end of which is connected with a screw carried by the small frame E pivoted to the lower part of the body. F is the upper knuckle turning on a pin G, having its bearing in the upper solid part of the frame, and connected to the upper side of the lever L by means of the ring as shown. I is the lower knuckle, connected to the under side of the lever by a similar ring, and to the body or carrier of the punch also by a ring. The action of the punch is as follows:—On the lever being brought into an inclined position by turning the screw, the two inclined knuckles F and I are moved, until at the end of the stroke they are brought into a vertical line with the pin or fulcrum C of the lever, thereby carrying down the punch with the force applied in a direct vertical line through the centre of motion of the lever. Instead of the two rings, one elongated ring or link may be used for connecting the knuckles together and with the lever. The knuckles also may be varied in form and size, and if required for certain purposes, either of the two could be lengthened or shortened, or in extreme cases reduced to a simple roller, as will be apparent to our mechanical readers.

ELECTRO-METALLURGY.—I.

By J. T. SPRAGUE ("Sigma").

Introduction.

IN the series of articles headed "Electricity: its Theory, Sources, and Applications," I have examined closely the general principles of the science, and described fully all the more important instruments for the generation and measurement of the electric current. These articles, however, are scattered through Volumes X. to XIV., and, therefore, are not in possession of many readers; for their convenience, therefore, and also for the purpose of treating the general subject now, in the point of view of the special application of the current to the depositing of metals, I will, as required, touch afresh upon such matters as are requisite. As many readers will probably be mere beginners, I shall arrange these papers also upon the system of leading on from step to step, which in this application of electricity is possible, though quite impossible in the study of the science itself, where advanced knowledge is necessary to comprehend the simplest fundamental facts.

Although electro-metallurgy is a purely practical art, and its successful practice may be accomplished with a very small modicum of science, this is true only of the factory; to learn it from books and solitary practice, and in any case to learn it intelligently and to pass beyond the range of mere "rule of thumb," it is necessary to clearly understand the principles in operation, and the terms necessarily employed in explaining those principles. Therefore, to avoid the misconceptions so commonly due to imperfect acquaintance with the meaning of terms, I will here give a concise explanation of each of those likely to be used by myself, or to be met with and misunderstood in other books. That this is necessary will be evidenced by the following extract from one of the best of existing books on the subject—viz., Watt's "Electro-Metallurgy:"—"Smee's battery, although far from economical, and somewhat uncertain in its action, is still employed by some, owing to the great *intensity* of the current which it produces, a quality of but little service to the electro-plater when the *quantity* is deficient." Now, *intensity of current* is a term in common use for "quantity;" the special feature of the Smee is its production of large quantity against small resistance at a minimum cost; its fault is that it has a very low intensity, if this term is used (as it appears to be here) as meaning *tension* or electro-motive force.

The following definitions are only intended for outlines; references are given for full information to the former series of papers, and, where requisite for the present purpose, further information will be given at the proper portion of the papers themselves.

AMALGAMATION.—Zinc is protected from waste by having its surface coated with mercury. Information as to use and economy of zinc will follow.

ANION.—The electro-negative or chlorous radical of the salt or acid decomposed. Oxygen, acid radicals as chlorine are anions; see ions.

ANODE.—The positive electrode or pole of a battery; the wire or plate connected to the copper or other negative element of the battery; the plate which leads the + current into a solution to be decomposed, and at which are set free the oxygen, acid radicals, and all — ions (anions). In electro-metallurgy it is usually formed of the metal to be deposited, in which case it is called the soluble anode or pole.

ATOM.—The supposed ultimate particle of the elements; there are constant discussions as to the actual existence of atoms, but chemical reactions can only be satisfactorily explained by means of the atomic theory. The old idea was that atoms were ultimate particles of matter and indivisible; this is by no means necessary; all we need to assume is that matter, as we know it, is arranged in the form of these atoms, and that if divided the separated parts would no longer have the same nature; and, further, that whatever mathematical teaching may prove as to the *possibility* of subdivision, no such division does or can occur under the existing conditions of nature.

There is still much confusion as to the terms atom and equivalent, which were formerly used for the same purpose, but modern chemistry attaches a distinct idea to the atom, which correlates it, not only to chemical affinity, but to heat and other forces.

ATOMIC WEIGHT.—The relative weights of the atoms as compared with that of hydrogen taken as 1. In No. 342, Vol. XIV., p. 55, I gave a table of the atomic weights and other particulars of the elements most important in electricity.

Battery.—A combination of voltaic cells. The word is commonly—but erroneously—used for a single cell (*e.g.*, Smee's battery), but it strictly means two or more cells coupled together in series. For the laws regulating the combination, see Electro-motive Force, Resistance, Current, Cell. For full description of the different forms see Vol. XI., No. 264, General Classification; No. 267, Smee and other Single Liquid Cells; No. 269, Daniell's; No. 270, Minotto's and other Modifications of Daniell's; No. 272, Grove's and Bunsen's; Nos. 275 and 277, Bichromate of Potash; No. 281, Manganese, Leclanché, Sulphate of Lead, and of Mercury. In these papers the relative cost of working, &c., was given, and further information as to those cells, useful in electro-metallurgy, will be given hereafter.

Base.—See Radical.

Break.—See Commutator.

Bridge. — Wheatstone's. An apparatus for measuring resistances by balancing the unknown R against one known and capable of regulation. Description, No. 299, Vol. XII., p. 290.

Cathode.—The negative pole of a battery; the wire or plate connected to the zinc; the plate at which, in any decomposition cell, the cations or − ions are set free. In electro-metallurgy, the object upon which the deposit is to be formed is the cathode.

Cation.—Electro-positive elements and radicals, which are set free in electrolysis at the cathode. Hydrogen and metals in the order of the electro series are cations; see ions.

Cell.—Each separate vessel in which a chemical action occurs, forming part of the electric circuit. Thus there are the active or generating cells—*i.e.*, those which form the battery, and the decomposition cells, and these last may be of two classes: (1) Passive, or mere resistances, such are those employed in electro-metallurgy where the metal is dissolved from the anode, and simply transferred to the cathode; (2) where chemical force is exerted and absorbed in effecting true decomposition, as in the voltameter.

Chemie.—See Units of Current.

Chlorous.—Pole, a term sometimes used for the negative pole or cathode. Chlorous radical is that radical of a salt or acid which answers to chlorine in HCl—that is, it is the acid radical or electro-negative element or anion.

Circuit.—The path along which the current travels. It may be divided at any part into two or more paths. If this happens in the external circuit the proportion of the current which passes in each "derived circuit" will be in the inverse ratio of the several resistances. When in the battery the cells are arranged side by side (or "for quantity"—*i.e.*, for small resistance), instead of in series, they are such derived circuits, and their internal resistances and consequent contribution to the general current will be governed by the same law. See No. 330, Vol. XIII., p. 423. It is of importance in electro-metallurgy to bear this law in mind, because when several objects are suspended in one depositing vessel, each of them forms a "derived circuit," and the amount of deposit on each will depend upon its position and distance from the anodes. The same applies even to the different parts of the same surface when not flat, and these laws explain the causes of uneven deposits.

Commutator.—Break, contact breaker, and circuit changer. They are of many forms, according to the purpose required; a simple spring pressing on a point serves for a mere break or interrupter of the current, but the arrangement is often complicated when it is necessary to provide several different circuits for the current.

Conductivity.—The degree of power to permit current to pass; it is the opposite of "Resistance," which see.

Conductors.—Substances which permit electricity to pass. It used to be thought that substances were of two distinct classes, conductors and insulators; but it is now known that it is only a question of degree of resistance. Silver is the best conductor, then other pure metals, then alloys; solutions of electrolytes follow, but at a long interval. Current passes through conductors in the ratio of their sectional area, and the inverse ratio of their length; see wires.

Connections.—Wires, &c., completing the circuit between different apparatus; they should be sufficiently large, and of copper, so as to give little resistance. There is often much trouble caused by the stiffness of stout wires, it is, therefore, well to form a spiral upon each connection, so as to give a little elasticity. The best connections, however, are made of wire cord, such as is made for window sash-line, or by twisting up fine copper wire into a cord; lengths suited to various purposes should be cut, and to the ends pieces of No. 12 copper wire, of a couple of inches long, soldered, for insertion in binding screws. If these ends are well silvered or gilt much trouble in cleaning will be saved. Annoyance from accidental contacts, &c., is also avoided by covering these conductors with narrow tape plaited on, and soaking with boiled oil.

Current.—This word is used in many ways. The electric current means the supposed flow or passage of electricity or electrical force in the direction from + to − or positive to negative. It, therefore, originates at the zinc surface in contact with the solution, and passes from the zinc to the copper or other negative metal *in the liquid* of the battery, but *from* the negative metal *to* the zinc in the external circuit (see Positive and Negative). *Current* also means, scientifically, the measured work done chemically, or what was formerly called "quantity" (which see, also Intensity of Current). For the laws governing this, see Ohm's Laws and Units.

In electro-metallurgy an important consideration is the *density* of the current—that is, the relation of the actual or total current passing, to the surface or area of the anode and cathode. This will be fully explained hereafter. It is the *current* or quantity alone, and entirely irrespective of the force developing the current (*i.e.*, intensity in the older books) which affects the amount of work done chemically, or which is measured either by the galvanometer or the voltameter. The electromotive force or tension (or intensity) is concerned only in producing the current against the special resistance in each case (see Tension). Current was explained, No. 331, Vol. XIII., p. 450.

Density.—See Current.

Elements. — The ultimate substances into which all the bodies we know can be resolved, and which, themselves, have not been resolved into any simpler bodies. There are 63 elements known, and two or three more suspected. They are assumed to exist in the form of *atoms*, and further information will be found under that head and under *equivalents*.

Electrodes.—Faraday's term for the poles or plates leading the current into and out of a cell. (See Poles, Anode, and Cathode.)

Electrolysis.—The act of decomposition by an electric current. (See example in Equivalents.)

Electrolytes.—Bodies capable of being decomposed by an electric current. They must be composed of (or rather be capable of breaking up into) two radicals (see ions); therefore, substances which contain three or more radicals are not electrolytes; they may, however, be decomposed by secondary actions. Thus all acids are electrolytes, because they are composed of an acid radical (simple or compound) and basic hydrogen, as HCl hydrochloric and H_2SO_4 sulphuric acids. Water appears not to be an electrolyte (H_2O), indicating that the two hydrogen atoms are separately combined, and do not form a radical; it is, therefore, not decomposed when absolutely pure, but when it contains an acid or salt it is decomposed by the "secondary" action of the acid radical; thus, $H_2\underbrace{SO_4H+{}_2O}$ sets free the elements of water, the hydrogen coming, not from the water but from the acid, the chlorous radical of which decomposes water, reforming the acid and setting oxygen free.

Electrometer. — Instrument for measuring electro-static charge, but which is inapplicable to current electricity.

Electromotive Force.—The tendency to develop electric tension; in ordinary galvanic batteries the electromotive force is set up by the attraction of zinc for an acid radical; its degree depends upon the force and number of such chemical affinities in the circuit, and inasmuch as there are also opposing affinities tending to develop electromotive force in the opposite direction, the actual force depends upon the excess of the total affinities in the direction of the current, over those in the opposite direction. For full discussion of this subject see No. 333, Vol. XIII., p. 504 and 342, 344, and 346; Vol. XIV., p. 54, 136, and 187. *Electromotive force* of batteries, see Table E, No. 346, Vol. XIV., p. 187. The unit of electromotive force is the Volt.

Endosmose.—The power possessed by liquids and gases of diffusing into each other when separated by a partition or septum of animal membrane or unglazed earthenware. Electric endosmose is this action, greatly heightened by the passage of an electric current, which will frequently raise the liquid on one side of the partition several inches above the other. The laws ascertained by Weidemann are (1) the quantity of liquid which flows out in equal times is directly proportional to the strength of the current; (2) the quantities flowing out are (all other conditions being equal) independent of the size of the porous substance; (3) the height to which a galvanic current causes a liquid to rise is directly proportional to the extent of the porous surface; (4) the force with which an electric tension present on both sides of a porous division, or in a liquid, urges the liquid from the positive to the negative side of the partition, is equivalent to a pressure proportional to that tension.

The action is very troublesome in batteries, in which the liquid in the zinc or positive cell is transferred to the negative cell. Ordinary endosmose at the same time transfers the liquid of the negative cell to the zinc, causing local action, as when the copper solution of the Daniell cell enters the porous vessel.

Equivalents.—All chemical actions take place in a definite ratio, which is explained by the atomic theory as due to the combination of 1, 2, or more atoms of one substance or element, with 1, 2, or more atoms of others. Each element has its own equivalent weight, as compared with hydrogen, as 1. There is much confusion of ideas, due to the change of modern chemistry from the old system of stating reactions in *equivalents* to the modern system of stating them in *atoms*. For general purposes the latter is the best; for ordinary purposes of electro-metallurgy the equivalent system is most convenient, and will be used here. The Table A, No. 342, Vol. XIV., p. 54, gives the equivalents and other information, but, for convenience, I will here give a list of the symbols and equivalents of the substances likely to be mentioned. The relation of electricity to these equivalents is such that in a chain or circuit composed of any variety of compounds of two of these bodies (which are, in fact, elements, radicals, and ions) the same current would release from combination the relative weight set against each substance. The weights themselves are relative or abstract, but throughout these papers they will be taken as "grains," for the purpose of getting a definite electric measure of current and work. As example, a current from a Smee cell may be taken as passing through water (dilute acid, see Electrolyte), sulphate of copper, and cyanide of silver; in each cell it would release an equivalent for an equivalent of zinc dissolved, which is commonly expressed by saying that in every cell in a circuit (battery or decomposition) there is equal, *i.e.*, equivalent action.

$$\underset{32\ 6\ 48\cdot\ 1}{+\ ZnSO_4H\ -}\qquad \underset{8\ 1}{+\ OH\ -}\qquad \underset{31\cdot75\ 48\ 31\cdot75}{+\ CuSO_4Cu\ -}\qquad \underset{108\cdot\ 26\cdot\ 108}{+\ AgCyAg\ -}$$

The upper brackets show the substances as arranged before action, the lower ones those formed or set free, + marks the anodes or dissolving plates, − the cathodes in each cell.

Name.	Symbol.	Equivl.
Carbon	C	6·
Chlorine	Cl	35·5
Chromium	Cr	26·75
Copper	Cu	31·75
Gold	Au	197·
Hydrogen	H	1·
Iodine	I	127·
Iron	Fe	28·
Lead	Pb	103·5
Magnesium	Mg	12·
Manganese	Mn	27·5
Mercury	Hg	100·
Nickel	Ni	29·5
Nitrogen	N	14·
Oxygen	O	8·
Platinum	Pt	98·5
Potassium	K	39·
Silver	Ag	108·
Sodium	Na	23·
Sulphur	S	16·
Tin	Sn	59·
Zinc	Zn	32·6

Compound Radicals.

Name.	Symbol.	Equivt.
Ammonia	NH_3	17·
Ammonium	NH_4	18·
Cyanogen	C_2N / Cy	26·
* Sulphuric	SO_4	48·
* Nitric	NO_6	62·

* See notation

SEA SICKNESS.

THE following extracts from a paper by Dr. F. Pollard, in the *British Medical Journal*, will be of more than usual interest at the present time. Two opposite theories have been suggested as explaining the cause of mal-de-mer—one that it arises from a depressing effect on the brain produced by the motion of the vessel, for which the remedy would be lying so as to obtain an increased supply of blood to the brain; the other, supported by Sir J. Alderson, that increase of blood in the brain is the real cause, an analogy being drawn between the blood in its vessels and the mercury of a barometer.

The theory is that, as the ship sinks in the water, the barometric tube falls more quickly than the mercury that it contains, so that the latter tends to impinge on the upper part of the tube; and it is argued that, in like manner, as the body descends, the blood falls less quickly than its containing vessels, and so tends to produce pressure on the brain, these successive impulses causing the vomiting. "When the rigid tube falls," says Sir J. Alderson, "the mercury having its own inertia, and not being attached to, or a part of, the tube, remains stationary, at least for a time; thus the tube is pushed down upon or over the mercury." Now this might, perhaps, happen if the barometer were actually pushed down suddenly, because in that case the pressure would be applied to the tube, and not to the mercury, which would simply fall by its own weight. But in the case of a barometer merely allowed to fall, the glass and the mercury begin to move under the action of gravity at precisely the same moment; and so far from the mercury having a tendency to lag behind, its greater specific gravity tends to make it fall more quickly than the tube, the result being that it carries the tube down at a greater rate than that at which the latter would fall if it were empty. At sea, the falling of the ship is due to the action of gravity. There would be no tendency, therefore, for the mercury in the barometer or the blood in the body to commence falling later than the tubes which contain them. They would all begin to move at the same instant.

It is, nevertheless, a fact that the action of the waves does cause the mercury in an ordinary barometer to oscillate when the sea is rough. As already shown, the mere falling and rising of the ship would not account for this. It is the sudden striking of the ship by the waves which in rough weather jerks the mercury up in the tube; and in order to reduce this to a minimum, certain ingenious modifications have been introduced in the construction of marine barometers; moreover, they are suspended from a ball and socket joint, so as always to maintain a vertical direction; otherwise, the mercury would become tilted with the various movements of the ship, and an erroneous impression that it rose and fell might be acquired.

Now, theoretically, we might imagine the blood as being jerked upward against the brain by successive blows of the sea on the ship. But it is obvious that merely assuming the recumbent posture would not prevent this. There would be more probability in supposing that the brain itself might be jerked against the interior of the skull when the ship was violently struck; thus causing a series of small concussions, and adding something to the mental and bodily distress. But this will not explain the occurrence of sea-sickness in ordinary cases, when the ship rises and falls without violent concussions. For this an explanation other than a merely mechanical one must be found.

The most probable theory of sea-sickness is that held by Dr. Carpenter, Mr. Bain, and other writers, who consider that the mental and bodily prostration and the other symptoms arise from the continued action on the brain of a certain set of sensations, more particularly the sensation of want of support. This feeling, arising from the sudden loss of support, as when the footing or any prop that we lean upon suddenly gives way, is one of a most disagreeable kind. Should the accident have been perilous to life, as when the foot slips close to the edge of a precipice, or a rope cracks in Alpine climbing, a sickening feeling seizes the brain, the whole frame is agitated, and cold perspiration is felt all over.

The phenomena of sea-sickness appear to be due to the constant repetition of this feeling of loss of support, consequent on the pitching and rolling of the ship, more particularly the former. This explains the fact that the distress is most acute at the moment of the descent of the ship; whereas, when the part of the vessel in which the sufferer is placed rises beneath him, a comfortable sense of support is felt. It is well known also that the distressing sensations may be to some extent warded off if a downward motion of the body be made at the time of the ship's descent, and an upward motion when the vessel rises. In this way a kind of voluntary character is given to the sinking of the body, the nervous system is not taken so much unawares, so to speak, and thus the sensation of loss of support is less acutely felt. The feeling of want of support resides essentially in the muscular system; but the sensations of other senses contribute towards it. The sight of continually shifting lines and surfaces is an important factor; and on board steamer the constant vibration, the noise of the machinery, and evil smells of various kinds, are other items in the elements of causation.

That vision has something to do with the production of sea-sickness is shown by the fact that closing the eyes will often keep off the sickness for a time; and in illustration of this point, we may refer to the general depression, faintness, and even nausea, which may be produced in susceptible persons by "doing" too many picture galleries in rapid succession, and this not dependent on the quality of the pictures themselves. That the vibration and noise may add to the general depression is shown by the painful effect produced on a person not used to it, by going into a large room of a cotton-factory, full of steam-looms at work. As regards smell, I can testify that going down into a hot cabin and sitting close to a reeking joint of boiled mutton, has nearly brought on sea-sickness, only warded off by a timely retreat into the upper air.

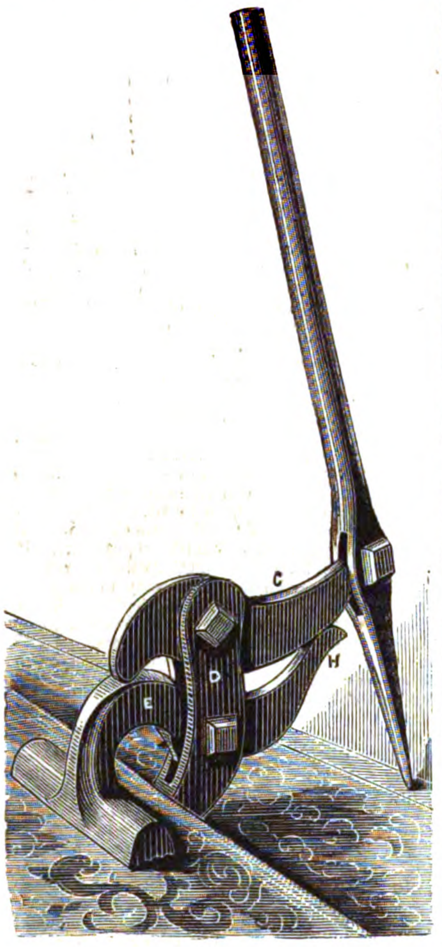
As regards treatment, since sea-sickness arises from certain impressions on the senses, the obvious indication is to render these sensations as feeble as possible. Application of the mind to an engrossing book will keep it off for a short period; and Dr. Chambers relates that his having to bind up a broken finger of one of the seamen relieved his own distress for the time. But the mind will speedily become alive to the sensations which force themselves on its attention. In order to lessen them as much as possibly, the patient should preserve the recumbent posture, as near the centre of the ship as possible; he should lie on a thickly padded couch, so as to diminish the vibration. Fresh air should be admitted in order to remove bad smells. The eyes should be shaded, and as much noise as possible shut out. As regards drugs, the most rational suggestion is that of Dr. Döring, of Vienna, that a full dose of hydrate of chloral should be taken shortly before the vessel starts; and even in long voyages the repeated use of this medicine will insure comfortable nights without the disagreeable after-effects of opium and chloroform.

A BONE CAVE IN YORKSHIRE.

THE scientific exploration of caves in various parts of Europe is daily becoming more important from the light which it throws on ancient races of men, and on the animals which are no longer to be found in the districts which they once occupied. Each fresh discovery offers fresh proof of the continuity which exists between geology and history. A cave seems, indeed, the last place to find anything bearing on history; but, nevertheless, the results of the labours of the Settle Cave Exploration Committee, carried on for the last two years, are most valuable both geologically and historically. The Victoria Cave is situated about half-way up a line of gray limestone cliffs, overlooking the gray limestone "pavements" and broken precipices which extend northwards to Ingleborough, and consists of large chambers filled very nearly to the roof with accumulations of earth, clay, and stones. The committee began their work by cutting a trench from the outside of one of the entrances through a layer 2ft. thick of angular fragments of stone broken away from the cliff above by the action of frost, which rested on a dark stratum composed of fragments of bone more or less burnt, burnt stones which had formed fireplaces, very many fragments of pottery, and a few Roman coins. It was evident that the cave had been inhabited in ancient times, and that the broken bones of the animals strewn about were the relics of the food of the inhabitants. As the trench passed into the entrance the talus of stones disappeared, and the black or Roman-Celtic layer, as it may be called, covered the floor, passing over its inequalities, and lying sometimes underneath enormous masses of rock which had fallen from the roof since it was accumulated. Besides spindleworts, beads, and curious articles of bone, it yielded bronze fibulæ of Roman workmanship, spiral bronze gilt armlets, and a portion of the ivory hilt of a Roman sword. Some of the ornaments present a style of art which is certainly not Roman, being composed of two plates of bronze soldered together, and bearing flamboyant and spiral patterns of admirable design and execution. They certainly belong to the same school as that which produced the illuminations of one of the Anglo-Saxon gospels at Stockholm, and the gospels of St. Columba preserved in Trinity College, Dublin. The bronze gilt brooches and finger-rings, ornamented with enamel in red, blue and yellow, and green, were also of non-Roman workmanship, although some of the designs bore traces of Roman art. Most probably they are the work of the Roman Celts; and there is nothing at all strange that the Irish art of the sixth or seventh centuries should have had some points in common with that of the neighbouring kingdom of Strathclyde, which at that time embraced the whole of Lancashire and a considerable portion of Yorkshire, since there is clear historical evidence that Ireland in the seventh and eighth centuries exerted important influence on the neighbouring countries. The broken bones of the animals show that the Celtic shorthorn, the goat, horse, and pig, were the principal domestic animals which supplied the food of the dwellers in the cave. Bones of fowl implied that they kept poultry, while the roebuck, red-deer, and grouse, contributed but little to their feasts. There can be no doubt that this strange collection of objects was formed during the abode of a family for some time in the cave, and we have to account for the presence of so many articles of luxury in so lonely, strange, and uncomfortable a place. The personal ornaments, and the delicate Samian ware are worthy of the villa of a wealthy Roman, rather than of the dwelling of men who lived by choice in caves. The few coins which were found explain this difficulty—some belonging to Trajan, Constans, and Constantine, and others being barbarous' imitations of Roman coins, which are assigned by numismatists to the time when Britain was being evacuated by the Roman legions. To say the least, there are two extremes between which the date of this occupation of the cave must lie—the fifth century, as shown by the barbaric coins, and the first quarter of the seventh century, when the kingdom of Strathclyde was conquered by the Northumbrian Angles. It cannot be later, because of the presence of Roman, and the absence of all English cultus. So long as the Celts of Strathclyde, cut off from the Roman Empire, held their ground against the Angles, they would certainly follow as nearly as they could the manner of life handed down to them by their forefathers, the Roman provincials, and they would use Roman coins and rude imitations of them for their currency. We can hardly doubt that this cave was used by unfortunate dwellers in Ribblesdale, who were compelled to fly from their homes with some of their cattle and other property, and to exchange the luxuries of civilisation for a hard struggle for common necessaries. In no other way can the association of works of art of so high an order be accounted for side by side with the rude instruments of savage life; for it cannot be allowed that they were introduced into the cave by robbers, because many other caves in the neighbourhood contain articles of the same order. These remains, therefore, afford as true and vivid a picture of the troublous times of the sixth or seventh centuries as the ruins of the Roman villas and cities, which, for the most part, have been burnt. In the latter case we see the homes of the Romano Celts ravaged by the invading English, and in the other the holes in the rocks to which the Romano Celts fled for refuge. But there were evidences of a very much older Roman occupation than this. At the entrance below the Romano-Celtic layer there was a talus of angular stones 6ft. thick, which rested on a layer of stiff clay. At this level the committee discovered a few rude bone awls and a bone fish spear or harpoon, along with chipped pieces of flint and broken bones of ox and bear, which proved that men in a rude state of civilisation inhabited the cave before the accumulation of the talus. And if it be admitted that the débris has fallen from the cliff in equal quantities at equal times, the fact that it is 2ft. thick above the Romano-Celtic layer, and 6ft. thick between that and this earlier one, would prove that the interval between the two is three times as great as that which separates the former from our own time; the 2ft. being accumulated in about 1,200 years, and the 6ft. in 3,600. If this rude estimate be accepted, the date of the earlier occupation would be about 5,000 years ago. The gray clay on which these more ancient traces of men rested offered a serious obstacle to further examination, since it was more than 25ft. in thickness within the cave, and contained no remains of men or of animals. Fortunately, however, the enterprising gentlemen who form the committee have lately sunk another shaft, and have obtained evidence of a still older occupation of the cave, not by men, but by hyænas. The broken bones, coprolites, and teeth of those animals show that in ancient times they lived there in considerable numbers, and the gnawed bones and teeth of the mammoth, bison, reindeer, red-deer, the great woolly rhinoceros, and the cave-bear belong to the creatures which formed their prey. The time when these animals were living in Yorkshire is that which geologists know as "Pleistocene" or "Quaternary," and corresponds with that during which Kent's Hole and Kirkdale caves were being filled with similar remains. The shaft at present has been sunk to a depth of 30ft. from the original surface, and the accumulation of earth and bones extends to an unknown depth below. We very much hope that the committee will be encouraged by these results to continue the exploration, and we should certainly advise any one who cares for beautiful scenery and feels any interest in such investigations as these, to visit the district which lies round Settle, and to see the wonderful contents left behind by the hyænas, which are being discovered every day.—*Pall Mall Gazette.*

CARPET STRETCHER.

A USEFUL form of carpet stretcher has been patented in the United States, which, while holding the carpet firmly, does not tend to injure it. It is very strong, being constructed of iron throughout, and is capable of stretching the thickest and most unyielding carpet. It will be seen, on referring to the figure, that it consists of four levers pivoted together; the longer, which forms the operating handle, being provided with a point at the bottom to take a firm hold of the floor. The two levers marked respectively D, E, are furnished with serrated jaws, which are made to grasp the carpet at a sufficient distance from the edge to secure a firm hold without straining the fabric. The jaws being properly placed, and the point of the long lever pressed into the floor, the handle is pressed in the direction in which it is desired to stretch the carpet, when by the action of the levers C and D the jaws are brought together with a force regulated by the amount of pressure applied to the handle. On reversing the motion of the long lever, the lever C presses on that portion of the lever E signalised by the letter H, thus opening the jaws, so that they can be readily



placed in a position to take a new hold. With this implement a very little exertion will enable any person to lay the most refractory carpet perfectly smooth.

ANCIENT MUSICAL INSTRUMENTS.*

ON the 1st of June the South Kensington Museum opened a special exhibition of ancient musical instruments. They have been obtained on loan from all quarters; money, powerful as it is, could not buy the greater part; and every man and woman, who loves music, or possesses a mind, should study them before the unique opportunity runs away, and this multitude of gems is dispersed for ever.

Talk of the treasures of the deep! Give me the treasures of the country house; for there curiosities can always find a corner to live: in London, novelties jostle them into their graves through mere want of space. In a word, private contributors, English and foreign, have peopled one of the halls of this museum with the spoils of time. Here are Egyptian and Indian instruments, Turkish and Chinese, very curious; oriental banjos, &c.; and above all a most amazing specimen of roundabout resonance—a long black wooden tube, over which the strings are stretched, and the tube rests on two hollow everlasting pumpkins. But the main feature is a number of mediæval instruments, exquisite in form and workmanship, and sometimes encrusted with gems, and inlaid with oriental lavishness and the skill of a Genoese jeweller. Here in stringed instruments alone are full a score of obsolete varieties, and many specimens of each kind, especially of the lute, the archlute, the mandolin, the sweet viola d'amore, with its sympathetic wires that lay and trembled in unison beneath the gut strings, and prolonged the vibration; the viola di Bardone, a larger and more complicated instrument, whose sympathetic wires, twenty-two in number, were placed so that they could be struck with the thumb, while the fingers played the gut strings; the viola da gamba, called by Sir Andrew Aguecheek the "viol de gamboys," and all the tribe of citterns and ghitterns that used to hang in every barber's shop for gentlemen to play, when England was famous as a musical nation, and that was before the monstrous idea of confining musical education to the less musical sex had entered the national head. Here, too, are all the instruments the translators of our Bible have bravely transplanted to Assyria and the night of ages—the sackbut, psaltery, dulcimer, &c.; and here are the children and grandchildren of the dulcimer—viz. the keyed dulcimer, the virginal, the clavichord, the spinet, harpsichord, pianoforte. There are nearly two hundred specimens of the old Cremonese and other Italian violins, violas, violons, and basses, and amongst them I see a violin that a friend of mine once gave £450 for, and a bass that was bought for £800 in Paris. But as this is the one branch I am well versed in, I postpone it for the time, my present object being merely to indicate the various character of the treasures, and the profit that may be reaped. The Marquis of Kildare lends an Irish harp with its one row of metal strings, the wooden frame black with age, exposure, and, methinks, a little peat-smoke. To such a harp Carolan, the last great improvising Irish harper, sang his traditionary melodies that lived by ear and now are dead, alas! One comfort: as the devil escaped being put in a pie by shunning Cornwall, so those divine melodies—some gay, some sad—have died and gone to heaven, and so escaped the defilement and degradation of being hashed and smashed into quadrilles by Jullien and his followers, and played in false time and utter defiance of their dominant sentiment. There is an older harp, lent by Mr. Dalway, on which is inscribed "Ego sum Rex cithararum." "Pride goeth before destruction;" so this self-trumpeting harp is in pieces. The epithet of "King of Harps" is better merited by the noble instrument of Lady Llanover—a triple-stringed Welsh harp, made by the famous John Richards about 140 years ago. On such a harp, made by the same maker (Richards), blind Parry of Ruabon harped his "ravishing tunes a thousand years old" to the poet Gray, and so fired him with brave thoughts that he wrote "The Bard" while the music was fresh in his soul. Woe is me! who can play this harp nowadays? This one looks bursting with music. "I would give a few pounds to hear 'Sweet Richard' played on it." But I ransacked Wales five years ago, and not one public harper did I find could play the triple harp. Yet their greatest airs were all composed for it, and are half lost without it.

Then there are Italian spinets, one of which ought to interest the ladies; for it has nineteen hundred and twenty eight precious stones outside it, and very little music inside. There is Handel's harpsichord. He had more harpsichords than Cromwell skulls. But this time there really is a tidy pedigree made out. There are two much finer double harpsichords with stops and swell, one of them made by Joseph Kirkman and lent by his descendants. I heard this harpsichord played by Mr. Sullivan and the learned Mr. Engel; and it is a great and beautiful instrument, full of sweetness and tenderness, yet not deficient in grandeur: and sings to the heart. It ought never to have been allowed to die. There was room in the world for the pianoforte and the harpsichord too; each can do things the other cannot.

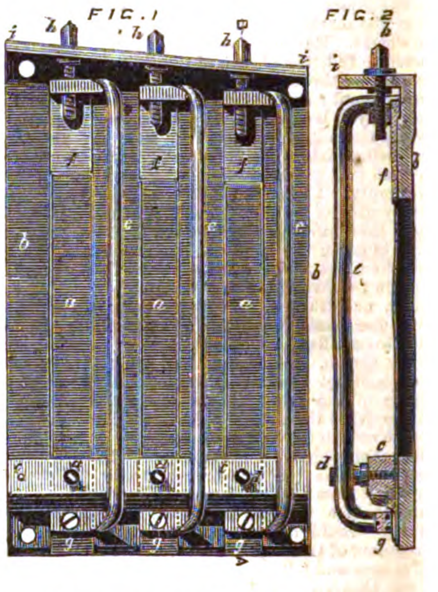
It seems at first sight strange and sad that so many stringed instruments should have been invented in modern Europe, and framed with so much skill and taste, only to die away, when so poor a thing as the guitar survives. They were not killed, as some people fancy, by our four-stringed instruments, for they ran parallel with these for centuries. Some of them no doubt deserved to die; the mandolins, and little citterns, for not making noise enough in such a world as this, and the lute and viola di Bardone for being always out of tune. I read that a contemporary of Handel said, "If a lutenist lives to eighty he must have been sixty years tuning;" and another, writing to lutenists, gave them this warning, "You shall do well ever when you lay it by to put it into a bed that is constantly used." So mankind rose against these invalid instruments and put them to bed once for all.

But I hope that true lovers of music, both male and female, will inspect the harpsichord, the viola d'amore, and the viola da gamba with candid eyes, and give them a trial. Put these two last at their lowest, they must be superior to the guitar, since they have more tone, and arpeggios can be played on them with the hand and suddenly the chords swept with the bow—a rare musical effect for any single instrument to produce. The larger viola of the two could also be fitted with the sympathetic wire strings; the finger-boards of both could be fretted, and I apprehend the bridge of each could be arched a little. Ladies could play the viola d'amore gracefully. Indeed, a Mrs. Ottey played the viola da gamba publicly in 1720, and a Miss Ford in 1761; teste viro doctissimo Carolo Engel. Meyerbeer thought well of the viola d'amore, for he wrote a part for it in "Les Huguenots." The late Prince Consort had music of the sixteenth century performed on various ancient instruments such as are now on show. On that occasion a viola da gamba—that figures in this very exhibition—was played by Mr. Hatton—who, I hope, is alive to play it again—and was much admired. The deceased Prince had many ideas before his age, and I think your readers will appreciate what he did for music in 1845, when in 1872 they have examined this noble collection with the attention it deserves.

* By Charles Reade, in the *Pall Mall Gazette*.

HARMONIUM REEDS.

AN improved form of harmonium reed, which is claimed to afford great facilities in tuning, has been patented by Messrs. Fontainemoreau and Co., as agents for a Miss Procopé, of Stockholm. As most of our readers are aware, the usual practice is to secure the tongues by screws or rivets to the frame, the right pitch being attained by scraping



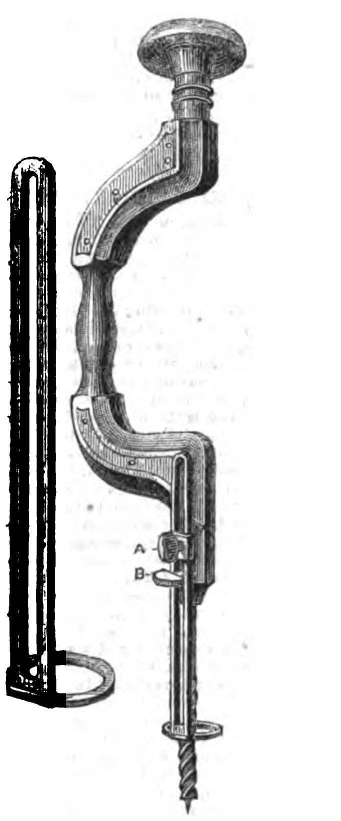
the reed at one or other of its ends. Miss Procopé considers that besides the inconvenience inherent in this system the reeds in time become so worn as to be almost useless, frequently breaking unexpectedly and at awkward times. These unpleasant annoyances and expensive accidents Miss Procopé thinks will be obviated by the use of her improved reed and frame, a plan and section of which is here annexed. Fig. 1 shows three reeds in plan, and Fig. 2 a section on line A B (Fig. 1). The main feature of the invention consists in employing two tongues instead of one, arrangements being made to allow of the tongues being moved in tuning them, so as to increase or diminish the length of the vibrating part of the tongue until the proper pitch is obtained. The metal strips *a*, are ordinary vibrating tongues, held and guided by a bar or ledge *c*, fixed to the frame *b* by screws, and passing through slots on the underside of the bar *c*; they are fixed by the screws *d*, each tongue is connected by a bar *e* to a short tongue *f*, which does not vibrate; and the connecting bars are attached to the tongues *a* by screws *g*, and to the tongues *f* by solder, rivets, or screws; *h h* are set screws passing through holes in a flange *i* on the frame *b*, and through the ends of the connecting bars *e*.

To tune any particular reed it is only necessary to loosen the fixing screw *d* of its tongue, when by turning its set screw *h*, the length of the tongue *a* may be increased or diminished as required until the proper note is obtained, after which the screw *d* is again tightened. In some cases graduated scales are adapted to the frames of the reeds to assist in regulating the position of the tongues *a*.

Such is the inventor's specification, but we have no information whether the effects claimed to be produced have been really obtained in practice.

GAUGE FOR BIT BRACES.

THE gauge for attaching to bit braces, of which the annexed figure is an illustration, has been patented in the United States. It is the invention of Mr. C. Whitus, of Philadelphia, and may possibly be found suggestive, if not useful, to many of our readers. Where a number of holes of uniform depth have to be bored, wooden tubes of the requisite length are frequently used to slip over the bit and prevent it entering too far, or to show the mechanic when the bit has penetrated to the desired depth. It is of course obvious that a number of these wooden tubes are required to suit various descriptions and dimensions of work; these, however, are dispensed with by the employment of this simple contrivance. It consists of a sliding gauge shown detached and in position on the bit-stock. This may be made of brass, steel, or iron nickel-plated, and can be graduated to inches or to any fractions of an inch that may be desired. The sliding gauge is attached to the side of the stock and held in the required position by means of the thumbscrew and plate A; while B is the thumbscrew holding the bit in the stock. The sliding gauge has a ring-shaped foot, through which the boring tool passes as shown, and this meeting the surface of the material being bored prevents the bit penetrating to a greater depth than that to which it is set. The



sliding gauge must, however, be screwed very tightly to the stock, or the action of the tool in boring will force it to slip, and so mislead the workman. Moreover, this attachment seems to us to be a modified "re-invention" of a contrivance we have seen in use in England for boring a number of holes when of a uniform depth.

PLATING WITH NICKEL AND PLATINUM.

PROFESSOR RUDOLPH BOETTGER, the well-known discoverer of gun-cotton, has, according to the German correspondent of *Engineering*, recently vindicated his priority as the inventor of the method of galvanising metals with nickel and platinum, processes which are now attributed to E. Becquerel and Isaac Adams, though they were made public by Professor Böttger, more than thirty years ago, in *Erdmann's Journal für Praktische Chemie*, 1843, Vol. III. He had discovered that a solution of sulphate of nickel-ammonia, even under the action of a not very powerful current, will readily and firmly deposit a bright metallic coating upon copper and brass, which within half an hour becomes so thick and coherent that it will prevent the action of nitric acid upon the underlying metal. Since then, the process has been extended to galvanising iron and steel, and has become highly valuable for the protection of those metals against rust and atmospheric influences when used in the construction of delicate machinery. The coating of metals with platinum is effected by Böttger even without the aid of a galvanic battery, simply by boiling them in a solution of chloride of platinum-ammonium with a small excess of free ammonia, when a bright metallic coating of platinum is firmly united with the metal, which will protect it against oxidation as well as metallic nickel. When a galvanic battery is used, the metal is not generally so well deposited in one coherent mass, but is apt to form minute black crystals; when, however, the above solution is kept sufficiently ammoniacal, and not too hot, it will also deposit on the negative electrode a bright metallic coating. Both processes are now much in use with physical instrument makers for the protection of brass and copper parts, such as wheels in chronometers and other fine instruments, and they were first published at the meeting of German naturalists and physicists at Mayence in 1842.

USEFUL CEMENTS.

A FEW days ago, says the *British Journal of Photography*, we found it necessary to prepare a glass dish from ordinary pieces of window glass, as a vessel of the size and form we wanted could not be obtained to purchase. Cutting the glass was a very easy matter, but a good junction, which would stand a liquid at a temperature of about 80° Fahr., was not satisfactorily effected. We have tried several cements for this purpose, but have found one sold as "coaguline" the best. The glass surfaces are best roughened, so as to give the cement a "bite;" and then, on applying the warmed liquid coaguline, pressing the glass plates together and then allowing the whole to stand for some time, an excellent joint is obtained. In the same way glass and wood, or glass and metal, can be cemented together with facility. All these joints, however, give way to prolonged treatment with water if it be warm; it is, therefore advisable to cover the joint with a layer of mastic or shellac varnish, in order to be secure against mischance. We have not found cold water to affect the cement in ordinary saline liquids, but silver slightly acts upon the unprotected coaguline. We have jotted down the above, as our readers may often wish to prepare large glass dishes for floating paper, &c., economically and conveniently. Our own results have been so satisfactory with the cement in question that we always keep some by us. A cement for glass and earthenware, which is much liked by many who use it, is made by adding half a pint of vinegar to an equal bulk of skimmed milk; the curd thus obtained is mixed with the whites of five eggs (well beaten) and sufficient powdered quicklime to form a paste. When the objects cemented with this "curd cement" are dry, they resist water and a moderate degree of heat.

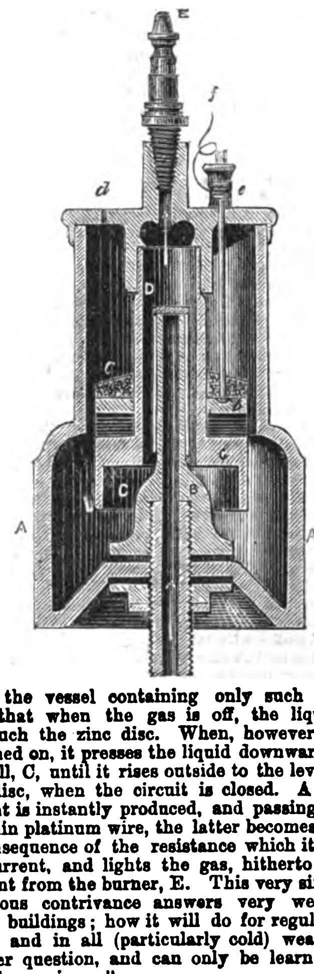
NOVEL BLOWING APPARATUS.

A NOVEL blowing apparatus has, we learn from the *Adelaide Observer*, been erected at a Colonial foundry, constructed on a similar principle to the "trompe" of the Catalan forge, illustrated on p. 73, Vol. XIII. At present it is only used for blowing the ordinary blacksmith's fire, but eventually it will, no doubt, be used for the smelting-furnace. It consists of an empty barrel, or quarter cask, stood on end behind the fire, to the centre of which a blast-pipe, from 2in. to 3in. in diameter, is fixed. On the top of the cask is another pipe, the same size as the blast-pipe, some 6ft. in height, with a funnel-shaped top. Just above this there is a horizontal water-pipe of the ordinary service size, with a nozzle, having an aperture of ⅛in. in diameter, fixed at right angles—that is, pointing down the pipe leading to the barrel, down which there rushes, with considerable force, a tiny jet of water, which causes a rush through the blast-pipe far superior both in power and steadiness, it is said, to any that can be obtained from the common blacksmith's bellows. The waste water, which is very limited in quantity, escapes through a pipe attached for the purpose to the bottom of the barrel.

AUTOMATIC GASLIGHTING.

THE German correspondent of *Engineering* gives an account of the arrangement of automatic gaslighting apparatus designed by Prof. Klinkerfues, the astronomer to the University of Göttingen. It seems that the system has been introduced into the Imperial Parliament House, having first been tried on some of the street lamps of Göttingen. The great feature of these burners is that they are completely self-regulating; the tap at the meter or the one which gives entrance to the building from the street main has merely to be turned on, and immediately all the lamps fitted with these burners assist in the illumination. The following is the description given by the correspondent of our contemporary:—

"A cylindrical glass vessel, A, with perforated bottom, is screwed upon a brass gaspipe, which is prolonged by a lead cylinder, B, the latter being closed at the top and covered by an inverted glass cylinder, D, with which it communicates through small holes. The glass vessel bears a cover of brass ending in a gaspipe and the burner, E, which communicates with the interior of the vessel by means of the bell-shaped lead cylinder C, which incloses the lead pipe, B, and glass cylinder, D, reaching considerably below the latter. If now the vessel is filled with any liquid, so that the bell-shaped part of C is perfectly covered, this liquid will stand equally high outside and inside of the glass cylinder, D, and interrupt the communication between the inlet gaspipe and the burner. If, however, the main cock be opened, and the pressure of the gas allowed freely to play, the gas will enter the glass cylinder, D, through the small holes, and press upon the liquid inside the latter so much that it escapes from under that cylinder, and now, outside of it, communicates with the burner. When the gas is turned off, and the pressure ceases, the liquid will immediately rise again by the action of the atmosphere which, through the opening, *d*, in the cover, presses upon the surface of the liquid outside the lead cylinder, C. It will be seen that by this arrangement it is easy to admit the gas to as many burners as may be desired (?), and to shut it off simultaneously by only turning the main cock, and by regulating the pressure. The next thing is to light all flames simultaneously, and this is done by electricity, each apparatus acting as its own battery. For this purpose a disc of carbon, *b*, is fixed upon the bell-shaped part of C, and at some distance apart, and isolated by glass, the disc, *c*, made of zinc, which by the insulated conductor, *e*, and a wire, *f*, communicates with the top of the burner though a thin piece of platinum wire. The liquid with which the vessel is filled consists of a mixture of 18 parts of water, 4 of sulphuric acid, and 3 of bichromate of potas-



sium, the vessel containing only such a quantity, that when the gas is off, the liquid does not touch the zinc disc. When, however, the gas is turned on, it presses the liquid downwards inside the bell, C, until it rises outside to the level of the zinc disc, when the circuit is closed. A galvanic current is instantly produced, and passing through the thin platinum wire, the latter becomes red hot, in consequence of the resistance which it offers to the current, and lights the gas, hitherto escaping unburnt from the burner, E. This very simple and ingenious contrivance answers very well in all closed buildings; how it will do for regular street lights, and in all (particularly cold) weathers, is another question, and can only be learnt by prolonged experience."

It is to be regretted that the writer does not inform us of the cost of this ingenious apparatus when compared with other and more simple methods of effecting the same object. The contrivance is only applicable where a number of burners are required alight at the same time; for, so far as we can discern, there is no means of cutting off the gas from a single burner without putting out all the lights supplied from the same pipe or tap. This being the case, it seems as if the ordinary arrangement, with the simple addition of a piece of platinum wire to each burner, and a galvanic battery and a few hundred yards or so of copper wire, would answer the purpose equally as well, with the further advantage that, the taps being retained as usual, and kept open as a rule, it would be possible to stop the supply to any single burner or any twenty. No information is offered as to the frequency with which the solution requires replenishing, nor as to the consumption of zinc. Nevertheless there may be circumstances under which the use of this invention of Prof. Klinkerfues might be found advantageous, and it is certainly ingenious.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

PROCTOR'S "ESSAYS ON ASTRONOMY."

[4809.]—As a general rule an author acts unwisely in commenting on remarks made in reviews of his work. But there are exceptions to this rule; and I think an exception can reasonably be made where, in the first place, as in the ENGLISH MECHANIC, correspondence is encouraged, and where, in the second, it must be obvious, as in the case of your review of my "Essays on Astronomy," that the author must be greatly gratified by the general tone of the critique. Your readers will understand, then, that if I defend certain points to which objection has been taken by your reviewer, it is because I think them worthy of discussion on their own merits, and not because I simply wish to prove myself in the right.

I may note, but this only in passing, that my objection to Herschel's "familiarising" of science is based on the *way* in which he familiarised, not on the *fact* that he did so. I objected, not because he "gambolled," but because "his gambolling was that of Behemoth." He was not used to gambolling, and (*me judice*) did not do it well. After all, the fault is but a spot on the sun, and a small spot (a penumbral one, as it were). But the points I care to discuss are the following three:—

First, as to the probable colour of the earth seen from Venus. Here I would point out that it is only because the moon's disc in eclipse, chiefly illuminated as it *must* be by earthshine, does actually appear sometimes green and sometimes brown, that I infer that earthshine, taken as a whole, is sometimes greenish and sometimes brownish. Now, I must demur altogether to your reviewer's objection based on the assumption that "a very large proportion of the visible hemisphere" (that is, the half of the earth turned towards the moon) "was covered with cloud on the occasion of the eclipse of 1870." Your reviewer does not sufficiently take into account the fact that the part of the earth's disc traversed by the moon's shadow was close by the extreme northern rim of the disc, and that inferences from *its* cloudy condition cannot apply to the great extent of the disc occupied by the Atlantic, South America, equatorial and Southern Africa, and the Indian Ocean. Moreover, *that* part which (as your reviewer justly remarks) was much covered with clouds was precisely the part which, being in the moon's shadow, supplied least light to our satellite. I may add that I had before me, when I wrote, a projection of the disc, constructed by myself (see *Quarterly Journal of Science* for October, 1870), with a picture of the moon's shadow upon it, and that my opinion was formed from a study of that projection, and with a full consideration of the points mentioned by your reviewer. A similar remark applies to the eclipse of 1860. I constructed a projection of that eclipse before venturing to express an opinion as to the probable colour of the earth as seen from the moon on that occasion. I do not think the existence of extensive cloud masses in the least affects the argument. The clouds would shine with a white light, and would not neutralise, but simply *dilute* the green, blue, or brown light proceeding from unclouded regions. I by no means suppose (nor have I ever asserted) that the earth would be of a strong green, blue, or brown colour, as seen from Venus, at *any* time, even if wholly unclouded. But I think that as Mars shines with a recognisable ruddy colour, notwithstanding extensive tracts of indigo or bluish green on his surface, besides large whitish tracts, and as the strength of this ruddy colour is variable independently of the condition of our own atmosphere, the case may be somewhat similar with the earth as seen from Venus. The oceans being relatively much larger on the earth, her colour would vary, I conceive, from the brownish hues (much diluted with white glare) due to continents to the bluish green hues due to oceans. I fancy the "blue black" of the oceans, if diluted with the slightly yellowish white of clouds, would give bluish green glare. As for the forests of America, I demur to the theory that *they* would be green, nor would the *heathy* prairies so appear; though at certain seasons the "rolling prairies" and the "Llanos" of South America would be greenish if separately discernible from Venus. But the "Gran Chaco" in South America, and the extensive deserts by the Rocky Mountains in North America, would be brownish, and I conceive the general resulting colour for the whole American continent (diluted with yellowish white light from clouds) would be dun or fawn colour. The supposed greenness of forests is altogether mythical. My old drawing-master used to say, "Trees, as a whole, may be red, yellow, black, or brown; almost *any* colour, in fact, *except* green"—and, "with allowance for friction," this is not far from the truth. I should add that the Americas were not the *only* land regions turned towards the sun and moon during the eclipse of 1860. The whole of Africa and large parts of Europe and Asia were so turned. In any case, my views were not put forward without careful study of the subject.

Secondly, as to Mädler's theory of the orbital motion of our system round Alcyone, it is not quite the case that this theory "only had its warrant in that astronomer's imagination." Mädler based the theory on arguments of considerable weight in themselves. However, it will scarcely be thought that *I* adopt Mädler's theory, since I have been at great pains to show that it is erroneous. I presented his reasoning, and the objections against it (overwhelming, as I conceive) in my lecture at the Royal Institution in May, 1870, and I touched on them in a paper read before the Royal Society in January of the same year. I quote from this paper the following passage:—"It is worthy of notice that Mädler, having been led by certain considerations to examine the neighbourhood of the Pleiades for traces of a community of proper motion, founded on the drift he actually found in Taurus his well-known theory that Alcyone (the *lucida* of the Pleiades) is the common centre around which the sidereal system is moving. But in reality the community of motion in Taurus is only a single instance, and not the most striking that might be pointed out, of a characteristic which may be recognised in many regions of the heavens. In Gemini and Cancer there is a much more striking drift towards the south-east, the drift in Taurus being towards the south-west. In the constellation Leo there is also a well-marked drift, in this case towards Cancer."

Thirdly, as to the nomenclature of star-magnitudes. This is a matter which ought to be attended to by writers on astronomy, in order that a definite rule may be adopted. I must say it seems to me that my method is the most natural. Let your reviewer ask any ten persons at random whether they would understand "a star of a very high magnitude," to mean a very faint or a very bright star. I think he will find, as I have done, that great brightness is usually inferred. I admit that "twenty" is a higher number than "one," but I submit that the "first" is a higher order than the "twentieth." When we speak of any person or thing standing high in a list, we imply that the *ordinal* number expressing his or its place is small. The highest place is the first, in ordinary parlance; and we only associate "highness" with "largeness" of number, when we use the number cardinally. The only exception I know of (and that a doubtful one), is where a mathematician speaks of equations of a high order, but even here *number* is in question, the high order being arrived at by so many "multiplyings," so to speak, of the involved quantity in that term which determines the order.

Of the errata, your reviewer's "'Handibook' for 'Handbook,'" should have been "Handibook" for "Handy Book." The printers governed this matter. Buchan calls his book "Handy Book of Meteorology," and I so wrote it, but the printers would not have it, and I left them to their own devices.

The other errata are indefensible (I observe that one of them is repeated in the essay you have reprinted, where "southern" horizon, line 16 of the essay, should be "northern horizon") except in so far as the law of averages teaches us that in a given number of pages, a certain number of errata will always occur. If the odds are a hundred to one that no glaring error in a given page will escape detection, the probability is, that in a work of over 400 pages, there will be four glaring errors. RICHARD A. PROCTOR.

SPINNING TOPS AND GYROSCOPES.

[4310.]—I AM somewhat surprised at "A Barrister's" statement (let. 4303, p. 306), that "amidst all the plausible theories and speculations to account for the movements of tops and gyroscopes, none as yet appear to afford any satisfactory solution of the problem." The movements in question are strictly in accordance with the results deducible from the mathematical analysis of the subject. The difficulty is in popularly expounding the subject; and this difficulty is almost insuperable.

As to the general features of spinning motion, I would remark that for a spinning top to fall in a given direction, all the moving particles in the top, except those in a certain vertical plane through the axis of the top, must have their direction of motion changed. But the weight of the top is insufficient to change the direction of the particles' motion in a brief interval, so long as this motion is sufficiently rapid; precisely as this weight would be insufficient to change the direction of the top's motion appreciably in a brief interval, if the top were simply flung through the air at a high velocity. The principle is the same in both cases. But in the case of a top flung through the air, the top's weight has time to act, and does eventually so act as to change the direction of flight. It is otherwise with the particles of the rotating top. For a particle which, moving horizontally in rotation, should move somewhat downwards if the top is to fall in a particular direction, will a moment after be so placed that for the top to fall in that direction, this particle should move somewhat upwards. Hence the steadiness of the top's motion while the rotation is rapid. RICHARD A. PROCTOR.

ATMOSPHERIC ELASTIC FORCE, &c.

[4811.]—MR. J. M. TAYLOR (letter 4250, p. 279) intimates that he would be surprised to hear that a top has "stood erect in vacuo." He means, I presume, while spinning. If Mr. Taylor will refer to No. 47., p. 352., of the *Philosophical Transactions*, I think he will find an account of one that spun for two hours and sixteen minutes. Has Mr. Taylor tried the experiment himself? If not, would it not be better for him to do so before attempting further to maintain so very novel a theory?

The centrifugal force, or, as it is now the fashion to call it, the centrifugal tendency, causes all rotating bodies to resist, to a greater or less extent, any force acting in such a manner as to shift the direction of the plane of rotation. When a paddle-wheel steamboat is lying at anchor in a seaway she rolls to an extent that she never does when the paddles are at work; and the top wobbles when its rotation is ceasing for the same reason—it is succumbing to the forces of gravitation and of friction, which are trying to pull it down. Mr. Taylor doubts whether I ever spun a top in a vacuum. I own I never have; but I doubt whether he ever spun a top at all, or, at all events, many tops, or he would know that a top will spin with perfect steadiness, gyrating certainly, but not rising nor falling, at an angle to the horizon of considerable amount, its inability to raise itself depending upon the fineness of the point of the peg. When a top "sleeps," gravity acts equally upon it, and its fall is occasioned solely by the friction of the ground and air. When the top is inclined, a composition of forces takes place, and the effect of gravity is to cause gyration. The reason why a top with a blunt point can raise itself is owing to part of the force of friction acting at right angles to the axis of rotation. With a fine point, this resolution does not take place, and the top is incapable of getting up to go to "sleep;" but instead, gyrates in an "orrerific" manner, to the delight of that very disagreeable young person, the too scientific schoolboy. M. PARIS.

THE COMETARY DELUGE.

[4312.]—I SAID, p. 303, "These are my last words upon it," but "Derf Errac's" let. 4290, p. 303, being mainly addressed to me, compels a reply, beyond which I will not go, because I prefer to expend my time and labour upon subjects of some use, and to write about things I know something of. To discuss the progress of a hypothetical and impossible event, appears to me waste of time; and as is evident from some remarks in the "Replies to Correspondents" the "odium theologicum" is unavoidable: let one debate ever so reasonably, one is sure to be charged with "infidel attacks on the truth of Holy Scripture," exactly as Galileo was when he argued for the Copernican system. Now, will "Derf Errac," who asks me if I think I am arguing honestly for the truth, tell me if he thinks he does so when he attributes to others that which they never said? Will he have the goodness to say where either "F.R.A.S." or myself say that we "consider all who differ from our dicta, as regards a flood 5,000 years ago, to be playing deliberately into the hands of the infidel and scoffer"? This is just an illustration of the unfair way in which men of science are treated, and which generates the much talked of antagonism between religion and science. We said that to link together religious dogmas and statements of very questionable facts; that to say that any one who doubts whether the world was made in six days, or whether a flood covered the entire globe, or whether the sun and moon stood still to give one set of men a little longer time in which to murder another set of men; that to venture the credit of religious faith in contact with these statements, and to compel every man to choose between being an "Infidel," or swallowing bodily all these statements—that *all this folly* is "playing into the hands of the infidel and scoffer." In fact, is it possible to conceive any better process for compelling reasoning men to reject altogether principles so discredited? This is a very very different thing from what "Derf Errac" asserts of us.

I cannot help "Derf Errac's" understanding "E. L. G." in a different sense; to me it appears that he used the illustration of the action of falling water upon a heap of sand or clay as describing the action of the flood; and, if so, it was a fair reply that the conditions being different altogether, the illustration fails; that illustration was that in a heap of sand or clay, causes now in operation—that is, rain—would produce only deep furrows and steep walls, while a flood, as the tide flowing over, would convert them into sweep vales; ergo, it was deduced, sweep vales on the earth were formed by a flood, not by ordinary causes.

I may incidentally remark that we may see the early history of the earth in the moon; instead of the moon being, as the author I quoted (p. 196), and others suppose, a dead planet merely, it very plainly shows that planetary bodies were at one time in a state of fusion, that a crust first formed on them, that that crust was pierced by openings through which the fused contents poured out as the crust contracted, and that, ultimately, as the mass solidified, its surface would be rent by vast chasms. All this we actually see in the innumerable craters and clefts on the moon, all this we see when any body of lava pours from a volcano, and can watch in progress any day in the slag pouring from a blast furnace. In the moon, the result remains because there is no water and atmosphere to disintegrate the first formations. (Probably the greater mass of the earth retained all the lighter materials, gases, and vapours, around it.) In the earth, when this stage was reached, the vitrified crust was exposed to the action of heated gases and vapours which, as the temperature lowered, were enabled to react upon it, to change its nature chemically, and to break it down mechanically, and when at last liquids could be formed, the débris thus produced would drift into the hollows of what was then truly a mere film covering a mass freely mobile, because in a highly heated state of fusion. In this stage small changes of pressure would be really capable of disturbing the equilibrium of the shell and its contents. In this way we can easily conceive how through gradual very slow changes, through many a myriad of ages, the world assumed its present state.

Returning to "Derf Errac's" remarks, it is very difficult to argue and analyse exactly as to the pressures the supposed falling torrents would produce—there is too much of the "might be" about it. According to the originator of the notion, few of the now elevated lands then existed: it appears that the Andes and Himalayas did not (at least so "E. L. G." says), and therefore what can we know as to the supposed spaces on which an extra pressure *might* accumulate? I see no sort of reason to imagine that under the supposed conditions the fall would be even a second earlier on the land than on the sea, as the whole atmosphere would be densely charged with vapour first; but it is a pure assumption, without a particle of evidence to support it, that such a pressure (if real) could produce any distorting effect whatever. I referred to the assertions of some distinguished mathematicians that the crust of the earth must be, from astronomical considerations, 800 miles thick; I did not say I believed it; on the contrary, as a mere matter of present opinion, claiming no great weight, even in my own mind, I consider it probable the thickness lies between 20 and 40 miles of solid matter, resting upon an exceedingly dense and agglutinated fused mass; but I see no sort of reason to conclude that any possible accumulation of water upon any portion of this could appreciably distort it—taking into account the balancing effect of the water fallen on the sea, the hypothesis appears monstrous and improbable.

The key to the discussion lies in the point I have already stated. One single fact inconsistent with the occurrence of a universal deluge disproves it. Ten thousand circumstances consistent with such an occurrence *do not prove* it, because there may be other explanations. Now, we need no comet to show that all the earth has been under water—that is, that every portion of its existing surface was formed under water except a few protruding eminences—in fact, all its surface has been so under water many times, and for prolonged periods, one part at one time and another part at another; *there* is the explanation of all those facts which appear to support the universal flood, and which also fits in with those other facts which incontestibly disprove it.

Before turning from the subject, however, I may as well add that when "E. L. G." has explained what became of the water of his comet, he has a still more difficult problem behind—viz., what became of the *heat*, and how did anything survive it. Comets would seem to be incandescent, and it is very doubtful if water could possibly exist undissociated into its elements in cometary conditions; but as we must assume against all evidence (as "E. L. G." admits) that there was *one* water comet, we need not stick at assuming it to have been cold; give it the temperature of absolute zero; it must have been in a highly diffused state, filling a vast space; it *may* have been moving in the same direction as the earth, so we may disregard the loss of its motion and consequent transfer into heat. But the earth's attraction drawing the water to it from space in quantity sufficient to generate a fall of 10ft. per minute, would also generate enormous heat, as we see when any substance actually comes under these conditions, as with meteors; so that it is probable that not only would the water itself be uncomfortably hot, but the air would be filled with heated vapour. Cold vapour would not form cool water after falling (say) 200,000 miles, and having that motion suddenly arrested.

And all this is devised to support the idea of the mere universality of a flood, while its deviser is going to prove one of the worst foes of the theological dogmas attached to that idea, which alone give substance to it; if we are to take the account as literally true, Noah's Ark was provided for the purpose of perpetuating life; to suppose that any land-living creatures were saved except those in the Ark is equally subversive of the account as to deny the universality of the flood, for if the greater part of the world was replenished by creatures saved upon "E. L. G.'s" "rafts" (fancy anything living on a raft under a fall of 10ft. per minute) the Ark was an entirely unnecessary provision, except for the comfort of Noah and his family. I move (and carry for myself) "the previous question."

SIGMA.

P.S.—If any one feels inclined to smile at the number of "may be's," and "it is probable," will he kindly remember this is "'rote ironical"?

THE DELUGE.

[4313.]—I PERCEIVE that there are those among your readers who consider the case of "E. L. G.'s" "steam comet *versus* Lyell and Scrope" as the case of "religion *versus* the infidel." This being so—"*E.L.G.* *having started so dangerous a notion*—I conceive that it has become his duty to tell us something more about his comet. Of course, no one can expect him to tell us exactly the nature of the actual comet; but he should be able to describe the nature, size, motion, and condition of a hypothetical comet which *might* have accomplished what he requires from his steam comet. Thus, it rained upon the earth forty days and forty nights (Gen. vii., 4 and 12). In this time the earth travelled (roughly) some sixty millions of miles on her orbit, rotating forty times on her axis. This should be considered. Then, again, the waters of the earth had returned to their normal condition one year and ten days after the commencement of the flood (Gen. viii., 14). This allows 335 days for the subsidence or drying of the water—subsidence, I suppose, according to "E. L. G.'s" theory. Then, by the way, what was the action of the wind which "passed over the earth" after the flood? It would be well, also, to describe the condition of a suitable comet, as to total quantity of steam, maximum pressure at or near nucleus, actual quantity of aqueous vapour (per cubic mile, say) in the part traversed by the earth; because, if a creed is to be formed containing the words, "I believe in 'E. L. G.'s' steam comet," it is as well that we should be able to give reasons for the faith that is (or that, I suppose, *will be*) in us.

I would submit, further, that while there may be excellent reasons for believing Darwin, Lyell, Scrope, Huxley, Tyndall, and others, who do not take certain Scriptural assertions *au pied de la lettre*, to be *mistaken*, it is certain that these gentlemen are fully persuaded of the truth of what they assert; that they have spoken with the object of advancing truth, not of injuring any man's faith; and that even by comparison with "E. L. G." they are not, strictly speaking, idiotic. It can serve no good purpose, then, to sneer and be scurrilous. Correction, not castigation, is called for if Lyell or Scrope (for instance) be mistaken. We may sympathise with that courage arising from conviction which leads a man to oppose argument to authority; but I have never yet heard that abuse or ridicule strengthened any cause against those who, right or wrong, are certainly in earnest. I conceive, therefore, that "E. L. G.'s" steam comet would not suffer if he could eliminate "oh" and "ah" and "assuredly" and "just observe" and "now mark" from his paragraphs, and trust rather to "semicolons" and "points" than to "notes of admiration and (startled) interrogation." Sydney Smith has told us that "nothing does, for ten pages together, but the indicative mood," with whom, also, I would remark that I should "not wish to deprive 'E. L. G.' of these indulgences altogether, but merely to put him upon an allowance, and upon such an allowance as will give to these figures of speech the advantage of surprise and relief."

As a change from the Deluge, "E. L. G." might exercise his talents in showing us (for example) how the destruction of Sodom and Gomorrah was brought about by a downfall of the November meteors. I commend this in a special manner to his ingenuity. He will see that the time of day and other circumstances of the catastrophe agree well with the theory; and as these meteors contain much sodium, the transmutation of Lot's wife into a pillar of salt (chloride of sodium) becomes pleasingly explicable. It is true Leverrier has set the introduction of the November meteors into our system at the year 126 A.D.; but that is a detail,—like "Sigma's" question as to what may have become of the water received from "E. L. G.'s" steam comet.

RICHARD A. PROCTOR.

[4314.]—I AM sure many other readers of the ENGLISH MECHANIC agree with me in hoping that the forty days of this flood are nearly over. With a view of pouring oil upon the troubled waters, I cannot refrain from expressing a very decided opinion that there was no occasion at all for any such disputation. I presume that it is only a laudable zeal for the authority of inspiration which has led "E. L. G." and a few others to believe in the universality of the Deluge; because they concluded the Scripture expressions to be quite unmistakeable, consequently, in defiance of the overwhelming evidences afforded by both geology and astronomy, they have taken up the wildest notions and most impossible theories. With the deepest conviction that their difficulties are imaginary, I put forth the two following statements:—(1) That the inspired record does not declare the Deluge to have been universal; (2) that the description of it given in Genesis vi. is inconsistent with such a belief.

The former was the clearly expressed opinion of Bishop Stillingfleet before the days of Lyellian geology, of Dr. Pye Smith, and many other good men who had the profoundest reverence for inspiration. Such men pointed out that the right way of reading those statements which seemed to declare the universality of the Deluge was to compare the expressions used with others of a similar kind in Scripture, of which the contexts or other passages gave an explanation—*e.g.*, in Matt. xii., we read that "the Queen of the South came from the uttermost parts of the earth," when the actual distance was a few hundred miles, but not to multiply examples, I would ask whether the expression "all the high hills under the whole heaven were covered," proves that the Alps, and Andes, and Himalaya ranges were submerged any more than the expression "there were dwelling in Jerusalem Jews, devout men out of every nation under heaven," asserts that some came from China, others from Great Britain, and others from America. I dare say it will be replied that, of course the writer of the Acts meant only all the nations where Jews were then established. Precisely; and so the writer of Genesis meant only the lands where the human race then existed. The tract of land between the Caspian and Black Seas appears to have been the cradle of the human race, and a deluge extending no further than that—the then known world—would fulfil both the divine intention of punishment and the language in which it is narrated.

2. I maintain that the account given in Genesis is inconsistent with the idea of a universal deluge, and especially with an extraneous source of the water such as the cometic sac d'eau invented by "E. L. G." The record does not say that the chief part of the water descended from the skies, though it did rain during forty days, and we must remember that such a downpour as would produce a layer of water six miles thick in so short a time would cease to be rain, and become a furious cataract that would leave no olive leaf for the dove to pluck off. But what do the Scriptures assign as the sources of the water? They are twofold, mentioned twice in the same order; (1) the fountains of the great deep; (2) the windows of heaven, of which last the equivalent is certainly rain, nor can there be any doubt that the former is the sea or ocean to which the priority of causation is ascribed. Thus we find Scripture and geology in harmony, when we regard the Noachian Deluge as the result of a local subsidence by which the barriers of the sea were removed, and the "fountains of the great deep broken up."

E. L. B.

[4315.]—IF "E. L. G." (letter 4239, p. 276) has not explored the Upper and Lower Eifel, I strongly recommend him to take his wallet and walk about this wonderful district. In the neighbourhood of Gerolstein alone he will find enough to upset, in my humble opinion, his Whartonlike theory. The Auberg here, a limestone rock, so exactly resembles a castle that every one who has seen my sketch of it has taken it for a ruined feudal stronghold, and when I took the sketch I actually thought it a castle. Now, "E. L. G." would maintain that this shape was produced by a deluge of water which rounded the slopes, out of which the rocky mass protrudes; yet within a mile we find a large crater with beautifully rounded sides. If this crater existed before the Deluge, why was it not filled up with the débris of the adjacent hills and rocks? If it was subsequently formed, why are its sides and its lava stream so rounded, except by the same agency that has rounded Cæsar's camp at Wimbledon, the moats and earthwork all over the country—namely, the never-ceasing action of gravitation upon the surface? The sand-dunes but of yesterday are again a case in point. Loose sand may at first be piled up and form ridges with sides more or less steep and not undulating, but sand-dunes formed a century ago will be rounded. Old chalk quarries show just the same thing.

M. PARIS.

[4316.]—WITH every respect for "E. L. G.'s" intellectual and polemical powers, I am at a loss to understand how he has, as he says (letter 4292, p. 304), "demolished any connection between their facts and their dogma about the Deluge." (Who has propounded any dogma but "E. L. G." himself?) Now I maintain that the facts mentioned by myself (let. 4240) and others are pertinent to the question, and any one who undertakes to give a theory of a universal flood is bound to take them into account. In the letter in question, "E. L. G." appears to have got himself on to the horns of a dilemma in this way; fresh-water plants and animals die in salt water, salt-water plants and animals do the same in fresh water; if the flood covered the whole earth either one or the other must have succumbed. Supposing the sea to have been made sufficiently fresh to have transported pond life, then the corals must have died; if it retained sufficient saline material to keep the latter alive, then the former could not have been transported in this way. This deluge is certainly most accomodating, for it occasions not only the wide distribution of fresh water life, but also "the fewness" and "separateness" of species "on islands even within sight of each other," *i.e.*, the same cause gives origin to two diametrically opposite effects. The quotations in the latter part of the letter neither militate against Darwin's theory, nor support that of "E. L. G.," but as we are discussing the Deluge and not Darwinism I will not go into them. In conclusion, I would point out that "E. L. G." has as yet given no evidence fixing the date of this deluge at 5,000 years ago, and it seems to me that if he does not make haste we shall be overtaken by another comet before he has finished.

P. SANTALINUS.

"E. L. G." AND HIS COMET.

[4317.]—I HAVE read through the column and a half of words with which "E. L. G." attempts to dispose of "F.R.A.S.," M. Paris, "Sigma," and myself, if not with instruction, certainly with amusement, being strongly reminded of the old lawyer's advice to his son reduced to practice, "Bad case, abuse plaintiff's attorney." As an example of "special pleading," I would commend to the attention of the bar the way in which "Sigma's" reply to the remark of "E. L. G." that a deluge would obey "the laws of yesterday's shower" has been answered. "Sigma" is, however, well able to fight his own battle, and those who read his letters can take the real meaning out of them, though, I very much doubt if they are able to do the same out of the parenthetical periods of "E. L. G." In entering into the Deluge controversy, my only object was to obtain the premises from which "E. L. G." draws the conclusion that a deluge did occur about 5,000 years ago, and that that deluge was caused by a comet; but this information he appears determined not to afford me, for the very good reason that indeed I must be ignorant of all concerning "comets, the earth, and properties of fluids," or I would have never asked for it. And this ignorance of mine he infers, *mirabile dictu*, because a letter of twenty odd lines contains no proof of my knowledge of such subjects! If any reader will come forward, however, who believes it proved from his acquaintance with science that a comet could cause the Deluge, "E. L. G." will kindly prove it for him! Considerate "E. L. G."! As in my defective knowledge, I am placed on a par with such a writer as "Sigma." "E. L. G." has done me honour over much; for if "Sigma" and "F.R.A.S." are ignorant men, what a light of science he must be, and how well suited to be our instructor in "steam comets," *ad hoc genus omne*. For my part, I shall never aspire to stand on the eminence occupied by men of science (?) who have adopted for their motto *nul n'aura de l'esprit que nous*.

In conclusion, I will once again ask "E. L. G." to prove that a comet could cause the Deluge, and then that one did cause it, when, no doubt, the readers of the MECHANIC will join with him in the belief that we all must have been "profoundly ignorant" to have doubted even for a moment its steam comet origin. I hope "E. L. G." will believe me when I declare that if his theory be true (which I do not believe), I hope he may be able to prove it for the sake of the cause of science; but, I trust, that he will at once apply himself to the task, and waste no more space in what savours only too much of struggles for victory, not for truth, otherwise the Editor had better put his veto on the discussion, which is fast becoming like Hamlet's reading, "Words, words, words!" UN IRLANDAIS.

P.S.—If "E. L. G." is not acquainted with the weight of a comet, nor cannot even form an approximate idea on the subject, why does he quarrel with Roscoe's ideas as to the magnitude of one? If Roscoe's assertion is to be put against "E. L. G.'s," may we not take our choice; for if both parties are ignorant on the matter, and Roscoe a "buffoon," for saying a comet might fit in a room, may not "E. L. G." be a still greater "buffoon," for saying that one did deluge the earth?

WHERE IS THE WATER GONE TO?

[4318.]—THIS question of "E. L. G.'s" possesses very great interest for me, and I shall be very glad if some of our learned friends will tell us where the water does go to. I have a theory, but will instantly abandon it if it can be shown that it will not hold water, my object being to discover either what does hold it, or what becomes of it.

While cruising in the Mediterranean with the British fleet, in 1862, we had occasion to touch at Cephalonia, and, coming to anchor off Port Argostoli, the Admiral gave leave to the watches to go on shore; and, availing myself of this privilege, I landed, and proceeded to inquire whether there was anything to be seen, and upon hearing of a wonderful well, within half an hour's walk to the northward of Argostoli, I provided myself with a guide, and upon arriving at the so-called well I found what greatly excited my surprise, for the water was rushing through a break in the sea-barrier, and along a rocky channel, until it finally disappeared in a large cavity in a rock, which crossed the channel at right angles, and at about 40 yards from the sea, and my guide informed me that so it has gone on for ages, and without interruption, the tide not disturbing the almost uniform level of the sea in this region. He told me also that scientific men from various countries have visited this well, many of whom have cut inscriptions on floating substances, which they have sent into it; but, although the waters in the bay and surrounding the island have been anxiously watched, and the island itself explored, nothing ever sent into the well has been known to reappear.

If there were any geysers in that part of the country, it might be concluded that they ejected the water received by the so-called well, but there being none, the matter is not so easily settled. Is it probable that the water may be conveyed into a huge cavern somewhere near the crater-passage of one of the volcanoes of the Mediterranean, and, there being converted into steam, is carried off by the passage? J. W. RODWELL.

DOUBLE STARS.—CORRECTION.

[4319.]—There is an error in the place of the new double star, f δ Corvi, mentioned in my last letter. This star is Lalande 23536 (not 23488), and its right ascension is 2m. 50s. greater, and declination 10′ in excess of the latter. The magnitude in Lalande is 6½, but it seems nearer 7 now. It is brighter, however, than L. 23488, which is noted in the same catalogue as 8 mag. As stated, the double is the most northerly of two stars of the same right ascension, and is easily found from δ, which precedes, 5m. 50s.

Chicago. S. W. BURNHAM.

DR. CARPENTER AND PERSPECTIVE.

[4320.]—I HAVE been surprised that none who have taken part in this controversy have mentioned Cruikshank's attempt to picture a *converging giant*. Falling into the same mistake as Dr. Carpenter, Cruikshank reasoned that a *very* tall giant should be pictured with his "upper works" somewhat reduced, since his head (for example) must be further away than his feet from an observer of ordinary size. The effect, of course, was a complete failure. The picture of the giant represented him monstrous in more respects than mere size.

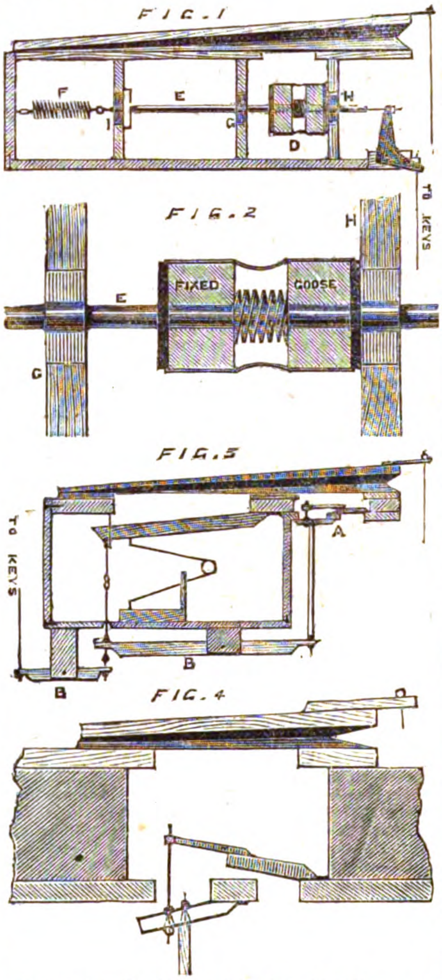
I must demur to M. Paris's remark about pictures being compromises, understanding that remark to apply to perspective. As to colour, shading, and so on, there must always be some degree of compromise, but the perspective of a picture ought to be mathematically exact. There is only one point which is conventional, and that is, that the plane of projection shall be regarded as vertical. (This holds, of course, even when a picture lies on a table or desk; it is *understood* to be vertical.) This rule renders it mathematically necessary that all vertical lines shall be drawn parallel, no matter where the point of sight may be. More generally, all lines parallel to each other, and also to the plane of projection, must be parallel in the picture. Thus, if an artist is drawing a long horizontal row of equal houses, placed in a direction square to the line of sight, he must draw the roof-lines and basement lines parallel and horizontal. Dr. Carpenter's reasoning would indicate that these lines should converge, *as well to the right hand as to the left*, which is, of course, out of the question.

The fundamental rule in perspective—strictly in accordance with the mathematics of the subject—is that scale depends on the relative distance of objects from the plane of projection. Under ordinary circumstances this amounts very nearly to saying that scale depends on the relative distance of objects from the eye; but in cases such as that considered by Dr. Carpenter there is a difference.

RICHARD A. PROCTOR.

PNEUMATIC LEVERS FOR ORGANS.

[4321.]—As there are many of the subscribers to the ENGLISH MECHANIC who take great interest in organs, I venture to send you sections of two pneumatic levers, thinking that they will be acceptable to many readers. The construction of them presents as great a contrast as, I think, can be found in similar contrivances. Drawings of these were shown to me by a person who had been employed for many years by a celebrated German organ builder.



The most noticeable, and in fact chief feature, of Fig. 1 is the great simplicity and ingenious application of the valve D. This valve is composed of two round pieces of wood, each of which is faced with soft leather; one of these pieces (nearest the hinge of the bellows) is fixed to the sticker E, the other is loose, so as to work easily to and fro on the sticker. These pieces are connected at a distance ½in. apart by a strip of leather (split skin) glued round the circumference of each of the pieces; and a light spiral spring is placed between them on the sticker. The object of this is that the valve may accommodate itself to any little variation in the working of the key action. This contrivance forms both the supply and escape valve. When the key is not pressed down the spring F draws the fixed surface of the valve to the hole at G and prevents the wind from entering the bellows, while the hole at H allows the wind to escape out of the bellows, when the key is not held down. The sticker E is pursed at the hole I. Fig. 2 is an enlarged section of double valve at D. Fig. 3 is a very complicated piece of mechanism; its absence of simplicity is its chief feature. The double escape valves A are particularly objectionable, as are also the two backfalls, the latter take up so much space, and are very liable to make the key action noisy. Fig. 4 shows escape valves; enlarged section at A, Fig. 3, the valves in contrary position. Both the sections show the levers with the key pressed down.

PNEUMATIC LEVER.

SOLAR EYEPIECES.

[4322.]—I HAVE been much interested in reading the letters of the Rev. Mr. Berthon and other correspondents on solar eyepieces; and as the subject is by no means yet exhausted, perhaps a few remarks on my own experience may not be altogether uninteresting to your readers. Your valued correspondent "A Fellow of the Royal Astronomical Society" will, I think, forgive me for pointing out a remark in his letter (4223, p. 273) which surely must be a mistake. In comparing smoked field lenses with silvered ones he remarks, "Absorbing light and heat by minute solid particles. In the one case they are of carbon, in the other of silver; but the principle is the same." With smoked lenses the light and heat are undoubtedly absorbed, but with silvered ones the greater part of the light and heat must certainly be reflected—a most important difference of principle. I formerly used smoked field lenses for several years. They defined beautifully; indeed, I doubt if it is possible to surpass, or even to equal, the definition of a Huyghenian eyepiece which has the front surface of its field lens smoked. But there are the following serious objections to this form of eyepiece:—

1. It is by no means easy to obtain a perfectly level surface of smoke on the lens, especially if the eyepiece is of low power, and the lens consequently large. There is also great risk of fracturing the lens in the process of smoking. 2. If the most minute particle of smoked surface comes off the lens, bright dazzling rays diverge from the point in question over the field of view, and the eyepiece is practically useless till a new surface of smoke is deposited. This happens incessantly, for the intense heat of the solar rays in the focus of the telescope usually causes fragments of the smoke to fall from the lens within the first half-hour of using. 3. The smoked surface being black, nearly the whole of the light and heat is *absorbed* by the field lens, which consequently becomes intensely hot, and very often splits.

The continual expenditure of field lenses, and consequent trouble of grinding new ones, and the lenses so often requiring to be smoked just when a favourable moment for observation occurred, caused me to abandon these eyepieces, in spite of their fine definition. I now use Huyghenian eyepieces with coloured lenses—the colours of the two lenses so combined as to produce a white image. By this arrangement I obtain a clear white image of the sun upon a very deep blue sky, and the definition is quite satisfactory. This form of eyepiece, however, has its objections. In my lowest power, the field of which is exactly the size of the sun's image in the telescope I use, I have had no less than three field lenses split, owing to the absorption of the solar light and heat; but no accident of the kind has happened to the two higher powers. When a white image is produced, the chromatic dispersion of our atmosphere produces coloured fringes round the solar spots when the sun's altitude is less than about 35 or 40 degrees. When the sun is in this position, a reddish orange fringe is seen along the upper limb of the sun (with inverted image), and a bluish violet one along the lower limb, the right and left limbs being free from colour. As the spots are black (or bluish black) on a white ground, the position of these fringes is, of course, reversed—the orange fringe being produced on the lower portion of the spot, and the violet fringe on the upper portion. I am convinced that these fringes are much more strongly developed in rainy weather, when our atmosphere is charged with moisture. In such weather, when the sun's altitude is not more than 15 degrees, the colours are sometimes so violent as nearly to destroy all definition. At first I tried to get rid of the colour by tilting the eye-lens in the manner adopted by our Astronomer Royal in his correcting eyepiece; and although this improved the definition very much, I could not *totally* get rid of the colour; but I found another way of doing it as follows, without altering the eyepiece: If, when the sun's altitude is low, the upper or lower limb be brought into the centre of the field, the characteristic fringe will be seen. If the eye be now gradually lowered, the fringe will be seen to become narrower until a point is at length reached where the fringe completely disappears, and the limb is quite free from colour and sharply defined. By carrying the eye lower than the achromatic point, the fringe reappears of the complementary colour; where the orange was at first it now appears violet, and *vice versâ*. In the same manner, all the colouring round the solar spots may be quite got rid of. Numerous printed observations might be quoted where observers have noticed colour round the spots, or round Mercury in transit, without apparently knowing what produced it; but had they looked through the telescope a little below the centre of the eye-lens, the colours would probably have vanished at once.

I have not yet tried the silvered lenses recommended by the Rev. Mr. Berthon, but from the correspondence which has appeared I infer that nearly the whole of the light and heat is reflected. As but little is absorbed, the lens cannot become unduly heated, and consequently cannot split; but I think it probable that silvered lenses will ultimately be found to fail, from the same cause as the smoked ones—viz., minute particles of silver coming from the lens.

In No. 390 of the ENGLISH MECHANIC is an article on "Solar Microscopes," in which the writer explains a method of separating the rays of heat from the rays of light by taking advantage of the smaller refrangibility of the heat rays. Could not something be done in this direction with solar eyepieces? If the rays of heat could be got rid of, the rays of light could be easily managed.

W. A.

THE HOWE SEWING MACHINE.

[4328.]—The Howe Machine Company, established by Elias Howe, jun., original inventor of the sewing-machine, make three varieties; one kind, the A, B, and C, being table machines nearly alike, but differing in size; the D, arm cylinder machine; and the E, a large cylinder arm machine, all specially adapted for boot work; the latter making the nearest approach to the hand and boot closing stitch, the holes made by the needle being filled well up with the silk or thread. This is accomplished by drawing out the needle, the thread is then pulled through the leather, instead of allowing the needle to remain in while the thread is passing through, which, of course, must make the hole larger; although the best work from the E machine is seldom to be met with even in high-priced boots. It is, however, deserving the attention of all who like the very best work. The machine called the "Howe" has been imitated by many makers, with more or less success; the newest form is represented in Fig. B, and one of Elias Howe's earliest machines, the A size in detail in Fig. A. The figures indicate the corresponding parts. 1 is the bed, 2 the arm, 15 the outside face plate. Fig. A shows the top side of bed 1, shuttle race, and holes, with the four screws for fixing the arm 2 to bed. Fig. B shows the under side of bed 1, and the position of the working parts, 179 the main shaft supported by brackets cast in the bed. In the early machines, no allowance was made for the wear of the shaft holes; in the new, caps are placed on the bearings so as to allow for refacing when worn; two screws to each cap keep them tight. On the right hand outside the bracket is the driving pulley 13, the right hand cam 52 works the needle lever 48, and 49 its stud being the centre from which motion is communicated to the needle bar 40. The left hand cam 74 is the shuttle cam, which gives motion to the short arm of the shuttle lever 78, which is pivoted on its bolt 79, riveted in the bed, it has a washer and pin to keep the shuttle lever in place. Outside the left-hand bracket is a collar, 180, set up to prevent lateral play of the shaft.

Howe Wheel Feed.—This feed mechanism consists of 24 separate parts, besides the presser 8 parts; when the machine is made to lift the presser at each stitch so as work patterns, 12 pieces additional are added, making a total of 44 pieces for the complete feed mechanism. Instead of 12 pieces for the *vibrating presser* 5 pieces will serve, as shown in Fig. A, 300. The face plate 15 is shown with its top screw hole enlarged on the inside, and a slot cut to the top; in this is placed the standard 300, the face-plate screw 24 passing through its hole, keeping all firm together. On the top of the standard is pivoted a lever; its curved end is driven downward on the descent of the needle bar, by the thread-guide 43 striking on the curved end of the lever, its other end then raises the presser-foot 186 placed on the presser bar 56. The top end of the presser bar is fitted with either a bracket and adjusting screw; or the top end formed into a screw to receive thereon, a nut with a flange which the end of the vibrating lever strikes and raises. The nut serves the purpose of regulating the height of the lifting of the presser-foot at each stitch; a set-screw in the top of the nut prevents unscrewing. Any Howe machine may be cheaply and simply improved this way; it makes more noise, but acts effectively, and can, by unscrewing the nut, be disconnected so that the foot is continually on the work. This improvement of a *vibrating-presser* to the Howe Machine was first made in London, and made it more popular in the Exhibition of 1862. The Howe feed must be kept clean, and have the patient study of any one determined to master the machine, and to prevent the delay and expense of going to a mechanic to regulate it. The feed-wheel stud 163 has on it a collar between the feed-wheel and bracket; the bracket has a vertical slot, and the stud made flat to fit it; on its inner end is a washer and nut, which by means of a spanner can be set fast, when the feed-wheel is placed in the best position for stitching, or just above the needle plate. When this is done, then the feed-clutch lever 169 may be put in its place (when all is taken to pieces to clean, it is advisable to put all the parts together, and test

FIG. B

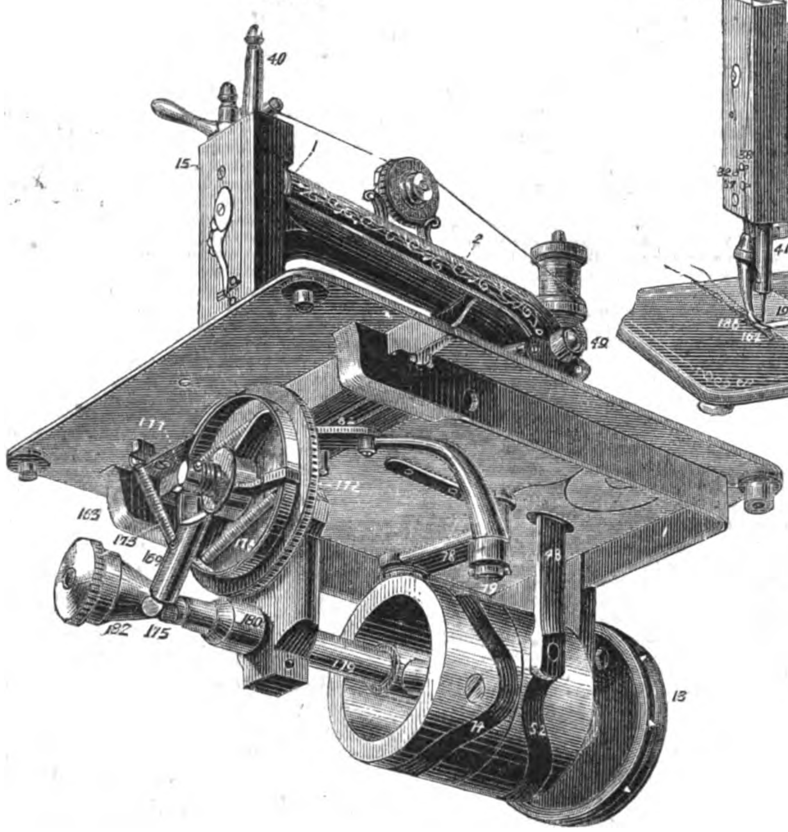


FIG. D

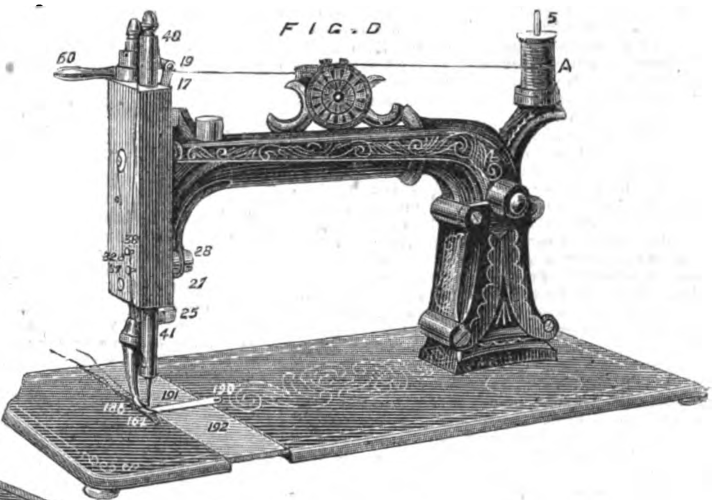


FIG. C

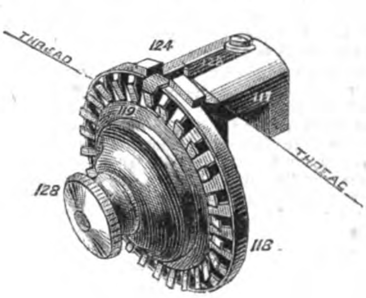


FIG. A

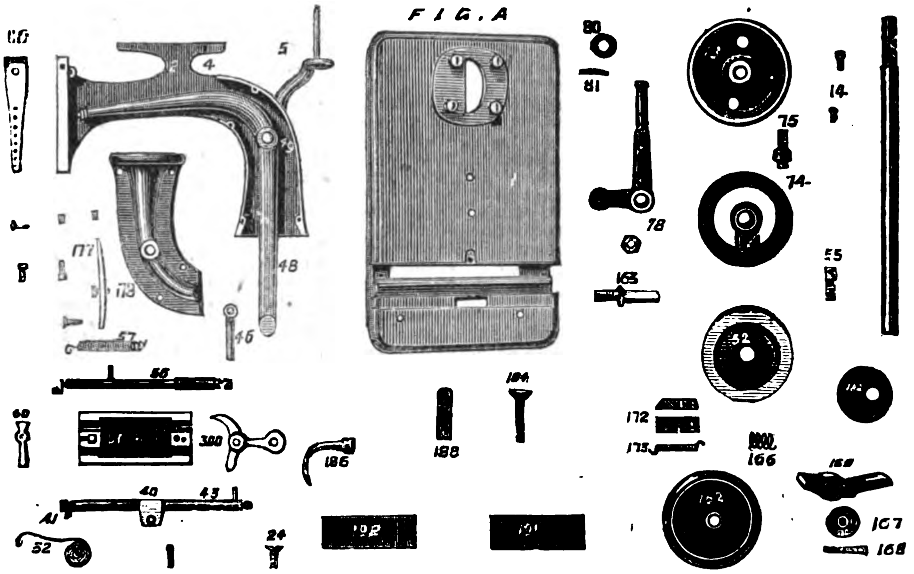
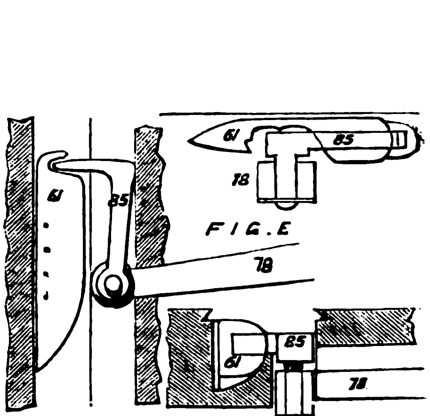


FIG. E



them, before fixing in the machine). Now put in the two feed clutches 172, and connect their springs 173, to the feed clutch lever; holes or hooks are arranged for the eyes on the ends of spring to connect to. Now put on the feed clutch lever washer, its spring, and press in while putting the pin through the hole in the end of feed wheel stud. Now try if all moves very evenly, and easy, no jerks; test by moving a little at a time for a short stitch, and if the feed clutches are drawn back by the springs, lively and with certainty, if not try one at a time. This part of the machine—the feed clutch—wears sooner than other parts, and it requires a mechanic to repair it, or to get a new one from the maker. The slotted part in the feed clutch must be hard, or it will not grip on the band on the side of the wheel. This band must be kept very clean. If oiled in parts only it will make short and long stitches. On making certain all is right set up the screw of the feed brake 177, until the wheel cannot be pulled backwards by the feed motion. Get the hand to judge by practice the strain required; for want of this knowledge many workers strain and wear out the machine.

All being right, set the feed cam 182, Fig. B, towards the feed wheel, and the feed rider 175 will be made to operate the wheel. Connect the feed clutch lever spring, 173, to its hook under the bed, and test it. Now advance the feed cone cam 182, by turning its nut, 184, and all is ready for work. The feed cone cam is kept in its place from turning on the main shaft by a slot, in which slides a screw along with the cam to prevent its twisting. This description applies to the new feed. The old feed differs only in the cone cam part, 182. Instead of this silent motion the action in the old is by an eccentric, 182, in Fig. A, fixed on the end of the shaft, so as to act on the lower end of the feed clutch lever, 169 (on a solid part instead of a hole and its rider 175). The upper or short end has a projection which can only move the length of the stitch as regulated by a screw 184 A, placed under the bed in front of the lever. The parts are shown detached in Fig. A. The durability of this feed lever is very good, if the eccentric is oiled in the old machine. As it works well, boot machinists care little about the noise of the feed. Indeed, all well constructed machines, however noisy, maintain their place in trade use, over others recommended as silent. Noise with plenty of good work done is cheerful, but silence with much trouble in working, or slow speed and poor earnings, is condemned by employers and employed.

The Howe Shuttle Mechanism consists of 13 parts in the new, Fig. B, and 11 parts in the old, Fig. A and E. In the latter the parts are shown detached, the shuttle 61 has on its butt end a hook or tail piece; between this hook and the butt end the shuttle driver is fitted, leaving room for the thickest thread to pass easily between the shuttle, 61, and the hook driver link, 85, Fig. E, which, instead of sliding, is simply carried direct by the shuttle lever 78; it has on its longest end the hole to take the stud of the shuttle driver, so that it will swivel slightly, and is thus kept guided by the shuttle race in a straight direction, while the end of the lever 78 makes a curved motion. To prevent the driver lifting out, a washer and pin below the lever keeps it in place. The shuttle lever works on a stud, 79, as a centre, and is kept up to its place by a washer and pin. The stud is riveted into the bed of machine. On the short end of shuttle lever is a hole into which is riveted a steel stud, on which revolves the roller, actuated by the groove of the shuttle cam 74, adjusted on the main shaft by a screw. An inspection of Fig. B will show the parts in working position, having the same reference numbers as Fig. A pieces. This new shuttle driver is more steady and durable at its work. It will be seen the hook shuttle driver 85, is here replaced by a slide. It has a stud riveted in it to connect to the hole of the shuttle driver link 82, which has its stud working in the hole on the end of shuttle lever 78. The shuttle driver slide is fitted into a groove on each side of the shuttle race, which makes it travel truly. On its upper side is fixed the shuttle driver, and adjusted by two screws so as to work and clear the shuttle. Instead of this plan to work the hook shuttle, sometimes a shuttle without hook is used, and then the shuttle driver is formed to embrace the shuttle so as to drive it from both point and butt end, as in the Singer or Thomas's machines.

The Howe Needle Mechanism consists of 16 parts in the new, B, and 9 in the old, including some of the thread guides. The detached parts are shown in Fig. A, old machine, and all in place in new machine Fig. B. The needle-bar 40 is drilled at the lower end to hold the needle, which is set fast by its screw 41. On the opposite side of the screw a hole is drilled in the bar to guide the thread, but in the new machines separate pieces are attached for guiding the thread and keeping the oil away from it. On the top of the bar there is a hole or short tube to guide the thread, and carry it up and down with the bar. About the middle of the bar a projection holds a pin and forms a joint for the needle-bar piston 46. The piston end fits into the hole in the end of the needle-lever 48. This is a very durable joint, but it is badly applied, the centre pin and strain not being in the centre of the needle-bar; it is not only harder to work, but throws the wear to the sides of the bar. The needle-bar works on a centre stud 49, and is bent downward, passing through the hole in the bed, to the needle cam 52. In the cam groove fits a roller revolving on a stud riveted in the needle arm.

The Howe Presser Mechanism consists on 9 parts in the old, and 10 in the new machine, Fig. B; but to lift the presser so as to stitch patterns, or work figures or designs, about twelve pieces more are added. For toe-cap flowering this is needed. Without this lifting the presser or feeder at every stitch made, there is a great stiffness in handling the work, yet the bulk of modern machines, especially for family use, are so made, to avoid expense sometimes, but mostly because of the impossibility of attaching mechanism that will keep in order. For general work there is a decided advantage in the presser lifting off the work, or better still, as in Thomas's machine, and its class, the feeder itself lifting. In this machine the feeder mechanism is certainly complicated, but has only a total of 18 parts, compared with 44 in the Howe. If the same work could be done with 4 instead of 44 pieces, every mechanic would pronounce in favour of simplicity, and every machine-worker would find far less trouble. In practice the repairing of Thomas's machines often require no work to the feed, but the Howe seldom escapes without it. The fact is here noted in its place, and will in due time be compared with other facts to be brought forward respecting other machines, some of them cobbled with leather or wood when new to prevent noise, but such that a few days good work would show the makeshift nature of such contrivances.

The Howe Tension consists of two pieces in the old plan machine. A plate of steel Fig. A 116 with a large hole at the wide end, through which the thumb stitch screw is passed to its hole. At the top, on the right hand side of the arm, or nearest the arm spool pin 5. The spool of thread placed on this pin is passed to the tension-plate, entering a hole in the end, at the right hand of the thumb-nut, then passing its side enters a series of holes, to make friction according to the tension required, the final adjustment being regulated by the thumb-screw pressing the tension-plate 116, acting as a spring upon the top of the arm, Fig. A., the thread laying between the plate and arm is thus pressed with delicacy. It is a good tension, but troublesome to thread through so many holes; to avoid this, the new thread is tied to the used up, and so drawn through all the holes quickly, but it is a waste, especially felt when silk is used. The new tension, Fig. C, avoids this; it consists of 12 pieces. The stand 117, back plate 118, tension-wheel 119, its edges are formed somewhat like saw-teeth being bent alternately on opposite sides, which leaves a V space for the thread to lay in. The thumb-nut, 123, regulates the tension when screwed by pressing on a washer, which acting on pad or cloth washers, one each side of the tension-wheel presses thereon to check its turning, and is thus graduated to the nature of the work.

Ready for Work.—Fig. D represents the upper side of the new machine, with the manner of threading it ready for work. 190 shows the throat-plate screw in one end of a narrow steel-plate, in the other end is the needle hole, covering the needle-slot in the shuttle-race. To suit different sized needles or work, there are two throat-plates, and easily changed. By sliding out the shuttle-case cover, 192, the shuttle can be removed or replaced. The needle bar set-screw secures the needles, the bar slides up and down between a front and a back cap-plate, the back cap-plate being adjusted to the arm, so that by turning, and adjusting cam 27, and its screw 28, the needle-bar and needle can be moved nearer to or from the shuttle.

Thread "Take-up."—At 32 is a coiled spring wire, at its upper end screwed against the cap-plate, its lower end having an eyelet. 37 and 38 are guide pins. From the spool, the thread is passed to the tension, Fig. C; draw it under its check spring 123, that rests on the top of the tension stud 117, carrying the thread back until it rests against the check spring 124, then pass the thread around the outside of the tension wheel 119, once, or if fine twice, then through the thread controller 19, Fig. D, and thence into the slot at the top of the needle-bar 40, thence downward under the thread guide pin 33, and through the take-up eyelet 32, and back again to the right of the lever pin 37, and thence through the guide at the end of needle-bar, and, lastly, the eye of the needle. The shuttle placed in position, one turn of the machine will cause the shuttle cotton to be brought up through the needle hole, and lay in the position shown ready for working.

[*The formation of the lock-stitch will be explained hereafter, when describing a more simple machine, to avoid perplexing the reader needlessly.*]

Before leaving the Howe take-up, it is well to notice that it is copied in many machines, but for domestic use it is certainly much too liable to derangement by bending, and it will cause "slip-stitch" and other troubles. The strain on the thread is regulated by setting the screw when the take-up eyelet 32 is placed away from the pins 37 and 38, about 1in. to 2in. to the left. On pulling into place the spring must be tested by the fingers, until experience enables it to be done properly, otherwise to meddle with it will cause very great trouble indeed. The eyelet should be set for the medium thickness of fabric; the travel varies for thick and thin. One of the newest improvements is to make a self-acting compensation for this by causing a pin in the presser bar to act upon the side of the take-up, so as to press it forward when the presser bar is lifted by the extra thickness of fabric. This is a welcome improvement, as it prevents slip-stitch or breaking thread.

A review of the foregoing description cannot fail to show the contrast between one of the earliest and one of the most modern Howe machines. While Figs. A and E illustrate the principal parts in detail, it is necessary to observe that all the items, such as screws, pins, &c., are not shown, nor the holes in the parts, so as to enable any one to make the machine from this description. It is not a convenient machine to make, too many special tools being required for the purpose, and to be of any service the Howe machine must have good workmanship, especially the modern machine, and the extra number of parts in it would make the task a severe trial to put so much work in a machine for family sewing. Figs. B, C, and D, if shown in detail, in all its parts, would convey an idea of immense labour. It is usually supposed that Americans aim at simplicity in construction, and economical production, but here, as in the Singer machine, we have examples to the contrary. Having spent thousands of pounds in factory and special tools, any change would involve a great outlay, and no doubt it has been considered better to continue to make the old plan, and add costly improvements, rather than make an entire change on a new system.

Without counting shuttle and winder, in the old machine, Fig. A and E, there are 80 separate parts, and in the modern machine B, C, D, with vibrating presser, 130 parts. If the parts were merely castings containing but little work, then this complication would be an objection, but as nearly every part is machined, and some passed through several machines, the amount of labour far exceeds what is necessary for a sewing-machine; and on consideration it really is astonishing to find such extravagant samples from the Americans, who are usually allowed to be above all other makers throughout the world in devising and making the most simple and economical articles, especially in light domestic machinery. The Wheeler-Wilson machine is an exception to this complication, but its power is so limited that it cannot be fairly compared with the Howe and large Singer machines, which are so well known for doing heavy work. The Howe class machine, no doubt, is doing nine-tenths of all the boots made, besides other work; the Singer class is also doing heavy work in various manufactories. The fact of this extensive and constant employment will be sure, in no distant time, to cause manufacturers to consider the advisability of adopting machines simple in construction, cheaply made, less liable to expensive wear, and equally effective.

Some manufacturers consider three years as the duration of a machine, and then replace the old with new, to keep up the quality of the work, and save the enormous cost of repairs such complication entails. When they are able to discover machines may last four times longer, and be equally, or more effective, because of simplicity and scientific construction, then a great change will occur in factory management. By means of the English Mechanic conveying throughout the world valuable information on this subject, and reliable, because open to correction if error be advanced or misstatements made, the truth may be simply arrived at, while the information obtained by the perusal of conflicting trade circulars is comparatively useless, seeing nearly all claim to vend the best machine, and such statements have influenced many to buy machines that are remarkable chiefly for the trouble they give the worker, and their money-wasting properties. When sewing-machines become as common as clocks, and as commonly understood, better things for the users will appear; then puffing circulars and big column advertisements will diminish, merit will stand secure, the best and cheapest will be sought and obtained, while the useless disappear. A Practical Man.

"P. SANTALINUS" AND HIS CORALS.

[4324.]—"P. Santalinus" may depend on it that it takes not much "care" (letter 4240, p. 277) to avoid mentioning these "reef-building corals." Why should I mention them? If there be evidences at what rate any reef is growing, then at what rate it formally grew, at what rate the growth has been accelerated or retarded at each period for the last 80,000 years (or whatever age he is going to argue about)—evidences as to what kind of interruption a fall of fresh water would cause (they must have rather heavy falls from tropical rains twice every year)—evidence of the pressure it would take to arrest them, of how long their growth has been unbroken, and a few other points, it may throw some light on the Deluge, possibly on its amount. But whatever evidence is *known* must be somewhere producible or recorded. Why does he not tell us where? That would surely be a less waste of your paper than asking me if I expect him "to believe" this or that. I have no doubt he will believe with a very capaciously "digesting faith" whatever he likes; but what on earth can it matter to any one else what a man "believes," who is capable of believing hills and vales rounded off, with their convex and concave sweeps of half a mile to a mile radius, by frost cracking the strata (p. 220, letter 4108)? His last letter (p. 277) seems to imply we have somebody who has lived upon and watched certain coral reefs long enough to "report from personal knowledge," how many "thousand years" they have grown without a break. Of course Agassiz never said anything so absurd. He has, probably, discussed evidences about the said length of growth, and these would be matter of scientific interest, and proper to explain in a "*Mirror of Science*." But if he used the language of "Santalinus" above, that is in no sense "*Science*," but *Dogma*; and the acceptance thereof is *Religion*. Whatever is taken thus, on what some one "reports from personal knowledge," whether the "personal knowledge" be that of Agassiz or of Brigham Young, or of Elder Harry, pastor of the Peculiar People, is *Religion*, a totally distinct thing from science.

In the beginning of his letter "Santalinus" appears to know this difference, because in the matter of the Alpine and Arctic plants, he imitates scientific method. Before any such Alpine facts, however, become "subversive" of anything of mine, he has missing links to supply. First it has to be shown that a new Alp, now upheaved among lowlands, would remain some time (indeed 50 centuries) without those same peculiar plants. In the absence of opportunity for experimental proof of this, I can only suggest the nearest analogy at hand. Many plants, he probably knows, are peculiar to the sea-side fields, except that they also grow around salt springs, natural or pumped up for salt-works. In the heart of Germany are many salt-mines and works, always with these plants abundant; and when a new mine is opened, be it hundreds of miles from such plants, no sooner has the brine been at the surface one season, than the sea-side plants appear. They are as incapable of growing in other inland fields as the Alpine and Arctic plants in a rich lowland, or rather more so. For Alpine ones could probably thrive in far warmer climates if not *crowded out* by the competition of the many fitter to those climates. Well, you see, most plants have their seeds nearly microscopic, to be conveyed everywhere. Arctic and Alpine ones especially have them minute, abundant, and transportable; and their non-growth in a given place no more implies the non-arrival of their seed there than the absence of sea-side plants in Oxfordshire implies absence of their seed; or than the (reported) existence of but one plant on London Bridge, a cherry stock, proves that no more cherry-stones than one have been thrown there.

What Mr. Wallace means by "a perfectly distinct fauna" in two islands, I cannot tell. In the only accurate sense I can give the words, namely, that no animal should be common to them, I doubt if any two countries on earth have been proved to have a "*perfectly* distinct fauna." Perhaps, the most striking fact of this kind is that stated in Johnston's Atlas about Borneo and Java, that on the former (the largest equatorial island, largest but one or two on earth, and absolutely largest *wholly intertropical* piece of land) no snake has yet been found; while Java, its next neighbour, has the *most* ophidian species (both harmless and venomous) of any island known! But I fail to see the bearing of such facts on the Deluge questions.

E. L. G.

ROSCOE'S "HATFUL" OF COMET.

[4325.]—ON referring to Roscoe's "Spectrum Analysis," second edition, I find, as I suspected (p. 277), that the playful (or rather buffoonish) expression quoted by "Sigma" (let. 4193, par. 11) is modified by something that would have opened any reader's eyes to its absurdity. Copying one line further would have done so, and accordingly the "verbatim extract" carefully stopped short without this line. "We do not know," wrote Roscoe (p. 292), "whether there is as much matter in this comet [Brorsen's] as would fill this room, or as much as would fill one's hat; and *this* amount of matter [*what* amount?] is spread over an enormous space. The diameter of this comet has been determined for me by Mr. Baxendell, who tells me that it is about 60,700 miles—an immense space over which to spread so small an amount of substance." The rich Hibernicism of this whole extract, when one comes actually to write it down, is really too much for me, and leads me to apologise for the insinuation that he was only "playing the buffoon *as much* as" our "Sigma." I must frankly acquit "Sigma" of rivalling, or as yet approaching, this bit of professional logic. The cream of the fun is that instead of a measure of mass,—instead of saying "we know not whether there is" a ton or a hundred-weight, Roscoe pitches upon that sole kind of measure, for the cometary matter, which *was* known. The only thing popularly known about it was, not indeed how much matter, but what space it filled,—not how much more than a ton, or a billion or a trillion tons (each equally probable), but simply and directly, how much more than a hat or a room it "would fill"!—namely, according to his computing assistant, 60,700^3 spherical miles. All that he can say of the matter, dense or rare, is that it *does* fill these 60,700^3 × ·5236 cubic miles. "And this amount of matter" (namely, whatever occupies these billions of cubic miles,—we know not whether much or little for them)—"is spread over an enormous space"! "Mr. Baxendell tells me,"—60,700^3 spheric miles,—"an *immense* space over which to spread *so small* an amount of substance"! He had just as much ground to say, "a *very little* space wherein to compress *so great* an amount of air or vaporous substance"!

For aught that any astronomer knows, that very comet's "*inappreciable*" mass exceeds an equal bulk of the very air the Professor was then breathing. In Herschel's "Familiar Lectures" (p. 132) it will be found that only two comets hitherto, Lexell's and Encke's (this is neither of them), have approached near enough to planets to have made their masses appreciable had they exceeded (according to Mrs. Somerville and Humboldt in "Cosmos") a 5,000th of the earth's mass, which latter I find in Chambers's "Descriptive Astronomy" set down as 6,069 trillion tons. Either of *the se two* comets then, for aught yet known, may contain *one* trillion tons, and *any other*, as Brorsen's, several trillions! and still have their mass *inappreciable*.

But I need not have said (p. 277) that possibly the buffoonery about the room or hat might be logically allowable, that possibly the comet is not *known* to contain more. A heavenly body, though of mass "inappreciable," must, to continue in its orbit, even the few days it is observed—much more to make, like Brorsen's comet, whole observed revolutions—have very many times the mass of the same volume of cosmic fluid or ether. Now, Sir William Thomson showed in a paper in the *Edinburgh Philosophical Transactions*, 1854 (p. 57), "On the Possible Density of the Luminiferous Medium," that its density cannot be below a limit he there computes; and he says "it is also worth observing that the luminiferous medium is enormously denser than the continuation of the terrestrial atmosphere would be in interplanetary space, if rarefied according to Boyle's law always." His conclusion is, "A pound of the medium, in the space traversed by the earth, cannot occupy more than the bulk of a cube 1,000 miles in side. The earth itself, in moving through it, cannot displace less than 250 pounds of matter." That is not weighing the ether by its *gravity*, observe (since it must be non-gravitant) but its *inertia* density. Well, then, the comet, occupying 60,700^3 × ·5236 cubic miles, or ·5236 × 60·7^3 of the above cubes, you see the very cosmic fluid or ether occupying that space must not be under 60·7^3 × ·5236 pounds—that is, close on 224,000 pounds, or 100 tons; and the comet's own mass, constantly overcoming this inertia, and being not mere inertia, but also visibly gravitation downward, could not be under a very great many such hundreds of tons, without being rapidly retarded and brought to a stand-still. These, *at least*, Professor Roscoe has to get into his room or hat.

E. L. G.

[It is really a pity that so able and so industrious a writer as "E. L. G." should so freely utter provocative words. Why call "Sigma" a "buffoon" or "buffoonish"? We believe "Sigma" to be an earnest and sincere searcher after truth, as much so as "E. L. G." It is the easiest thing in the world to call names and use exasperating language; and the lowest porter in Covent-garden, as we can testify to our sorrow, can beat "E. L. G." in that line any day. But it is not so easy to speak with propriety and precision. Wisdom, as a rule, is moderate, and strength, as a rule, is calm. "E. L. G." has launched a theory as to the cause of the Deluge as recorded in the Old Testament, which naturally evokes spirited criticism, and he must not expect that every one who opposes him is necessarily a fool, or hostile to him personally. As he gives hard blows to others he might fairly expect hard blows in return. He seems always ready "to strike out from the shoulder," but unprepared for reciprocal action. More than once "E. L. G." has wisely deprecated wasting our space. Might he not economise fragments of it, and fragments of correspondents' temper as well, by a less generous use of inevitably irritating epithets? If he did so his wealth of learning, his courage, his enthusiasm, and his "devouring activity," would command the admiration of a still larger circle of readers.
—ED.]

ON THE RIFLING OF GREAT GUNS.

[4326.]—NOT being a scientific artillerist, I shall be greatly obliged if "Artillery Captain," or "any other man" who knows, will correct any errors I may inadvertently have put forth on this subject, the practical importance of which—until all men become Christians—seems to justify its ventilation.

I believe most of our great guns are rifled on the American plan, otherwise known as the French or Woolwich system of increasing twist, the advantages (?) of which seem to be very problematical, for it is open to the objection that the rotation of the projectile depends on the employment of soft metal studs, usually inserted in holes bored in the shell, which must necessarily weaken its walls, unless the casting be reinforced where those holes are drilled. Increasing twist is also objectionable; because if the projectile be guided by two series of studs, one of which is necessarily in practice some distance behind the other, they cannot both be made to fit the grooves of the rifling, simply because the cast-iron shell is a trifle too rigid to enable the gunner to twist it while it is being rammed home. To enable shells thus guided to be introduced and thrust down the chase, the front series of studs is usually made considerably smaller than the other, so that nearly the whole work of rotating the projectile is thrown on the hinder series. This prevents the twist from being increased sufficiently to insure the rotation of shells whose length much exceeds two and a half diameters—in other words, it limits the weight of the projectile which can be employed for a given calibre. I think this a fatal objection—not to mention that drilling holes in shells and fixing studs therein must be more costly than casting them on the shell itself, which might be done were it not that soft metal is a necessity for guiding shells in guns with increasing twist. It is not a necessity when the twist of the rifling is uniform.

I have taken some trouble to learn what the advantages of the increasing twist are; but I fear, like the Spanish fleet which could not be seen because it was out of sight, those advantages are quite hidden from both intellectual and corporeal vision. "Out of sight, out of mind" was the good old practical rule, especially in the case of our friends; but the advantages of increasing twist, although to me quite out of sight, seem by no means out of the minds of those who direct the construction of our great guns (probably because their minds are characterised by a considerable, not to say an "increasing" twist), but however that may be, the twist they employ, although increasing, certainly is not enough for modern long ranges with greatly elongated projectiles.

Probably the original "Yankee notion" we imported was that if the grooves had little or no spiral inclination near the chamber, putting the shot into motion would be less resisted, which is quite true. It is also quite true that this is not (when proper powder is used) of the slightest practical importance. Were the greatest pressure of the gases, into which burnt gunpowder is converted, developed before the shot commenced to move along the chase, it would be no more than reasonable to employ some means (not necessarily this means) of diminishing the resistance to its motion, or what is far preferable, preventing so rapid development of pressure, which is the very thing we do when we employ prismatic or pebble powder. Practically, nothing of the kind happens; the maximum of pressure does not obtain until the projectile has travelled some distance, usually from half to two-thirds its own length, so that the very slight increase to its forward motion, which results from making the twist of the rifling as great at the chamber as it is now made at the muzzle, would not dangerously increase the strain on the gun, in fact, it would enable us in practice somewhat to diminish that strain, for a smaller weight of powder would expel the projectile with the same velocity it now obtains, because a uniform twist does not resist its expulsion nearly so much as an increasing twist does. N. B.—This fact was proved by many experimental trials.

Increasing twist is a common cause of the gun's destruction. Several of the American "Parrott" guns thus rifled had their muzzles blown off at the siege of Charleston, and one 8in. cast-iron gun employed at Sebastopol suffered the same rather rapid method of shortening its chase, but it is some comfort to benevolent Christians (who invariably do good to those who despitefully use them) that this "Whistling Dick," as our men designated it, afterwards did very good service as a howitzer.

I have already mentioned that among the evils of increasing twist, diminution of range is one, and not the least. Burning the same weight, 25lb., of the same powder, Mr. Scott's 7in. gun expelled its 110lb. shell with a velocity of 59ft. per second, greater than the Woolwich gun of the same calibre did; it would consequently have struck a blow 133 foot tons heavier—or what comes to much the same thing, it would have sent its shot considerably farther, for *cæteris paribus* range depends on the velocity with which the projectile leaves the muzzle of the gun.

We are told Sir J. Whitworth has succeeded in casting shells which fit his new gun with sufficient accuracy just as they leave the mould, or rather, I opine, as they leave the trimming shop. "What man has done man—*i.e.*, another man—can do," so as soft studs are not a necessity for guns rifled with uniform twist, I presume Woolwich can rival Manchester, and cast shells with continuous spiral ribs on their outer surfaces. Such ribs, being part of the casting, rather strengthen than weaken the walls of the shell, and add nothing to its cost except the trifling additional weight. Probably, however, as the shell, if cast in sand and moulded vertically, would have to be withdrawn spirally, machine moulding would, as usual, be preferable to hand labour, especially for lifting the pattern or model out of the sand; but I suspect in practice metal moulds would be generally employed, and they may be formed in any number of parts required to enable them to be taken away from the casting, even if the latter could not be withdrawn from them by having spiral motion communicated to it; however, I see no practical difficulty in doing this.

I suspect it would be difficult in practice to cast continuous spiral ribs, even in metal moulds, which would fit the grooves of the rifling like planed ribs do, and, as planing is costly, and we can do without it, I think it would be well to cast the ribs with these surfaces, which bear against the grooves somewhat hollow. It may be objected that doing this would convert the continuous ribs into two series of studs; doubtless it would, but they might in practice be very long studs, indeed, so long that there would be no danger of their becoming crushed like soft metal studs are whose bearing surfaces are usually too small to endure the pressure they are subjected to. In conclusion, I beg to inquire if there would be any insuperable practical difficulty in converting Woolwich guns into guns with uniform twist, provided the twist be not increased. Of course, it could be done if they were bored out about the depth of the grooves larger. If this be done, the new bores might have any amount of twist required even for projectiles five or six diameters long; but I fear our guns are hardly strong enough to bear this treatment. They might, however, have new steel tubes forced into the old ones after boring them, and their calibres thus diminished.

THE HARMONIOUS BLACKSMITH.

BILLIARDS.

[4327.]—I BEG respectfully to suggest that a few articles on the science of billiards (if not written *too* scientifically) would be acceptable to many of your readers. I have recently been trying to purchase a book on the subject, but can get nothing between a worthless handbook, price 3d. and a thick tome, price 80s.

H. J. C.

AURORA.

[4328.]—ON June 3, 1872, at 11 p.m., a fine aurora, exhibiting a pale, delicate, silvery-gray light, was observed at Walthamstow. A perfectly vertical rectilineal, but not very broad, streamer nearly coincided with the magnetic meridian. Should any of the numerous readers of the ENGLISH MECHANIC have observed this aurora spectroscopically and will kindly communicate a notice of the lines seen, with a measurement of wave length, the observations may be of service.

While announcing this aurora, I may just note that, from the researches of Loomis, it appears that the number of auroræ has a maximum and minimum about every ten years, and this is confirmed by Donati. It is a singular circumstance that in the period of ten years there are two or three consecutive years during which fine auroræ are seen in places which are not very near to either of the poles of the earth. The heights of auroræ vary from 60 to 160 miles. "What," asks Donati, "exists at these heights?"

W. R. BIRT.

TIME MEASURERS.

[4329.]—LAST month's *Argosy* contains an excellent article on the above subject, and believing that the article is one that will be of interest to many, if not all, of your readers, I give a condensation of it. It states that the probable mode for the men living in the earliest ages to find the time would no doubt be by noticing the movement of a shadow from a rock, &c.; but as the world grew, a more minute division was essential. Pliny said that twelve years before the war with Pyrrhus, a sundial was said to have been erected at the Temple of Quirinus, and this dial served for ninety-nine years, after which one more minutely defined was placed near it. As this would only serve when the sun shone, a water-clock was invented by the Greeks, and introduced into Rome about 195 B.C. The water clock consisted of an earthenware or metal vessel perforated with a hole, and filled with water, and the water dropped into another vessel marked with lines denoting the hours, as the water rose to the level of the mark. In the Athenian and Roman Courts of Justice the water clock was used, the water being in three portions, one each for defendant, prosecutor, and judge. The next mention of a sundial was that erected by the Emperor Augustus in the Campus Martius. In the middle of the third century an Alexandrian invented the hour or sand-glass. King Alfred the Great measured time by wax tapers, marked off and denoting the hour as they burnt from mark to mark. The first clock showing the hour on the dial, was supposed to be one sent by Pope Paul as a present to Pepin, King of France. Then one is mentioned as invented by Pacificus, Archdeacon of Genoa, in the ninth century, that indicated date, day, and phases of the moon as well as the hours. But the most splendid amongst the early specimens of horology was the clock presented to Charlemagne by the Caliph Haroun-al-Raschid. Its case was of brass, damascened with gold, and it showed the hours on a dial, and at the end of each hour an equal number of iron balls fell on the bell, which sounded, and immediately twelve windows opened, out of which proceeded the same number of horsemen, armed *cap-à-pie*. After performing various evolutions the figures withdrew, and the windows closed. The motive power was water. After remarking that it has never been clearly ascertained where or by whom weights were first substituted as motive power, the article adds, the invention must have remained imperfect, as little use was made of clocks in the 11th and 12th centuries. The first allusion to a striking clock is found in the "Usages de l'Ordre des Citeaux," compiled about A.D., 1120. In the eleventh year of Edward I., A.D., 1228, the clock-house, near Westminster Hall, was furnished with a striking clock. In 1286, the first clock was erected in St. Paul's, and in 1292, one in Canterbury Cathedral. In the reign of Edward III. protection was granted to three "orlogiers." An impulse was given to clockmakers in the fourteenth century, and the art from then made steady progress; about this time weights and a fly-wheel began to be made for private use. About the end of the fourteenth century, the spiral spring (a band of fine steel rolled in a drum or barrel) was invented. Watches would now begin to be made. One watch is mentioned in the sixteenth century set in a ring, and in 1572, Parker, Archbishop of Canterbury, bequeathed to his brother a walking-stick with a watch in its head. Henry VIII. had a watch that only required winding up every eight days. Watches were mostly oval in shape and of exquisite exterior, and coffins and death's-heads were also the forms used. A death's-head watch, belonging originally to Mary Queen of Scots, is still extant. In 1540, the fuse was invented. But even in Shakespeare's day pocket dials were much used. In the reign of Charles I., a charter of incorporation was granted to English watchmakers, forbidding any clocks, watches, or alarums, to be imported from any other country. In 1639, Galileo Galilei published his discovery of pendulums, and the pendulum was then applied to clocks. If Huyghens was not the inventor of the pendulum clock, he applied the regulator in the most scientific manner. In 1641, Richard Harris invented a long pendulum clock, and this, or a similar one, was put in St. Paul's Church, Covent-garden. In 1676, Barlow, a London clock-maker, invented the repeating mechanism, by which the hour last struck might be known by pulling a string. The anchor escapement was added by Clement in 1680. In the eighteenth century further improvements were made, and Jno. Harrison constructed a chronometer which determined the longitude within such limits as to procure for himself the Parliamentary reward of £20,000. Other interesting particulars and anecdotes are added, which I have omitted for fear of encroaching too much on your space. I may add that the article is well worth the perusal of all your readers.

Farnworth, near Bolton. FRED. W. BRISCOE.

TIN BOXES TO HOLD COPPERS.

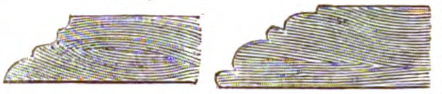
[4330.]—I SEE that in large grocery establishments coppers are counted out in five shilling bundles and tied in brown paper; this system does not give the receiver a sufficient means of checking the amount, as it is awkward to break the paper and count them over again, although the initials of the sender placed on each bundle may be given as a guarantee. I propose that small tin boxes of a cylindrical form, having a hinge at the end or along the side, as most convenient, and stamped with a maker's name should be used, each to have 30 divisions; each division should be large enough to hold one penny loosely.

PHILANTHROPIST.

ORNAMENTAL TURNING.—XII.

[4331.]—HAVING described the mode of turning and ornamenting small table pillars, I may not be out of place if I describe the easiest way to finish off the table by making and turning the top. Procure the wood required for the top, make good joints with best glue, the more joints the better, if good, as that prevents the table top from warping or twisting; when the joints are quite dry (by the way, do not dry the joints too quickly, near a fire is best) plane off the top smooth; then veneer with walnut burrs or ordinary walnut-wood veneer; when dry you may turn the mouldings; if the top be twisted, stand it before the fire a short time, having previously damped the other side, but if the twist cannot be removed by ordinary means, the following process very seldom fails: If the table top is 20in. in diameter, turn a piece of wood 16in. in diameter, as a back board; bore four holes ½in. from the edge, equal distance apart; lay the table top upon the bench, the back board upon the top as near the centre as possible (by the way, a very simple means of so doing is to mark the centre of the top with the compass point, stick in a bradawl minus the handle, carefully lay the back board so that the awl is the centre of the hole in the back board); then fasten the board to the top with stout screws; by that means a table top can be invariably drawn flat, and when the mouldings are turned, kept in a flat position by means of the clamp. I send sketch of two descriptions of mouldings suitable for small fancy as

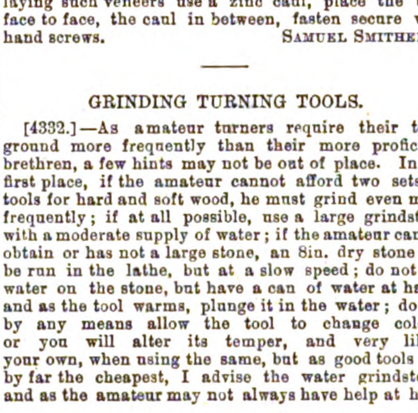
1 2



well as coffee tables. No. 1 is called an ogee and thumb moulding; No. 2 is a double moulding adapted for carving. By the way, a very simple mode of ornamenting such mouldings, where the amateur is not up in carving, is to purchase one or two stamp punches, and stamp the mouldings; if care be taken in the execution of such, a very pretty effect can be had. While upon this subject, I may state for the information of our readers that veneers can be purchased very cheap, and of suitable sizes to suit the amateur; if a fancy top be required, the pattern can be purchased entire, such as draught boards, basket of flowers, and in fact, every variety; the veneers are laid on paper, and in laying such veneers care must be used, not forgetting to lay the veneer the paper side upwards, as when dry can be removed easily. The veneers for such tops vary from 9s. to 10s. each; in laying such veneers use a zinc caul, place the tops face to face, the caul in between, fasten secure with hand screws. SAMUEL SMITHER.

GRINDING TURNING TOOLS.

[4332.]—As amateur turners require their tools ground more frequently than their more proficient brethren, a few hints may not be out of place. In the first place, if the amateur cannot afford two sets of tools for hard and soft wood, he must grind even more frequently; if at all possible, use a large grindstone with a moderate supply of water; if the amateur cannot obtain or has not a large stone, an 8in. dry stone can be run in the lathe, but at a slow speed; do not use water on the stone, but have a can of water at hand, and as the tool warms, plunge it in the water; do not by any means allow the tool to change colour, or you will alter its temper, and very likely your own, when using the same, but as good tools are by far the cheapest, I advise the water grindstone, and as the amateur may not always have help at hand



to turn away at the handle, I send sketch of a simple way of doing without extra help; the sketch will explain the mode to our readers. A grindstone of the above description can be purchased, and the frame made and fixed for 10s., or those who would rather buy than make, can purchase one ready for work for £1. For wet grindstones purchase a bilstone; if required to work dry as described above, state so on purchasing one. SAMUEL SMITHER.

HORSE-POWER.

[4333.]—I AM directed to forward you copies of a letter addressed by the Board of Trade to this Institution on the subject of nominal horse-power, and of the reply thereto, and I am to express a hope that you may be able to find room for these in the columns of the ENGLISH MECHANIC.

ADRIAN VIZETELLY, Assist. Sec.

Institution of Naval Architects, 9, Adelphi-terrace. London, W.C., June 6, 1872.

[*Copy.*]

Board of Trade, Whitehall-gardens, March, 22, 1872.

SIR,—I am directed by the Board of Trade to inclose some copies of a Memorandum on "Horse-Power" of Steam Engines. Representations have been made to the Board that the term "nominal horse-power" conveys no definite meaning. This term occurs in Section 5 of the Merchant Shipping Act, 1862, of which a copy is inclosed. The Board of Trade will be glad to receive any observations on the subject with which the Council of the Naval Architects may be able to favour them. If some understanding can be come to on the point, a definition of the term might be agreed to which will be accepted not only by the manufacturers and users of engines, but by the Legislature in the event of the term "nominal horse-power" being retained when the Statute is revised.—I am sir, your obedient servant, (Signed) THOMAS GRAY.

The Secretary, Naval Architects, Adelphi.

Institution of Naval Architects, 9, Adelphi-terrace, London, W.C., June 4, 1872.

SIR,—In reply to your letter (M) of the 22nd March, in which you ask for certain advice with respect to the term "nominal horse-power," I am directed to inform you that the subject has been carefully considered by a Committee of the Council of this Institution, with the following results:—The committee were unanimously of opinion that the "nominal horse-power," as at present ordinarily used for commercial purposes, conveys no definite meaning. They were also unanimous in considering that the proposals contained in Mr. MacFarlane Gray's pamphlet could not be recommended for adoption. The majority of the committee were of opinion that no formulæ depending upon the dimensions of any parts of the engines, boilers, or furnaces could be relied upon as giving a satisfactory measure of the power of an engine, and that even if the varieties of engines and boilers now in use could be comprised under one general expression for the power, the progress of invention would soon vitiate any such expression or formula. The entire abandonment of an old commercial standard, such as "nominal horse-power," however inaccurate, must be a matter of considerable inconvenience, and accordingly great attention was given by the committee to the question whether that standard could not be amended and retained. Among the many plans considered, not one received unanimous or even general approval. That which met with least objection was that the indicated horse-power, as ascertained on a trial trip, should be taken either as the "nominal horse-power" or as a basis for it, being divided by a suitable divisor. The committee were of opinion that for the purposes of the Act, if any standard at all of horse-power is to be used with reference to the engineers, it would be better to name 400 "indicated horse-power," in place of 100 "nominal horse-power." The committee were also of opinion that all engineers of coasting and sea-going ships should be required to pass some examination, and the council think it desirable that this opinion should be communicated to the Board of Trade.—I have the honour to be, sir, your obedient servant, (Signed) C. W. MERRIFIELD, Hon. Sec.

The Secretary, the Board of Trade, Whitehall-gardens, S.W.

OUR SUMMER VISITORS.—THE NIGHTINGALE.

[4334.]—LIVING in the East Riding, I am told that the nightingale is, though rather rare, yet not unknown, and a clergyman has told me that he has heard two about three miles apart, singing all through the spring of 1870 near here, so that "Avon's" statement (page 197, let. 4088) would appear to require modification. HEDERA.

RECURRENT VISION.

[4335.]—MR. PETRIE (let. 4272, p. 282), in his remarks on Professor Young (see p. 190), overlooks a fact that should be noticed. Continuous sight requires but eight pulsations per second on the eye. The repetitions of light observed were more faint each time, and rarely reached a fourth. Cannot this be accounted for by external causes? The Leyden-jar sparks of the Holtz machine reached 9in. in length, and the intervals between the illuminations were less than ¼ second each. Could recurrence result from reverberation of the cosmic fluid, as echo results from reverberation of air? Was there no spherical concavity in any part of the room, and was not the Professor in its reflecting focus? May not even a *flat* surface, after a very near and *extraordinary* electric-shock, reproduce vision in the way that sound is reflected from the flat surfaces of an empty room?

In Professor Young's experiment, the intervals of darkness were less than a ¼ second each, and light from the ether-pulse is retained ⅛th of a second, so that the real intervals between the recurrent pulsating in *less than* $\frac{1}{4} - \frac{1}{8} = \frac{1}{8}$th of a second. Does not this admit of the supposition of its arising from ether-reverberation? J. BARWICK.

ENTOMOLOGICAL.—(III.)—ON LARVÆ.

[4336.]—I WILL now proceed to speak of the management of Larvæ. Firstly, the cage demands our attention; very cheap and serviceable cages may be made from boxes purchased for almost nothing at the grocer's, and having a piece of perforated zinc substituted for the bottom, and a piece of glass in the top, the case being stood on end when in use. I should never give any larvæ a space less than 4in. cube to five in. Of course the cages can be divided into suitable compartments. The food should be put in a little bottle of water to keep it green, and there should be a small box of damp earth in the cage for such larvæ as like to enter it, to turn to pupæ. Concerning the earth, I think leaf mould is as good as any, though many soils are recommended by many collectors. Concerning food, pieces should be gathered from the plants on which the larvæ were found. However, this is sometimes not easily obtained, and I then recommend allied genera of the plants, which may be found in botanical books, for these are often useful. Next may be mentioned general favourites; by these I mean plants liked by a family of larvæ. Of these I have found sallow and buckthorn generally liked by *Geometræ*; lettuce, birch, plum, and others by *Noctuæ*. The food should be gathered early in the morning, while it is moist with dew, but wet food should not be given to young larvæ.

Many larvæ are very apt to be lost when new food is given them, as they cling to the old food and hide themselves in it, so they are overlooked and thrown away. Hybernating larvæ should be left out of doors all the winter, and hairy ones should be kept dry, or mouldiness will attack them; whilst smooth ones should be kept moist during the winter. I must caution the reader against cannibals, such as *C. Trapesina*, *S. Satellitia*, and others, which should be kept in cages by themselves, or they will devour all others that are with them. Some, as the puss and kittens, nibble off each other's tails when kept in confinement. The larva of *Cossus ligniperda* should have a piece of a branch of ash that is green given him to feed on.

Larvæ have many ailments peculiar to them, of which I will mention some. Stings of Ichneumons are fatal if the eggs are laid in the larva, for it is sure not to come out, though it may go into its pupa state. Next, larvæ have a great liking for committing suicide by drowning, and this should be avoided by filling the mouth of the bottle in which the food is with cork. Thirdly, hairy larvæ have often been attacked by a fungus produced from a damp atmosphere, and when this comes I think no remedy can be applied, and the larvæ must die. Larvæ may be preserved by being killed by immersion in spirits of wine, and then have the contents of their body extracted and the case filled with wool. ENTO.

A CLEAN PIPE.

[4337.]—I HAVE read all the prescriptions for this luxury which have appeared in the MECHANIC, but have seen none so simple, inexpensive, and effectual, as the following:—Cut up with a pair of sugar-nippers common charcoal into bits about the size of a pea; place two or three bits—more if a half pipe only be wanted—into the bowl, and fill up with tobacco. The latter will be found to burn more freely, unaccompanied by any wheezing or bubbling sound; the charcoal, when the pipe is finished, will have absorbed all the oil and saliva, and the tobacco will be wholly consumed. By this process, there will be effected a saving of at least 20 per cent., as there will be no waste in the shape of the sodden mass of unconsumed tobacco usually left at the bottom of an ordinary pipe. TRY IT.

SAFETY LAMP FOR MINERS.

[4338.]—THE objection to Mr. Plimsoll's lamp (let. 4284) that it would be an inconvenience for the light to go out when brought in contact with gas, is not a valid one. Compared with the less liability to an explosion, the inconvenience is but dust in the balance. Davy's lamp may be an excellent one for measuring the strength and quantity of an accumulation of gas; but its unfitness for the working miner is proved by the fact that it is now little used. At the comparative experiments that were made at the Oaks Colliery, shortly after the great explosion, the Davy lamp was declared the least safe of the whole tried, except, I believe, the "Clany." The lamp wanted for the unintelligent miner is one which is self-extinguishing in an accumulation or a current of gas, and also in the act of being opened. ASSISTANT MANAGER.

SILVER FILMS FOR SUN-SCREENS.

[4339.]—THOUGH an able and esteemed Fellow of our society, the R. A. S., generally writes to excellent purpose what he has well considered, I think the question he has addressed to me (letter 4225) is an exception to this rule—*Nemo mortalium, &c.* In reply, I beg to say that I leave to him the experiment of smoking the field-lenses of his eye-pieces, as I have too great a regard for mine. I must add that I do not "advocate" absorbing light and heat by silvered glass sun-screens, and that, on the contrary, I aim at their reflection. The difference between a coating of lampblack and one of the most brilliant silver is about as great as can well be imagined, the first being the best absorber and the worst reflector of light and heat, the latter their worst absorber and best reflector.

Romsey, June 8, 1872. E. L. BERTHON.

BELL PIANETTE.—To "THE HARMONIOUS BLACKSMITH."

[4340.]—I AM now in a position to fulfil the promise made at p. 275 of the present volume. The name of the original patentee of the instrument, of which the above is a modification (?), is Charles Clagget. The specification is No. 1664, date A.D. 1788, at p. 4, eighth improvement. S. BOTTONE.

WIRING GARDEN WALLS.

[4341.]—HAVE any of "our" horticultural or gardening readers ever tried the French plan of wiring walls and erecting trellises for training fruit trees? Some time since I was strongly recommended by a friend to try the plan, which has answered very successfully, and which I now submit to "our" readers. I know of no way whereby one may so highly improve the garden culture of the pear as by paying more attention to it—as an espalier tree. This is the opinion

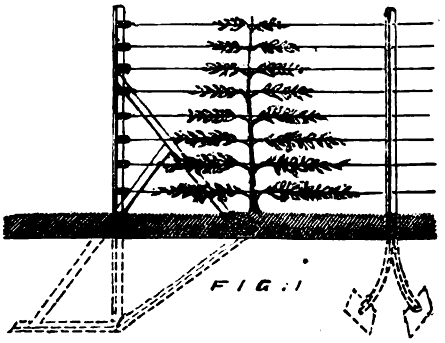


FIG. 1

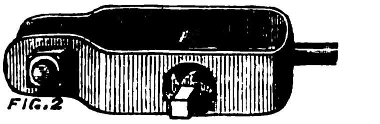


FIG. 2

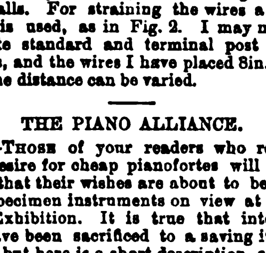
of many of the best fruit growers in Britain, who agree that there is no finer fruit than that gathered from well managed espalier trees. To form the support for their espalier fruit trees, the French have adopted the system, which will at once be apparent to all readers of "ours" as a cheap, neat, and everlasting method. All the fittings are galvanised, No. 14 being the best size wire for walls. For straining the wires a galvanised raidisseur is used, as in Fig. 2. I may mention the intermediate standard and terminal post have self-fixing bases, and the wires I have placed 8in. apart, but of course the distance can be varied. H. B. E.

THE PIANO ALLIANCE.

[4342.]—THOSE of your readers who recently expressed a desire for cheap pianofortes will find some little hope that their wishes are about to be met in a couple of specimen instruments on view at the International Exhibition. It is true that intensity and compass have been sacrificed to a saving in bulk and costliness; but here is a short description, and some of your readers may probably pay them a visit, and give us the benefit of their inspection. There are two instruments, one of five octaves, the other of four, each 3ft. 5in. high, which severally stand in spaces of 2ft. 8in. by 1ft. 8in., and in 3ft. 8in. by 1ft. 8in., and to which are affixed prices that ought to make one or the other admissible to the most modest household and the scantiest study. Instruments are also spoken of as being forthcoming, of the same compass, but of the shape of the spinet. It is claimed for these comparatively diminutive instruments that all the pianoforte music best worth playing is within their compass; but of this I know nothing, and shall feel glad if any of your readers can supply further information. K. T. L.

DUPLICATION OF THE CUBE.

[4343.]—IN 1863, I found that $\sqrt[3]{2}$ is nearly equal the square root of $0{\cdot}93^2 + 0{\cdot}85^2$, or 1·5874—*i.e.*, 1·25992682; the excess being ·00000,526, about 2¼ millionth. Since 1·5874 is 1·26 squared, less ·0002, take this construction. Bisect a line S H successively six times, so as to get its 64th part = H A. Hence, if S H = 1·28, S A = 1·26. Let A V = half diagonal on square of A H = chord A F in circle diameter S A; the supplementary chord $SF = \sqrt{1{\cdot}5874} = \sqrt[3]{2}$ to a 2¼ millionth.



To find the unit of which S A = 1·26, bisect R H in C, C A = A R, chord K A = radius = K E ⊥ on S K. Drop ∠ K ⊥ E S, join E R, and L D parallel to E R. S D = 1·00 to S R = 1·25; for S K : L E : : 4 : 1 : : $SK^2 : KE^2 = KA^2$ chord. S D : S F : : 1 : $\sqrt[3]{2}$ numerically approximate. S. M. DRACH.

THE PALÆOLITHIC AGE AND PRIMITIVE MAN.

[4344.]—THE Palæolithic (or "first stone") age was a period in which, according to Sir J. Lubbock, "man used rude implements of stone, which were never polished," and in which "he was ignorant of pottery, and of metals" (See Lubbock's Introduction to Nillson's "Stone Age of Scandinavia.") Will these definitions stand the test of recent facts? I think not.

First, it is an undoubted fact that pottery has been found in caves which are classed as Palæolithic. In a cave at Pondres in Languedoc, pottery was found in a stratum older than that which contained remains of Palæolithic mammalia: M. Rochebrune lately found pottery in the Rancogne caves mixed with the bones of the cave-bear, and cave-hyæna; at the cave of Frontal M. Dupont found pottery and the bones of the cave-bear together; in Bavaria a cave has just been opened, in which pottery was found mixed with the bones of the lion, cave-bear, and hyæna; and so often did Dupont find pottery in the Palæolithic caves of the Lesse that he devotes a special section of his work to its description. Now, if cave-evidence is worth anything at all, we have proofs that man made pottery in an age when the rhinoceros, cave-lion, mammoth, and cave-bear existed, and as Sir J. Lubbock himself tells us that these animals characterised the Palæolithic age, it follows irresistibly that in the Palæolithic age man did make pottery.

Sir J. Lubbock, it appears, admitted in a recent address to the Anthropological Society that pottery had been found in Palæolithic caves, but he said that these were only "exceptions." This is amusing, for Sir John is taking for granted what he ought to prove; these fragments of pottery in the Palæolithic caves are exceptions only if his hypothesis is true, but not otherwise, and to assume that man made no pottery in the first stone age, and then to call the facts brought against that assumption "merely exceptions" is to beg the whole question in dispute. Secondly, it is also a fact that polished stone weapons have been found in Palæolithic deposits. In a gravel pit in Charente in Western France, a few years back, a fragment of a polished stone hatchet was found below the bones of the elephant, and tichorhine rhinoceros; in the gravels near Monthiers of the same age, a polished stone instrument was also found; a hatchet perfectly polished was found in the diluvial beds of Loire-et-Chère by M. l'Abbé Burgeois; while in the diluvial beds on the shores of the Lake of Soing polished stone weapons were found. Not merely have the gravel beds yielded these polished tools, but M. Rochebrune has found them in the caves at Charente, and he states that the polished hatchet found in the gravel beds of Roffit was just like the ordinary type of polished stone hatchets, and that these polished tools occur in the valley gravels, mixed with the bones of the mammoth and rhinoceros.

Now, Sir J. Lubbock says that polished hatchets "do not occur in the river-drift gravel beds, nor in association with the great extinct mammalia" (Nillson's "Scandinavia," p. 28), but the instances given above show that this statement is now quite incorrect, and as these valley gravels in which the polished hatchets are found are undoubtedly of Palæolithic age, it follows that man made polished weapons at that time.

But now let us go a step further, and ask the question "On what evidence is the opinion founded that Palæolithic man made neither pottery nor polished weapons, and that he was ignorant of the metals?" We find that it rests on negative evidence alone. We have not found these things in the Palæolithic deposits, therefore they did not exist at that time. But every geologist knows that Sir C. Lyell and Sir J. Lubbock regard negative evidence as nearly valueless, and believe in the extreme imperfection of the geological record; how, then, does it happen that when they approach the questions of the antiquity and primitive condition of man, they suddenly change front and say that negative evidence which in palæontology is almost valueless, suddenly in connection with primitive archæology becomes so very valuable that a whole series of classifications can be based on it? The value of negative evidence is thus expressed by one of the best known of modern English geologists:—"The absence of fossils of a certain kind, assumed because such fossils have not yet been determined, is no proof whatever that the animals which would have left them did not exist." Very good; then we ask that in common fairness this principle be also applied to primitive archæology, and we say in the same words, "The absence of pottery and of polished tools, assumed because such relics have not yet been discovered, is no proof whatever that these relics were not made." If Sir C. Lyell's principle is good in the Silurian or Carboniferous period it is also good in the Palæolithic period, and as he hesitates to say that certain races of animals did not exist in the Cambrian age because we have not found traces of them, so he ought also to hesitate to say that pottery and polished axes did not exist in the Palæolithic age because we have not found them.

Curiously enough, Sir C. Lyell, when he comes to answer the question why no bones have been found in the Somme gravel-beds, regards negative evidence of no value, for he immediately puts forward ingenious arguments to account for their absence, and precisely in the same manner, instead of assuming no pottery or polished tools existed in the Palæolithic age, he ought, in accordance with his principles, to try to explain that although we have not found these relics yet they were in use at the time.

We have seen that primitive "Palæolithic" man was neither ignorant of polished tools nor of pottery, and this being the case, we find that geology does not reveal that man originally was in a state of "utter barbarism." The fragments of bones from the caves refute such a notion, for the Engis skull might have belonged to a European of the present day, and the Naulette jaw has affinities with the Sclavonians. These are the oldest human remains in Europe that we can call into court, and they are emphatic witnesses against the theory of "utter barbarism." True it is that that theory has other sciences brought in to support it, but whatever may be said in its favour it is clear that geology does not support it. As for the arguments brought forward in its favour from modern savages, they break down totally under a searching investigation, and only afford another instance of how a ponderous theory can be built upon a foundation of sand, while fresh discoveries only show us how true were the words of a modern philosopher when he described "the slaying of beautiful theories by ugly facts."

D. G. W.

ARE CONVENTIONAL TERMS SCIENTIFIC?

[4345.]—IN "Sigma's" letter (4193) the following argument is used:—As the biblical cosmogony is always in perfect accordance, not with late scientific discovery, but with the ideas of the people to whom the narrative was addressed, therefore, accounts involving scientific facts cannot be relied on; this is only partially true, as the evident exceptions in accordance with "late scientific discovery" (such as the earth being stated to be hung upon nothing) will, of course, be borne in mind. Now, if "Sigma's" above argument be true, I am forced to the conclusion that as modern scientific works contain expressions not in accordance with scientific discovery, they cannot be relied on; Humboldt, for instance, used such terms as "The Celestial Vault," "Fixed Stars," though we all know they have a vast motion of translation, and probably of rotation also; he says that the zodiacal light "rises in a pyramidal form," and he mentions as distinctly as possible that there is a "Milky Way between the Scorpion, the Centaur, and the Southern Cross;" are we to believe in the scientific accuracy of the description of this curious collection? Herschel also writes of the "diurnal motion of the stars," and defines the day as the time between "the departure of the sun from a given meridian, and its next return to the same;" he also implies a top and bottom to space, for he writes of the "ascending and descending nodes."

As we accept all the statements of modern scientific books, unless they are professedly such terms as are conventional, so we must do with that one most ancient book, which stands alone in antiquity by its showing a perfect agreement with modern science, excepting, of course, certain conventional terms which, like the above quoted, were perfectly understood as such. It is news to me that the Mosaic accounts are only concerning "the Jewish family and race, and all the rest of the world and its history is ignored;" if so, what is the tenth chapter of Genesis about, and to whom does it refer? If the Deluge only affected a people dwelling in "a fertile river district," as "Sigma" gratuitously supposes, how is it that those people were landed on the top of a high mountain? One part of the narrative is quite as authoritative as another. I have as great a desire as "Sigma" not to get "into a morass of theological squabbles" in the ENGLISH MECHANIC; but as he has already stated one side of a matter, the other side must also have a hearing.

W. M. FLINDERS PETRIE.

ARTIFICIAL STONE.

[4346.]—"KHODA BUX" (letter 4242, page 277) says "an artificial stone has been produced of surpassing hardness and capable of a beautiful polish by the mixture of caustic magnesia slacked with chloride of magnesium." Will "Khoda Bux" kindly mention whether he has personally tested this assertion, which I know well appeared in many papers a few years ago? I have repeatedly made the mixture, and never obtained anything approaching to stone—at least, nothing more like stone than, say, Keene's or Martin's cement is—not, in fact, much harder than good plaster of Paris. Ransome's artificial stone is more like real stone, because the constituents of stone are induced to combine and form his compound, but Ransome's method produces only surfaces too coarse to take a polish. His siliceous fluid will not sink into sand, &c., in an impalpable state. Mr. Ransome was working at this when I last saw him, and, amongst other experiments, had pumped the air out of masses of plaster, &c., and then, while in the exhausted receiver, had let in his dissolved silica; but the flinty-hearted fluid still refused to enter the pores of fine plaster, or, indeed, practically, of any substance whose pores were not as open as coarseish sand, which is, of course, incapable when it sets of anything like a polish. Being, therefore, unable to find anything so like (say) marble as to be suitable when set, for statuettes, &c., I shall feel greatly obliged by "Khoda Bux," or S. Bottone, or any of our chemists, saying whether caustic magnesia and chloride of magnesium, or any other mixtures, have been proved by themselves to do what M. Sorel claims for his invention.

As "Khoda Bux" is interested in concrete, it is well worth his while to see Mr. Nicoll, the shirt manufacturer in the Regent-circus, not the Regent-street tailor. When working under a Government commission, we examined his method of building thoroughly, and it has some excellent features. Amongst other things he proposed to whitewash his insides with Sorel's mixture, so as to obtain that much desired thing for the poorer classes—washable walls—but being, as I have some reason to still fear it is, only a porous cement, it absorbed water, and he had to give up that feature in his plan for building cottages, &c.

Time seems to be a sine-quâ-non in stone-making. Whenever Nature gets a very hard job to do she takes plenty of time to do it in. Perhaps a sham meerschaum, the constituents of which are the same as a real one, if let alone for a few million years, and pressure, perhaps, added, would get real in the end.

NOT PROVEN.

DEFINITION OF CHEMICAL COMPOUNDS.

[4347.]—I HAVE not had time to analyse the contents of both bottles sent by "S. S." (query 9457, p. 489, Vol. XIV.). "S. S." adverts in one of his communications to his analyst leaving *two* inorganic compounds undefined, as also to organic matter being present of unknown kind or origin. The fluid I have examined must surely be very different from the substance originally quoted, for this is simply crude liquor soda, very possibly prepared as a boiler anti-incrustating fluid. The amount of organic matter present is very small, certainly less than half per cent., and is merely dirt—that is, matter out of place, and is probably derived from the crude materials of which the preparation is made. I cannot understand why two undefined inorganic substances should remain in the former analysis, for the mixture is simple enough, presenting no difficulties to any one engaged in analytical operations. I must, however, mention that all the alkali in the analytical table is calculated as soda. I may explain that this includes some potash present in undetermined quantity. The second bottle which I have not analysed appears to contain a large quantity of carbonated alkali, and is probably somewhat analogous to the other specimen, but of different quality. It should be noticed that my analysis is quantitative, that of Mr. G. E. Davis qualitative. Table of results of chemical analysis of a sample of fluid marked "No. 1 Liquid," received from "S. S.," a correspondent of the ENGLISH MECHANIC, &c.:—

	Percentage.
Water	87·50
Sodic hydrate	7·52
Sodic chloride	3·32
Sodic silicate	0·14
Sodic sulphate	0·76
Iron and alumina	0·10
Carbonic acid, organic matter, and soda combined with alumina	0·66
	100·00

W. R.

GOVERNMENT AND AMATEUR SCIENCE.—II.

[4348.]—THE subject of the cultivation of science by amateurs is of no ordinary dimensions. To arrive at a just conclusion upon the relation of the amateur to the professional astronomer, for example, many circumstances must be taken into account; in both departments there are different grades, dependent on the one hand upon patronage, and on the other upon mental capability. In my first letter I discussed the subject of Government patronage as extended to one of the most important branches of astronomy, and endeavoured to show that to bring that branch to its present state of perfection a high order of mind was necessary. Now, patronage from the highest source extends downwards through every grade of society, and we may recognise two directions in which it has been manifested in the greatest degree short of Government aid. We have, for instance, the establishment of endowed observatories maintained by funds bequeathed by cultivators of astronomy administered by trustees; others have been necessitated by the requirements of commerce and are maintained by municipal or other funds; and there are not a few observatories, which have been founded by private gentlemen, who either themselves cultivate some branch of the science or employ observers to carry out their views, but they make no provision for carrying on their work. The highest class of professional astronomers are those immediately connected with the Government; next to them rank the regularly appointed observers of endowed and similar observatories; and, lastly, in the same class—*i.e.*, professional astronomers—may be reckoned the assistants in private observatories, and those classes may to a certain extent afford a measure of astronomical calibre. Amateurs, who stand on a different footing are, like the various sources of patronage, found in every grade of society. The private gentleman having ample funds at command, and possessing an astronomical taste, erects an observatory, furnishes it according to his means with the best instruments of the day, and employs his leisure in observing, and, probably, prosecuting some special object for the advancement of which he employs an assistant, or it may be that even with the services of an assistant he may not devote the observatory to any special branch of inquiry, but use it in a desultory manner. The artisan, who has but few leisure hours, saves a few pounds of his earnings and purchases a telescope, with which he observes the heavens, comparing his seeings with such records as the astronomical literature that he is able to command affords, and which, perhaps, induces him to bestow his attention on some particular subject in which he supposes there is a deficiency of information. It is to these sources of patronage and developments of mental power that astronomy is indebted for its progress otherwise than from Government aid.

The mention of astronomical literature directs attention to the greatest of all human helps, either to the professional or amateur astronomer. There are two methods by which the results of the labours of astronomers may be preserved, either by manuscript or printed records. There is, doubtless, in one way or another a large quantity of manuscript records in existence; but it is in comparatively few instances that such records are permanently preserved. Even in the case of an office closely connected with astronomy some valuable manuscript calculations were sold for waste paper; it is, therefore, of the last importance that the results of observations should in some way be promptly printed. It is by the publication of astronomical works forming the staple literature of the science that the amateur is helped forward in his inquiries, and the more he is acquainted with the labours of his predecessors and contemporaries the less likely is he to tread on ground already occupied.

It was my intention to glance in this letter at the progress of three departments of astronomy which have been specially cultivated by amateurs—namely, variable stars, binary stars, and solar physics, but the above remarks on the relation of amateur to professional astronomy have left but little space for the purpose. As regards binary stars, I may briefly remark that it is not so much the history of the subject as a notice of its departments which at the present time would, I apprehend, be of the greatest use to amateurs. These departments consist (1) of measurements, (2) of catalogues, and (3) of computations of orbits, and exercise three classes of mind. In his report to the Board of Visitors, the Astronomer Royal, alluding to a possible extension of the objects embraced by the observatory, spoke of the *exclusion* of double star measurements. He had previously said that "observations which can be made at any convenient times, which do not require telescopes of the largest size, and which do not imply constant expense, ought to be left to private observers." It is, therefore, probable that the further progress of our knowledge relative to double stars will be left entirely to the efforts of amateurs. Now, what do we require to insure steady progress? We have existing in our literature numerous notices of double star measures. We have valuable catalogues of double stars at various epochs brought down to a comparatively late date, and we have scattered here and there in works not so readily accessible as our popular literature, the computations of the orbits of certain binary systems. Taking the present moment as our standpoint our literature contains the records of what has been done. For the future we need early publication of measures, the issue of revised catalogues at stated intervals of a certain number of years; a tabular view of the elements of binary orbits, and a synopsis of existing records in the form of a table of references to the various works in which they occur. On the means of meeting these wants, I may probably speak in a future letter; as regards the first there is no difficulty.

W. R. BIRT.

OUR COAL STORES AND THE ATMOSPHERE.

[4349.]—THERE has lately been much inquiry as to the period when our coal-mines will be exhausted, or the time when our carboniferous store will have disappeared. But I have never seen the question asked or answered where is it all going to, and can the atmosphere contain it without being reduced to a poisonous mass.

Now, when three tons of carbon are burned in the atmosphere they unite with eight tons of oxygen and produce eleven tons of carbonic acid, or what is the same, one hundred million tons of carbon will unite with two hundred and sixty-six million tons of oxygen, and form three hundred and sixty-six million tons of carbonic acid, and as England alone is raising to the surface one hundred and twelve million tons of coal annually, it will be seen that she is converting three quarters of a million tons of oxygen into one million tons of carbonic acid every day. Also, when we take it into consideration that carbonic acid gas is more than half as heavy again as common air, consequently its tendency is to float near the surface of the earth, and when we know how small a quantity it takes to render the air unfit for respiration—for Dr. Smith has shown that when there is two and the one-tenth per cent. of carbonic acid gas in the atmosphere candles give indications of going out, and the young lady who was breathing in the same air suddenly became pale, and had to be assisted out of the chamber in which the experiment was made—I think it behoves us to inquire how long this process can be continued without affecting the animal kingdom, especially as other nations are following the footsteps of Great Britain, for had they been producing and consuming coal at the same rate, we would evidently have had to cease working coal before the expiration of a century; and before our mining engineers talk about raising all the coal to the surface—that is, thick seams and thin seams, and seams at a great depth—they must tell us what they are going to do with it. Evidently it will not have to be burned, or the animal kingdom will have to perish.

To illustrate the above remarks, I will take Great Britain and its atmosphere, whose weight is about three and a quarter billion tons. Now we have one hundred and forty million tons of obtainable coal, which, when burned in the atmosphere, will give half a billion tons of carbonic acid, a sufficient quantity to render ten atmospheres like Great Britain unfit for respiration.

I am aware that vegetation is ever active in decomposing this gas, but the carbon extracted from the atmosphere in this way is sent back to it again by the animal kingdom in the form of carbonic acid gas, and as the population of the earth increases, all those large and ancient forests which exist will have to be broken up and cultivated, consequently their large store of carbon will be reduced to carbonic acid gas, and ultimately find its way to the atmosphere. In concluding, I may remark that the time when we shall have to cease working coal for the above reason may be far distant, but it will surely come long before we have consumed such an amazing quantity of coal as is imbedded in the bowels of the earth. WILLIAM THOMPSON.

BOOT AND SHOE MAKING.

[4350.]—AMONG your correspondents, do any understand the philosophy of boot and shoe making? It strikes me forcibly (telegraphed up from my big toe) that the science of fitting is very far behind the age. Some really practical articles on this subject would be of much greater utility (which Lenoir defines as that which has the power of producing pleasure, or preventing pain) to many readers than theories on the Deluge. Unfortunately, I am only Jack of some trades, and these don't include shoemaking, else, wanting "the thing done, I would do it myself," but my poor feet have compelled me to give some thought to the subject, and I fancy I have made the following discoveries:—Boots and shoes are generally made according to a fashionable, but faulty pattern—or in other words, the form of a last, instead of that of the feet on which they are to be worn. Now, I happen to have an extra long big toe, which refuses (without giving great pain) to be twisted over its neighbours, though shoemakers have laboured to produce this distortion, and last-makers have abetted them. The joint has been somewhat swollen by this brutal treatment, and can now stand very little pressure. The instep at one part measures less than at big toe joint, and the hollow of the foot at the inside stands an inch clear above a level surface on which the foot may be placed. I have never been able to find a ready made pair of boots or shoes that I could wear, and when shoemakers make them according to the ordinary system, to measure, I cannot even get my feet into their place. I have had lasts made twice, and even that is no remedy, as the last maker pursues the same course with the shoemaker. Now, I think the form of the foot must be considered as well as the measure. Two persons may have feet of same length and width, and require very differently shaped boots to fit comfortably, yet shoemakers would make them on the same lasts. It is clear that to do the thing perfectly, every one should have his own lasts, but then, where will you get competent lastmakers? My big toe lies straight forward, and has raised the boot at the point on that side, but the lasts I have lately got are pared off to a thin edge on both sides, and have only height for point of big toe in the very centre, where that member cannot possibly utilise it. Can any one advance the science, and help sufferers in the feet, and among the rest,

IRISH MECHANIC?

PIANOFORTE BRACING AND BELLYING.—I.

[4351.]—THE subjoined article was written several weeks ago, but postponed for more interesting matter.

There can be no doubt the method "T. C. L." (let. 3772) proposes for making the backs of cottage pianos stronger, would be effective in preventing them from becoming arched, because almost the same method, and other methods identical in principle with it, have long been successfully employed. Somewhere about sixty years ago the late Mr. J. J. Hawkins effected the very same result by subjecting the backs of his iron braces to compression by means of tension rods which effectually resisted the tendency of the tensile force of the strings to arch them. Yet later, others have done similar things, especially Messrs. W. Rolfe and Sons, in 1851. Mr. Hattersley (1845), produced the same result by trussing the wooden bracings just as other wooden beams are trussed by metal rods, but all these contrivances are more costly than that of Mr. Mott, in which the bracings are tied to the key frame, as shown in Fig. 2, p. 613, Vol. XIV., in which all the tie bolts required for one piano would not cost more than about half-a-crown. I think, however, that excepting this plan, it would puzzle any engineer or pianoforte maker to truss his bracings even on Hattersley's system—one of the least costly—or to increase their power to resist flexure by counter tension rods, *à la* Hawkins, or to back them up with angle or T iron (in the manner the late Thos. Rolfe did about 1854), or with flat iron, as "T. C. L." proposes, for so little cost as that of a few additional wooden bracings which stand the maker in only about eighteenpence each. Such contrivances are perfectly legitimate for strengthening the backs of old pianos, although personally I prefer front iron bracings on Kohlman's plan, when they are found to be either too weak for their present strings, or when it is desired to string them heavier (in most of such instruments, no great improvement can be expected unless both this and increasing the lengths of their strings of given pitch be effected), but they can hardly be termed legitimate methods of making new strong backs, when cheaper and simpler methods are in common use.

The besetting sin of most of these contrivances—and they share this reproach with additional wooden bracing—is that they exaggerate a too common existing defect—viz., excessive weight, for cottage pianos are now, as usually constructed, much too heavy to be handled conveniently. *Cæteris paribus*, the lightest bracing will be that which is in the same plane with the strings—or at least that bracing parts of whose material rises above and descends below that plane just like that employed by Messrs. Erards for upright instruments. Any piano with its bracing entirely above or below its strings, or in two series (one above and the other below them, which is just what the bracings of ordinary grand pianos and of cottage pianos braced *à la* Kohlman are, both of which arrangements require the bracing to be tied or strutted, or both), must be so much heavier than Erard's as the additional material necessitates. Of course, it is theoretically possible to design and construct bracing partly above and partly below the strings whose weight—excepting the weight of the tie-bolts—shall not exceed Erard's, but it would be rather difficult, in practice, to apply it.

When the bracing is only on one side (say, under the strings), the tendency of their tension to arch it increases in proportion as they are placed further from it—unless, indeed, the braces be tied to the key-bottom on Mott's system, when, practically speaking, they cannot become arched, so their distance from the strings becomes of no importance. Hence, it is desirable to place the strings of ordinary cottage pianos as near their bracing as possible. Their strings are too often from 1½in. to 2in. from their bracings; but when the soundboard is not arched more than is needful, and the down bearing of the strings not excessive, by making the bridge only ⅝in. thick the strings may be kept within about 1⅛in. of the bracings; closer they cannot well be, as any one may satisfy himself by making a sectional full-sized drawing of the parts. Of course, when the bracing is disposed above and below the strings, it cannot be of any practical importance how far the one set of bracings is from the other, for their power to resist the tension of the strings will be equally great whatever distance they may be from the latter, and it becomes a mere matter of practical convenience how far they shall be placed apart.

"T. C. L." also asks for my experience in sounding-board making. Alas! it is nearly *nil*, at least, very limited, although I have some rather peculiar notions thereanent. If, however, my practical experience has been but small, I have long been a persevering industrious inquirer and a careful observer of others' doings in this matter; but I may remark that practical pianoforte makers are usually remarkably reticent on bellying, and some other branches of their art. Whether they know much or little, may be a fair question, but certainly they are very unwilling to communicate knowledge.

I have observed the thicknesses of pianoforte soundboards differ considerably, and that really good instruments are constructed in which they vary much, not only in thickness, but also in superficial area, and in the section of and number of their bars. In ordinary cottage pianos the number of belly bars seems often to be subordinated to and determined by the number of bracings in the back and the distance the latter are apart. When few in number, say five, two belly-bars are often found between each, which makes their total number ten or twelve; in my opinion, this is none too many in the treble, but needless for the bass. When the number of wooden bracings became increased to seven, eight, or nine—I have seen nine in some modern backs—the spaces between each became so much diminished that there is not room for more than one belly bar between each. In pianos with seven bracings, I have, however, occasionally seen two belly bars, between each of the bracings nearest the treble end, those bracings being placed somewhat further from the lining and further apart to allow room for two bars between it and them, which I consider an improvement. This enabled ten to be used, which I think quite numerous enough.

If designing a soundboard, I should prefer placing the four shortest belly-bars only 4in. or 4¼in. apart from centre to centre. This would necessitate the introduction of one additional brace into the back figured on p. 613 (No. 302)—in other words, placing five braces in the same space four occupy in that figure at the treble or right-hand side. It is obvious the more numerous the belly-bars the more nearly uniform the rigidity of the soundboard must be. I think this is a matter of some importance, especially in the treble, for avoiding inequalities of loudness in the sounds of adjacent notes; and I am not singular in this opinion, for the late W. T. constructed a back the six treble bracings of which were made of only 2in. stuff, which, when planed, became about 1¾in. thick. These were placed 2½in. apart from centre to centre, leaving spaces ¾in. wide between them, in each of which was a belly-bar made of ⅞in. stuff (tapered sideways so that it could not touch the bracings), the section of which, before its sides were tapered, was 1in. × ⅞in. It was also tapered pretty regularly from its deepest part beneath the bridge to three-sixteenths of an inch in thickness where it entered the rebates. The design was mine, and its executant had not much faith in it until the strings were put on and he was able to "hammer" them, after which he acknowledged it was the most powerful treble he had ever constructed. Certainly it was fine, although the scale was comparatively a short one: pitch C, bichord, being only 12in. long, No. 17; its octave 6⅛in., three unisons, No. 16; and the top A 2in. long, of No. 14 wire. Had the scale been that figured in No. 372, its power would have been increased at least 50 per cent.

Besides its normal function of affording a firm support for the strings, the bridge acts as a transverse bar, not only connecting the strings with the soundboard, but also with all its belly-bars, thus distributing the downward pressure of the strings (technically termed the down bearings) pretty equally over a considerable area. The more massive the bridge be made *cæteris paribus* the better must it do this, which is probably the reason we see the bridges of modern grand pianos so much thicker and wider than those of older instruments. It would seem, however, that every augmentation of the mass of the bridge must, like increasing the stiffness of the belly-bars, obstruct the communication of the impulses of the vibrating strings to the soundboard, and we ought to bear in mind that the latter is only caused to vibrate by the former.

The ordinary practical method of proceeding is to glue the bridge on the soundboard before the belly-bars are attached to it. As it is then quite flat, this greatly facilitates making the joint, and is the least costly way of proceeding, but I am far from believing it to be the best way, because, considering the bridge is a rigid oblique transverse bar, it must resist—in proportion to its rigidity—any force which is applied to the belly to arch it. This is usually effected by making the under faces of each belly-bar a segment of a circular arc—it is much preferable to make it elliptical —and the belly bars, when glued to the soundboard, are forced down on its back by wooden spring bars (technically termed "go bars"), many go bars being sprung on each belly-bar, so that the convex surfaces of the latter are compelled to become parallel to the flat surface of the soundboard. Thus all the arching the latter obtains being caused by the reaction of the curved belly-bars when, after the glue has become dry, they are relieved from the pressure of the "go bars." So long as we are content to have our soundboards segments of circles, this plan would answer admirably if the bridge were not glued to the soundboard, although it won't serve for soundboards whose surfaces are longitudinal segments of ellipses, by far the best form. They require a belly-board hollowed out or blocked up, so as to become a counterpart—allowing for the thickness of the wood of which the belly is made—of the elliptically formed belly-bars, provided always the bridge be not attached before the belly-bars, because the thin soundboard, whose grain is at a right angle with the direction of those bars assumes their form readily, but it don't do this when the bridge has previously been glued on it. On the contrary, instead of becoming a circular or elliptical arc, it becomes distorted; in workshop phraseology, "it winds like roast pork," and we can hardly expect distorted soundboards to vibrate as freely as those do which are either flat or of some regular geometric figure (say) circular or elliptical, which latter has the advantage of enabling the soundboard to be made sufficiently convex in the treble without making it unnecessarily convex beneath middle C, and thereby necessitating the placing of the strings further from the bracing than is desirable in ordinary cottage pianos, all the bracings of which are usually behind their soundboards, and therefore unavoidably more distant from their strings than could be wished.

I think I hear ye practical man exclaim "All very fine, 'Mr. Harmonious Blacksmith,' but if you arch your belly before the bridge is glued on, how are you to make a sound joint between the bridge and the belly." Well, I must acknowledge it is more difficult to do this after than before, and rather more costly, but certainly no impossibility, for it has been done more than once. It was done by the late W. T. in my experimental grand, who made the bridge in four pieces (lengths), connected by long vertical-scarfed joints duly dowelled. He fitted each length separately to the convex surface of the belly, and glued them on it successively, commencing at the treble. To insure the total absence of any possible strain which might distort this sounding-board (the reader will understand that in this sense I prefer being "a total abstainer,") it was fitted into the case of the instrument and fixed by screws, just as it was to be fixed ultimately, before the bridge was fitted to it, and the latter was even glued in its place before the soundboard was taken out. No "go-bars" were used, indeed they were not required, for he inserted several screws through the soundboard into the bridge, which effectually clamped that and the bridge together. Of course, both were made pretty hot before glueing, and the (thin) glue used was not allowed to become cold before the screws where driven home, and a better joint I never saw made. I will conclude this subject next week. THE HARMONIOUS BLACKSMITH.

BEE MANAGEMENT.

[4352.]—"COLNEY HATCH" (let. 12010, p. 288) does not seem to understand my figurative allusions to the almanack and the weather in a late letter on this subject, and I am equally in the dark as to what he is driving at; but considering the strong local associations of both Colney Hatch and Hanwell, it is not at all surprising that one cannot understand the other.

Quibbling at my figure of speech will not alter facts, and it must be patent to every one that "time is out of joint" as regards the experience of men and the instinct of bees. Bees, and men too, have a right to expect more favourable weather in this month of June, and I adhere to the sense of my former letter, that with bees as with men, instinct and experience are both at fault. What I chiefly wish to impress on bee-keepers is the fact that at this time of year a spell of weather like the present means ruin to the bees if they are not assisted. Prophesying after all is over, and telling people what they ought to have done, is rather like insuring after a fire, and is about as satisfactory.

If a farmer had a herd of cattle or a flock of sheep in a field, be it ever so large, and drought and heat made growth impossible, would he not be thought an arrant fool, and criminally cruel, if by neglecting to supply his flock or herd with the means of existence from other sources, he allowed them to die of starvation?

Bees, however, may be penned in their hives by the weather like a lot of pigs in a stye, or sheep or cattle in a barren field, yet in the name of common sense why have not bees as much right to assistance as the animals aforesaid? The law holds it criminal to starve either of the latter; but millions of poor bees are annually starved to death without a thought of the cruelty inflicted, or the great waste of wealth to the country at large. In England, the crop of honey in summer, like the crop of ice in winter, depends entirely upon the weather, yet from want of thought and care, the greater parts of both crops are allowed to waste themselves, while thousands of pounds are expended annually in importing similar articles from foreign countries, or else John Bull manufactures them at home for himself.

Hanwell, June 8. C. N. Abbott.

USEFUL AND SCIENTIFIC NOTES.

The Fireweed.—The epilobium, or fireweed, a species of cotton plant, springs up spontaneously on evergreen lands that have been burnt over. Hundreds of acres of this plant are to be seen in the north woods of New York. It is perennial, grows to the height of 4ft. to 6ft., the stem being ½in. in diameter, and some 2ft. from the top, putting out a dozen to twenty branches, each bearing from fifteen to twenty pods, that, in August, open and display a white fibre like that in the boll of the cotton plant. The seeds are very small and numerous, but do not require ginning to separate them from the fibre. The plants grow close together on poor or rich soil, and in any climate from 40° north to the Arctic Circle. Its southern limit of growth is the northern limit of cotton, and is very similar to cotton. Mr. Miller, of Utica, made candle and lamp wicks of it, and ropes that proved as strong as cotton ropes of the same size. Carded and spun, it made excellent yarn, from which a stocking was knit. Its fibre makes the finest of paper, being almost equal to silk for this purpose.

Preserving Cucumbers.—A Russian correspondent of the *Revue Horticole* thus describes a method of preserving cucumbers:—The cucumbers are washed, placed in a barrel in layers with herbs such as fennel, parsley, tarragon, onions and rose leaves intermixed. Sometimes allspice or long pepper is added. When the barrel is nearly full, a solution of salt (1lb. to 123 litres of boiling water) is poured when cold into the barrel through a small hole in the top, which is afterwards tightly corked. The barrels are kept in a cellar or in a house, and when required for use the cucumbers are sliced and sent to table. Sometimes a little vinegar is used in addition to the salt.

Sea Water at Home.—A scheme for supplying North Shields with salt water is being rapidly completed. The reservoir at the north-west end of the town is about finished, and two-thirds of the pipes have been laid. It is anticipated that, besides providing themselves with water for flushing the sewers and cleaning the streets, and likewise supplying the public baths, the corporation will be able to connect many private residences with this novel scheme.

Hydro-Electric Telegraphy.—According to *Les Mondes*, M. Ferdinand Tourmasi is the inventor of a new method of telegraphing through tubes full of water, which he is at present exhibiting at Paris. The tube is of copper 1-16th of an inch in diameter. The experiment is made with a length 3,280ft., and the inventor hopes to obtain, first a speed of transmission of at least 600 signals a minute, even through a length of 1,000 miles; second, a simultaneous exchange of correspondence by the same tube—that is, to signal both ways at once; third, the facility for printing despatches; and fourth, a very small cost of construction. The thread of water is in communication at each end with two pistons of the same diameter. One of these pistons is slightly pressed, and the motion is immediately transmitted to the other piston. The tube and its pistons are in connection with an electro-magnetic apparatus to facilitate the transmission and the reception of messages.

Boiled Rice.—"Ixion" says:—It is an interesting and important physiological law that the same food, if mashed, will not nourish, whereas, if cooked firm, it will nourish adequately. The Irishman eats his potato with a "bone" in it, while the Scotchman likes his brose gritty. It is a perfect study to see an Irishwoman boil a potato. She does it with skill intuitive. I have often watched her as I have watched the West African cooking his rice, the grains of which roll over, just like the Irishwoman's potatoes. Dame Nature, too, cooks baby's breast-milk with a bone in it, which ignorant mothers and nurses esteem a mistake. And now as to rice. Immersion in boiling water, loose or in a cloth, for thirty minutes, cooks it perfectly and beautifully. It may take a minute more or less according to the state of the barometer and quality of the water.

New Green Pigment.—A new green has been discovered, which is said to be brilliant enough to replace the poisonous colour produced by arsenic. It is composed of twenty parts of oxide of zinc and one of sulphate of cobalt, mixed into a paste with water, and exposed to a red heat.

To Preserve Pegged Boots and Shoes.—If pegged boots are occasionally dressed with petroleum between the soles and upper leather, they will not rip. If the soles of boots and shoes are dressed with petroleum they will resist wet and wear well. The pegs, it is said, are not affected by dryness after being well saturated with the liquid.

The progress of all real science is towards compression and condensation, and its whole aim to supersede the endless detail of individual cases by the announcement of easily remembered and readily applicable laws. —*Sir J. Herschel.*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[11120.]—**A Question of Sight.**—Steel need not be "a dense solid." It is sometimes a dense but perfectly mobile fluid, and the rate of propagation of impulses depends, not on the solidity or fluidity, but only on elasticity, which may be equal (for aught that is known) in solid or fluid steel, as it is nearly in ice and water. Mr. Barwick did not call the velocity of light in any medium 17,000ft. per second, that I am aware; but he copied this as the velocity of sound (and therefore of any kind of impulse) in steel—that is probably near the mark, and if so, it follows that if the "cosmic fluid" were replaced by steel (probably either fluid or solid steel), then any impulse from the sun (call it light or what you will) would take 2½ years to reach us, instead of 8¼ minutes. Mr. Barwick is wandering utterly out of his depth, and becoming a second "T. A.," or if possible, worse.—E. L. G.—[This controversy must end here.—Ed.]

[11416.]—**Cross-bow** (U.Q.).—Make a bow as described at p. 180, reply 11471, then get out a stock of deal, resembling in every respect a single barrel gun-stock except that the groove must not be so deep, but longer—*i.e.*, a few inches longer than your arrows, which must be double-feathered. The brass trigger resembles a roughly formed 7, riveted to work freely through the stock, and held in its place by a strong spring. The bow is fixed horizontally at the end of the groove. The string is pulled back over the trigger, the arrow lying in the groove.—Hedera.

[11457.]—**Motive Power for Amateurs.**—Our friend, "A Barrister," is in error if he supposes that I, for one, can produce motive power from a fly-wheel (that is to say, in the light he took my explanation). A circular or rotatory motion is required for a certain purpose, say to drive circular saw. Steam is not obtainable! Consequently, what is next best? Most decidedly not the lever—*i. e.*, pendulum. I stated in reply to query 11457 that I would produce more power from a fly-wheel than "Zoo Andra" can with his lever—*i. e.*, pendulum—that is to say, for the same person to exert his strength in turning a fly-wheel as will swing the pendulum. Now, it is a well known fact that the larger the fly-wheel of an engine (in reason), so much the better the working of the same—for instance, a two horse-power steam-engine, nominal, in good working order, with ordinary boiler room, and limited to a pressure of (say) 40lb. to the square inch; the power derived from the said engine used for the purpose of driving a small saw bench, the workman cannot get sufficient power. What is the cheapest and best mode of remedying the same? I can, from experience, say a larger fly-wheel on the engine will allow more work to be done from the same—that is to say, if the fly-wheel is of the ordinary size. On the other hand, a quicker and equally good plan would be, if allowed, to raise the pressure of steam from 40lb. to 60lb. per square inch, as it is far cheaper to drive at a high pressure than a low. "A Barrister" says the best plan to fit a manual saw bench is to fix a fly-wheel on the saw spindle. I am afraid "A Barrister's" experience with saw benches is, well for him, brief. In the first place sufficient speed could not be obtained. The plan I have found answer when steam, or, in fact, any other than own labour could be obtained, was to fix a fly-wheel on a crank under a table made for the purpose; above the fly-wheel a saw spindle running in two centres, with a wood pulley fixed on the spindle; a leather band (1in. wide), from pulley to fly-wheel, and a treadle same as on an ordinary lathe; but, as I have in previous numbers of the Mechanic stated, sawing without steam power is very hard work.—Samuel Smither.

[11529.]—**Dermestes** (U.Q.).—As no other correspondent has come forward to give the required information concerning this beetle, I have ventured to acquaint "Redivivus" with the little I know of it. In the first place he has given the wrong name, by which means it escaped my notice for a time. The name of the beetle referred to is, *Dermestes lardarius*, not "Vermestes" as given by "Redivivus." The *D. lardarius* belongs to the family of Necrophagous beetles, six genera of which have been found in Great Britain. They are easily distinguished by their black heads and abdomen, and a rather broad gray band across the back, with three black spots on each wing case. The larvæ are known by their long slender body, which is divided into thirteen segments, and thickly covered with reddish brown hairs of a bristle-like shape. They very carefully conceal themselves from sight in the object they are engaged in devouring, and their presence is only made known by their cast-off skins, which they shed several times during their larval state. They are particularly partial to the preserved skin of any animal that happens to fall in their way, therefore they prove very destructive to collections of natural history, where they gain access to them. Bacon and hams form a favourite diet of these destructive insects, which invariably attack them for the skin's sake, and having by nature a ravenous appetite often extend their depredations to the flesh. As "Redivivus" requires them for preparing skeletons of small animals, I must confess my doubt as to whether they will attack freshly killed specimens, as their food generally consists of preserved natural history subjects.—Henry Blake.

[11531.]—**Water Wheel.**—I certainly understood "P. W. H. J." (p. 156) to mean a rotary water engine, not a turbine wheel, but in his subsequent letter (p. 258) he says a rotary water engine is usually called a turbine, distinguished by the name of the inventor. This may be the practice of our friends in Massachusetts, where it is said they can produce turbines which give out 185 per cent. of the gross power produced by the fall. Unfortunately for us in this country we find it as impossible to create power as it is to create matter. For this reason no class of motive power engines can ever be made or expected to give out the same amount of power as that due to the driving body, whether it be water or steam. The rotary water engine, of all others, may be said to give the greatest power, the reciprocating steam-engine the least. At best it never exceeds 9 or 10 per cent. of what is due to the power of the water vapourised, and in many instances not even 3 per cent. of useful effect is obtained. This is certainly to be regretted, as the expense or economising of fuel is a matter of considerable importance to the employers of the steam-engine, and I fear so long as the reciprocating principal is continued so long will it remain a prodigious destroyer of power. If my rotary engine can in anywise tend to suggest improvements in the reciprocating steam-engine I am quite willing to place it at the service of "P. W. H. J." or any other respectable person, on condition that satisfactory security can be given for its safety, and if it does not beat any other class of motors by 6 per cent. (Schmid's water pressure engine included) "P. W. H. J." or any other party accepting this challenge shall receive my engine, dynamometer and all appliances connected therewith, as a reward for his or their trouble.—D. S. [Any one accepting the challenge must advertise his address so that we may communicate direct.—Ed.]

[11554.]—**Pedestrian Tour.**—May I ask "Philo" whether his canvas shoes (mentioned at p. 232) will stand a walk through long wet grass, or a ford across a stream? "Philo" seems to speak as though he used linen shirts, but flannel shirts are infinitely preferable; with them a cold in the head is not a necessary consequence of a five minutes' halt.—Hedera.

[11572.]—**Compressing Water.**—"A. J. V. G.'s" correction is not by any means "carping criticism." I cannot find any notice of the *state* of the water in either Ganot, Miller's "Elements," or Deschanel's "Natural Philosophy." The latter work says, "The true compressibility of water, according to recent experiments conducted under the direction of M. Jamin by MM. Amaury and Descamps is, at the temperature of 15° C., ·0000457 per atmosphere." Nothing is said about the water being free from air. It seems singular, too, that the compressibility of water free from air should be greater than when air is present in that liquid, 51·3 as against 49·5 millionths. I cannot agree with "C. S.'s" notion of "where the water goes to" (p. 234); for if the water can enter the pores of the cylinder sides, I see nothing to prevent it coming out at the other side, and under these circumstances it would be impossible to keep up the pressure all night without touching the pumps, an event of daily occurrence in any large printing-office where books are turned out.—Saul Rymea.

[11625.]—**Deaf Dog** (U.Q.).—I know no certain cure, but this query being unanswered, I will give a suggestion. Let one or two drops of Dellar's essence for deafness (obtained at any chemist's), fall into each ear once a day. I have tried it personally with good results. It is painless.—Monte Christo.

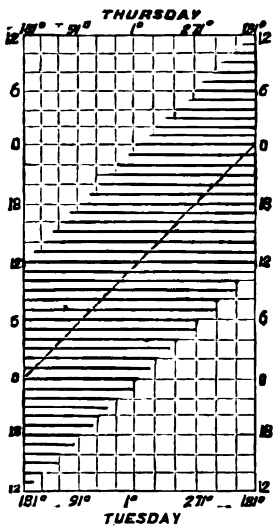
[11532.]—**Debility.**—As I said before, on page 207, there is no occasion for an insignificant individual like "Saul Rymea" to defend allopaths against the charges of either "Amateur" or Charles Rooke. The "principles of allopathy" are, or, rather, the main principle is, to assist Nature in her endeavours to throw off disease and its effects; whether the best means for effecting that purpose are adopted and put into force I do not know, but I do know that the practitioners of this system of medicine think they are right and are quite willing to listen to any better method that may be pointed out to them, on the "si quid novisti," &c., principle. Mr. Rooke says that "till lately" the lancet was the sheet anchor of the medical profession, and I suppose the "drastic purgatives" were the trusty cable. He also puts the question, "What shall we say of a system which can thus repudiate its grand procedure, and yet claim the adhesion of a community not void of common sense?" Well, "till lately," we used to travel by coaches, and employ special messengers with relays of horses on business of importance; but what would a "community not void of common sense" think of the individuals who adopted the same means nowadays? What would a "community not void of common sense" think of a system of medicine which clung to the lancet and drastic purgatives in spite of the progress of the last half-century? Mr. Rooke asks me to explain how it is that of three men subject to the same influences one takes cholera and dies, another takes it and recovers, and the third escapes scot-free. Well, old-fashioned people have an [illegible] on this point which the "Peculiar People" carry out on the "rest and be thankful" principle; but I prefer to leave this aspect of the question to the "Deluge" correspondents. The theology of one scientific subject is quite enough at a time for the readers of the ENGLISH MECHANIC, so I reply that the two men who were attacked with cholera were more susceptible to the poison than the one who was not attacked, and the man who died had not sufficient strength of constitution to enable him to throw off its effects. I never said that heart disease was "inconceivable as a result of nervous debility," but what I did venture to ridicule was the preposterous notion that nervous debility was the cause of diseases of characters so opposite as typhoid, eczema, rheumatism, and heart disease, and *all* other ailments. Surely, no one who understands the subject will assert that nervous debility is found as a normal condition in the healthy man. Nervous debility is, in fact, an effect—not a cause; and the causes which give rise to such an effect may, of course, render the human system susceptible to the poison-germs of disease. But what does Mr. Rooke mean by "nervous debility"? What does the author of the *Anti-Lancet* intend to imply by that term? Probably, *his* nervous debility is something as extraordinary as those "two most noble medicines" which cure every disease under the sun, and enable every one to live to the "allotted span" at least. It is my misfortune never to have seen or read the *Anti-Lancet*, and I am afraid, after what I have heard, that I am not likely to read it unless it be on some very unlikely occasion, when I have nothing else to do—and can't *sleep*. "Non amo te, Sabidi, nec possum dicere quare: hoc tantum possum dicere: non amo te." ("I do not like thee, Dr. Fell; the reason why I cannot tell; but this I know right well—I do not like thee, Dr. Fell.") It is very easy to sneer at medical men and their art (not *science*, mind), but these very sneerers are often the first to seek the aid of the doctor; if left to the tender mercies of the quacks, how long before they would be improved off the face of the earth! If Mr. Rooke seeks to make capital by calling up the forgotten errors of medicine, I think he will find himself mistaken; if he, or the author of the *Anti-Lancet*, knows of any means of curing the ills which flesh is popularly said to be heir to, in the name of Humanity let him make them public. I do not believe in panaceas, neither can I conceive such a thing possible as that the Designer of the human economy left his work in so unfinished a state that man found it necessary to "mend it." I am not above learning anything that is worth knowing, but I hate quackery, while I pity its dupes.—SAUL RYMEA.

[11632.]—**Debility.**—*Ignatia amara* (St. Ignatius' Bean) will cure nervous debility and various painful and irritable conditions of the brain and nervous system. Hooper, in his "Medical Dictionary," page 638, fifth edition, says that "in the Phillipine Islands the ignatia is used in all diseases." Chambers, in his "Cyclopædia," folio edition, 4 vols., published in 1799, says, "The ignatia is much celebrated for its medical virtues, being recommended in vertigoes, lethargies, epilepsies, asthmas, quartian agues, and worms." Huc, in his "Travels through Tartary, Thibet, and China," a work published in 2 vols., at the office of the Illustrated Library, 227, Strand, says, in Vol. 1, page 158, "That the ignatia is called Kon-Kono; that if taken inwardly, it modifies the heat of the blood and extinguishes all inflammations. It is an excellent specific for all sorts of wounds and contusions, and enjoying a high character in the Chinese Materia Medica." The plant is common in the West Indies and the Phillipine Islands, and may be procured of the herbalists, Covent Garden Market. The extract is prepared by pulverising the bean and subjecting the powder to the action of alcohol for 10 or 12 days, observing to shake it occasionally; at the expiration of this period it should be filtered through blotting-paper, and the filtered liquor put into a basin placed over boiling water. In a few hours the spirit will have evaporated, and the extract will be found at the bottom of the basin ready for use. The proportion of the extract and the bodies necessary to bring it into the form of pills, are as follows:—Alcoholic extract of the ignatia amara, 30 grains; powdered gum arabic, 10 grains. Make into 40 pills, and take one an hour after breakfast, and one an hour before supper, or at least an hour before retiring to rest. Half a pill night and morning will be found sufficient for very young, very aged, or very delicate persons. The pills may be easily cut if laid on a damp cloth for a short time to soften them, or they may be made of the half grain size at the time of preparing them.—E. PARKER.

[11652.]—**Tasmania (U.Q.).**—There is a small pamphlet entitled "Practical Hints to Emigrants to Tasmania," by H. M. Hall, Esq., clerk to the House of Assembly. Apply for it to Charles S. Bailey, Esq., Secretary to the Emigrants' and Colonists' Aid Corporation, 84, Lombard-street, London.—HEDERA.

[11711.]—**Time at our Antipodes.**—I cannot conceive what elucidation this very simple, not to say puerile, question, can need. Surely, the slightest consideration would show any one that there can be no meridian nor spot where the same sunrise is reckoned the beginning of Sunday and of Monday. Which, then, shall it be? A ship arriving from Europe westward would find it Sunday, when one arriving eastward, having passed through another night, calls it Monday. The name of the day, then, can only depend on whether the first European settlers or missionaries arrived at the island *viâ* Cape Horn or *viâ* the Cape of Good Hope. Of course there are islands about the mid Pacific that were first approached each way, and so, though very near together, have to call the same day Sunday in one island and Monday in the next. This is unavoidable, and there might be a sinuous line marked from Behring's Strait to the south pole (of course, crossing no land) as the line where "the day begins." But in all probability, islands discovered from the east and from the west are so mixed up that Monday may begin in some before Sunday begins in others, and the line would have to be accompanied by detached bits of each, like the bits of English counties "situate in" another county, as gazetteers say. I believe all our furthest colonies name their days as if reached round the old "Cape," therefore begin and end every date before us; and so, if you go there by Suez or Cape Town you find no change of time; but if you go by the Horn or Panama, and arrive on the ship's "1st of January" or what not you will have to call the next day the same.—E. L. G.

[11711.]—**Time at our Antipodes.**—Although the fog has not yet cleared away from some of us, there are others who see the thing so clearly as to satisfy "Kelby," and set the question at rest. "Seperator" quotes the reckoning, at the Fiji Islands as being in advance of ours, and that when it is noon in England it is twelve the previous night at Fiji—*i. e.*, the Tuesday, for example, is ending, and the Wednesday beginning. So far we have a starting point from which to reckon our absolute day. Tuesday, twelve o'clock at night at Fiji, is Wednesday, 6 a.m., at New Orleans, noon at London, and 6 p.m. at Calcutta. "T. S." clearly shows the reckonings at London and New York to be of the *same* day by the dispatch and arrival of telegrams at 11 a.m. and 4 p.m. respectively at New York and London, and reasons that New Orleans being one hour west of New York the time there is 6 a.m. of Tuesday, at which his telegram would be dropped, and he finds himself landed at his original starting point—viz., the arrival of the message dispatched from London at noon, at the Antipodes at both Tuesday midnight and Tuesday break of day, meaning, of course, the ending and beginning of the same day, Tuesday, and this is his perplexity. I am sorely afraid that by introducing another diagram I shall not only make "confusion worse confounded," as "F. N." has it; but accumulate confusion upon confusion until at last the whole subject will be such a mass of confusion that the truth of this knotty question will disappear, and there will be no unravelling it; nevertheless, I must claim your indulgence, Mr. Editor, and ask for the admission of the accompanying diagram. "T. S." does not doubt that every day has an absolute commencement somewhere on the earth's surface, and imagines that every country fixes its own time. That the absolute day is independent of arbitrary settlement is, I think, obvious. Time is not as we choose to reckon it, otherwise I might not have erroneously assumed 270° as the meridian at which the day commences, and which "T. S." finds does not fit nor will 180°, that of our Antipodes, fully meet the question. The diagram, which is



arranged to show the latter half of Tuesday, the whole of Wednesday (the thick horizontal lines), and the first half of Thursday, is to be read from right to left, and from bottom to top. The commencement on the right of each partial dark line signifies the midnight between Tuesday and Wednesday. The thick diagonal line 0—0 shows the progression of Wednesday's noon from 181° to 181° in the reverse order of the longitudes—*i.e.*, from east to west, and the upper terminations of the dark lines represent midnight between Wednesday and Thursday. Now, applying this diagram, in the first place, to the perplexity of "T. S.," we have the middle line 12—12 right across the diagram, signifying that all over the world it is Wednesday and nothing else. For clearness of expression we may regard the meridian 1° east as that of London, from whence the message is dispatched (in this case Wednesday instead of Tuesday); the 12 on the right hand under 181° is midnight, between Tuesday and Wednesday, the time of the reception of the message. The meridian 6 hours to the east is 271° corresponding to New Orleans, where it is 6 a.m. Wednesday morning, noon occurring at London, and 6 p.m. at Calcutta. The line terminates at 12 on the left, also under 181°. Now to find the true value of the second 12 under the same meridian we must take these facts into consideration. All the meridians east of 1°, the central vertical line of the diagram, have afternoon hours, therefore their natural *termination* is 12 at night of Wednesday, or the commencement of Thursday. All the meridians west of 1° have morning hours, the natural *commencement* of which is the moment after 12 at night on Tuesday. It would appear from this that on the meridian of 181° both Wednesday and Thursday were commencing at the *same* instant, but it is actually not so, as there is really the 24 hours of Wednesday between them on the earth's surface, the absolute Tuesday just expiring, and the absolute Thursday commencing. These 24 hours, however, begin and end on the same meridian, consequently, the intermediate hours between beginning and ending apparently disappear at that meridian, and the reckoning from the eastern meridian 181° to the one immediately west of it, 180°, passes suddenly from Tuesday to Wednesday, explaining the facts mentioned by "F. N." of a ship going to the westward skipping over a day, and a ship sailing towards the east gaining one. This leads me to the consideration of the second difficulty of "T. S." —viz., the occurrence of 7 a.m. 5 hours west of a meridian, at which it is noon of a given day, and 6 a.m. of the succeeding day, at a meridian still farther west, which "Kelby" styles a *reductio ad absurdum*. In applying the diagram to this case, instead of the noon meridian being 1°, it is 271°, the lowest 18 — 18 line represents 6 a.m. at 181°, the dot on this line over 271° signifying noon at Tuesday at New Orleans. Now, it is midnight at Calcutta between Tuesday and Wednesday at this moment, and 6 a.m. Wednesday at 181°. There being six hours of Wednesday and eighteen hours of Tuesday in existence, the diagram shows that 7 a.m. of Tuesday falls on meridian 196°, or one hour east of 181°; a similar case to that supposed between New Orleans and New York, and may be thus expressed—

164° West longitude, 7 a.m. Tuesday,
179° " 6 a.m. Wednesday.

Perhaps "Kelby" can show that this also is a *reductio ad absurdum*, and if so, perhaps he can still further show how the change from Tuesday to Wednesday can be effected without it. As the greatest portion of the meridian 181° is on the ocean, no inconvenience of any moment can arise from the circumstance that a sudden change of reckoning from Tuesday to Wednesday, for example, accompanies it as it approaches to and recedes from the sun. Let us take the earliest noon of Wednesday, which occurs, according to the diagram, in longitude 181° at the time when it is 1 p.m. of Tuesday, in longitude 196° or 164° west. If in my last communication, June 7 (p. 308) the meridian 181° be substituted for 270°, and diagram No. 2 (p. 284) for No. 1; the lowest line 12 — 12 representing the establishment of Tuesday over the whole world in the present diagram—will correspond to diagram No. 2 (p. 234), and the whole of the present diagram will illustrate my last communication.—W. R. BIRT.

[This controversy has exhausted all the space we can spare for it.—ED.]

[11731.] — **Hair Wash.** — I don't know why "Excelsior" fails, because I know that borax and camphor is a very good thing, as I have often used it. The camphor does not dissolve except in very small proportions in water, and if the lumps are big enough may be used to fresh water and borax over and over again. But why use *any* wash? Impurities from the body are secreted on the scalp as on other parts of the body, and there is nothing a person can use cheaper, or more effectual, than soap and water, a brush, and a small quantity of ammonia.—E. T. S.

[11743.]—**Humea Elegans.**—This is generally considered a sub-tropical plant, but is easily raised from seed with a little heat. It may be planted out in May. Any good compost will do—rotted turfs, stable manure, and sand. It will not grow so well in such a season as the present as it would if we had a little summer warmth.—K. T. L.

[11756.]—**Water Wheel.**—I promised in a former issue to supply the required information, provided your correspondent would give some more explicit data; however, I must crave his patience, being still in want of one of the most essential points—*i.e.*, the velocity per second, which I omitted in my former query, not being wishful to encroach upon your space by merely assuming velocities, as I see two of your correspondents do. If your correspondent "Water Wheel" will kindly furnish the velocity, I will reply to his query.—J. GILLAIRD.

[11760.]—**Soldering Jewellery.**—If "New Pivot" will fuse together 3 parts gold, 2 parts silver, 1½ copper, then add ½ part zinc, he will have a solder that will flow at a dull red heat, suitable for gold brooches, guards, &c.—H. B. B.

[11772.]—**Black Lacquer.** — Brunswick black, recipes for which have recently appeared.—K. T. L.

[11781.]—**Lathe.**—In section 2, read "beading tool" for "treading tool."—SAMUEL SMITHER.

[11809.]—**Cool Air in Hot Climates.**—I am surprised that if the "new and excellent sun-screen "(reply 11845), is so easily made by silvering small glasses, no sheets of "sheet plate" glass are so treated for use either in tropical windows (with a partly translucent film), or (quite opaque and reflective) for covering the boards of jalousies, and even roofing. A conservatory-like structure wholly so glazed would certainly be the coolest possible place in sunshine. The silver film, I would suggest, might be fixed on the glass by a coating of fusible earthenware glaze, fused upon it in an oven.—E. L. G.

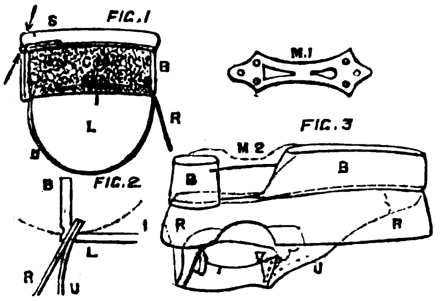
[11813.] — **Oatcake Making and Baking Machine.**—There is a machine for that purpose, made and invented, I believe, at Shipley in Yorkshire.

I am well acquainted with a baker who purchased one, but he soon gave it up, as he could do it far quicker by hand. If I remember right the cost of the machine was about £25.—A Would-be Baker.

[11872.]—**Carbonic Acid Gas and the Atmosphere.**—The proportion of carbonic acid is nearly four times as much as "Philanthropist" guessed—more exactly, three-and-a-third times as much in the open country and from four to five times as much in towns. In Dr. Angus Smith's "Air and Rain," the smallest proportion stated as observed is ·03 per cent.—*i. e.*, three parts by measure in 10,000, the mean of a large number of country places in Scotland, is ·0336 per cent.; and that of specimens in London is ·04394 per cent. As carbonic acid is heavier than air, the weight of that in the atmosphere may be assumed to be about 5 parts in 10,000, or one in 2,000. As to the increase that might be borne without injury to animal life, but little is accurately known. When the enormous proportion of 88 per cent., or 90 times that of pure air is mixed, animals die quickly, not, as some suppose, from direct deficiency of oxygen, but from the presence of carbonic acid, for if that be absorbed by lime or otherwise, air still more deficient in oxygen may be breathed with impunity. Close rooms sometimes contain air with twice or three times, occasionally as much as ten times, the natural proportion of carbonic acid, which, if produced, as it usually is, by respiration and combustion, renders it dreadfully oppressive; but air containing a similar proportion of pure carbonic acid, produced when making soda water, is neither unpleasant, nor, I believe, injurious. Certainly, the unpleasantness, and, probably, the injuriousness of ordinary close rooms is caused, not by the carbonic acid, but by other products of respiration, nor are those products themselves injurious in moderate quantity until they have undergone some change, for, as "M.R.C.S." a short time since reminded us, we are constantly drawing back into our lungs some of the air which has just left them, but remained in the windpipe or other air passages, while the lungs themselves must be always filled with air containing a very large proportion, probably ten per cent. of carbonic acid, together with moisture and pulmonary excretion. It is evident, therefore, that it is not either carbonic acid or pulmonary excretion which is, *per se*, injurious, for they are always present. There must be either a considerable excess of carbonic acid, or the presence of pulmonary excretion, which has undergone a change in the air to render it injurious; and if it be removed before it has undergone such change, we shall not suffer from it, as all experience proves.—Philo.

[11875.]—**Spectrum Colours.**—The impossibility of making a coloured spinner appear white in the presence of a real white (equally illuminated) is absolute, arising from the nature of light, and need not imply any imperfection in the paints, as "H. P. H." fancies (p. 262). But "Utile Dulci" will find it possible, after a few well noted trials, and with care and thought, to make sectors of either two, three, seven, or any intermediate number of colours, combine by rotation into so clear a gray that the contrast of a black border and middle will make it (in the absence of white) pass for a very tolerable white in the sunshine. He should repeat the series (whether two or seven) four or six times, that is, complete it in each quadrant or sextant of his disc. The following pairs are nearly complementary, or will produce white, the latter of each pair exceeding the former one in depth, and also in space, possibly as three to one in space, or less, as found by trial:—Pale chrome yellow and smalt; orange chrome and cobalt blue; vermilion and bluish verditer, or verdigris (equal); emerald green and magenta, or burnt carmine. Of course, what each pair will do separately, any two or more of such pairs will do together.—E. L. G.

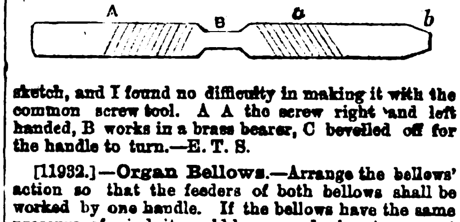
[11886.]—**A Thick Soled Shoe.**—These soles are of cork, and to build them is considered a crack job, and those crack hands who do them are few and far between. Years ago many elderly ladies had corks made for winter wear, and your humble servant has had a round sum for building them. If "Wee Pet" can work to or understand a sketch, I send him one. The upper is the same as the ordinary one, the inner sole rounded upon the last, but the chamfer is more upright than for welts. The box for cork is a rann of



tight rainge leather, prepared the same way with chamfer as the ordinary welt, but is not sewn on the same as ordinary welts, but vertical, or at right angles with the sole (see B, Fig. 2, which is a section). The rann proper is a piece of good kipp or calf, tough, and not too tight. This is laid down upon the upper and sewn between the box and upper. The box piece should be long enough to pare to shape and thickness required. After the cork is fitted in with good resin paste, draw the rann over and lace it, and stitch the sole to the rann edge (see arrows, Fig. 1). The dotted line figured is the sewing of rann and box or welt. The heel is best filled up with light wood; a piece of willow is best. The outer sole is stitched on to the edge of the rann with a round awl, not what is usually termed a round awl or sewing awl, which is oval, but a perfectly round needle awl, such as is used or was used for wood heel work for staff ranne in olden times. Description: S, outer sole; C, cork; L, last; U, upper; R, rann; B, box. The same letters show same parts. M1 is a brass plate to shield the cork and shoe, and forms a bridge, M2, put under the sole and top piece.—Jack of All Trades.

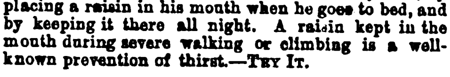
[11887.]—**Hair Dye.**—Would T. I. Preston (p. 287) oblige me by giving the formula for the terchloride of gold hair dye, and the directions for using it?—Another Gray Beard.

[11897.]—**Fastening Fret Saw.**—"G. W. C. H." must make a movable joint between the end of the ash spring and his saw catch. I send sketch; the joint



is at A, the lower part must work on a bearing; by that means a vertical motion can be obtained.—Samuel Smither.

[11901.]—**Grip Chuck.**—Why does not "F. G. T." make the screw in the lathe? I have a chuck I made, which is worked by one, and will take in from 3in. to ⅜in. The screw is somewhere about the size of the



sketch, and I found no difficulty in making it with the common screw tool. A A the screw right and left handed, B works in a brass bearer, C bevelled off for the handle to turn.—E. T. S.

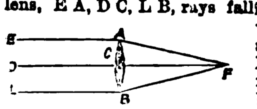
[11932.]—**Organ Bellows.**—Arrange the bellows' action so that the feeders of both bellows shall be worked by one handle. If the bellows have the same pressure of wind, it would be a good plan to connect them with a wind trunk also; if the pressures are different, don't use the trunk.—Pneumatic Lever.

[11948.]—**A Bad Sleeper.**—The disagreeable symptoms of which "N. K. R." complains may be alleviated by his leaving off the use of alcohol, supposing him to be a drinker of spirits; by smoking less, if he indulges in the weed; or, in any case, by placing a raisin in his mouth when he goes to bed, and by keeping it there all night. A raisin kept in the mouth during severe walking or climbing is a well-known prevention of thirst.—Try It.

[11950.]—**Sewing Machine Difficulty.**—The needle-bar goes down, then rises again a little way to form the loop for point of shuttle to pass through, then goes down again to enlarge the loop while the shuttle is passing through; when the needle is at the lowest point the second time the shuttle should be rather more than half past the needle. If the upper thread catches the shuttle when the needle-bar comes up to tighten the stitch; move it a cog forward.—H. A. S.

[11965.]—**Dandelion Roots.**—April and May are the most popular months with the old Yorkshire dames. They use the large roots only, slicing them and boiling them down well. The liquor is said to be a tonic, and "good for the liver complaint."—Hedera.

[11991.]—**Focal Length of Lenses.**—The focal length of a lens for parallel rays:—Let A C B be a lens, E A, D C, L B, rays falling upon it, these converge nearly to a point at F, C F is the focal length, or if the thickness of the lens is to be considered I F is



the focal length. One very simple way of determining it is to use the lens as a burning glass and observe the distance of the object which produces the best effect, or else use it in a telescope tube with one eye lens of known focal length. When the best definition is obtained the distance between the lenses is measured, if the eye-lens be concave, as in an opera glass, its focal length added to this distance will give the focal length of the object glass. If the eye-glass be a convex one, showing an inverted image, subtract its focal length from the distance between the lenses. As applied to photography, *cæteris paribus*, a lens of short focus acts more quickly but does not give so good a definition, except in the part focussed for, the centre of the field.—Philanthropist.

[11993.]—**Photographic Process.**—There is no dry process yet discovered which has the rapidity of exposure and development peculiar to wet plates. But, if "Anon." wishes, I will (with permission of our kind Editor) send particulars of a dry-plate process which gives very good results indeed, with one to two minutes expose; good light; single stereo. lens three-sixteenths aperture.—J. David Smith.

[11995.]—**Patent Rights.**—The result of any party patenting a machine similar to another, which has been in use previously, is that the second patent is invalid and worthles.—A., Liverpool.

[12000.]—**Insects in Tables and Chairs.**—The seat-framing of chairs, and possibly the parts of the tables mentioned by "Fox," are usually made of beech and English wood, peculiarly liable to attacks of the wood worm. For such ordinary articles, I know of no remedy if the means adopted by Mr. W. G. Rogers in restoring the world-famous carvings of Gibbons is inapplicable or too expensive. The carvings in the chapel at Chatsworth were restored by Mr. Rogers in the following manner:—To destroy the insects, he placed the carvings in a strong solution of corrosive sublimate (chloride of mercury) in water. The original tint of the wood, being impaired by this, was restored by ammonia and muriatic acid. An infusion of gum or gelatine was afterwards injected to fill up the worm holes, and strengthen the fabric of the carvings. An after-varnish of resin, dissolved in spirits, restored them to their original beauty—sound, I believe, to this day. All English woods are liable to attacks of worm—English walnut, oak, beech, or any others used in furniture, perfect immunity from which is noticed in the case of foreign woods.—Before Noon.

[12001.]—**Nitrate of Soda** is met with in Spain, and in various parts of India, but the most remarkable deposit occurs in Peru, in a tract of country about thirty-five miles from the coast, where no rain falls, and even wind is hardly known, with scarcely a trace of vegetable matter. The depth of the deposit varies from 5in. to 5ft., and extends over the country for several leagues. Genuine nitrate of soda should not contain more than 7 per cent. of impurities. The nitrogen which it contains in the form of nitric acid is the element that stimulates the wheat plant to a healthy growth. I shall be happy to give further particulars, if necessary, regarding its manufacture and uses, &c.—Soda.

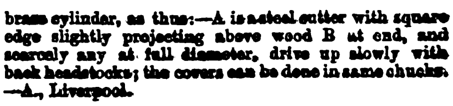
[12009.]—**Photographic Lens.**—It is possible to take a picture by a single bi-convex lens; but it will require a pretty small stop in front, and so will be slow. An arrangement must also be made to allow the plate to lie a little nearer to the lens than the ground glass is, as the chemical focus is shorter than the visual focus. If I remember correctly, the difference is about the one-twentieth part of the focal length of the lens. A lens with a focal length of about 5in. will give a very good picture the size mentioned. If "A Beginner" is going to purchase a lens, he should get an achromatic on at first, and then he will have no difficulty about the chemical and visual foci. An unmounted achromatic view lens to take pictures 8½in. × 4¼in. will only cost about 5s. "A Beginner" will also find the collodion process much easier to manage than the calotype.—Occasional Photo.

[12012.]—**Water-Power.**—Better than assuming a deprecatory title, such as "Ignoramus," would be a careful attention to, and a plain and full description of, a case requiring an answer. Would not "Ignoramus" see, with a little consideration, that his question is so vague as not to admit of an answer? What is a "3in. run of water (through a 3in. pipe)" as to quantity? I am sure I do not know. Now, if the question had been put in this form: There is water at A, and it runs through a 3in. pipe from A to B. The point B is ft. from A, horizontally, and ft. below it, vertically. The quantity of water, whatever it may be, is sufficient to keep the pipe constantly running full. At the point B there is a sudden drop, or fall, of ft. What would be the best, &c.? Such a question would admit of a definite answer. Different persons might give different answers, according to their opinions, but at least they would have data upon which to give them.—C. S.

[12014.]—**Organ.**—If "E C." will look back at "our" Mechanic of January 26, 1872, on p. 488, he will find both drawing and explanation of what he requires.—York.

[12020.]—**Tireing Cart-Wheels.**—In answer to "U. V. W.," if the wheel is merely dished—that is, if the tops of the felloes are upright with the wheel, the tire will not require bevelling; but if the felloes are bevelled to make the tire wear even, shut the tire up a little smaller than the front or smallest edge of wheel to draw it up tight when on, then hammer round towards one edge of tire to bevel it to fit the largest edge of wheel, which may be tried by running both tire and wheel with the traveller, with which I suppose you are acquainted. For wheel 3ft. 8in. high, tire 2¼in. by ⅝in., say ⅜in. smaller than the wheel in circumference. For wheel 4ft. 10in. high, same size tire, say 1½in. smaller. The size varies, the thicker and larger the tire the smaller in proportion it should be, as it will expand more in heating.—A. B.

[12021.]—**Turning.**—All you require is a metal chuck with a piece of hard wood driven in, to chuck up cylinder to bore, which is easily done as follows: When chucked up, turn the mouth perfectly true, take a piece of hard wood turned to size of bore, and tapered off, run a cut with tenon saw across the diameter, and insert a piece of sheet steel, say part of the busk of a pair of stays, or crinoline steel will do if



brass cylinder, as thus:—A is a steel cutter with square edge slightly projecting above wood B at end, and scarcely any at full diameter, drive up slowly with back headstocks; the covers can be done in same chucks.—A., Liverpool.

[12022.]—**Forest and Rainfall.**—I am not aware that it has been asserted that "the destruction of forests causes a diminution of the rainfall" if we understand by that the rainfall over a considerable length of time, but it has been noticed on the European continent (and I believe first in France) that the effect of clearing the forests has been to cause the total amount of rain to flow off the ground more unequally during short lengths of time, therefore causing floods at some times and drought at others; and it was after an excessive flood which swept away a railway viaduct and part of an embankment that, as far as I know, attention was first drawn to this question. At present I can only echo the question put—"Where can the best information on this subject be found?"—C. S.

[12024.]—**Photographic.**—It is likely that the glasses are all right, but a smaller stop is wanted to give sharpness all over the plate. This is how the glasses of a portrait lens are placed:—The front pair are cemented together and are placed with the convex side towards the sitter. The back pair are separated by a ring, the concave glass with its convex side next the front lens and the double-convex glass with its most convex side towards the concave glass.—OCCASIONAL PHOTO.

[12024.]—**Photographic.**—Let "One in a Fix" insert a suitable stop in front of his lens. I think his difficulty will be then overcome. It will, of course necessitate a longer exposure.—J. DAVID SMITH.

[12026.]—**Greenheart Timber.**—Greenheart is used for wine laths—that is to say, a great quantity is cut for such purposes; the exact way of using I cannot tell. The size the laths are cut is one inch by one half inch; any length over 4ft. Greenheart is also used for gun carriages, and I have had portions of old ships made of such. I do not know if it has any special use apart from what I have stated, with the exception of a few fancy goods requiring hard woods—such as office rulers, draughts, &c. I should expect it would stand any amount of sun and weather. Santa Maria timber, as regards the cabinet trade, was a failure. I have cut a great quantity of it. It very much resembles mahogany, but it differs from mahogany when being made up. It very soon splits—for instance, chair legs turned out of Santa Maria, when being mortised, split sooner than deal. It also contains a kind of grit that dulls the tools and notches them. I should not advise it myself for cart shafts or cart panels, or any kind of work likely to receive rough usage, unless of any bulk. Most of the woods purchased at the sales at the dockyards are the remains or refuse of ship building and manufactories of gun carriages. I have attended many sales at Woolwich and Deptford, and never saw much greenheart or Santa Maria. The wood principally consists of teak, mahogany, birch, beech, elm, and at intervals greenheart, African oak, English oak, American oak, fir, and deals.—SAMUEL SMITHER.

[12027.]—**Albert Durer's Engravings.**—The distinguishing marks on Durer's etchings are his monogram, his softness, and his touch. A number of his plates can be seen at the British Museum.—XYLOGRAPHER.

[12029.]—**Object Glass.**—The layer of air between two lenses will always cause a loss of more light by reflection than a similar layer of balsam would, the latter having nearly as refractive a density as glass, and at the surface dividing equally refractive media, there is no reflection at all. But some object glasses have the two surfaces that meet of very different radii, and then the inclosed lens of air is necessary, and balsam would not supply its place.—E. L. G.

[12031.]—**Hot Peas.**—Let the peas stand in cold water all night. Afterwards place them in a pan of water, just allowing the water to cover them, add a good-sized ham bone. It must have ham on, of course. Place the pan upon the fire, and as the water boils add salt and pepper. After a time the whole will become soft. After which nothing remains but to eat them with a little vinegar. Numbers of hawkers prepare them this way. I often indulge in them myself, with sundry misgivings as to the quality of the meat employed, which is often mere slink.—JOHN HOPKINS.

[12034.]—**Ordnance Map of London and Environs.**—Trinity high-water mark at London-bridge is 12·48ft. above approximate mean water at Liverpool.—H. C. L.

[12035.] — **University of Turin.** — Unless "Silex" intended to enrol himself as a candidate for one of the Government examinations, no special inquiry would be made as to his nationality, and no fees are expected. As, however, a five years' residence in the kingdom gives a foreigner the right of citizenship, no fear need be entertained of rejection on the grounds of nationality, but a small fee, amounting I believe to about 100f. per annum—£4—is required of those who intend enrolling themselves as candidates for examination. Learn Italian and French tolerably before going, as otherwise you will lose much time; take Bulwer's advice and avoid Englishmen abroad; attend the really excellent classes in German, French, Spanish, Latin, Greek, besides Chemistry, Botany, Physiology, &c., and you cannot fail of coming home a better and wiser man. But avoid all gambling, be it billiards or cards, for the Italians are crack players at the former, and rather too strong for an Englishman at the latter. Above all, do not let the delightful softness of the climate superinduce a like softness in your purpose.—S. BOTTONE.

[12039.]—**The Pressure of the Wind.**—This question is put in a wrong form. The intention is, I will assume, to ask what effect the wind of a given force, acting at right angles to a plane surface one foot square, would have in moving it horizontally, supposing it to be laid flat and horizontal, and taking no account of the thickness of its edges. And then the questioner, in the latter part of his question, assumes that the wind acts obliquely to the surface of the plate. But this is a form of "begging the question." If the plate in the first instance is to be supposed to be at right angles to the direction of the wind acting horizontally, then there is no oblique action at all. The action of the wind blowing horizontally upon a flat and horizontal surface, tending to move it, is that of friction only. In order to determine what the force of friction would be we must know the velocity, and this is not stated. It is left to any answerer to guess, or assume, what velocity would correspond to a pressure of 1lb. per square foot. Let the inquirer tell us what is the velocity of a wind that will exert a pressure of 1lb. per square foot, on a surface placed at right angles to its direction, and then one may be able, by reason of mechanical laws, to say with what force such a wind would tend to move a plate horizontally.—C. S.

[12039.]—**The Pressure of the Wind.**—A late number of the *Mechanics' Magazine* contains a series of experiments on this subject. An inclined plane having an inclination to the horizon of 15°, experienced an upward pressure of about four times as much as the horizontal resistance. We might have expected such results from the theory of the resolution of forces. When $\theta = 15°$, cosine θ^2 is about four times as great as sine θ. I do not think that the wind blows in a horizontal direction, but at a slight angle downwards.—PHILANTHROPIST.

[12041.]—**Burnishers for Brasswork,** either for use in the lathe, or at the vice by hand, are nothing more than pieces of steel hardened, polished, and coloured on an emery top, and of the shape suitable for the description of work. Brass is lacquered after it is burnished to prevent its tarnishing.—W. ALLAN.

[12045.]—**Analysis.**—In order to determine the relative quantities of sulphur and beeswax in the mixture which your correspondent "Lictor" wishes to analyse, the only accurate method will be to convert the sulphur into sulphuric acid, and then into sulphate of barium, and from that to calculate the amount of sulphur present. In order to effect this, weigh out (say) 100 grains of the mixture and add pure nitric acid, then warm and add gradually portions of chlorate of potash. So soon as the sulphur is oxidised add hydrochloric acid and evaporate almost to dryness, and then filter. To the filter add a quantity of water, and then a solution of chloride of barium and boil; allow to stand till almost cold, then pour the clear liquid upon a filter (the amount of ash which is left on burning being estimated); add a fresh quantity of water, and repeat the operation several times; and, lastly, pour the precipitate upon the filter, dry, and ignite upon a platinum or porcelain dish; allow to cool, then add a few drops of sulphuric acid, and heat gradually; then weigh. From the following data the amount of sulphur may be calculated. 233 parts of sulphate of barium = 32 parts of sulphur.—ANDREW F. HARGREAVES.

[12047.]—**Radius of Sector.**—If it be a sector—that is, if the two cuts would meet at the common centre of the curves—their radii are in the same ratio as their lengths, or the lengths of their chords. "T. E. G.," therefore, has only to work the "rule of three" sum:—As the difference of the two chords (or of the two curves) is to the outer chord (or outer curve, as the case may be), so is the difference of the two radii to the outer radius.—E. L. G.

[12048.]—**Trip to Ireland.**—Black's or Bradshaw's Guides to Ireland, and tourists' handbooks. I forget the exact titles.—PHILANTHROPIST.

[12050.]—**Socotrine Aloes.** — Any intensely-coloured, but transparent (or non-opaque) body, necessarily, by the laws of optics, appears of deep colour in the mass, but a very pale shade when ground small. Thus, you may grind the deepest blue glass used ornamentally (or any mock gem, or real either) into a nearly white powder. The blue glass ground to make even the palest smalt blue is in the mass merely jet black. Dry gamboge will illustrate the same fact, being slightly transparent, but with the singular property of turning opaque when wetted.—E. L. G.

[12055.] — **Works on Pedal Playing.** — The most useful studies out for the pedals are those by W. T. Best, Esq., Organist, Albert Hall, Kensington, and St. George's Hall, Liverpool. Novello and Co. Price 12s. If "A Struggling Organist" wishes to master the pedals, get the book, learn the first study before the second, attend to the directions given, and by the time he gets to the last study, he will find no difficulty in any pedal obligato he may meet in organ music.—YORK.

[12055.]—**Works on Pedal Playing.**—I don't think you could have a better book for instructions on playing the pedals than George Cooper's "Introduction to the Organ for the Use of Students." Price 6s. Rinck's are also very good. Cooper's may, perhaps, be out of print, as I have had mine about ten years.—W. H. SKELTON.

[12056.]—**Echo.**—A curtain of thick woollen cloth, hung from the point, and fastened to the sides of the roof, will stop the echo complained of. "J. T. O." must find out by experiment the depth required, as, of course, that will depend upon the height of the building, &c.—SACRISTAN.

[12058.]—**Bees.—Swarm or Brood.**—It is just possible that a swarm of bees has taken possession of the hive, but the great probability is that the hive contained a quantity of honey which some neighbouring bees have been plundering, hence the busy appearance. It would be absurd to suppose the heat of the sun in June could revive the bees that have perished of cold in the previous winter. If a swarm has taken possession "C. R. H." will observe the workers bringing home loads of pollen on their legs in fine weather, when we get any, and the bees will remain in his hive all night, but if they are robbers they will bring nothing to the hive at all, and except a few benighted or benumbed bees none will be left in the hive after dark. It was culpable carelessness, at least, on the part of "C. R. H." to leave a hive in which bees have perished, and which might contain the germs of disease, to be preyed upon by a neighbour's bees; but if "C. R. H." placed it on its stand to become, as it were, a trap to catch a neighbour's swarm, the action was simply dishonest.—C. N. ABBOTT, Hanwell, W.

[12061.]—**Chemical.**—Chlorate of potassium is easily distinguished from chloride of potassium, as the former does not form a precipitate with nitrate of silver, whilst the latter produces a white curdy precipitate, which turns blue in the daylight, and is entirely soluble in liquor ammoniæ.—F. T.

[12061.] — **Chemical.** — In answer to "Emily Jane," chlorate of potash (or, more correctly, of potassium) when melted in a test-tube evolves oxygen, and a match dropped into the hot liquid deflagrates vividly. With concentrated sulphuric acid the solid salt gives a deep yellow explosive gas, possessing bleaching properties, while the chloride evolves hydrochloric acid gas, reddening litmus paper and soluble in water. The solution of a chlorate gives no precipitate with nitrate of silver, but a chloride produces white, curdy, silver chloride, insoluble in nitric acid, and gradually darkening in the light. Consequently, if the chlorate contain chloride, which is often the case, a precipitate will be produced on addition of silver nitrate. To detect small quantities of chlorate in solution, and in the absence of chloride, acidify with dilute sulphuric acid, and make blue with solution of indigo. Then add gradually a solution of sulphurous acid or sodium sulphite. In the presence of a chlorate chlorine will be liberated, which will discolorise the indigo; excess of sulphite will prevent the reaction. If a chloride be present in a liquid together with a chlorate, they are best detected as follows:—Add nitrate of silver to the solution, and filter from the precipitated chloride. To a solution of sodium sulphite add nitrate of silver till a permanent precipitate is produced, then add dilute nitric acid till clear. Mix the solution with the filtrate from the chloride of silver, when a fresh precipitate of chloride of silver will be produced if chlorate is present. The precipitation is immediate and complete on heating, but only occurs slowly in the cold. If sulphate of silver and sulphuric acid are employed instead of nitrate and nitric acid the test is still more perfect, and the presence of nitrate may readily be detected, if desired, in the filtrate from the second precipitate of silver chloride.—ALFRED H. ALLEN.

[12061.]—**Chemical.**—In reply to "Emily Jane" (p. 313) potassium chloride may be distinguished from the chlorate by precipitating it with nitrate of silver, which will leave the chlorate in solution.—J. BOSKELL.

[12062.]—**Induction Coil.**—1. It is indifferent which way you lay the secondary wire; but it is usual to coil it in the same direction as the primary. 2. Yes, when you have laid one coil from end to end varnish it, when dry cover it with a layer of gutta-percha, and then proceed to lay on another coil. Full illustrations have been given in back numbers.—S. BOTTONE.

[12072.]—**Magnetic Moment.**—The quotation which "Beacon Lough" wishes explained is one which presupposes that the reader understands the technical mathematical term "moment," and of the readers of Ferguson probably not one in a thousand does this. The *moment* of any agency is its relative power in some especial application; the *moment of a magnet* is its power to return to its position of N. and S. after disturbance, or rather the force required to deflect it from that position; this depends on the actual intensity of the magnetism, and also on the length of the magnet—*i.e.*, the leverage exerted by its energy supposed to be concentrated in its poles (not its ends). As this is comparative any units may be used; but the absolute units are the only ones desirable to employ.—SIGMA.

[12073.]—**Scarlet Runners.** — Scarcely worth while, even if possible, these beans being so peculiarly subject to thermometrical changes.—HENRY NEWMAN.

[12078.] — **Cabbage Planting.**—**Rhubarb.** — I would advise George Richardson to obtain seed of the Early Dwarf York, as one of the best early cabbages. If his garden is in an exposed situation, and in the North of England, I say do not plant cabbage in winter, as they very rarely grow to any size. Dig in manure in autumn, and let the ground lie in a rough state all winter, and merely turn the top soil over when he puts in his plants. When he is digging in the manure he may trench it to the depth of 18in. As to rhubarb, it ought to be planted in autumn and watered freely with soapsuds.—BED OF STONE.

[12079.]—**Detonating Crackers.**—A small piece of fulminate of silver is mixed up with small pieces of gannister. When thrown upon the ground the friction upon the fulminate causes the explosion.—ELECTRIC.

[12080.]—**Analysis of Manures and Assaying for Certain Metals.**—This is a commercial query, and crept in by mistake. "X. Y. Z." must ask for his information through an advertisement, and he will get replies.—ED.

[12081.]—**Chemistry.**—In answer to "Molecule," for the detection of phosphoric and arsenic acids, make a solution of ammonium molybdate in water, or boil molybdic acid with ammonia. Add this solution to moderately strong nitric acid, taking care that the nitric acid is in excess; filter if necessary. This solution when added in plenty to any acid liquid containing a phosphate or arseniate produces a yellow precipitate, which is promoted by stirring with a glass rod, the precipitate having a tendency to become deposited in streaks on the sides of the vessel wherever the rod has touched. Moderate heating much promotes the precipitation. If much hydrochloric acid is present in the solution to be tested, it is best to evaporate to a small bulk with some nitric acid before applying the test. Silica, when present, should be separated by evaporation to dryness and re-solution in nitric acid. The test is very delicate and reliable when carefully performed, and is especially adapted for detecting small quantities. To ascertain whether the yellow precipitate is due to arsenic or to phosphoric acid, filter off the liquid and wash the precipitate with a little cold water; then pour ammonia on it, in which it will dissolve. To this liquid add a clear mixture of chloride of ammonium, ammonia, and sulphate of magnesium, and stir well with a glass rod. Streaks will be produced on the sides of the tube. Decant the fluid into another tube. Wash the streaks well with distilled water, and then pour in some nitrate of silver (free from acid). The streaks will become brown if arsenic acid is present, but yellow if produced by phosphate. If both be present together, gradual addition of weak acetic acid will dissolve the yellow first, and the brown colour will become better developed. If further confirmation be required, the liquid decanted from the streaks may be filtered, the precipitate washed with cold water, and dissolved by pouring dilute hydrochloric acid over it. Add sulphite of sodium to the solution, boil well, and treat with sulphuretted hydrogen, when any arsenic will be thrown down as a yellow precipitate, while phosphate will remain in solution. Arsenic and phosphoric acids present the closest resemblance, and the above reactions are the only ones by which they can be distinguished, and in the method described they are employed in the best manner. By following the directions carefully, "Molecule" may insure success. If the molybdate solution and magnesia mixture are kept ready prepared, the process is not a long one. At any rate, it is the shortest there is for the given conditions—namely, acid liquors containing various metals in solution. If "Molecule" meets with any difficulty from the presence of antimony or tin, I can help him out of it.—ALFRED H. ALLEN.

[12081.] — **Chemistry.** — Arsenic will be distinguished most often by the red yellow precipitate it forms with sulphuretted hydrogen, the red precipitate it forms with nitrate of silver, and still better by the ring it produces in the Marsh apparatus. For the research of phosphoric acid try the action of magnesium sulphate, which produces a white crystalline precipitate soluble in acids; that of nitrate of silver which forms a yellow precipitate, soluble in ammonia and diluted nitric acid; and that of molybdate of ammonium, which produces in a solution of phosphate acidulated with nitric acid a yellow precipitate, which appears sometimes immediately, sometimes after a moderate heat has been applied to the test tubes.—F. T.

[12086.]—**Velocipedes.**—Guttapercha cement will answer "Bob C.'s" purpose. He can get it where shoemaker's materials are sold, and the shopkeeper will tell him how to use it. Half-round rubber is much better than flat. This cement will last for hundreds of miles, and when it gives out can be renewed in a few minutes.—SACRISTAN.

[12088.] — **Cleaning Jewellery.** — Probably jeweller's rouge.—ELECTRIC.

[12089.]—**Felt Hats.**—Perspiration, or grease, or both, soaks through. Dissolve some ammonia in warm water, and wash the hats with it, using a piece of cloth, black or light according to the colour of the hat. —SACRISTAN.

[12094.] — **Preserving Caterpillars.**—Kill the caterpillar by immersion in boiling water. Cut a small slit at the posterior segment, from which you must extract the intestines and fatty matter. Fill up with cotton wool, which has been previously soaked in an alcoholic solution of camphor and mercury bichloride. This is about the best means known, but it is very unsatisfactory.—S. BOTTONE.

[12097.]—**Venetian Blinds.**—Procure some ordinary paint, and add spirit of turpentine till the paint is very thin indeed, then lay it on in the usual way. Blind-makers dip the laths into the paint; but unless "F. A. R." has a great many laths to colour, I think he had better not do that. At least three coats will be required; then varnish in the usual way.—SACRISTAN.

[12098.]—**Dandelion Roots.**—I am not a medical man, so that I should not feel justified in recommending anything of which I had not personal experience. With regard to Taraxacum, or dandelion, it is usually held to be an excellent remedy for the disease mentioned by my interlocutor. But I should certainly not advise him to make his own extract, as that necessitates the use of a vacuum pan. Let him go to some respectable manufacturing chemist, such as Morson, Bell, Burton, &c., and ask for extract of taraxacum, and he will get a much better article than he could possibly prepare, at a very low figure. The process usually adopted in its preparation consists in washing the roots, crushing them between rollers, expressing the juice from the pulp by means of a screw or other press, and finally evaporating the juice in a vacuum pan, until it attains the consistency of stiff jam.—S. BOTTONE.

[12099.]—**To Advanced Chemists.**—Drink large quantities of pure milk, after it has become sour, as the lactic acid which has been thus produced forms with magnesia a compound soluble in water. This remedy has very often been applied with success by Prof. Bouchardat, of the Faculty of Medicine in Paris. —F. T.

[12100.]—**Venomous Serpents.**—The "snake stone," and every other so-called antidote that could be obtained, was tried in India and found useless. It should be mentioned, however, that they were tried on cases in which there was no doubt the poison had been injected. The case which "Cireb" refers to as having witnessed was probably one of many in which no venom was ejected by the cobra: hence the recovery. I believe there is a reward offered for the discovery of an antidote, and if "Cireb" is acquainted with one he can claim the money and make himself famous. The appalling number of deaths annually occasioned by snake bites in India would seem to contradict the notion that any snake stone or snake bean is successfully employed as a remedy. Further and complete information on what has been done in the matter will doubtless be furnished in the monograph of the "Indian Thanatophidia," by Dr. Fayrer, which I see is announced to be shortly published.—SAUL RYMEA.

[12105.]—**Equation.**—1st.—$x^2 + xy = 28$. 2nd. $xy - y^2 = 3$. From the 2nd, $x = \frac{(y^2 + 3)}{y}$. Substituting this for x in the 1st, $\frac{(y^2 + 3)^2}{y^4} + y^2 + 3 = 28$, $\therefore \frac{(y^2 + 3)^2}{y^2} = 25 - y^2$, $\therefore (y^2 + 3)^2 = 25\,y^2 - y^4$. Squaring the first part, $y^4 + 6\,y^2 + 9 = 25\,y^2 - y^4$, $\therefore 2\,y^4 - 19\,y^2 = -9$, $y^4 - \frac{19}{2}\,y^2 = -\frac{9}{2}$, $\therefore y^4 - \frac{19}{2}\,y^2 + \left(\frac{19}{4}\right)^2 = \frac{19^2}{4^2} - \frac{9}{2} = \frac{17^2}{4^2}$, $\therefore y^2 - \frac{19}{4} = \frac{17}{4}$. $\therefore y^2 = \frac{36}{4} = 9$, $\therefore y = 3$. From equation 2nd, $3x - 9 = 3$, $\therefore 3x = 12$, $\therefore x = 4$.—SUMMA.

[12105.]—**Equation.**—1st.—$x^2 + xy = 28$. 2nd.—$xy - y^2 = 3$. Let $x = vy$. Then (1st) $v^2 y^2 + vy^2 = 28$, $y^2 (v^2 + v) = 28$, $y^2 = \frac{28}{v^2 + v}$. 2nd.—$vy^2 - y^2 = 3$, $y^2 (v - 1) = 3$, $y^2 = \frac{3}{v - 1}$. $\frac{28}{v^2 + v} = \frac{3}{v - 1}$. $3\,v^2 + 3\,v = 28\,v - 28$, $3\,v^2 - 25\,v = -28$, $v^2 - \frac{25}{3}\,v + \frac{625}{36} = \frac{625 - 336}{36} = \frac{289}{36}$, $v - \frac{25}{6} = \pm\frac{17}{6}$, $v = \frac{4}{3}$ or 7. Then $x = \frac{4}{3}\,y$ or $7\,y$, $\frac{16\,y^2}{9} + \frac{4\,y^2}{3} = 28$, $\therefore y = 3$, and $x = 4$; or $49\,y^2 + 7\,y^2 = 28$, $\therefore y = \sqrt{\tfrac{1}{2}}$, $x = 7\sqrt{\tfrac{1}{2}}$.—WILLMOTT HENDERSON.

[12105.]—**Equation.**—All simultaneous homogeneous equations can be solved by putting one variable equal to a multiple of the other. Let $x = yv$ solve with respect to v. If you find such easy equations as this too hard for you get the key to the book. —MATHEMATICIAN.

[12108.] — **Confusion in the Head.** — Let "Agent" try half-rations, or at least abstinence from meat and beer (especially stout and porter) once a week, and get all the fresh air and exercise he can. An occasional dose of Epsom salts will do him good.—SACRISTAN.

[12109.]—**Old Locomotive Tubes.**—Plug one end, fill with molten lead. When cold, bend as you require. Then apply sufficient heat to melt out the lead.—S. BOTTONE.

[12110.]—**Silver Plating.**—If "Electro" will place his solution into a large open pan and then add sulphuric acid very carefully the silver will be precipitated in the form of sulphate of silver. When it is settled he may pour off the supernatant liquor, collect the sulphate, dry it, and then send to the refiners. Perhaps the cause of the silver depositing brown is, if a bright solution, an excess of bisulphide of carbon. Remove the gold by the porous cell process, when the gold will go into your gilding solution. If "Electro" lives in the neighbourhood of Sheffield, I shall be very glad to put it to rights for him gratis.—ELECTRIC.

[12115.] — **Battery.** — The description of my arrangement of battery shall be given at an early date in my papers on "Electro-metallurgy" now commenced. It has given me great satisfaction.—SIGMA.

[12124.]—**Voice Weakness.**—Speaking and singing loud are good, but you can't sing to the accompaniment of a "light catarrh." Is the fault occasional or constant: in the larynx or lungs?—HENRY NEWMAN.

London Association of Foremen Engineers. —At the last monthly meeting, on Saturday, June the 1st, Mr. J. Irvine, vice-president, in the chair, a paper on cast iron was read by Mr. Laird. The main points touched upon and considered were the effects of contraction from cold and expansion from heat, the laws which regulate the action and reaction of cast iron under the conditions of motion and rest, the bearing of chemical equivalents on mixtures of metals, and the improvements to be effected in the cooling of molten metal as well as the ameliorations of form desirable in castings. The paper was discussed by several members, and the discussion ultimately allowed to stand over until the next meeting, on Saturday, July the 6th. The candidates, Mr. W. Daubney and Mr. W. Ladley, were elected members of the association. Mr. Charles Leager was put into nomination.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Hedera" has answered 11416, 11652; Henry Blake, 11529; "Monte Christo," 11625.

11734 Engine Counter, p. 184
11735 Gilding on Glass, 184
11740 Potash Salts, 184
11742 Painting Iron Bedstead, 184
11745 Watch Keys, 184
11746 Coil Construction, 184
11753 Crucible for Quartz, 184
11754 Polishing Diamond, 184
11755 Tempering Charcoal Iron, 184
11757 Boring for Coal, 184
11758 English Mechanic Colony, 184
11759 Oil Painting, 184
11763 Watchmaking, 184
11766 Piano in Canada, 184
11769 Tricycle, 184
11771 Varnish, 184
11773 Cleaning Plain Blue Silk, 184
11775 Tugboat for River Wye, 184
11776 Commercial Geography, 184
11778 Sweeping Machine, p. 185
11779 Photographic—To "Iodide," 185
11780 Machinery for Cutting Envelopes, 185
11782 Band, 185
11783 Molten Lenses, 185
11787 Electric Signal Bell, 185

QUERIES.

[12126.]—**a Draconis.**—Will "F. R. A. S." oblige me by referring to query No. 11716, which he kindly answered on p. 171? Then, however, I did not obtain the answer I required. I took my idea from the following passage, which is from a paper by P. Smyth, on the Great Pyramid. Will "F. R. A. S." kindly explain it? "The writer ascertained also that the entrance passage had been pointed at a Draconis when crossing the meridian below the pole, at a distance of 3° 42' therefrom." But the question which puzzled him was, "which of the two times of the star being that distance from the pole, could have been the one intended to be typified?" For two such conflicting times there were, seeing that the star's closest approach to the pole, and within only ten minutes thereof, occurred near the year 2800 B.C.; and on that account, both 600 years before such date, equally with 600 years after it, the star must have reached (though on opposite sides) by its uniform "precessional displacement, the typical 3° 42' indicated by the entrance passage." It is the latter part which I wish particularly to have explained.—J. X. T.

[12127.]—**Herbs.**—Can any one recommend to me a good (cheap) work on the medicinal properties of the common English field herbs?—HEDERA.

[12128.]—**Portable Dark Tent.**—Will some of your numerous readers favour me with instructions for making a portable photographic dark tent, for working small plates in? Any hints as to the construction, material for covering the person, mode of applying it, &c., will greatly oblige—OCCASIONAL PHOTO.

[12129.] — **Fire Bars.** — Will some correspondent inform me whether cast-iron fire-bars last longer than wrought-iron bars, and why the latter are always used in locomotives and never in stationary or marine boilers? The fusing point of cast iron is, no doubt, less than that of wrought iron; but some authorities state that cast iron resists the wasting action of heat and flame up to a certain point better than wrought iron. Perhaps the chemical properties of the coal have something to do with the duration of the bars, and will affect cast iron less than wrought. Does Welsh steam coal of the best quality require a less air space between the bars, or a greater one than wrought iron?—ROBERT JOHNSON.

[12130.]—**Electricity.**—Will some one of your electrical correspondents be so good as to inform me to what extent a current of electricity from a common machine is similar to one from a galvanic battery? How far will it produce the same effects?—E. T. S.

[12131.]—**Electricity Applied to Engraving.**—Has electricity been applied to engraving and copying writing? If not, I should like the opinion of correspondents on a suggestion. Suppose a metallic plate, thinly coated with wax, to be subjected to the action of a galvanic battery (the engraving or writing being previously drawn with a steel point to remove the wax on the parts to appear in the engraving), we should have a deposit of copper, &c., in relief, and the plate, when taken from the battery and the wax removed, might be printed from as in a wood engraving.—PHILANTHROPIST.

[12132.]—**Polariscope.**—I have endeavoured to construct a polariscope thus:—I have arranged two layers of crown glass plates (16in. each) at an angle of 56° 45' in two different pill boxes, holes about the size of sixpences being cut in lids and bottoms of the boxes, but upon revolving either layer the light at 90° or 270° is but slightly dimmed. I have placed various crystals between the analysing and polarising layers, but can get no colours. I wish, if possible, to do without tourmaline, selenite, or Nichol's prism. Should dimness or perfect darkness be produced at 90° and 270° by revolving either analyser or polariser? Should the tubes be blackened inside? Can brilliant colours be obtained by simple brindles of glass, arranged at 56° 45'? If so where do I fail? Pray help the—NEEDY.

[12133.]—**Hard Water.**—The water from the well in my house is very hard, and a medical man gives it as his opinion that it will cause gravel, if used for drinking purposes. Can anything be done to it? Will Condy's fluid be of any use?—J. PEARCE.

[12134.]—**Restoring Brass Wire.**—I have about a ton of brass wire, varying from Nos. 8 to 16 in thickness, but which has been exposed to the air and is now rotten

Are there any means to bring it back to its former state of quality?—KEIGHLEY.

[12135.]—**Chest Expander.**—I am in the habit of using a chest expander, but I find that after using them a short time they generally break at the junction of the indiarubber with the handle. Will "Jack of All Trades" or some of "our" mechanical contributors kindly tell me how to make one to act by the compression of a spring, and to be capable of being set to suit different degrees of strength?—THOMAS SOUTHWELL.

[12136.]—**Monkey or Jamaica Nut.**—What is this nut's real name? I have planted a few of them, which have now sprung up; they grow very quickly; the nut is of a yellow-brown colour, rough, and is like a small sausage, 1in. long, and slightly squeezed in the centre. It generally contains two kernels, which taste like an uncooked broad bean and are situate at each end. The leaf is lilac-shaped and is made of three petals or branches. Will the plant outlive an English winter?—J. D.

[12137.] — **Liquid and Solid.** — What are the generally received definitions of the words liquid and solid? In a book before me mercury is called a solid, while in Ganot's "Natural Philosophy," it is ranked with the liquids.—C. P. E.

[12138.]—**Chemicals that Absorb Moisture.**—Will some one give me a list of chemicals that absorb moisture from the air? Not such as lime, which does not thereby become damp, but such as become and remain wet from the moisture absorbed.—LXXXVIII.

[12139.]—**Mechanical Education.**—Will you or any of your readers inform me of a school where they give a thorough practical mechanical education?—QUADRANT, Nottingham.

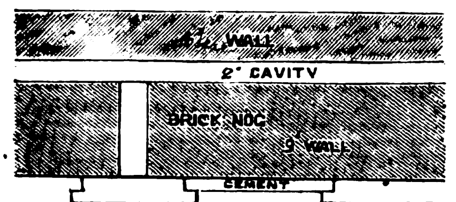
[12140.]—**Chemical.**—Can any one tell me if the mode of making potassium by Professor Dolbear, and described in last week's MECHANIC is at all dangerous? I have hitherto understood that it is not the cost of the materials so much as the danger incurred in making it that is the reason of its being so dear. Also, how would it be separated from the coal-oil completely, so as to be fit to use?—J. S. HOYDES.

[12141.] — **Watchmaking.** — Will "A Yorkshire Pivot" kindly inform me how to put an isochronous hairspring to a lever watch? Also, how to put a new jewel hole in the 'scape wheel cock of a Geneva watch?—NO AMATEUR.

[12142.]—**Leaky Tubes.**—What is the proper way to stop the tubes leaking in a portable engine, firebox end. The tubes are very good?—F. G. R.

[12143.]—**Cayenne.**—I have to pack occasionally a gross or two of small packets containing cayenne. I generally have a cold after it, caused, I believe, by the cayenne. Can any of your readers give a plan so that I can escape its disagreeable effects? It also causes me to sneeze very much.—J. G.

[12144.]—**Timber Houses.**—I shall feel obliged if some of your numerous readers will inform me of the



7×7¾ REBATED TO RECEIVE CEMENT

best mode of constructing half-timber framing for outside walls, giving the best method of keeping the weather from the interior. I propose doing it thus—BEE.

[12145.]—**Small Steam Boiler.**—I have a table engine, cylinder depth, 5¼in.; bore, 2¼in. Would any brother reader state through the columns of the MECHANIC the dimensions of the boiler I should require to drive it with facility? Also best shape, thickness of copper, whether riveted or brayed, and probable cost?—J. R. C.

[12146.]—**How to Procure a Patent.**—I have constructed a new apparatus which I am desirous to protect by letters patent, but have no means to employ a law agent. Will any of my fellow subscribers to this journal kindly inform me how I may proceed to obtain a patent myself? and they will greatly oblige—G. Y.

[12147.] — **Cochineal.** — The other day I made a fixateur for the hair, after a recipe in Beasley's "Useful Druggists' Receipt Book," adding mucilage of trajacanth to a solution of cochineal in spirits of wine, scenting with otto of roses. Instead of being coloured red as one might expect, the resulting compound was of a dirty grey colour. What was the cause of this?—D. N. E.

[12148.]—**Boiler Query.**—I have a boiler of sheet-iron three-sixteenths inch thick, riveted with ½in. rivets 1in. apart, 2ft. 6in. high, 1ft. 10in. diameter, with six tubes of 1in. internal diameter of iron external fire-box. What is the greatest pressure it is safe to work at, and what horse-power is it?—LANCA.

[12149.]—**Fellmongering.**—Will any readers inform me how wool is taken off sheepskins by means of spirits, or recommend a work on "Fellmongering?"—CAPE COLONY.

[12150.]—**Photography.**—Could any subscriber of practical experience advise an amateur which would be the best process for him to adopt—viz., the old plan of collodion and silver bath or the new collodio-bromide process? I should work either process in the wet state and chiefly for portraiture. A hint or two as to the advantages and disadvantages of either process and short working details, would oblige—TRIPOD.

[12151.] — **Concrete Engine Beds.**—I wish to know if there are any concrete engine beds in use, and, if so, how do they answer? Are they as substantial and firm as those of ashlar stones? Does the concrete take long to set?—NORTH-WEST YORKSHIRE.

[12152.]—**Dyeing Raw Cotton.**—Would some of "our" brother readers kindly inform me the cheapest and quickest way to dye raw cotton a good black, if possible, by only one immersion in the dye?—F. E.

[12153.]—**Ant Hill Earth.**—Could "Khoda Bux" kindly put me in the way of importing some of the ant-hill earth, mentioned a year or so ago by "Eos" (who for some reason seems at present eclipsed), as used by native jewellers, &c., as moulds for casting metals into? A quart or so would be sufficient. I will give my fellow readers the benefit of any success I may obtain by using it. In a former letter I mentioned 2 brick dust and 1 plaster as answering for brass, &c., and so it does, but I want something harder and not so friable as this mixture heated red hot becomes.—PROVEN.

[12154.]—**Coloured Printing Inks.**—Will "Zoo Andra" be kind enough to mention the name of the varnishes used in mixing the above?—H. W.

[12155.]—**The Suspended Shilling.—Another Reason Wanted.**—Like the problem of lifting heavy weights without difficulty, the following is an old experiment, but may, like that, afford food for the ingenuity of some of "our" experimentalists, in trying to discover the raison d'être. Tie a shilling to one end of a piece of thread, and hold the other end between the thumb and forefinger of the right hand; rest the elbow upon the table and throw back the hand so that the thread shall pass over the ball of the thumb, and let the shilling be suspended in the centre of an empty tumbler. Premising that the hand of the operator be perfectly steady, the shilling will in a few moments become perfectly steady also, and will maintain a state of rest for a moment or two, when it will assume the motion of a pendulum, increasing in velocity until it strikes against the sides of the glass, which it will do a number of times equal to that of the hour which is nearest at hand—*e.g.*, if the operation be performed at (say) a quarter to twelve, it will strike the glass twelve times; if at a quarter to one, only once. Its motion will then gradually subside until it again remains suspended at perfect rest, after which it will move no more. I have repeatedly performed this experiment successfully, and have witnessed others do the same. I have also seen others, whose hands appeared equally steady, utterly fail, the shilling persistently refusing to oscillate. The former part of the experiment may be explained, I imagine, by the action of the pulse, but how to account for the shilling striking the hour is the desideratum.—H. G. W.

[12156.]—**Mice Eating Peas.**—I have sown both peas and beans in my garden twice, but mice or something else eat them. Please say what would prevent these marauders doing so.—SEAGOE.

[12157.]—**Smell of Paint.**—Will some one be good enough to say what will take away the unpleasant smell of new paint?—SEAGOE.

[12158.]—**Packing Rings of Piston.**—Would Mr. J. C. Molton or any brother reader of "our" valued MECHANIC, tell me how to turn up and fit the packing rings to a piston? Mine is 3½in. diameter; are they merely sprung on for such size?—M. L. DODSWORTH.

[12159.]—**Lime Juice.**—Will Mr. S. Bottone or some chemical friend inform me what lime juice and lemon juice are made of, and how?—J. R., Leicester.

[12160.]—**Size of Iron Tool, &c.**—Thanks to Mr. Purkiss for the kind and satisfactory manner with which he has answered my questions, but I wish to trouble him once more. Will he be kind enough to say what proportion he finds best of iron tool to mirror? I may, perhaps, just say I am anxious to arrive at perfection with my mirrors, hence the reason of my troubling Mr. Purkiss. I have made some very good mirrors, and have one at present with which I can read (under favourable circumstances) the Inventor's column 180 yards distant.—OPTICAL BRICKLAYER.

[12161.]—**Mangle.**—Will some kind mechanic help me? I wish to make a mangle. I want the sizes of timber in the frame, length and width of frame, and what sort of wood would stand best. The sort I want is one of those that works with a chain.—MANGLE.

[12162.] —**Machine Punches.**— Will any reader kindly give a short description of any machine punches other than the lever, the screw, and that exerting force by an arrangement of cog-wheels?—TRY AGAIN.

[12163.]—**Meerschaum Pipes.**—Will "Zeta" describe the process of re-waxing a pipe? Can it be done by a non-professional? Also, how can I remove the colour from a pipe, which has not coloured nicely?—W. ALLAN.

[12164.]—**Temperature of the Planets.**—In the article on "Jupiter" in the number for May 24, p. 244, it is assumed that an intensely heated planet is "unfit to be the abode of living creatures." Are there any scientific grounds for believing that our own temperature is the only one suited for living beings, or the best one? Does the great heat of Mercury, for instance, preclude that planet from swarming with creatures as delicately and wonderfully adapted to surrounding conditions—of which temperature is only one—as we are ourselves?—TELLUS.

[12165.]—**Cream Cheese.**—Will some subscriber kindly inform me how to make a good cream cheese? Also, how to prepare or make rennet for the same?—FLAX DRESSER.

[12166.]—**The Enfield Rifle.**—Why is the Enfield rifle bored out to ·577 of an inch?—WILLIAM MILLAR.

[12167.]—**Dry Soap.**—I should be very glad to know, through the MECHANIC, the ingredients of, and *modus operandi* requisite to produce, the dry soap, such as Shaw's, now so much in use.—AN OLD WESTON SUBSCRIBER.

[12168.] — **Limelight or Electric-light for Magic Lantern.**—The Committee of a Young Men's Christian Association are desirous of obtaining replies to the following queries from one of the many readers of the MECHANIC who has had practical acquaintance with the matters inquired of:—1. The first cost of a superior single and double lantern with limelight, and also with electric light, all necessary apparatus to be included. 2. The cost of working each for each occasion on which it might be used. 3. Which is the cleaner and more easily worked? 4. The advantages and disadvantages of each kind. 5. How many cells would be required for the electric light, and which kind of cell the best? 6. To what other uses could the electric light be put that the limelight could not? Any other information that might seem necessary would be thankfully received.—HON. SEC.

[12169.]—**"E. L. G." and the Yorkshire Wold-Combes.**—May I ask "E. L. G." (1) how the "Lyellists" account for the Yorkshire wold-combes? (2) How does he account for them?—HEDERA.

[12170.]—**Dyeing.**—Can any reader inform me if there is an association for the special instruction of dyers in the chemistry of dyeing, in any town in the United States? If so, where?—JEUNE TEINTURIER.

[12171.]—**Utilising Chemical Products.**—Will Mr. Bottone, "Sigma," or any other competent kind friend, inform me of a method to save the following valuable products, which I am convinced ought not to be thrown away? In electro-plating establishments silver is stripped from articles by means of saltpetre in hot sulphuric acid, and then precipitated by common salt. I am not a chemist, but I suppose when the chloride of silver is taken from the solution, there remains nitrate of soda and sulphate of potash diluted with about eight times their volume of water. How can I crystallise out these salts to pay? I should like to take them out in the form of caustic potash and soda if possible. Can it be done by means of lime?—SUBSCRIBER.

[12172.]—**Constipation.**—As a regular subscriber may I ask for advice of your numerous and talented correspondents for the following:—I am a dreadful sufferer for most obstinate constipation. Perhaps some of your correspondents have received relief from this annoyance, and would gladly give their experience for the benefit of a sufferer. I have been under eight doctors, and they give me no relief—at least only temporary.—H. S. A.

[12173.]—**Coloured Ink.**—I have used Judson's dyes, which I find advertised in the ENGLISH MECHANIC, to make various fancy inks with, yet they all seem to want lustre when they become dry on the paper. I would be glad if some correspondent would tell me what to add to impart this required quality.—E. B. F.

[12174.]—**Agriculture.**—I am anxious to know how to discern between red clover and American cow-grass, and beg to submit the query to the kindness of some of "our" agricultural readers. These grasses, so seemingly alike in appearance, are strangely different in the effects they produce on cattle fed on them. The cow-grass may be eaten with impunity, but the red clover, if eaten to excess, generates such quantities of gas in the cow's stomach, that it swells to an immense size, ruptures and bursts, so that the cow dies speedily.—E. B. F.

[12175.]—**Soundboard.**—"The Harmonious Blacksmith" has told us that the tones of a musical box can be increased in loudness by placing the instrument on a soundboard. Will he kindly say what size, and how I am to construct a soundboard suitable for a musical-box which is about 2ft. in length by 8in. square and would it not be better to take the mechanism out of the box, and screw it directly on the board?—E. B. F.

[12176.]—**Hydrogen Flame.**—I want to procure a good hydrogen flame, and for this purpose I have frequently put zinc with sulphuric acid and water, into a bottle fitted with tube, with small bore as directed in books; but I have invariably been rewarded by an explosion of the whole affair, and though I have repeatedly tried, I have always failed to attain my desire. I wait some time for the air to escape, but it is no use. I am well acquainted with the theory, but very deficient in practice. Perhaps "our" practical friends can help me. I desire to express my thanks to "F. R. A. S." for his kind answer to my inquiries respecting Jupiter.—WHITAKER.

[12177.]—**Algebra.** — In Todhunter's "Algebra," section 147, the author says that the expression

$$\frac{a}{(a-b)(a-c)(x-a)} + \frac{b}{(b-a)(b-c)(x-b)} + \frac{c}{(c-a)(c-b)(x-c)}$$

may be written

$$-\frac{a}{(a-b)(c-a)(x-a)} - \frac{b}{(a-b)(b-c)(x-b)} - \frac{c}{(c-a)(b-c)(x-c)}$$

Will some fellow reader kindly explain how this transformation is effected, and give the rule?—W. M.

[12178.]—**French Magazine.**—Can any subscriber to "ours" give me the title, price, and name of the publishers of a French magazine combining science and light literature, like "Chambers's Journal"? The "Revue des deux Mondes" is too much of a political periodical.—W. M.

"JACK OF ALL TRADES."

SINCE we went to press last week we have received from—

	£	s.	d.
Solicitor	£1	1	0
G. H. G.	1	1	0
Curative	1	1	0
Manus	1	1	0
J. Halden	1	0	0
T. Wheatley and Rev. Gerard Smith	0	15	0
	5	19	0

We intended at first to confine the sum to £10, but as others have signified their desire to subscribe, we can have no possible objection. And if two others will send us £1 1s. each, we will transmit to "Jack" another cheque for £10 10s. "Jack" is at Matlock, and has been there a week, and is likely to derive much benefit from change of air and scenery, and the curative treatment he is undergoing. One reason why we willingly fall in with the desire to make the sum £21 in all, is that Jack has a large family solely dependent upon him for a livelihood.

After the £21 are subscribed the list will be finally closed. This must not be looked upon as a general subscription, but as a sum presented to a kindhearted, industrious, and deserving man, by a few brother readers who appreciate and respect him.

CHESS.

All communications intended for this department to to be addressed to J. W. Abbott, 7, Claremont-place, Loughborough-road, Brixton, S.W.

A gathering of chess players will take place at the Crystal Palace on July the 18th and 20th, under the auspices of the British Chess Association.

TO CORRESPONDENTS.

J. K.—You will see that we have availed ourselves of your smart little problem.

R. A. Proctor (Clapham).—We are much obliged for the problems, which shall receive our best attention.

Argo.—Your problem shall be examined. In the mean time have the goodness to forward your name and address.

A. R. Molison (Swansea).—The variation is wrong. If (1) K to Q Kt 7; (2) Q to K B 6 will not solve it, compare the published solution.

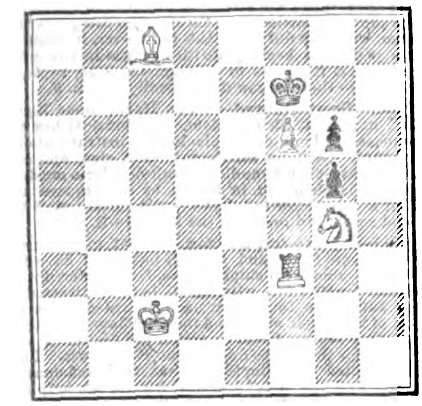
T. T. D.—Thanks. Next week.

F. Owden (Hoxton), and Wiseaf (Dulwich).—Problem No. 1 cannot be solved in the way you propose.

Correct solutions to Problem 1 have been received from R. A. Proctor; J. Beresford (Vauxhall); and C. D. (Clapham).

Problem II.—By J. Kling.

Black.



White.

White to play and mate in three moves.

Solution to Problem I.

White.	*Black.*
1. K to Kt 7	1. Kt to Q B 3 or (*a*)
2. Q to Q 5 (ch.)	2. Kt. takes Q.
3. Kt mates.	
	(*a*) 1. P to K. 3.
2. Q to B 8 (ch.)	2. K moves.
3. Q mates.	

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£335	12	1
F. Weatherh gg	0	1	0
Henry Newman	0	1	0
H. S.	0	2	0
	£335	16	1

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, June 11, and unacknowledged elsewhere:—

J E. Crowther.—J. B. Ward.—D. H. G.—Capt. D. F Allan.—Wm. Cooper.—J. M. Mayfield.—R. A. Proctor. —Charles Brewer.—B. C. Hughes.—H. B.—Geo. Sant. —Frank Mason.—H. T. Miles.—Rev. Gerard Smith.— E. Colling.—J. C. Lambert.—T. A.—Wm. Milroy.— John Bailey and Co.—Cunningham and Co.—Dr. T. C. Burton.—R. Starkie.—General Thompson.—S. Hewitt. —P. H. Gosse.—Shasloden.—Rev. J. C. Carrick.— W. L. Nash.—J. Hewitt.—E. W. Gadsby.—J. H. T.— S. H. B.—M. Paris.—E. L. G.—W. F. Potter.—495.—One Anxious to Learn.—F. M.—Aroma.—A Newport Lad.— En Avant.—H. B. E.—M. H. B.—M. N.—J. Marsden.— C. A. S.—Constant Reader.—E. H.—A. Woolsey Blacklock.—M. D.—Lenia.—A Subscriber.—A. R. Molison.— J. U.—Vulcanite.—Another Gray Beard.—R. Tausley.— J. Tolver Preston.—Canis Manor.—Scrutator.—Kelby. —T. H. F.—Cottager.—Trigo.—D. T. L. R.—W. Hooper. —J. W. Taylor.—Aleph.—Maica.—C. B.—A New Subscriber.—Gaucho.—W. Rose.—Rat-Tat.—Excelsior.— P. France.—W. Bush.—P. H. Holland.—J. T. B.—F. Packman, M.D.—E. B. Fennessy.—William.—W. S.— Henry Newman.—T. S.—W. H.—Young Student.—T. R. —Rev. T. W. Nichol.—Wondering Willy.—M. Pike.— Beacon Lough.—Henry Bailey.—Zoo Andra.—Tripod. —R. G. B.—Citrus.—W. H. T.—Noturb.—England.— J. C.—Joshua B. Rayner.—W. L. Pendered.—Francis M. Crichton.—Francis Weatherhoff.—R. Walker.— John Fielden.—John Hick, M.P.—Assoc. Inst. C. E.— Bisnatus.—W. H. Skelton.—The Harmonious Blacksmith.—A Constant Reader.—A Fireman.—Cyclone.— W. Marquand.—R. G.—A Sub.—R. Tervet.—R. S.— Amateur.—Jas. Ford.—John Hopkins.—R. C. T.— A. Tolhausen.—James Hastie.—An Old Subscriber.— Nemo.—Charles Watson.—X. Y.—Sheffield.—R. A.— A Plain Man.—G. H.—Flax Dresser.—Sheffield Blade. — C. J. Recordon. — Andrew Wilkie. — Dane.—An American Amateur.—Countryman.—Tom the Tinker. —W. Allan.—J. W. Fennell.—P. W. Wyatt.—Philo.—A., Liverpool.—A Practical Man.—J. Foster.—Manns.— H. Hargreaves.—B. R. B.—A. H. Allan.—A. J. V. G.— W. L. G.—J. F. E.—S. T.—Edward Slaughter.— C. H. W. B.—W. S. and H. M.—W. Bush.—H. G. M.— C. H.—Thetamu.—T. B.—W. R. Hall.

W. Smith.—Your reply is an advertisement.

W. P.—Consult our advertisement pages from time to time.

J. Wilkins.—There is some force in your observations, but correspondents must be allowed a certain amount of latitude. We decidedly question the wisdom of striking out every passage that might run against the susceptibilities of every reader. If such a policy were resorted to, our letters "to the editor" would lose much of their piquancy and charm, and become to a large extent "stale, flat, and unprofitable." Besides, no correspondent who has anything worth saying would submit to it.

E. W. R.—Not suitable. Try again, and if unsuccessful try once more.

G. H.—Have done with shams. Try and deal with realities.

R. B.—Your solution of the "Fifteen School Girls" is interesting, but we cannot afford more space for a consideration of the subject.

Communications which can only appear as advertisements to hand from Ovo, G. E. Crick, R. Whitham.

York.—Write T. R. Willis, who advertises in these pages, or some other manufacturer.

Neil Downie.—The advertisement is that of a quack.

J. F. Wilkinson.—You must put your first question more plainly before we can answer or insert it. For your second see indices to back volumes. Your third would occupy too much space; try the experiment yourself.

Nautilus.—By constant and reiterated application, and a determination not to be repelled.

Philanthropist.—We think not.

J. Barwick.—Your letter on Scientific Education is inadmissible, on account of its theological comparisons. It is, moreover, somewhat incorrect. In the matter of scientific education the State "helps those who help themselves." If you and a few of the leading inhabitants choose to form a school of science, and put yourselves in communication with South Kensington, you will obtain help and increased facilities. If none of your townsmen have sufficient energy or public spirit to move in the matter, don't blame the Government. Do we understand from one part of your letter that you think the public libraries of all towns should be entitled, like the four great libraries, to demand free copies of every book and newspaper published? We think not. At present the tax is comparatively insignificant, though even now it presses with some force on the authors or publishers of expensive works, but we protest very strongly against any such gratuitous addition to our circulation as you appear to contemplate.

F. E. D.—We do not know.

F. Perry, J. F., Great Walker, T. Baker, and Young Mechanic are referred to indices to back volumes.

James Cunliffe.—For different reasons we cannot undertake the responsibility of answering either of your questions. See indices to back volumes, for information on imperfect hearing.

Hobes.—There was no necessity for your second letter. If your request were particularly complied with, some one else would be disappointed. Though you have taken in the work for so many years, you have not sufficiently appreciated its character and purpose. Every attempt that has been made to supply "the mechanic class," as you call it, with an organ exclusively devoted to mechanics has failed; and if we followed your advice, we should most likely fail too. The English Mechanic is what the mass of its readers make it. It is based on the principle of *mutual* help. As a rule, each subscriber finds in it something he likes and other things he does not care for; and, as a rule, he contributes to its existence, not merely for his own sake, but for the sake of others. Though you have taken in fourteen volumes of the English Mechanic, you appear not to exactly understand its essence. You are a watch and clockmaker, and the English Mechanic contains week after week fragments of useful information on watchmaking. But there are watchmakers and watchmakers. Some are only interested in their craft; others like to know something of other industries and sciences, of the laws and constitution of nature, and of the motives and movements of man. It is for the latter section that the English Mechanic exists, and by them it is partly sustained. It is the same with photography, with engine-making, with turning, with fiddling, and the thousand and one things discussed from time to time in our pages. We try to give something for the craftsman and more for the *man*. Judging from your letter, the English Mechanic, with its multifarious information, its wide-reaching intentions, and the true freemasonry spirit which exists amongst its readers, is not the journal best fitted for you. We are sorry for it. We must do our work, and the English Mechanic must endeavour to fulfil its mission notwithstanding.

E. L. G.—Your long letter on "Who Invented Noah's Comet" next week, and then we must close the controversy, as it is pushing aside more demonstrable and practical matters. We have no objection to the discussion of the widest reaching theories, but they should be treated as sandwiches between meals, and not as the meals themselves.

J. B. Sharpley.—Ask for as much information as you may want, and give in return as much as convenient.

William Hughes.—We cannot undertake to recommend articles that are advertised. The one you inquire about is supplied by a respectable house.

Pistol.—No.

G. W. K. L.—Thanks for your information on the *Anti-Lancet* philosophy. To publish your able letter would only advertise still further a piece of barefaced quackery. Some people don't care what is said about them as long as they can get talked about. They live by notoriety, and they would rather be exposed and painted in their true colours than treated with silence. We will not even gratify them by your withering exposure. Whoever will help us to put down shams, whether great or small, and to counteract the influence of humbug in any direction, has our heartiest thanks. We hate, with an inextinguishable hatred, quackery of all kinds, and we will take good care that the quack who has been trying, rather adroitly we admit, to advertise himself through our query columns shall not do so again. Once more, "G. W. K. L." our thanks.

G. T.—Yours about Westminster clock has been answered.

Equilibrium.—For what purpose.

S. M. Drach.—Your corrected diagram arrived too late.

Joseph Roskell, T. C. S., and Analyst.—Query 12080 was a commercial one, and got inserted by mistake.

Pneumatic Lever.—Yours on "Defects in Harmoniums" next week.

A Careful Reader.—See our footnote to "E. L. G.'s" letter.

. M.—Certainly not.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JUNE 4, 1872.

1611 A. C. Hobbs, St. Martin's-le-Grand, and J. M. Hart, Cheapside, City, for improvements in safes and other depositories for property and other articles of value, and in doors for such and other places, and in locks or fastenings for the same, part of which improvements is applicable to other structures.

1612 C. A. C. Eckhold, Green-street, Leicester-square, for an improvement of an apparatus for supplying ink on a pen fixed in a holder.

1613 H. B. Barlow, Manchester, for improvements in machinery or apparatus for washing, dyeing, and otherwise treating fibrous substances and other materials. A communication.

1614 A. M. Clark, Chancery-lane, for an improved engraving, cutting, and carving machine. A communication.

1615 S. Duer, Harewood-square, Middlesex, for an improved mode of and apparatus for lifting ships out of the water.

1616 J. H. Dennis, Liverpool, for improvements in the treatment of copper precipitate and in the utilisation of impurities contained therein.

1617 J. Pickup, Tong, Bradford, for improvements in grate bars.

1618 W. R. Lake, Southampton-buildings, for improvements in the manufacture of railway rails, and in apparatus employed therefor. A communication.

1619 W. R. Lake, Southampton-buildings, for improvements in the manufacture of railway carriage and locomotive wheels, and in apparatus employed therefor. A communication.

1620 J. Riddale, Minories, City, for an improved means of concentrating light for signalling purposes, and in appliances connected therewith.

1621 P. A. Ducros, Bordeaux, France, for improvements in tricycles and like carriages. A communication.

1622 E. Burstow, Horsham, Sussex, for a new or improved sash stop or fastener.

1623 D. Pidgeon and W. Manwaring, Banbury, for improvements in reaping machines.

1624 W. Hibell, Balsall Heath, Worcester, for improvements in annealing pots.

1625 H. K. Doria, Liverpool, for improvements in miners' safety lamps.

1626 A. Dawson and H. T. Dawson, The Cedars, Chiswick, for improvements in typographic etching and engraving, and in apparatus employed therein.

1627 J. Gathercole, Loughborough-road, North Brixton, for an improved machinery for making bricks, tiles, and articles of various sizes and shapes of plastic, cohesive, and other materials, and for measures of capacity of various sizes and shapes.

1628 T. Slater, Euston-road, for improvements in apparatus for obtaining electric light, and in magneto-electric machines to be used therewith, which machines are applicable for other purposes.

1629 H. L. Muller, Birmingham, for improvements in instruments for extracting or withdrawing nails, spikes, and bolts, and for other like uses. A communication.

1630 T. Corbett, Shrewsbury, for improvements in winnowing and grain-dressing machines.

1631 L. A. Guay, Paris, for improvements in buttons for cuffs, shirts, and other similar purposes.

1632 C. Martin and H. Martin, Great Winchester-street, City, for improvements in anchors.

1633 T. B. Hawkes and C. J. Freeman, Weymouth, for improvements in the construction of tables to be used for billiards, dining, and other purposes.

1634 L. G. Lyons and H. V. Forbes, Gloucester, for improvements in the manufacture or composition of paints or substances for covering or coating various surfaces.

1635 R. Long, Liverpool, for an improved case or book for containing postage, receipt, and other stamps, and tickets and labels.

1636 E. Keirby, Rochdale, for improvements in machinery or apparatus for recording low water in steam boilers.

1637 C. Moseley, Manchester, for condensing the vapours of coal-tar naphtha.

1638 H. Highton, M.A., Putney, for improvements in galvanic batteries.

1639 C. Whiting, Lewisham, for improvements in portable elongating dining and other tables.

1640 F. H. Wenham, Chadwell, Essex, for improvements in achromatic object glasses for microscopes.

1641 C. Boullier, Paris, for improvements in labels for stuffs and other similar purposes.

1642 R. Faulkner, Kensington, for improvements in the preparation of photographs and other prints for colouring.

1643 J. H. Dickson, Harefield, Middlesex, for an improved process of and machinery for treating fibre-yielding plants for the purpose of obtaining useful fibres therefrom.

1644 R. Hanson, Halifax, for improvements in steam boilers.

1645 A. N. Porteous and G. C. Bruce, Edinburgh, for improvements in and applicable to lamps.

1646 W. R. Lake, Southampton-buildings, for improvements in railway sleepers or cross-ties. A communication.

1647 J. F. Ollard, Lloyd's, City, and R. K. Barrow, Royal Exchange-buildings, City, for a new description of playing cards. A communication.

1648 T. J. Smith, Fleet-street, for an improved means of producing and maintaining musical tones, and in apparatus for the purpose. A communication.

1649 M. Doubelt, Berners-street, Oxford-street, for improvements in the preparation of iron for purposes where great tensile strength is necessary. A communication.

1650 T. Everitt, Norfolk, for improvements in feeding troughs or bins for sheep and other animals.

1651 J. Bolt, Halifax, for an improved stopper for bottles.

1652 E. T. Hughes, Chancery-lane, for improvements in safety valves for steam boilers. A communication.

1653 N. S. Walker, Liverpool, for an improved metallic bale tie or buckle.

1654 C. Turner, Lenton, Nottingham, for improvements in machinery for scudding or puring skins or hides.

1655 W. R. Lake, Southampton-buildings, for improvements in kilns for burning bricks. A communication.

1656 W. R. Lake, Southampton-buildings, for improvements in metallic packing for making steam, air, gas, or water-tight joints. A communication.

1657 D. Nicoll, St Paul's-churchyard, for improved preparations applicable to woven and other fabrics for the purpose of rendering the same uninflammable.

1658 A. V. Newton, Chancery-lane, for improvements in the manufacture of sugar and in apparatus to be used therefor. A communication.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 21, 1872.

ARTICLES.

REPORT OF THE COMMISSION ON SCIENTIFIC EDUCATION.

THE report of the royal commission appointed to inquire into the arrangements at present in force for affording scientific instruction to the masses, and for promoting the advancement of science, was published some few weeks back, and many of our readers will doubtless be interested in learning the recommendations of the commission as to the improvement of the means in vogue for achieving these desirable objects. The commission consisted of the Duke of Devonshire, the Marquis of Lansdowne, Sir John Lubbock, Professors Huxley, Stokes, and H. J. S. Smith, Dr. Sharpey, Sir J. P. Kay-Shuttleworth, and Mr. B. Samuelson, with Mr. Norman Lockyer as secretary, names which afford sufficient guarantee that no points worthy of consideration have been overlooked. Commencing with the state of scientific instruction in training colleges and elementary day-schools, the Commissioners, while approving the principle laid down by the Revised Code of 1861 that the money grants should depend to a considerable extent on the results shown by individual examination, consider that the limitation of such examination to the "three r's" has unfortunately narrowed the instruction given in elementary schools, and curtailed the syllabus of the training colleges, producing a very prejudicial effect on the education of the country. They do not underrate in any way the necessity for a thorough grounding in reading, writing, and arithmetic—subjects, which are, in fact, the very foundation of education, but they consider that the introduction of "extra subjects" into the curriculum would in no way interfere with the requisite amount of drilling in the "rudiments." With this opinion most of those who are practically acquainted with teaching must, we should think, agree; for as a matter of fact one at least of the three elementary subjects can be made to contribute in no small degree to the teaching of the rudiments of the natural sciences. Suitable books are ready to hand, or might soon be written, the language of which, while adapted to the requirements of the scholars learning reading as reading, is still sufficiently "technical" to convey a sound idea of the facts of which it treats. The New Code of 1871, there is only too much reason to fear, will have practically but little effect in widening the range of education in elementary schools; the grants are given almost wholly on the attainment of the required proficiency in the "three r's," and little encouragement is offered to the study of other subjects—even history and geography. Under the present arrangement, if 75 per cent. of the scholars pass in reading, writing, and arithmetic—a result almost invariably attained in fairly good schools — the maximum money allowance is awarded; and as a matter of fact the existing schools did earn last year almost the full grant without requiring the assistance of the "extra subjects." To alter this, in one sense, undesirable state of things, the Commissioners do not propose to raise the standards in such a manner as to reduce the passes below the 75 per cent., because they think, and very properly too, that such a course would tend to discourage both masters and pupils; but they consider that instruction in the principles of natural science can be and ought to be made an essential part of the course of instruction in every elementary school. They submit that the scale of payments may be so arranged as to encourage regularity of attendance on the part of pupils, to secure a sufficient staff of qualified teachers, and, at the same time, to insure the successful teaching of the rudiments, while a sufficient reward is given for proficiency in extra subjects. This, however, is a mere detail which can easily be arranged by the Education Department. What we desire more especially to draw attention to, is the repeated expression of the opinion of the Commissioners that scientific instruction must form a sine quâ non in the curriculum of every elementary school. Whatever difficulties may at present stand in the way are not insuperable, and "there can be no good reason why such elementary scientific instruction as has *long been given* in the primary schools of Germany and Switzerland should not be bestowed upon English children." Several of the school boards have already determined to make elementary physical science and social economy essential subjects in all schools under their jurisdiction—and the lead once taken others must follow.

The instruction which the Commissioners desire to become the rule and not the exception, though scientific in substance, would be free from needless technicality, and would be almost entirely confined to those facts which can be brought under the direct observation of the pupils. It is, in fact, that kind of instruction which is understood by the term "object-lessons." These would be so arranged and methodised as to afford an intelligent idea of the prominent phenomena which lie around the every-day life of the inhabitants of a civilised world; and are the very facts which children do not notice, and which have hitherto been held in slight regard by the arbiters of the primary education of the country. These "object-lessons" would not, of course, necessitate expensive apparatus or a complete mastery of the sciences by the teacher; they are, there can be but little doubt, the very best means of awakening in the juvenile mind the perceptive faculties, and the principles of the sciences thus mentally grasped are never afterwards forgotten. It is a question, too, which we should like to see discussed, whether it would not be advisable to "sacrifice" one of the half holidays, at all events in the winter months, to that "devouring element," science. We even venture to think that the children themselves would answer this question in the affirmative; for the afternoon's instruction which could be provided by an intelligent master at an expenditure in the first instance of a few pounds, might be made the source of much amusement, which would in reality, however, only serve to make the knowledge it is desired to impart stand out all the clearer and more prominent. It is true, as the Commissioners say, that in order to make the scientific instruction in these schools as successful as possible, the teachers must not only have acquired the needful amount of scientific knowledge, but must also have been carefully trained in the special methods of teaching science. It is not to be expected that all, or, indeed, any of the masters will display the skill of a Tyndall or a Huxley, and explain the transformation of energy into heat and the various branches which spring from that scientific tree, by means of a lucifer match or a hammer and a nail; but just that amount of ability is necessary which can put facts before the children in such a manner that they find no difficulty in comprehending and appreciating them. It is just at this point that the Commissioners are compelled to express their "fear" that the present machinery of the training colleges is inadequate to supply the necessary training to the students, and that an extension of the curriculum could not be expected to succeed until the means of scientific instruction are more complete, and the students receive a better preparation, or remain at the college for a longer period. Under these circumstances the Commissioners have made the following recommendations, the first two of which would appear to depend mainly on the speedy carrying-out of the third; for we are afraid that by far too many "certificated" teachers are as utterly ignorant of the natural sciences as the pupils under their care. 1. We recommend, say the Commissioners, that, as regards the elder children in elementary schools, the teaching of such rudiments of physical science as we have indicated should receive more substantial encouragement than is given in the regulations of the New Code. 2. As regards the younger children, that her Majesty's inspectors should be directed to satisfy themselves that such elementary lessons are given as would prepare these children for the more advanced instruction to follow. 3. That the mode of instruction of pupil teachers; the conditions of admission to the training colleges; the duration of the course of study, and the syllabus of subjects taught should be so modified as to provide for the instruction of students in the elements of physical science.

With regard to the scientific instruction given in science classes under the Science and Art Department, the Commissioners acknowledge that the system has given a "remarkable impulse" to elementary scientific teaching, the increase in the decade from 1860 to 1870 being, in the number of schools, from 9 to 799, and in the number of students from 500 to 34,283. This "remarkable impulse," however much it may be a cause of gratification when compared with 1860, is still far, very far, below the result it is desirable to obtain, for 34,283 spread over the various branches of study on the syllabus of the science classes shows but a very small percentage of the working population of this country as seeking to acquire a knowledge of the great scientific principles on which the commercial life of their industries and consequently their own well-being, so largely depend. There is no doubt, however, that with the scientific education fairly commenced in the primary schools a large influx of attendants on the science classes will follow; and it is fair to assume that the number of teachers will increase *pari passu*. The necessity of a more thorough system of inspecting science classes is strongly enforced by the Commissioners, for although they have "derived the impression" that substantial advantages result on the whole from the system pursued, yet, from the large number of failures which occur and from the character of the answers given, it is only too apparent that the vicious method of cultivating the memory instead of the intelligence is still adopted by a large number of science teachers. The instruction is derived from books, and the information thus acquired is tested and aided by the class examinations of the teachers, without being illustrated by specimens or experiments, the use of apparatus, or the out-door study of nature. Not only is apparatus wanting, as a general rule, but one of the examiners complains that even so simple an expedient as the blackboard and chalk is avoided in teaching geology; while the Commissioners affirm that "too often the teachers confine their instruction to the same routine of book-learning and class-questioning with which alone they were made familiar in the rudimentary classes in which they received their own *imperfect* elementary knowledge." With regard to payment by results, the commission recommend that higher rates of capitation grant should be allowed, according to the abilities of the teacher, which would be ascertained by "further examinations." Thus the student who passes the first examination would be recognised as an Elementary Science Teacher, and the increased money payment would be offered as an "inducement" to prepare for the further examinations to qualify as Second Grade and First Grade Science Master. The Commissioners think it "worthy of the consideration of the Department" whether it would not be possible to increase the resources of the science classes by greater payments from pupils and by local contributions. Some arrangement of this kind will become necessary in proportion as practical instruction is introduced—and if the instruction is valued there ought to be no difficulty on this head. The efficiency of the teaching is diminished, according to the Commissioners, on one hand by imperfect organisation of the classes and the absence of practical instruction, and on the other hand by the irregular and unsystematic manner in which scholars have taken up the subjects taught. The recommendations attached by the Commissioners to this section of their report are of some length and great importance; and they cannot fail if carried out in the spirit which has suggested them to be the means of disseminating the best of all knowledge far more widely than it is at present, and of imparting an immense stimulus to the scientific progress of the country. How necessary progress of this kind is will be apparent to any one who will inquire into the position of scientific inquiry in the United Kingdom. In another column we reproduce the opinions of Mr. Gore on the subject, and corroborative testimony could be found in abundance. Even as regards Chemistry, the President of the Chemical Society recently lamented the fact that the original researches laid before that society have fallen almost to zero. The cause of this state of things is easily discovered, for, as Mr. Gore says, there is absolutely no provision in this country for the support of scientific investigators, and thus the great source of new trades and improvements in manufactures remains undeveloped. It is too much to expect of men whose talents can be turned to account in a profitable manner, that they will devote themselves with self-sacrificing industry to the common wealth. Such instances are rare, and we have no right to expect them. But what has been done in Germany and Switzerland can surely be done in the richest empire in the world.

ELECTRICITY: WHAT IS IT?—III.

By B. Thompson.

(*Concluded from p.* 294.)

The Modification Heat Undergoes in Order to Appear as Electricity.—Before striking directly at the most important part of this communication, as to what modification the motion of heat must undergo in order to appear to us as electricity, it will be advisable—indeed, I think necessary—to notice two or three peculiarities in other modes of obtaining current electricity.

If we take a common battery, as Smee's, which differs very little from the one before described, the copper being replaced by platinised silver, we notice that there is a rapid decrease in its power when working, usually attributed to the adherence of molecules of hydrogen to the silver plate, which set up contrary currents, and thereby hinder the action of the primary one; but the importance attached to this may be over-rated; there is no doubt as to its being a hindrance to the action, but were it the only one, washing the plates ought to restore the energy of the battery, at least with no more decrease than there would be were it a constant battery of the same electromotive force, such as Grove's or Bunsen's; but the fact is it has lost a considerable amount of heat and electric force by the passing off of the hydrogen, which cannot be replaced save by recharging the battery, and this gives another reason—perhaps the principal one—why a two fluid battery is more constant and powerful than a one fluid battery; in the former kind the hydrogen is for some time retained and reduced, thus preventing the loss of power which would be occasioned by its passing off, adding generally to the conducting power of the liquid it passes into, and, of course, giving up again the force which liberated it.

Again, let us look at one of the batteries whose action it is rather difficult to understand by the common theories—Grove's gas battery. When the two platinum plates of a voltameter containing dilute sulphuric acid are connected with a battery the water is decomposed, and H and O pass to the two tubes respectively; in these two gases, as we have shown, is stored up a large amount of force, viz., that which was expended in their separation, and which we are bound to admit is a modification of the motion of heat, or heat itself, for heat would be the result of their recombination.* If now we disconnect the voltameter with the battery, the two gases will, after a time, have combined to form water. Besides this, however, if we connect the terminals of the voltameter, which before led to the battery, a second voltameter containing dilute sulphuric acid, the water in it will be decomposed the same as in the first one, and nearly the same quantity of gas will be liberated; the first voltameter acting on the second the same as the battery did on the first. The teaching of this experiment is very important, for the oxygen and hydrogen themselves give rise to a current of electricity oppposite in direction to the one which produced them, but this clearly is not the result of any dissimilarity of metals, for both the terminals are platinum; but to a difference in the electrical states of the two gases, one being + and the other −. In whatever way we destroy this condition of the gases, we produce heat, whether by exploding them, or allowing them to combine peacefully in the form of an electric current; of course, if work be done by the current instead of heat, we shall find its equivalent in work. Apparently, then, these two gases contain each of them a part of the motion of heat, for H and H or O and O alone will produce no heat, yet their combination produces intense heat, except when it takes the form of an electric current.

How can we, then, regard the forces of heat and electricity as such distinct phenomena? For there cannot be an electric current without chemical action; without either an absorption or liberation of heat, and without *superior affinity* (which is electrical attraction), and this excess of affinity of a body for any component of an electrolyte supplies the heat or cold—real or vertical—to enable the constituents to take another form, or exist independently if they do not retain this form; as they do not in batteries, part of the force will again be given up, and constitute what we call an electric current.

Now, I am about to make a bold hypothesis, but one, nevertheless, which, I think, has been partly forced upon us by the former part of this paper, and which will be supported by what follows—viz., that a current of electricity is identical in the *kind* of motion with "polarised heat," though they may vary very much in the rapidity of the motion. I am aware of the great drawback to this, presented by the fact that it requires a more ponderable substance to conduct it than heat does. The two states, however, are quite distinct, and a diathermanous body may, under certain circumstances, be quite athermanous when the heat has been polarised; but even a vacuum does not prevent electrical induction. I have not the means to experiment on this subject, so am obliged to depend upon reason alone. We will, therefore, consider the points which more particularly have led to this hypothesis with regard to a current of electricity. Because heat can be polarised the same as light, we must regard heat as constituted, like light, of two motions at right angles to each other, and a body which conducts it must, of course, vibrate in the same manner. Electricity is conducted by a continuous polarisation of the molecules, and we have shown that these polarisations must be accompanied by a motion of the molecules in a body transmitting it; but whether this motion takes place vertically, horizontally, or in any other direction, it must, of course correspond with one of the motions of heat, and thereby be equivalent—as far as the kind of motion is concerned—to a polarised ray of heat in a conductor.

The application of this theory will explain many things not satisfactorily explained by other theories: for instance, take the case where a current of electricity is generated by heating the junction of two dissimilar metals, or one end of a nearly homogeneous conductor. It is easy to see that part of the heat supplied will be divided or polarised when the metals are dissimilar, or in dissimilar states, and offer resistance to motion in one direction more than another. A perfectly homogeneous conductor when heated will give no signs of electricity whatever, but let the homogeneity be disturbed in the least by bending or twisting, immediately part of the heat which circulated before as heat takes the form of an electric current. In the first case, the heat was transmitted equally in all directions, but in the second one of the motions constituting a ray of heat was retarded or destroyed, giving rise to what we call a current of electricity, but what, according to this reasoning, is a true polarised ray of heat. And the greater the heat supplied the more powerful the current of electricity. If the dissimilarity between the two ends of the conductor be still further increased, by cooling the opposite end to that where the heat is applied, the current again will be augmented proportionally. We find, too, that it is the most crystalline metals, as bismuth and antimony, that give the most powerful currents: really selenium and bismuth most effectually polarise the heat, but the property which in great part is the cause of this—viz., the low conducting power of selenium—prevents its usefulness.

Faraday found that when a solid unmetallic body becomes fluid it almost entirely loses its power of conducting heat, but acquires a greatly increased capacity for conducting electricity, again, showing the influence which a change in density, or in the state of aggregation, has on the propagation or conduction of either electricity or heat.

The experiment above of producing electricity by heat may be exactly reversed, and a current of electricity be made to produce the heat and cold at the respective junctions, where the heat and cold were applied to produce the current of electricity, a change in the point of application of the heat and cold and of the direction of the current exactly reverse the effects; but perhaps this theory receives its greatest confirmation in the experiment quoted below. Taking a simple thermo-electric element of bismuth and antimony, if the cleavage of the bismuth is parallel to the face of contact, the current is increased, but if at right angles, decreased; and just the reverse holds in the case of antimony. But more important than this is the fact that the element may be constructed of all bismuth or all antimony if the cleavage of the pieces in contact is at right angles. The significance of this has, I think, been completely overlooked, as it seems to point so distinctly to the cause of a current of thermo-electricity. The two motions constituting ordinary heat being divided between the two conductors, each motion takes the direction which offers the least resistance to its progress, and the result is two currents of electricity flowing in opposite directions, which, if they combine, form again heat. I think we can scarcely fail to see that, at least in the case of thermo-electricity, the current is due to the decomposition of heat, the two motions appearing to us as + and − electricity; and if the reasoning holds for this it must for all, as electricity is of the same nature in whatever way produced.

This theory may be thought a peculiar one, and I rather expect to be told that were it true the experiments on polarised heat would have shown some connection before this; but I do not say that a current of electricity is one of polarised heat, for I believe that the amplitude of vibration has been lessened considerably, and the length of the wave altered, before heat appears as electricity; the fact of bad or poor conductors being invariably used where a current of electricity of any strength is obtained seems to point to this; indeed, some resistance is always necessary, whatever form of apparatus we use for its production.

No doubt, there are some difficulties to the acceptance of this which I have not thought of or have not mentioned, and I expect there will be plenty to point out any very flagrant errors or omissions. If there are any I shall be very ready to acknowledge or answer them.

* Faraday discovered that a plate of platinum, with extremely clean surfaces, plunged into a vessel containing oxygen and hydrogen in the proportion in which they combine to form water, would effect their combination, and would itself become red hot, from which it appears that the platinum in attracting the two gases brings them within the sphere of each other's attraction, and the particles of water formed are either vaporised by the intense heat or run off.

SMELL.

(*Concluded from p.* 295.)

Having examined this subject from the physiologist's point of view, we propose now to look at it from those of the naturalist and chemist. The three natural kingdoms all supply odours. Among mineral matters, a few solids are odorous, and a large number of liquids and gases, the odours being more or less strong and agreeable, and generally characteristic. They proceed from simple bodies, as chlorine, bromine, iodine; from acids, as hydrochloric acid and hydrocyanic acid; from carburets of hydrogen, as those from petroleum; from alkaline substances, as ammoniac.

Animal odours proceed from hydrocarburetted and hydrosulphuretted gases; from various acids and salts, from the decomposition of fatty matter, and from some kinds of matter secreted in glands, as musk and ambergris.

In the vegetable kingdom there is a great variety—from odours which are soft and agreeable to those which are most repulsive. Plants without odour are rare; many that have no odour when fresh give forth, when dried, a very distinct perfume. The odour of plants comes from certain kinds of matter distributed variously in their organs. In some it is solid, as balm or resin; in others liquid, as what we call essences or essential oils. Such essences are generally concentrated in the flower, as, *e.g.*, rose or violet; but in some cases, as that of Florentine iris, the root only has perfume. In the cedar and sandal, the odorous principle is in the wood; in mint it is in the leaf; in the Tonquin bean it is in the seed; in cinnamon it is in the bark. Some plants have several odours quite distinct; orange has three—that of the leaves, giving the essence called *petit-grain*; that of the flower, furnishing neroli, and that of the rind or peel.

Nearly all the essences employed in perfumery are of European production. England produces lavender and peppermint largely. At Nimes, attention is given to rosemary, thyme, aspic, and lavender. Nice makes violet its specialty. Cannes extracts the essences of the rose, the yellow acacia, the jasmine, and neroli. Sicily furnishes citron and orange; Italy, iris and bergamot.

What is the chemical nature of the odorant principle in plants? The varieties of it, as chemists will tell us, fall under three heads, hydrocarbons, aldehydes, and ethers. Hydrocarbons are compounds of carbon and hydrogen, and represent the most simple compounds in organic chemistry. To explain the two others we all know what chemists mean by an alcohol; it is a definite combination of carbon, hydrogen, and oxygen, and may be considered as resulting from the union of a hydrocarbon with the elements of water. Spirit of wine may be taken as the type, and it takes the formula C_2H_6O; that is, its molecule is made up of 2 atoms of carbon, 6 of hydrogen, and 1 of oxygen. Now, an aldehyde is simply *alcohol dehydrogenatus*—that is, alcohol with some of its hydrogen taken away, and an other is formed from the combination of an alcohol with an organic acid. Here, then, we have the constitution of nearly all the essential oils in plants—carbon and hydrogen, with or without oxygen—and according to the proportions in which these occur, we have a hydrocarbon, aldehyde, or ether. This, however, is not all. We have now spoken of quantitative differences. But it may happen that two substances, entirely differing in some properties, have the same chemical composition, both qualitative and quantitative. Such are isomerous bodies. How, then, do they differ? By the arrangement of their molecules. Carbon and diamond are identical in their composition. Ordinary phosphorus and amorphous phosphorus are one and the same substance. And in the odorous principle of plants we have some curious cases of isomerism. The oils of terebinth, of citron, of bergamot, of juniper, of lavender, of pepper, of cloves, are isomers; they all have the same chemical composition. On analysis, all give the same substances in the same proportions. In each molecule of the essence there are 10 atoms of carbon and 16 atoms of hydrogen—expressed by the formula $C_{10}H_{16}$. We are thus led to see how largely the qualities of bodies depend on arrangement and internal motions of small component parts, about which we as yet know very little.

But chemists have not been contented with merely investigating the nature of the odorous principle of plants; they have sought to produce it artificially. In many cases they have succeeded, producing substances with constituent parts which are identical with those of the products obtained from the plants. An Italian chemist Piria, working in France in 1838, was the first to reproduce a natural aromatic principle. He prepared, by certain reactions, a salicylic aldehyde, which proved the same as the essential oil of meadow sweet, the penetrating perfume of which is well known. Some years later, in 1843, M. Cahour discovered methyl-salicylic ether, and showed that it was identical with the essence of *Gaultheria procumbens*, or winter-green. Wertheim followed with further discoveries. The thing caused considerable sensation. Since then the art has advanced, and chemists can now produce various oils artificially, as oil of camphor, of bitter almonds, of cumin, of cinnamon, &c., without, that is, having recourse to any of the plants.

Besides the substances now referred to, various others have been produced of the ether class, in which a very good imitation of the aroma from certain fruits has been effected. These have been largely used by perfumers and confectioners. Such artificial oils appeared for the first time at the London Exhibition of 1851. One of these was pear oil, giving an agreeable odour of jargonelles, and used for bonbons. This was a solution of amylacetic ether in alcohol. Apple oil was made by dissolving amylvaleric ether in alcohol. The most plentiful was that of pineapples, which was ordinary butyric ether. Grape oil was used for giving to brandy of inferior quality the flavour of cognac. Various others might be mentioned. This synthesis of odorous principles is one of the most striking triumphs of organic chemistry. The creative faculty is still at work. M. Berthelot has been seeking to reproduce the fatty matters of the animal economy. Some progress has been made towards the artificial production of sugar; and this will, doubtless, be followed up by an effort to work out the synthesis of albuminous substances.

Linnæus brought his powers of analysis and classification to bear on the subject of odours. He arranged them in seven classes, as follows:—Aromatic odours, as those of the leaves of laurel; fragrant odours, as those of fleur de lis, jasmin, &c.; ambrosial odours, as those of amber and musk; alliaceous odours, as those of garlic, &c.; Fetid odours, as those of orach, &c.; repulsive odours, as those of many solaneæ; and finally, nauseous odours. The terms used are mostly familiar in ordinary language; but they have quite a relative and conventional value. As formerly remarked, we cannot construct a scale of odours, as we can a musical scale. We can only compare one odour with another from its effects on the olfactory membrane. They have not such characteristics as can be vigorously defined. Any classification of them must therefore be imperfect.

Professor James C. Watson, in a letter dated Ann Arbor, April 4th, announces to the Editor of the *American Journal of Sciences* the discovery of a new planet, hitherto unknown, in the constellation Virgo. It shines like a star of the eleventh magnitude.

BRITISH MANUFACTURES AND SCIENTIFIC RESEARCH.

IN an article on the future extension of Birmingham industries, recently contributed by Mr. George Gore to the *Birmingham Morning News*, he calls attention to the character of those industries, and in pointing out their origin he takes occasion to inculcate the necessity for the encouragement of scientific research if this country is to retain its present pride of place in the manufacturing world. Mr. Gore commences by noticing the principal industries of Birmingham, tracing the manner of their origin, and the method of their development, and then points out the necessity—or at least the advisability—of endeavouring by indefatigable research to found new manufactures and improve old ones. Let us consider, he says, German-silver and its manufacture. That substance is an alloy of copper, zinc, and nickel; it owes its peculiar whiteness or "silver-like" appearance to the latter metal, and cannot be made without it; it is certain, therefore, that by whatever means that metal or the alloy was discovered, the discovery was the origin of the German-silver manufacture, and was essential to all manufactures, processes, or appliances, in which German-silver, nickel, or any of its compounds are used. Nickel was discovered by Cronstedt during the year 1751, and its compounds were chiefly investigated by English and foreign chemists. Cronstedt found it as a peculiar metal in the mineral called kupfernickel, whilst chemically examining the properties of that substance. The general method by which he discovered it was careful experiment, observation, and study of the properties of matter. I believe it is a fact that the Chinese and other nations made alloys of nickel long before nickel itself was known to be a separate metal; they had found, by experiment, that when ores of copper and zinc were mixed with a particular kind of mineral and smelted, a white alloy was obtained; but this also proves the general statement already made, that the German-silver manufacture was originated by means of experiment and observation. It was by a more skilful, but similar mode of procedure, that Cronstedt discovered the metal itself, and thus laid the basis of improvements in the manufacture of its alloys. I need not here enlarge upon the multitude of uses to which nickel has already been applied in Birmingham manufactures, nor speak of the large sums of money which have been and still are made by means of it and its compounds.

The manufactures of iron wire and copper wire for telegraphs are two other modern trades of great magnitude in this town, and were originated in the following manner:—In 1799, Volta, an Italian philosopher, was experimenting, observing, and studying the electric properties of metals in liquids, and discovered the voltaic battery. In 1815, Professor Oersted, of Copenhagen, was experimenting on the relation of electric currents to magnets, and observed that when a magnet was suspended near and parallel to a horizontal copper wire, through which an electric current was passing, the magnet moved spontaneously, and placed itself at right angles to the wire. From these two small experiments, made by putting matter and its forces under new conditions, observing and studying the results, all our telegraphs and the immense manufactures of iron and copper telegraph wire have arisen.

There is a saying that "all great things have had small beginnings," and this is true, not only of electric telegraphs, but also of the great trade of electro-plating, and of the magneto-electric machine, which is now largely used instead of the voltaic battery. After Volta had made his small and apparently unimportant experiments on the electricity produced by metals and liquids, various persons tried the effect of that electricity upon metallic solutions. Brugnatelli, in 1805, found that two silver medals became gilded in a solution of gold by passing the electricity through them. Mr. Henry Bessemer, in 1834, coated various lead ornaments with copper by using a solution of copper in a similar manner. And in 1836 Mr. De la Rue found that copies might be taken in copper of engraved copper plates by the electro-depositing process. Faraday discovered magneto-electricity in the year 1831, by rotating a disc of copper between the poles of a magnet, and he has stated that the first successful result he obtained was so small that he could hardly detect it. This simple experiment was the origin of the magneto-electric machine, and many of those machines are now used by Messrs. Elkington for depositing copper, silver, and gold, instead of the voltaic battery.

Another large manufacture of this district is that of phosphorus. The origin of it is due to the man, whoever he was, who first isolated that element. Histories of chemistry tell us that it was discovered by Brandt, a merchant of Hamburg, in 1669; but evidence exists that it had been obtained in the separate state very many years before by the early Arabian chemists. Brandt obtained it by distilling a mixture of dried residue of urine and charcoal. His discovery was also made by careful experiments, and observation of the properties of matter, and had it not been made there would have been no manufactures of phosphorus or phosphorus matches in this district.

Priestly made many experiments on the absorption of gases by water, and proposed such liquids as beverages, and those apparently trifling experiments have since expanded into the large manufactures of aërated waters.

Persons inexperienced in scientific matters are apt to think that discoveries are generally made by accident. The reverse is, however, the case; nearly all our great modern discoveries were effected by men who were constantly making careful experiments upon the properties of matter and its forces, by subjecting them to new and definite conditions. Nearly all persons look upon such discoveries as fortunate ideas, which, when once found, are quickly developed, instead of which they are in most cases, slowly developed results of most difficult mental labour. Discoveries in science are occasionally made, not by original scientific investigators, but by practical men engaged in manufacturing or technical employments. The hydro-electric machine originated in this way: a man at Newcastle was attending to a steam-boiler, and found that he received electric shocks when he touched the boiler. This circumstance was investigated by his employer, Mr., now Sir William, Armstrong, and led him to construct the hydro-electric machine. The accumulation of electricity in submarine telegraph cables was also first observed at the Guttapercha Company's Works, London. It was noticed on testing the cable by means of a voltaic battery (the cable being submerged in water) that discharges of electricity flowed from the cable after the battery was removed; this circumstance was investigated by Faraday, and led to improvements in submarine telegraphy. In these instances also the same general method was employed—viz., new experiments were made (though not intentionally) by putting matter and its forces under new conditions, and new results were observed.

Scientific discovery, therefore, by developing new facts and laws relating to matter and its forces, constitutes not only the basis of new manufactures, but largely, also, of the improvements in trades made by inventors and practical men; and if discoveries are not made, the means by which improvements are effected by such men will become exhausted. The great value of new scientific knowledge to such men is proved by the fact that when new scientific discoveries are published there are numerous inventors and practical men who immediately endeavour to apply them to useful purposes. Since the first application of coal-tar to the production of dyes, every discovery in that branch of chemistry has been closely watched for a similar purpose.

According to all our experience, scientific discovery provides the knowledge necessary for making inventions, and practical inventions lead to increase of trade. It might easily be shown that in this way scientific research has already resulted in the employment of whole armies of workmen, and in the expenditure and investment of a fabulous amount of money in railways, telegraphs, machinery, gasworks, chemical works, electro-plating, photography, &c., in this country; and Birmingham has received a large share of the benefit.

The future success of this town and district is dependent upon original scientific research to a degree of which persons in general can form but little conception. Hundreds of millions of pounds are being expended in covering the earth with telegraphs, and thousands of millions in covering it with railways, gasworks, waterworks, &c., and Birmingham and its district has its share in supplying the rails, the wire, and the machinery. In this country alone more than 550,000,000 of pounds have been already expended upon railways only. Original scientific research is the great fountain-head of industry, and its capability of developing increased trade is practically unlimited: it is at present quite in its infancy, and we are only on the very threshold of a knowledge of the forces of nature, and of the constitution of material substances; and if such enormous results are being produced by the beginnings of unaided science, what may be expected from its future developments, especially if scientific research is assisted in an effectual manner?

Numerous important subjects of investigation, capable of yielding valuable results bearing upon the trades of this town, exist in all directions. Researches in electricity and in inorganic chemistry, particularly the metals and their compounds, would probably lead, as they have done before, to the establishment of new trades, and to improvements in local manufactures, and thus lay the foundation of future commercial prosperity. Discoveries in science, however, are best made, not by trying to obtain some valuable commercial or technical result (that object belongs to an inventor), but by making new, reliable, and systematic investigations. By investigating the chemical action of electricity upon saline bodies, Sir Humphry Davy isolated sodium and magesium, which has led to the recent establishment in Manchester of the manufacture of those metals. By the abstract researches of Hofmann and others upon coal-tar, the immensely profitable manufacture of the splendid coal-tar dyes was originated.

Scientific discovery is the most valuable in its ultimate practical results when it is pursued from a love of truth as the ruling motive, and any attempt to make it more directly and quickly remunerative, by trying to direct it into practical channels, will decrease the importance of its results, diminish the spirit of inquiry, and sooner or later reduce it to the character of invention. The greatest practical realities of this age had their origin, not in invention or a search for utilities, but in a search after important new truths, entirely irrespective of what utilities they might lead to.

I do not intend by these remarks to imply that any new trades or improvements in manufactures have been or can be effected without the labours of inventors and practical men; but that there should be a more judicious division of labour, one man to discover new truths, another to put them into the form of practical inventions, and the practical business man to work them; because it is proved by experience that in nearly all cases these different kinds of labour require men of widely different habits of mind, and that the faculties of discovery, invention, and practical manufacture, are very rarely united in one man.

Our large manufacturers and men of business have accepted and employed the advantages of science in an endless number of ways in their occupations, and have thereby acquired great wealth; but, notwithstanding this, and that the greatest trades of this district were originated and improved largely by means of scientific investigation, scarcely any of the wealthy manufacturers or landholders of the locality, who have derived such great benefits from the increase of trades, give the least assistance to scientific research; that which is the duty of all has been attended to by none. The probable explanation is, original scientific research is a subject quite outside the experience and knowledge of persons in general. It may be objected that such research is not aided, because it sometimes takes a long time to acquire a practical shape and make it pay. We do not omit to plant an acorn because it requires many years to become an oak; we do not neglect to rear a child because he may not live to become a man; but we leave scientific discovery to take care of itself.

Our practice with regard to science is very different from the plan carried out in Germany. Within the last few years great laboratories have been erected in Berlin, Leipsic, Aix la Chapelle, Bonn, Carlsruhe, Stuttgardt, Griefswald, and other places, at the expense of the State, and special provision has been made in them for original scientific research. A glance at the frequently published list of scientific investigations made in different countries will show us that the Germans are making a far greater number of discoveries in science than ourselves. If we are to maintain our position as a manufacturing nation, we also must adopt special means to promote scientific research; for how can we expect to obtain new arts and manufactures, or improvements in old ones, if we do not make new discoveries in the properties of matter and its forces? I need not multiply instances of the essential dependence of our present commercial success upon abstract scientific research, but may safely affirm that nearly all our great manufactures have been originated by means of experiment, observation, and study of matter and its forces; and that the great bulk of the improvements made in manufactures by practical men could not have been effected had not scientific investigators discovered, and made known in books, the properties of bodies. The inference from these conclusions is obvious: by adopting similar means, but in a more effectual way, we shall obtain similar but more successful results.

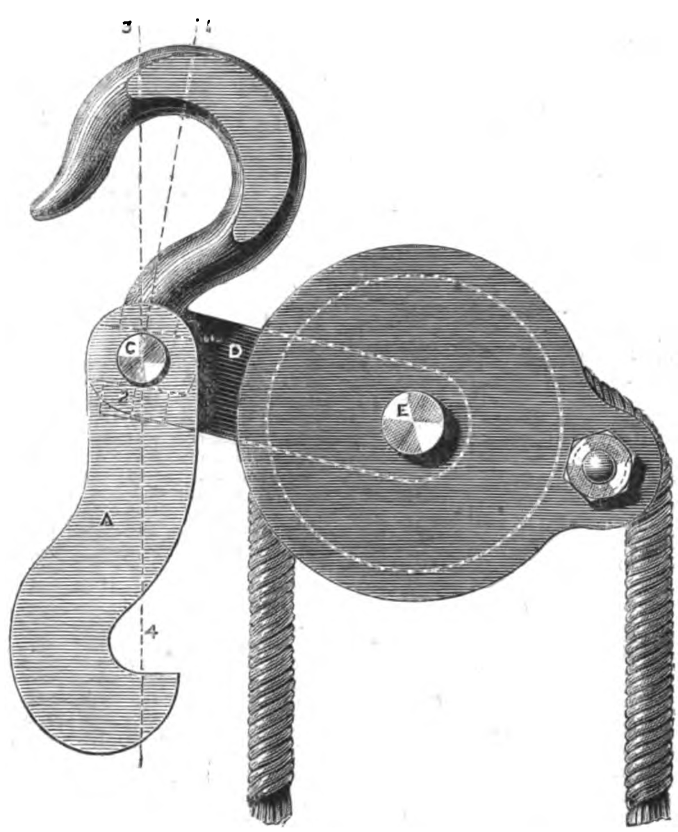
REMOVING SCALE IN BOILERS.

THE *Oneida Circular* says that the stoker who has charge of the boilers employed at its printing office has recently been making a trial of "tannate of soda" for removing the scale which accumulates on the inside of the boiler-pipes in consequence of using hard water. "After a two weeks' trial in our Root boiler, nearly half a bushel of broken-down scale and soft mud was taken out. The action of the tannate is to first loosen the scale. At present about 2lb. a week is used; but after the scale is once thoroughly removed, the occasional application of a much smaller quantity will keep the boilers free from any further deposit of it. The attendant thinks, if it continues to work as well as it now promises, it will make a saving of thousands of dollars in a few years in fuel alone, besides a saving in the wear and tear of the boilers, and relief from the risk of explosions. Tannate of soda has been in use for this purpose about three years, and is steadily gaining the confidence of the public."

It would have been an advantage if the *Oneida Circular* had said what is meant by "tannate of soda;" for, so far as we know, no chemical of that name is made in this country or imported from abroad, neither do we know of any formula for producing such a salt. Under these circumstances the value of the information thus made public is represented by an infinitesimal quantity. Possibly some of our American readers will be able to inform us what it is that is known as "tannate of soda" in the States.

IMPROVED SNATCHBLOCK.

THE improved construction of snatchblock shown in the annexed figure has been recently patented by Mr. G. Tangye, of Birmingham, who claims for his invention that the action of the weight or load automatically locks the movable strap or plate, rendering unnecessary the split pins or fastenings commonly employed, while the rope or chain may be more readily introduced or withdrawn than in those heretofore made. The illustration is a view of the snatchblock when opened for the adjustment of the rope or chain thereon. The movable strap A of the snatchblock is connected to the cross-head in such a manner that they will swivel together on the pin C of the cross-head which secures it to the strap D on the other side of the block. The free end of the movable strap A is formed with a hook, slot, or groove which, when the weight is on the block, engages with a pin or projection, preferably the pin, E, on which the sheave of the block revolves. By causing the movable strap A and cross-head B to swivel a space is left above the sheave, as shown, through which the rope or chain may be introduced or withdrawn. The hook being attached to the cross-head in the usual way by a neck and rivet, the action of the weight causes the cross-head and movable strap



to swivel and lock the latter securely on the pin or projection E; and in order to render this locking more certain the movable strap is so attached to the cross-head that when locked the centre line 1—2 of the hook makes an angle with the longitudinal centre line 3—4 of the pulley block. The action of the weight consequently tends to make these lines coincide and the movable strap engage with the pin or projection E.

CARRIAGE WHEELS.

ON the durability of the wheels more than on any other part of the carriage does the reputation of the builder rest. No matter how perfect all other parts may be, if the wheels are defective the vehicle is condemned. Knowing this, many first-class manufacturers employ none but the most skilful workmen, and have their wheels made under their own supervision, and any defect is detected before the wheels are finished. This is rendered necessary, says the *New York Carriage Journal*, from the multiplicity of causes that operate to injure the wear of the wheels—carelessness in mortising the hubs or in fitting the spokes, bad driving, inequality in the texture and stiffness of the timber, in spokes or felloes, badly seasoned or imperfect hubs, together with the injury inflicted by setting the tire or cutting out for the boxes—all to a greater or less degree produce defects that seriously impair the durability of the carriage. These defects are all the results of carelessness or ignorance on the part of the workmen, but there are other causes that operate against the durability of the wheel; the principal one is the failure to select those that are of proper proportions. Some manufacturers will make all parts of the vehicle as light as possible, but select a comparatively heavy wheel; others will act the reverse, and make the wheel as light as possible. In either case the result is injurious. If the wheel is too heavy it throws all the strain upon the axle, which is the cause of nine-tenths of all the broken axles where the break is at the shoulder; if the wheel is too light it receives all the strain, and is soon torn to pieces.

There are two classes of wheels—one class owes its strength to its elasticity, the other to its rigidity; in the first class might be placed all wheels having spokes 1in. and under, while the other class would comprise all heavier sizes. Any light wheel that is constructed with too great rigidity around the hub, or too great weight at the felloes, has not only the element of its destruction in it, but it also proves the destruction of the axle upon which it is placed unless this is unduly large. Then, too, if the spokes are too stiff they throw all the strain on the hub, and as a result the spokes are loosened or broken at the shoulder. In order to secure strength in light wheels it is necessary that the hub should be small and the throat of the spoke thin and flat, and as near the shoulder of the tenon as possible; the felloes and tire should be proportionately light. If a set of wheels are to carry 250lb., carriage and rider included, a hub 3in. to 3¼in. in diameter, three-quarters of an inch spokes, three-quarters of an inch felloe, and three-quarters of an inch by one-eighth of an inch steel tire is ample. If a set is needed for a top buggy that will accommodate two persons, the total weight to be carried being about 500lb., the wheels should be made with a hub 3½in. to 3¾in. in diameter, seven-eighths of an inch spoke, seven-eighths of an inch felloe, and seven-eighths by three-sixteenths steel tire, the axle being seven-eighths of an inch steel. If the roads are rough the wheels should be strengthened by adding one-sixteenth of an inch to the spokes, and one-eighth of an inch to the diameter of the hub, but nothing above this unless the axle be increased in size. Wheels are in some instances made lighter than those first mentioned, but when below that point there is danger of their lacking in power to produce a recoil if they become badly strained. A great mistake in making light wheels is in using too large hubs, under the mistaken idea that the hub, of necessity, is the point where there is the greatest amount of strain; for this reason a heavy hub will be selected, and light spokes, felloes, &c., be used, giving to the wheel additional weight and bad proportions, besides removing the point of elasticity too far from the centre, and thus increasing the rigidity and endangering the axle. The principal aim of inventors has been to secure great strength at the hub; for this purpose metal, and metal and wood combined, have been introduced; in some cases they have met with success, but this can be attributed as much to the manner in which the wheels are put together as in the advantages claimed in the patent. Heavy wheels with a wood and metal hub have proved valuable, and are taking the place of the large wood hub, but with light wheels the success has been less decided, and where it was most meritorious in preserving the wheel it was most injurious to the axles.

The trouble with wheel makers is that we have too many inventors and too few mechanics; but, after all the inventions have been sifted to the core and the best points combined, for light wheels there is nothing better than a good elm hub, clear young hickory spokes, and fine, close-grained hickory felloes, provided these are put together in a workmanlike manner. One of the latest inventions is the wheel line is the mortising of the hub with two sizes of mortise for the same spoke; the first mortise which is about one-third the depth of the whole mortised in nearly, if not quite, the full size of the spoke at the lower end; below this the thin mortise is made, the latter, however, being narrower than the former; and, strange as it may seem, it is claimed for this method of mortising that "the hub is not cut away so much in its centre, and a very small and light hub may be made to be very strong;" also, that "the wheel is more elastic than the old style of wheel, and therefore less liable to break axles;" more than this, "the spoke is strong just where it needs strength, namely, at the shoulder, and the hub is strong just where it requires most strength—at the middle." We confess ourselves to be at a loss to understand how the strength of a hub is increased by cutting it away to almost nothing at its extreme outside circumference, or how bedding a wide tenon into the hub in this manner increases its elasticity. According to our reckoning, a 3¼in. hub, made up with a spoke that has a half-inch face and a five-sixteenth tenon would have about 7in. of solid timber on the outside circumference, while the spokes would run together at the outside of a box of suitable size to receive a three-quarter of an inch axle, while with this improved plan there would be less than 3in. of uncut space, and by no manner of measuring can we discover where the extra amount of timber is located; but as a scientific paper gives the following endorsement, we presume they have a way of increasing strength by cutting it away. "The principle of construction is sound, and we have no doubt an excellent wheel may be made in this way." If any of our friends have an idea of trying this improved manner of mortising hubs let them make a diagram of a hub, cut off at the face of the spokes, laying off all the tenons full size, both with the old and new plan, and we think they will be slow to cut their hub away one-third more than is necessary, in order to secure greater strength.

There is another weak point in the fitting up of the wheels that impairs their strength; we refer to setting boxes. There are many good machines in use, but they all cut away the ends of the spokes on the same line as the bore of the hub, and when the box is forced in the spokes bear heavy upon the metal. The constant hammering that the spokes are subject to renders it necessary that they should rest upon the wood of the hub on account of its elasticity, whereas, if resting on the box, which is unyielding, it soon jars in the mortise and become loose. The right method is to cut away the ends of the spokes at least one sixteenth of an inch below the bore in the hub; a little more than this would do no harm, as it will need but one or two resettings of the tire to force them down as close to the metal as is consistent with the safety of the wheel.

ADULTERATION OF FOOD.

DR. WHITMORE, the Medical Officer of Health for Marylebone, writes:—

"Whilst the question of a pure and constant water supply is engaging public attention, some little consideration might also be advantageously given to the quality of our food supply. For some time past certain articles of food, principally those in daily consumption by the poorer classes, have been brought under my notice, which on examination I have found to be deficient in those nutritive properties, which, when genuine, they are found to possess. I may refer more particularly to milk, bread, and lard. With regard to milk, it has been a practice of late years amongst many dairymen to supply milk of a 'superior quality' for the use of the nursery, and to charge an increased price for it; but as this kind of milk can only be genuine at the best, the fair inference is, that all milk not intended for nursery use is not genuine, and that it is not I have in many instances been enabled by analysis to prove. With regard to bread, the principal adulterative article used in making it is the potato, which, although not injurious to health, is so far objectionable that it contains none of the vegetable fibrine which constitutes an important ingredient in wheaten flour, and to which it owes nearly all its flesh forming properties."

"Lard is not unfrequently adulterated with potato flour or the cheaper kinds of arrowroot, which is stirred into it when in a liquid state, and which gives to it when cooled an appearance of increased whiteness and purity."

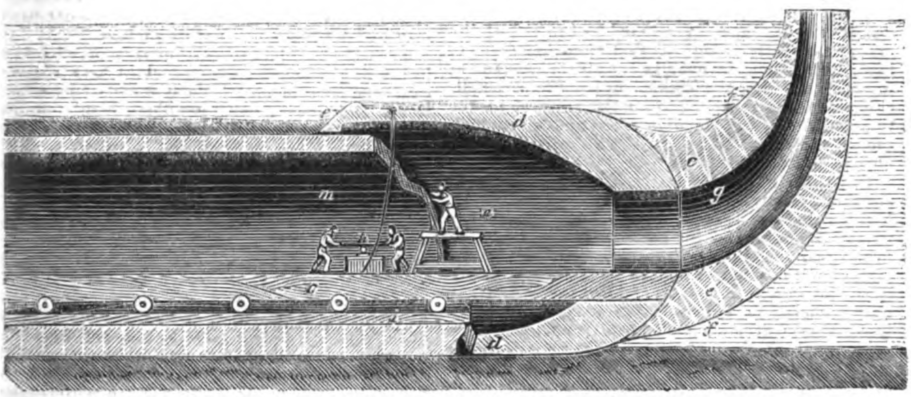
"I fear it will in time be discovered that many small shopkeepers, in their desire to compete in point of cheapness with the large co-operative stores, are resorting to a system of adulteration which in the end cannot fail to become an evil that will require stringent laws to repress."

SUBMARINE STRUCTURES.

OF the various methods hitherto adopted for forming structures under water, the most common is that which consists in surrounding the place of work with a dry inclosure called a coffer dam, formed by driving rows of piles into the ground, and filling the spaces between them with clay puddle, gravel, and sand.

Another system is that in which iron tubes, open at the bottom, are sunk into the water. They are then exhausted of air, and the material at the bottom, if soft, rises into them, while they, on the other hand, sink down into it. The material is then taken out and concrete substituted.

A third method is that which was adopted in making the Thames Tunnel. A sufficient thickness of earth is left between the place of work and the bottom of the river to support, during construction, the body of water above. M. Francois Durand proposes a new mode of making passages under water, which will not involve more expense than tunnelling in *terra firma*, and offering further advantages, which will best appear on description. He would apply the principle in



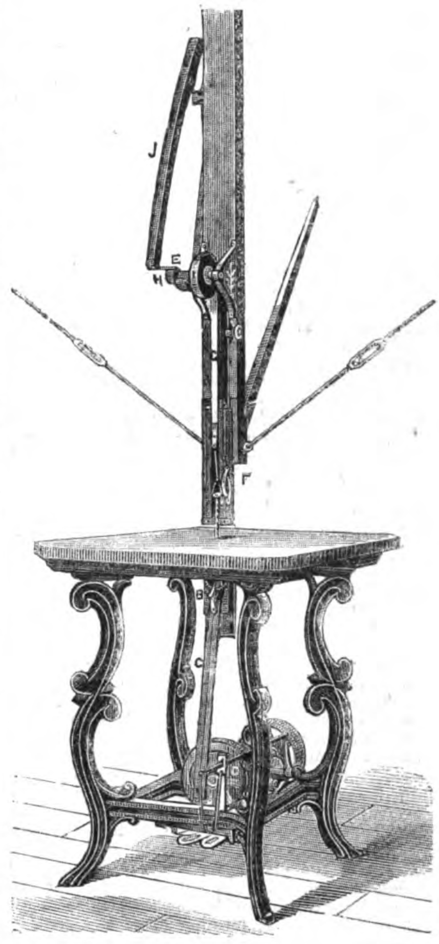
various ways, as for making a passage between the banks of a river, for laying the foundation of piers, breakwaters, &c. The principle of the invention consists in enveloping the structure which is in course of formation with a cloth texture impermeable to water. An iron shield of sufficient weight to remain at the bottom of the water, notwithstanding the air inclosed, supports this cloth, forming a work chamber, whose section is a little larger than that of the tunnel being made. The shield is represented in the drawing at *d*. This shield is crossed in its central part by metallic bars, on which are placed such weights as are necessary to the stability of the apparatus, and in such a way that its centre of gravity is between the wheels of the carriage C, which sustains it, and by means of which its advance is regulated. Lastly a pipe *g* rises to the surface, and is supported by a buoy, thus ventilating the work chamber. This pipe is surrounded by the cloth *e*, which has to be paid out, so to speak.

Suppose, now, a subway is to be formed under some river, and that the approach has been prepared to the surface of the water. Having dredged an even channel for the tunnel, gently inclining on either side, the shield is placed at the point of entrance into the water, and the extremity of the sack into which the shield is thrust fixed behind it, the rest of the sack being in front of the shield. The construction is then proceeded with, and the apparatus is gradually advanced to the opposite bank, the ring of masonry being always within the cloth envelope and metallic shield. The carriage is moved on rails fixed on that part of the bottom which is already constructed. The advance is effected by means of hydraulic pressure. The above apparatus can, with advantage, be adapted for tunnelling in *terra firma*.

IMPROVED SCROLL-SAW.

AN improved scroll-sawing machine, patented by Mr. J. Moseley, of Syracuse, New York, seems to be highly thought of by American mechanics, and has received several prize medals at the State fairs and exhibitions where it has been shown. Simplicity in construction and convenience in operation are its chief recommendations. It can be run, it is said, at a speed of from 800 to 1,200 "revolutions" per minute, and is equally serviceable in cutting heavy work as in shaping the lightest veneer or the most delicate fret. The following description and illustration will, however, enable our readers to form their own opinions of its capabilities:—

The saw passes through the table in the usual manner, and has its upper end attached to a suitable slide working in the adjustable guide, A, and its lower end attached to the sliding cross-head, B, fitted to guides underneath the table. The vertical movement of the cross-head, and consequently of the saw, is received from the pitman, C, connected with the wheel, D, the shaft of which also carries a fast and a loose pulley. The slide at the upper extremity of the saw is connected to



a strap, G, attached at its upper end to a wheel, I, on one extremity of the shaft of which is a cam, *c*. From a point on the periphery of this cam extends a strap, *d*, to the free end of a vertically arranged wooden spring, J, the elastic action of which tends to rotate the shaft of the cam and wheel, in such wise as to exert a tension on the strap, G, thereby straining the saw. The wheel, I, is made adjustable upon its shaft by simple devices, so that the strap may be adjusted either to different lengths of saw, or to exert any required tension or strain upon the same. The upper slide and the cross-head below are fitted so that the ends of the saw are gripped between clamping surfaces without the aid of pins, and devices actuated by a short lever, F, are so arranged that, when required in the exigencies of the work in hand, the upper end of the saw may be quickly and conveniently released from its fastenings. Means are also provided for readily raising the guide, A, out of the way under like conditions. At the base of the machine, and in convenient proximity to the foot of the operator, are pedals, so connected by appropriate mechanism with the fast and the loose pulley that one or the other of the said pedals may be used to shift the belt and to actuate the brake, accord-as the belt may be arranged to run in one direction or another in stopping and starting the machine. The upper part of the machine is secured to the roof by tie-rods in the usual manner, and the table and driving-shaft is mounted on a cast-iron frame, the whole apparatus weighing less than 400lb.

ON EARTHQUAKES AND VOLCANOES.*

By AUGUSTUS LE PLONGEON, M.D.

(*Continued from p. 221.*)

6.—How the Earthquakes are Produced.

LET us take it for granted that, owing to the living activities of the earth, a considerable quantity of these necessary chemical elements have collected, and that the waters of the sea having percolated and saturated them, a very active chemical action has taken place and evolved a considerable amount of caloric. This will soon reach the incandescence, particularly if the point where the chemical action is taking place happens to be in contact with the voltaic arch formed by the electro-magnetic current passing between the sun as positive element and the earth as negative. This is precisely what has occurred on the 13th of August, 1868, in the southern provinces of Peru, and three days later in the northern of Ecuador. It is a fact worthy to be noted, that the great and destructive earthquakes have always taken place at the time of some eclipse of the sun or moon. The moment a single atom becomes incandescent, irradiation takes place, and the surrounding atoms soon attain the same degree of heat as the first, the inciting causes being incessantly at work. From this focus of irradiation, caloric will extend from one molecule to another; and it will not be long before a large subterranean furnace will be in existence. What will then happen? It is perfectly obvious that the water existing in the neighbourhood will be converted into steam, and this constantly overheated into gases, which by their enormous dilatation will exert a tremendous pressure against the wall of their place of confinement.

Everybody is now acquainted with the force of expansion of gases. In their action on the superficial strata we shall find the explanation of earthquakes. These gases must find an issue. They press against the crust above in a perpendicular direction. This crust happens to be sufficiently resistant, composed of homogeneous materials that render it elastic—upheavals then take place, like those observed from the remotest antiquity to our times. All these upheavals are always preceded by earthquakes, with emissions of sulphurous vapours and sulphuretted hydrogen gas, smoke, &c.

If the crust is not sufficiently resistant, a new crater is opened, a volcano is formed. These are the boils on our mother earth's body, that having ejected all the matter contained in them, subside and even disappear. We have an example of this phenomenon a few miles from Granada (Nicaragua) in the volcano of Musalla, which has completely vanished since the conquest by the Spaniards, and the place where it stood is now a level plain covered with burned and blackened stones. Let us suppose that the superstrata are homogeneous, and so resistant as to withstand the enormous pressure of the immensely dilated gases. Then the soil will be convulsed, tremendously shaken; and the mighty works of men destroyed, levelled to the ground.

As deep as man has penetrated in the superficial strata of the planet, he has found them honeycombed; traversed in all directions by moats, conduits, caverns, and hollows, which contain large deposits of water, forming lakes and pools, originating subterranean currents, streams, and rivers. These moats, conduits, caverns, &c., &c., are separated by walls more or less thick. These walls in the vicinity of the furnace, being less resistant than the crust above, give way under the pressure of the gases; an issue is opened for their escape. They precipitate themselves into it with incommensurable force; hence the rumbling noise—the thunder-like explosions which always accompany earthquakes and precede them by a few seconds, giving warning of their coming. By the falling of the walls of the caverns and moats, the props of superstrata being destroyed, these cave in; hence the abasements of the surface, the rendings, the disappearance of some streams, the appearance of others—the changes that take place in the configuration of the countries where the catastrophe has occurred. The gases, in their onward rush, meet other openings; part precipitates into them. Soon they expand on a larger field; their forces, not being any longer concentrated, grow less and less as they find more avenues through which to escape; and as they are further from the centre of their generation, that is to say, from the furnace. Many of these furnaces, no doubt, exist that having communications with active volcanoes are not perceived on the surface; or have a vent in the shape of geysers, hot springs, mud volcanoes, &c., &c. The hot well discovered at Lacrosse, Wis., in the month of February, 1868, when some men were boring an artesian well bears witness of the truth of my assertion. The upward pressure against the ceiling of the conduits accounts for the waters in the wells overflowing, and for the changes of their level. The sulphurous nature of the gases accounts for the fetidity observed in subterranean waters, in caves and cellars.

Different and very distinct motions of the soil have been noticed during earthquakes. They are easily accounted for. The most common is known under the name of *undulating motion*. It may be explained in this wise. The walls and ceilings of the subterranean cavities are rugged and uneven, resembling somewhat the waves of the ocean during a gale, with more or less deep indentations; they are not composed of the same and homogeneous materials. In places they are more resistant than in others; and when gases come from a long distance, and somewhat disperse, they do not exert their power with so much force on the ceilings. They consequently give rise to a motion similar to that felt on board of a vessel at sea, and called for this reason *undulating motion*.

There is a second motion called *sussultaria*, eruptive. This has been observed many times, and always accompanied by great catastrophes. Such motion, foreshadowed by sulphurous vapours, occurred during the months of February and March, 1783, in the plains of Calabria and Mesina, when the tops of granite hills were clearly seen to jump up; the stone foundations of houses, even the pavement in the streets, were so lifted up as to be found turned upside down. The city of Riobamba was destroyed by one of these eruptive motions in the year 1797, and the bodies of some of the inhabitants thrown on the top of a hill 100ft. high. Palmeri and Scachi, in their report on the earthquake of Molfi, which occurred the 4th of August, 1851, expressly say that columns were broken at the base without losing their perpendicular position; that chimneys were heaved up into the air, falling again in their natural place. The city of Mendoza was destroyed in 1861 by a motion of that kind. The ceilings of the furnace, being homogeneous and resistant, will not swell or upheave, but sustain the shock occasioned by the puff of the gases incessantly arising, dilated from the focus of heat, in the same manner as the steam escaping at intervals through the escape pipe. The perpendicular shock is repercussed to the surface, in the same manner as if you give a sharp blow under a table; the table, to be sure, will resist, but the objects on it will be thrown up into the air.

The third motion (*moto vorticoso*) is rotary or circular. Many doubt its existence; but I see nothing that can be opposed to it. We read in the papers an account of the earthquake that was felt in the year 1868 in San Francisco, California, and a motion of that kind is said to have been observed in the lower part of the city. After the earthquake that occurred in Valparaiso in 1822, three palm-trees, placed at a short distance from each other, were found intertwined, and so have remained ever since. It is also reported that after the earthquake of 1783, in Calabria, two square obelisks placed in front of the Convent of S. Stephano del Bosco, were found turned round on their pedestals. Many other cases, similar to those, are reported, proving the existence of the rotary motion.

But how is such motion to be explained? In two different manners. Have you ever noticed how a rotary motion can be imparted to a small metallic wheel, supported on a steel or iron axle, on which it can revolve freely, merely by rubbing vigorously with a rough file one end of the axle? If so, you have seen it turn of itself, as it were, in the same direction as the file is drawn.

Why would not also a powerful stream of gases, rubbing against the rugged ceilings of the conduits, produce a strong electro-magnetic current, that would impart a rotary motion to the objects on the surface, in accordance with the laws that govern currents of induction. ?

Again, this rotary motion may be explained in this wise. When two currents of air, coming from opposite directions, meet each other, they give rise to a whirlwind. If these currents are very strong, a hurricane or tornado is the result. Well, there is no reason why the same phenomenon, which takes place above ground, should not also occur under ground, when two different current of gases, coming from opposite directions, meet in the interterrestrial passages and cavities. Nature works in the same manner in all its manifestations when the conditions are equal. Similar causes produce like effects; then two currents of gases meeting under ground will produce a tornado; and a rotary motion will be imparted to all objects within its boundaries.

I have reviewed in a very cursory manner all the effects produced by the convulsions of the earth, and, by the synthetic method of reasoning, tried to arrive at the understanding of their causes. I have not advanced an opinion which is not founded on facts acknowledged by science, on events recorded in history. I do not propose any theory, but merely give in these few lines the result of my own observations and investigations. If they satisfy your mind, as they do mine, then I am happy, for I have attained the object I had in view when I took the pen.

Let me then recapitulate, and sum up in a few words my

7.—Conclusions.

1. There is no central fire. It is unphilosophical, unscientific to uphold the opposite doctrine—for it merely rests on speculations, unsupported by facts and science. It must, therefore, be disregarded by all scientific minds.

2. The heat of the earth has its source: 1st. In the friction occasioned by its rapid motion through the cosmic matter that fills all space. 2nd. In the rays of the sun, that, however cold in themselves, carry light that, setting in motion the molecules of the atmosphere, generates heat, which is communicated to the earth. 3rd. In the constant chemical decompositions that are incessantly going on in its great interior laboratories. 4th. In the oxidation of the metallic substances that compose the superficial strata of the planet. All these phenomena are produced by the agency of electro-magnetism, which seems to be the life-sustainer of the whole creation.

3. The volcanoes are not the safety valves or vents of a central fire, which does not exist; but are merely local accidents produced by a conglomeration of materials, sulphur being one of the principal, that, being soaked by salted waters, enter into chemical decomposition, under the agency of electro-magnetism, and that the volcanoes are to the surface of the earth what boils are to the surface of the human body, which disappear as soon as the matter accumulated is expelled.

4. That the sun's immense reservoir of electro-magnetism, and the other celestial bodies, which are likewise reservoirs of the same agent, increases the action of the electro-magnetic currents that traverse the earth, according to their respective positions with regard to this, and hasten the effect of the chemical operations, if a point of the voltaic arch formed by them comes in direct contact with the place they are going on on a large scale.

5. That earthquakes and volcanoes stand in intimate relations, have a common origin, and will ever occur in those places where large chemical action is taking place. That, inasmuch as chemical action is alive in every part of the earth, earthquakes may be felt on any point of its surface.

6. That the origin of earthquakes may be found in the expansion of gases generated by the various causes enumerated, particularly chemical decompositions. These gases, being prodigiously dilated, press heavily against the wall and ceilings of the cavities in which they are confined, and in trying to find an issue through which to escape, produce the dreaded phenomenon.

7. That when a volcanic action is going on in the substrata of the surface of the earth, and earthquakes are impending, the phenomenon is foreshadowed by many precursory signs.

8. That among these forerunners the following are the most evident: 1st. Sulphurous vapours arising from the ground in the vicinity of the focus of the chemical action. 2nd. Strange and mysterious noises, produced by the activity of the gases. 3rd. Alterations of the mineral waters, occasioned by the percolation of the gases through the porousness of the superficial strata, and affecting its chemical compounds. 4th. Turbidity of the fresh waters in wells—phenomenon produced by the same causes. 5th. Changes in the level of the waters in wells caused by imperceptible upheaves and depressions of the superficial strata, affecting the sources or subterranean streams which feed them. 6th. Emanations of carbonic acid or sulphuretted hydrogen gas perceived in cellars, caves, wells, excavations. 7th. Electro-magnetic disturbances in the atmosphere suddenly taking place and without any apparent causes, manifested by the loss of power of magnets.

10. That the opinion of Pliny the Elder commends itself to the serious consideration of all men of science: that the evil consequences of earthquakes might in some measure be arrested by boring deep artesian wells in the countries subject to earthquakes, for those wells would act as vents through which the gases might escape, and their raging storm partly quelled.

A few years ago, four deep wells were discovered one at each corner of the cathedral in Lima which had been destroyed by the earthquake that laid that city to the ground in 1687. The church was rebuilt and these wells bored to act as protectors of the monument. They have well fulfilled their duty, for the edifice has withstood all the different shocks that since that epoch have visited the capital of Peru, and destroyed many of its strongest structures.

(*To be continued.*)

* From *Van Nostrand's Magazine.*

CARBOLIC ACID FOR PRESERVING HIDES

THE difficulty hitherto experienced by tanners in keeping raw hides during hot weather, according to the *Shoe and Leather Reporter*, is to be wholly obviated by the use of carbolic acid. It has been known for several years that the preservative properties of carbolic acid, when used on decaying substances of any kind, were of the most particular efficacy. This fact was very pointedly brought out by the experiments of the New York Board of Health, two or three years since, when it was found that nothing else would more effectually stop the decay of vegetable or animal substances than an application of carbolic acid. No matter to what state the decomposition had proceeded, an application of carbolic acid instantly checked its further progress, and rendered absolutely impossible any further decay.

Proceeding on the knowledge thus obtained, experiments were made at one of the large tanneries in Pennsylvania, as to the effect which carbolic acid might have on the colour and grain of leather, when the hide was thus treated. It was found that the decomposition or decay of the hide (without making any difference as to what extent it had proceeded) were instantly stopped by the application of carbolic acid, and that the colour and grain were in no way impaired. In fact, from the experiments thus far made, it would appear that both are somewhat improved and whitened by the use of the acid, but this matter has not yet been sufficiently tested to warrant the conclusion that either the grain or colour will be in any way improved, if, indeed, it is at all affected by this new agent.

PROTECTING SHEET IRON FROM RUST.

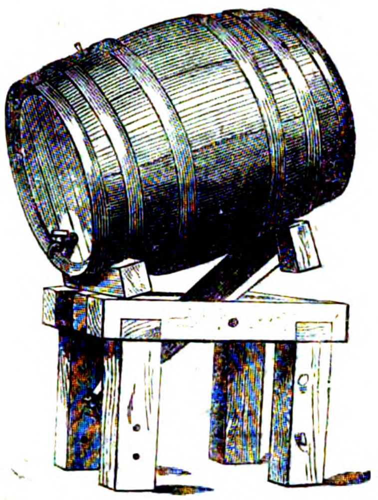
AN improved method of protecting iron from injury and deterioration has been introduced by Mr. B. Morrison, of Philadelphia, whose invention consists in deoxidising the scale oxide adherent to sheet iron, and amalgamating, blending, or intimately uniting with it any of the softer and more fusible metals, so as to render such scale oxide more flexible, soft, adherent, and less liable to rust, and the sheet iron also more perfectly annealed and flexible. It is essential that the sheets be made of the best charcoal bloom iron, and that the scale oxide thereon be even, or of uniform thickness and unbroken; and in order to produce such a scale oxide, it is recommended that the usual rough and imperfect scale be removed—by means of a weak acid, in the usual manner practised in galvanising iron, and that the sheets be then passed between a pair of smooth pressure rolls, and finally subjected to a sufficient heat to produce thereon a new and uniform scale of oxide.

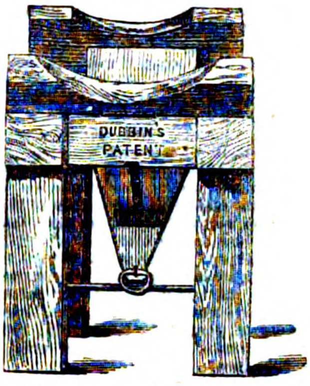
Having prepared saturated or strong aqueous solutions (say) of sulphate of zinc, chloride of zinc, chloride of tin, acetate of zinc, acetate of lead, and of any other readily fusible metal that will amalgamate, unite, or combine with the deoxidised scale on the iron at a strong or bright red heat under the hydrogen or carburetted hydrogen gas, immerse the deoxidised sheets either in one or a mixture of two or more of the said solutions for five or ten minutes, or apply the same by rubbing it on by means of a sponge or rough brush; let the excess of solution drain off, and the remainder crystallise or dry upon the surface of the sheets. Now place them in a box in the heated chamber of a furnace; then introduce the hydrogen gas, and slowly heat up to a scarcely visible red, maintaining the said low heat for (say) half an hour, more or less, to allow a perfect reduction of the oxide of the applied solution; after which the heat should be increased to a bright red, or heat a few degrees above that which may be required to fuse the now reduced softer metal and cause the same to amalgamate, blend, or unite with the deoxidised and, consequently, soft and porous scale on the sheet iron.

To obtain brightness of surface when desired, it is proposed to pass the sheets severally between and in contact with a pair of cylindrical rapidly rotating bristle brushes; and, if afterwards intended to be put up in packs for storage or shipment, the sheets may, as a further protection against dampness, be dipped into any suitable hydrocarbon oil, and then the superfluous portion drained or wiped off. The solution of the sulphate or of the acetate of zinc forms, with the deoxidised scale on the iron, an excellent coating. About three parts of the solution of chloride of zinc, mixed with two parts of the solution of chloride of tin, make, with the deoxidised scale on the iron, an excellent flexible coating of a whiter colour. Three parts of the solution of the acetate of zinc, mixed with two parts of the solution of the acetate of lead and one part of solution of the chloride of tin, make, with the deoxidised scale on the iron, a very suitable coating for sheet iron intended to be used in the construction of stoves, stove pipes, coal hods, &c.; but as the predominant metal in the coating is the deoxidised scale oxide of iron, the number and proportions of solutions of whatever metals are intended to be applied thereto may be increased and varied as the coating desired may require.

NEW CASK-STAND.

THE annexed illustrations of Dubbin's "patent self-raising and self-setting cask-stand for beer and other purposes" are almost sufficiently explanatory in themselves to enable our readers to understand the construction and appreciate its advantages. The principal feature of the invention consists in the adaptation of a lever actuated by a powerful indiarubber ring, so situated as to cause an almost imperceptible elevation of one end of the cask as the weight gradually decreases through the contents being withdrawn. The lever, it will be seen, is pivoted in the centre of the horizontal bars forming the stool or support; its front end being connected by a strong ring, or band, of indiarubber and a rod held between the two front legs. It is evident that as the cask

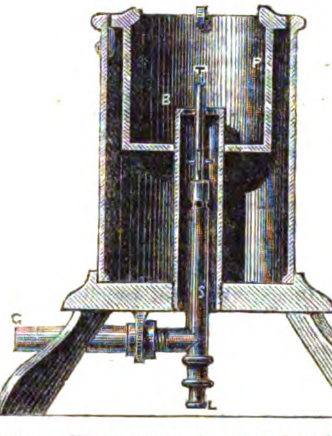




becomes lighter the rubber ring is enabled to contract and so tilt the cask, which is then supported in the required position by a ratchet-bar, as shown in the figure, thus relieving the rubber band from the strain produced by the weight of the barrel. The gradual nature of the motion thus imparted to the cask obviates the annoyance experienced with other contrivances for effecting a similar purpose, as the sediment is not disturbed and the waste is consequently reduced to a minimum. The absence of iron in the moving parts also avoids the inconveniences of rusty springs and screws, very natural results in the ordinary stands when placed in damp cellars.

HEATING BY GAS.

A SELF-ACTING apparatus for heating by means of gas has been patented by Messrs. Goldsmith and Dilkes, and the arrangement will doubtless be found serviceable for many different



purposes. The invention is adapted to the heating of sad irons or the melting of metals, and consists in principle of a combination of levers and springs so arranged that when the substance to be melted or the article to be heated is removed from the frame supporting it over the burners, the gas is lowered and waste prevented.

A rectangular or other shaped chamber is formed of sheet iron mounted upon a cast-iron bottom or stand, and is either covered or not by a hinged lid having a slot or slots made therein. It is also furnished with holes either at the upper or lower part thereof for the entrance of air. Within the chamber, and fitted to the upper part of it, is a cast-iron trough with an opening in the bottom; beneath the opening are fixed burners on Bunsen's principle, presenting a continuous or nearly continuous line of flame, the gas being admitted at the bottom of the burner from a pipe which extends to the outside of the chamber, where it is fitted with a valve. A lever which has its fulcrum within the chamber is so arranged that one end projects above the opening in the bottom of the cast-iron trough, while the other passes through a slot in the side of the chamber, and communicates with the valve. A spring is fastened near one end of the lever, which has the effect of keeping the valve in such a position as to admit but a very small quantity of gas to pass to the burner, but upon the introduction within the trough of the iron to be heated, or the melting pot containing the metal or other material to be melted, the weight will depress one end of the lever and cause the other end to rise and open the valve, so as to allow of sufficient gas passing to the burner to produce the requisite heat. On the removal of the sad iron or melting pot the spring will cause the valve to resume its former position, so that only sufficient gas will pass to just keep a light burning. It will be seen, therefore, that when the apparatus is not in active operation the consumption of gas is reduced to a minimum, but its full power is exerted the moment the material to be heated is brought within its action.

It is obvious that the shape of the apparatus may be variously modified. For the purpose of melting it may by preference be made round, and in this case the vessel containing the metal or other material may be made to press upon an upright spindle communicating with the valve without the intervention of any lever, as shown in the annexed figure, which will give a good idea of the principle, and suggest modifications to fit it for various purposes. In the drawing, which is a vertical section, a cylinder of wrought or cast iron or other suitable material is mounted upon a stand, in the top of which a piece of pipe forming the burner is firmly secured. Suspended from the top of the cylinder is the trough or pan P, into which the glue-pot or melting crucible is placed with its bottom pressing on the upright spindle T, which is forced upwards by a spring coiled in the interior of the tube S; B is the burner where the mixture of gas and air is lit, G the supply-pipe, and L is a nut used to regulate the quantity of gas supplied. When the melting-pot is placed in the trough, T is depressed, and the valve in S is opened to its full extent, so as to permit the passage of the gas to the burner B; when the pot is removed from the trough, the spring forces up the rod I, and only sufficient gas to just keep the flame burning passes through. There is, of course, nothing novel or original in the idea, but the arrangement may be found useful in many ways.

MICROSCOPICAL NOTES.

Pattern Lead Cells.—Mr. T. Charters White, the Secretary of the Quekett Club, says that he has been in the habit of using cells made of a thin kind of lead known as "pattern lead," employed by dentists for taking patterns for their gold plates. It is found to answer the purpose very well; the slide may be made almost red hot without melting the cells, and the cells are very easily stuck on with marine glue. For shallow cells a simple ring of gold size and gum dammar, put on thickly and allowed to get hard, answers the purpose excellently, and if Bastian's cement is used instead, the cell can easily be built up higher by adding layers upon those which have become dry. Another way is to use zinc cells, which stand any amount of heat; acid, however, affects these, but vulcanite cells resist acids. In making cells for mounting in fluid, Mr. White says, it will be found of great advantage to set up some standard size, and keep to it, as this enables the worker in a short time to estimate correctly the exact amount of fluid required for filling—a matter of some importance.

Staining Tissues.—Dr. Durnforth writes as follows on this subject in the *Lens*, a new microscopical journal published at Chicago:—"It is desirable to stain sections of all soft tissues, whether from healthy or diseased specimens. First, because it enables us more accurately to distinguish germinal or nuclear matter from formed material or tissue proper, by their differences in receptivity of colour; and secondly, because it brings into relief all constituents of soft tissue, and, therefore, renders their study easier and more satisfactory. The staining material which aids me most, and therefore suits me best, is the alkaline solution of carmine made after Beales's formula. The sections should be placed in the carmine solution as soon as they are made, and they should be made as soon as possible. No positive rules can be laid down as to the precise time required for the completion of the staining process. It will vary, within certain limits, according to the character of the tissue and alkalinity of the solution. In regard to this latter point, I may properly say that the carmine solution should neither be neutral nor intensely alkaline: in the former case, all portions of the tissue will probably be stained alike; in the latter case, much of the younger or softer portion of the formed material surrounding the germinal matter will be destroyed by the excess of alkali. I generally permit my own sections to remain in carmine for three or four hours. Having completed the staining process, the sections should next be immersed in a mixture composed of Price's or Sarg's glycerine and distilled water, 4 drachms of each, and 20 drops of acetic acid. This answers the double purpose of rendering the so-called nuclei (germinal matter, bioplast) sharp and clear, and of commencing the process of impregnating with strong glycerine; it will also remove the superfluous carmine. After being soaked in the glycerine and water mixture for from twelve to twenty-four hours they should be transferred to the following mixture: pure and strongest glycerine, 1oz.; pure acetic acid, 5 drops. They should be allowed to remain in this mixture until they are fully saturated therewith, which will take from two days to as many weeks."

Carmine Staining Solution.—The following is the formula for preparing Dr. Beale's well-known carmine solution:—Ten grains of carmine in small fragments are placed in a test-tube, and half a drachm of strong liquor ammoniæ added with agitation and the heat of a spirit-lamp. The carmine soon dissolves, and the liquid, after boiling a few seconds, is allowed to cool. After the lapse of an hour, much of the excess of ammonia will have escaped. The solution is then mixed with 2oz. of distilled water, 2oz. of glycerine, ½oz. of alcohol. The mixture being passed through a filter or allowed to stand for some time, the perfectly clear supernatant fluid can be poured off and kept for use.

Paraffin Oil Lamps.—Mr. John A. Perry, of Liverpool, suggests in *Science-Gossip* the addition of camphor to increase the illuminating power of paraffin oil and improve the quality of the light; this is a well-known fact, but here is Mr. Perry's recipe for those who have never heard of it. "I do not think it is generally known to microscopists that the addition of a little gum camphor to the paraffin oil in the microscope lamps burning that fluid is a very great improvement. About fifteen grains of camphor, put into an ordinary-sized lamp, about one hour before using, will cause the lamp to give a far more intense and brilliantly white light than the paraffin oil alone would give."

The "Germ" Theory.—At a recent meeting of the microscopical section of the Liverpool Medical Institution, Dr. Braidwood exhibited specimens of a very fine white powder deposited on the inner surface of the glass of a locket inclosing hair from a child who had died a year previously from malignant scarlet fever. After the child's death, a lock of hair *not disinfected* was placed below a well-fitting glass cover in the locket, and a lock which had been disinfected with Condy's fluid was placed outside the glass cover but inside the lid of the locket. On the locket being opened a year later a fine white powder was seen on the inner surface of the glass, next to the non-disinfected lock of hair. When examined with a one-twelfth inch lens, this deposit was found to consist of very minute spherical granules (like the microzymes in vaccine lymph), and of sharply-defined, acicular, crystalline-like bodies.

The Flavour of Butter.—The German *Agriculturist* says that a great portion of the fine flavour of fresh butter is destroyed by the usual mode of washing, and he recommends a thorough kneading for the removal of the buttermilk, and a subsequent pressing in a linen cloth. Butter thus prepared is pre-eminent for its sweetness of taste and flavour, qualities which are retained for a long time. To improve manufactured butter, we are advised by the same authority to work it thoroughly with fresh cold milk, and then to wash it in clear water; and it is said that even old and rancid butter may be rendered palatable by washing it in water to which a few drops of a solution of chloride of lime have been added.

Nitrogen in Plants.—M. Deherain (in *Comptes Rendus*) advances a somewhat novel theory of the reduction of atmospheric nitrogen to an available form for the support of plant life. He endeavours to prove that the free nitrogen of the atmosphere is brought into combination during the oxidation of organic matter in the soil. To demonstrate this, he dissolves glucose in a dilute solution of ammonia in water, placed in a large flask filled with a mixture of equal parts of nitrogen and oxygen. Having closed the flask, he heats the mixture gently for 100 hours, at the end of which time the whole of the oxygen has disappeared, and 5·9 per cent. of nitrogen has been taken up. The same process with humic acid and potash shows a loss of 7·2 of nitrogen. If these results are confirmed by subsequent experiments, they will throw light on the hitherto obscure subject of the production of nitric acid.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

WHO INVENTED NOAH'S COMET.

[4353.]—"P. SANTALINUS," "Sigma," and others, insist on taxing me with the crime of evolving a "pet" comet for Noah, as if the dullest intellect for these two centuries, ever since the relations of planetary and cometary motion were ascertained, could ever miss so obvious a lesson! "A legacy from Whiston," forsooth! (p. 303, let. 4289) as if, when Nature thrusts before the noses of you and your children sundry times per generation one of these "mythical" manufactures (let. 4240) waves before you such an ensign, as much as to say, "*There*, men! *Such things are.* Your world is tenant at will among such evictions as *that*, with no lease; you have never had one hour's lease;" it needed the man whom Newton chose as successor to make the historical application of this! As if it had ever been worth while, before more than children, to suggest how such a discovery established for ever the naturalness of the Noachian Story, the certainty of Nature's containing abundant means for any such catastrophe, at any moment; her redundantly superfluous displays thereof, and reiterations before each and every of you, again and again, that such catastrophes are, must have been, and must be, as long as she is Nature!

I have only this week alighted upon, probably, the first *written* statement of such a commonplace, and, of course (as I might have anticipated by only about one and a half "Sigma-fuls" of thought), by the first computer of a comet's return, a bigger than Whiston, though not, like him, successor to Newton's chair by Newton's desire. It is in the *Phil. Trans.*, Vol. 33 (1724), and entitled: "Some Considerations about the Cause of the Universal Deluge, laid before the Royal Society on the 12th of December, 1694, by Dr. Edmond Halley, R.S.S." In copying the following chief parts, I keep the capitals to substantives, that our neo-English ought, less than any other Teutonic language, to have dropped, if meaning to be understood.

"The account we have of the universal Deluge is nowhere so express as in the Holy Scriptures; and the exact Circumstances, as to point of Time, do show that some Records had been kept thereof more particularly than is wont in those things derived from remote Tradition, wherein the historical *Minutiæ* are lost by length of Time. But the same seem much too imperfect to be the Result of a full Revelation from the Author of this dreadful Execution upon Mankind, who would have spoke more amply as to the Manner thereof, had He thought fit to lay open the Secrets of Nature to the succeeding Race of Men; and I doubt not but to all that consider the 7th chapter of *Genesis* impartially, it will pass for the Remains of a much fuller Account of the *Flood*, left by the Patriarchs to their Posterity, and derived from the revelation of *Noah* and his Sons. . . . This we may, however, be fully assured of, that such a Deluge has been; and by the many Signs of marine Bodies found far from and above the Sea, 'tis evident, that those Parts have once or more been under Water; or either that the Sea has risen to them, or they have been raised from the Sea; to explicate either of which is a Matter of no small Difficulty, nor does the sacred Scripture afford any Light thereto. . . . What is meant by the Fountains of the *Abysse* being broken up, and the opening of the Windows of Heaven, seems not so easy to be understood, but is intended to indicate the *Modus* of the Deluge, which was, according to the *Mosaic Philosophy*, from the letting in of the Waters above the Firmament, mentioned *Genesis* i., 7, by the Windows of Heaven, and the rising up out of the Ground of the Waters under the Earth, spoken of in the Second Commandment"—[rather, in the human comment thereon, these comments being different in the *Exodus* edition, and that of *Deuteronomy*] . . . "so that we may reasonably conclude, that by one of those Expressions is meant an extraordinary Fall of Waters from the Heavens, not as Rain." [With much deference to Halley, I must quote, Yet seven days and I will cause it to *rain* upon the earth!] "but in one great Body (!): as if the Firmament supposed by *Moses* to sustain a *Supra-aërial Sea*, had been broken in." [The astronomer here lets the mislatinised word *Firmament* impose on him the vulgar error that the prophet regarded this *Rakia* (Expanse) as something solid, whereas the fowls were to fly "*in* the *open* Rakia of heaven."]. . . "But the Almighty, generally making use of Natural Means to bring about His Will, I thought it not amiss to give this Honourable Society an Account of some Thoughts that occurred to me on this Subject, wherein, if I err, I shall find myself in very good Company.

"In No. 190 of these Transactions, I have proposed the casual *Choc* of a *Comet*, or other transient Body, as an Expedient to change instantly the Poles and diurnal Rotation of the Globe; . . . but at that Time I did not consider the great Agitation such a *Choc* must necessarily occasion in the Sea, sufficient to answer for all those strange Appearances of heaping vast Quantities of Earth and high Cliffs upon Beds of Shells, which once were the Bottom of the Sea, and raising up Mountains where none were before, mixing the Elements into such a Heap as the poets describe the *old Chaos*, for such a *Choc* impelling the solid Parts, would occasion the Waters, and all fluid Substances that were unconfined, as the Sea is, with one *Impetus* to run violently towards that Part of the Globe where the Blow was received; and that with Force sufficient to rake with it the whole Bottom of the Ocean, and to carry it upon the Land; heaping up into mountains those earthy Parts it had borne away with it in those Places where the opposite Waves balance each other, *miscens Ima Summis*, which may account for those long continued Ridges of Mountains. And again, the recoil of this Heap of Waters would return towards the opposite Parts of the Earth, with a lesser *Impetus* than the first, and so reciprocating many Times, would at last come to settle in such a Manner as we now observe in the Structure of the superficial Parts of the Globe. In this case it will be much more difficult to show how *Noah* and the *Animals* should be preserved, than that all things in which was the Breath of Life, should hereby be destroyed. . . . Such a *Choc* may have occasioned that vast Depression of the *Caspian Sea*, and other great Lakes in the World; and 'tis not unlikely but that extreme Cold felt in the North-West of *America* about *Hudson's Bay*, may be occasioned by those Parts of the World having once been much more northerly, or nearer the Pole, than now they are; whereby there are immense Quantities of Ice yet unthawed in those Parts. . . . If this Speculation seem worthy to be cultivated, I shall not be wanting farther to insist on the Consequences thereof, and to show how it may render a probable Account of the strange Catastrophe we may be sure has at least once happened to the Earth."

Some further thoughts upon the same subject, delivered on the 19th of the same month, by the same.—"I have been advised since the last Day, by a Person whose Judgment I have great Reason to respect [Newton (?)] that what I then advanced ought rather to be understood of those changes which might have happen'd to the Earth, in Times before the Creation, and which might possibly have reduc'd a former World to a *Chaos*, out of whose Ruins the present might be formed, than of the Deluge whereby Mankind was in a Manner extinguished . . . that being much more gradually brought to pass" [but surely Halley here forgets that *the Day* that Noë entered into the Ark (Luke xvii., 26), they knew not till the Flood came and *took* them *all away* (Matt. xxiv., 39)]—"and with some Circumstances that this Hypothesis cannot admit of" [Yes, Halley, certainly, without a *Choc*, and with *Rain*, and "the same Day *all* the Fountains of the *great* Abyss," *i.e.*, all Volcanoes, "broken up and the Cataracts of Heaven opened"] "which abler Pens, perhaps, may account for" [or he should rather have said later knowledge]. "What I have advanced I desire may be taken for no more than the Contemplation of the Effects of such a *Choc* as might possibly and not improbably, have befallen this Lump of Earth and Water in times whereof we have no manner of Tradition, as being before the first Production of Man, and therefore not knowable but by Revelation, or else *a posteriori* by Induction from a convenient Number of Experiments or Observations, arguing such an Agitation once, or oftener, to have befallen the Materials of this Globe." [*Now*, of course, for a generation past, Elie De Beaumont has abundantly proved, how much "*oftener*" and *irregularly* as to time, and *generally* to the whole planet at once.] "And, perhaps" (adds Halley), "in due Periods of Time, such a Catastrophe may not be unnecessary for the well-being of the future World; to bury deep from the Surface those Parts which by length of Time are indurated into Stony Substances, and become unapt for Vegetable Production," &c. . . . "This may, perhaps, be thought hard, to destroy the whole Race for the Benefit of those that are to succeed; But if we consider Death simply, and how that the Life of each Individual is but of a very small Duration, it will be found that as to those that are to die, it is indifferent whether they die in a Pestilence out of 100,000 *per annum*, or ordinarily out of 25,000 in this great City, the Pestilence only appearing terrible to those that survive to contemplate the Danger they have escaped. Besides, as *Seneca* has it,

> Vitæ est avidus quisquis, non vult
> Mundo secum pereunte mori—

N.B.—The foregoing papers having been read before the Society thirty years since, were then deposited by their Author in their *Archives*, and not published, he being sensible that he might have adventured *ultra crepidam*; and apprehensive least by some unguarded Expression he might incur the Censure of the Sacred Order. ["Sacred" with a great S, observe, not a mere "sacred Scripture."] Nor had they now been printed, but at the Desire of a late Committee of the

Society, who were pleased to think them not unworthy the Press. Here the Reader is desired to observe that Mr. William Whiston's book, entituled, 'A New Theory of the Earth,' was not published till about a year after the date hereof, and was not presented before June 24th, 1696, to the Royal Society."

Of course, the possibility now of any such "choc" as the father of cometic science here imagined remains just as certain as when he wrote. No discovery has altered the possibility that any one of the comets of infinity (more numerous, as Kepler said, than fishes in the sea, and more various in quality) may have planetary density and solidity to do all that Halley or Whiston thought of. The only modification on their reasoning brought about by the modern discovery that the masses of this century's comets have been inappreciable, that is to say, none has yet been appreciable—two (and only two) having been observed in positions where any mass *over a trillion tons* or thereabouts *would* have been appreciable, so that *these two* were not denser than air, and hence, not improbably, the majority *may* contain no matter more dense than aëriform—the sole result is to dispose of Halley's difficulty about how animals' lives could be preserved; since a comet *might* (if resembling most of the present century's) be wholly vaporous, and therefore fall with *no "Choc."* So his chief difficulty is long ago disposed of. I should not say, however, the *only* modification, because there have come, besides this; (1st), the well-known properties of steam, the commonest or most abundant of all vapours, establishing, for every tyro, the certainty that a comet composed of this, the *only* material that *can possibly*, as Geology shows, have fallen in historic times on such a scale, *must* occasion exactly the kind of diluvial rain (or "cataracts of heaven") that Genesis describes; and (2ndly) the geological certainty of the mere filmy flotation of the terrestrial skin, on the molten abyss within, sensitive to the least variations of external pressure, and therefore certain to be remoulded by such equable additional load, and set moving toward a fresh equilibrium, exactly *the other* effect of the two in which Genesis makes the catastrophe consist; *the same day* all the fountains "of the great abyss,"—(epithet nowhere else found, observe, and term nowhere applied to the sea) —being "broken up." For this latter certainty, I need only, in answer to "Sigma," refer to Herschel's last work, *Familiar Lectures on Scientific Subjects*, p. 11; and to the hurricane lists showing that there are districts, as the Windward and the Virgin Islands, where the barometer has *never* sunk 2 inches below its normal height (which it has scores of times since their discovery) without an instant plutonic disturbance. The St. Thomas case is merely the latest of some hundred on record. There is a third modern principle, or circumstance indeed, I might name as having similar result on Halley's reasoning—viz., to confirm it—I mean the established certainty that Darwinism—*Natural Selection*—in all matters, without some such interruption, *won't do*. You see his last remark, about an occasional catastrophe being "not unnecessary for the well-being of the future World," is become pretty considerably clearer and less disputable. Darwinism would not have peopled a world (as now) with Noachides. Natural selection would have *abolished* Noah's family, or any such sort. Instead of any of us, the earth of these present ages, if retaining any human kind at all, would have contained only the breed of the *Nephilim* (Gen. vi. 4), on the improbable supposition that they had not long ago devoured each other, and left it to the less violent mammoths and cave-bears. And so, again, what manner of planet, think you, would natural selection, or the present social forces, uninterrupted by the *next* comet that is on its way, make of this in another century, or two, or five? A globe worthy of, or likely to be tolerated in, the universe of God, think you? I trow not. E. L. G.

MR PROCTOR AND NOAH'S COMET.

[4354.]—MR. PROCTOR'S demands (letter 4313, page 327) are readily satisfiable, but before telling more, I must first beg flatly to repudiate any such "*duty*" as he attempts, in italics, to fasten upon me. I have made no "case of religion *versus* the infidel," have never used the word "infidel," have attacked nobody's religion;" and though "Sigma" complains, in letter after letter (p. 303, 326), that the subject cannot be touched without "shocking many people's feelings," and being "charged with infidel attacks on the truth of Holy Scripture," I, the only writer whose columns he measures and grumbles at, have not been yet charged with shocking or attacking any one's faith, and only wish any reader so aggrieved, be he Christian, Jew, Mahometan, Bhuddist, "pure Deist," or Bradlaughite, would point out where I have offended his tenets, that I may make amends. My object has been confined entirely to matters of fact, physics and geology; and these, necessarily involving reference occasionally to professedly historic documents, where they strikingly agree with the indications of Nature, the only ones I have quoted happened to be the best known of any in this country; though I might and should refer, if allowed to pursue the subject, to Hindoo and other legends very *little* known here. But how on earth was a man to guess it would be such mortal offence to hint a probability that something you go on solemnly telling your God in your temples (at every baptism of a child, for instance) may possibly be true? Anywhere else, I believe, offence would be given by just the *contrary* suggestion, to worshippers, that they told their God something false instead of something true! And then, what *can* the reality or unreality of such a secular fact have to do with religion? To hear "F. R. A. S.," who called up the subject by his challenge (p. 61, middle), it would seem that so extreme is his dread of any influence from the "semi-barbarous Hebrews," he would actually seem to fear that if a man only admitted they had preserved us a single chapter of true history, he would forthwith be bound to swallow Heaven knows what mystical dogmas—the ten commandments, perhaps, or Trinity, or Papal supremacy at the very least! Why, save the mark, "F. R. A. S.," does admitting the naturalness of an event in an old history involve accepting the religion or ethics of its writers? May not the Hebrews' Flood story, if Nature happen to confirm it, be granted to be true, and their theology and commandments be rubbish all the same? And where have I implied I took them for anything but rubbish? Keeping, as I have, to a physical matter alone, apart from all men's faiths, and having started *no* "dangerous notion," it is no affair of mine what notions are started, or whose religion the facts of Nature adduced may square or not square with. Especially am I discharged from any such imaginary "*duty*" as Mr. Proctor italicises, when the editor has stopped the subject (p. 842), having obliged himself to do so by breaking his own rule against theology, and opening the floodgates to such abyssmal fountains as that of "Vertumnus" (let. 4291), of more theosophic wrangle, worthy of Milton's Pandemonium. Matters of fact, it seems, are to be decided by what "God's wisdom in adapting means to an end" will allow, or "not allow" "Vertumnus" to suppose! Probably it would not "allow, us to suppose" a sun as ruler, light, and life of a system, made to dispense momently twelve million times the utmost heat and light that the whole system can receive. So Mr. Proctor had better look to his astronomy, or rather, all current astronomy must give way to Hampden's, if indeed his dimensions for the sun be not exorbitant.

And after all, how *can* Scripture be attacked, if, as all these Christians are eagerly assuring us, any words thereof may mean anything whatever? Thus, according to "Vertumnus," the command, "Make thee an ark of squared timber . . . 300 cubits long, 50 cubits wide, and 30 cubits high, . . . and pitch it within and without," &c., may have meant, nay *must* have meant (or God was not so wise as "Vertumnus"), "Go and migrate with thy family and cattle to the district of Auvergne in Gaul, till the flood is over wherewith I am about to drown all the rest of thy race." If texts are thus adjustable to *any* meaning, what theories or discoveries can possibly hurt your Book? As it may have *any* meaning, surely it *may* mean the very thing the "infidel" is saying; or that the theory requires; or the thing discovered in Nature; or might even, in some cases, bear, as I have ventured to suggest, the grammatical meaning!

As for the comet's "elements," then, I will give Mr. Proctor the most probable, so far as data seem to exist:—

T = Julian Period, 1612 87 ± ·06 (*i.e.*, in November, 3102 B.C.).
ϖ = 58° ± 10°} From equinox of that date.
Ω = 58° ± 10°} (128° ± 10° from equinox of 1872.)
i = very few degrees.
q = between 0·99 and 1·0.
e = 0·68 to 0.7.
a = 3·1 to 3·3, motion direct.

At the fatal day the sun was entering or approaching Aquarius (thenceforth so figured), the moon Virgo, and the comet Taurus, where it had seemed stationary, but growing in size for seven successive evenings. It was tailed, and fishlike in form, and the spectators estimated the length of tail (ultimately), according to the only account I know of, at a million Hindoo leagues. They, our fathers, regarded it as an appearance of their deity—"Vishnu"—God the Saviour; and though never seen again after these seven nights, nor better represented to them than by their figure of *Capricorn*, they continued to believe that the divine Fish, having bound their vessel to his mighty horn, guided and protected it through the dark and raging Deluge.

Now the mass, I consider, may have been anything between a hundredth of a trillion and half a trillion tons. What volume, and therefore diameter of globe, this might at any moment occupy as steam, according to the temperature, its various coats would acquire in our sunshine, may some day be calculable, when Regnault's or Rankine's measures of the laws of vapour density are carried further. It might, for aught that appears, be as little as 100,000 miles in diameter, or 400,000, or even as large as the comet's head of 1811, for though it would in that case fall partly on the moon as well as the earth, the small portion taken by our satellite would doubtless disappear into the pores of her cindery crust. In the first of these three cases, the time occupied by the steam's falling, so as to be permanently attached to us, would be about 12 hours, in the second, eight times as long, or four days and nights, and in the last, perhaps ten. But whatever the time theoretically needed for this mere gravitational collapse, Mr. Proctor will bear in mind the actual fall took much longer, for two reasons: —First, the drops or rain-balls entering the air, say 50 miles high, with a speed of between 30,000 and 35,000 feet per second (according to the comet's diameter), and having to lose by friction in the upper atmosphere all but a 300th or 500th perhaps of this velocity, the heat thus evolved re-evaporated most of their bulk, so as to let them reach the ground or sea reduced both in weight and velocity to something like the moderate size and impact of ordinary raindrops, though many thousand times more abundant. Secondly, as tradition states (with all probability in its favour) that "*all* the fountains of the great abyss"—*i.e.*, all volcanoes became in eruption at once, a vast deal of such water as did reach the ground condensed fell on incandescent lava, to be violently revaporised again and again, rendering most of the lower atmosphere chaotic for weeks longer, with thunderous downpours (though only local) of both water and mud. And thus, however small the comet, and few the hours required for theoretical collapse, the stormfall, necessarily prolonged by these causes, might well last six weeks, and, indeed, must in any case till the subsiding of general eruption, or the fiery "fountains of the great abyss" began to be stayed (and in other than the Hebrew accounts, the action of fire is as prominent as as that of water). And note that the exact number of days these storms might endure, persons to be saved in an ark would need to be pre-informed of, though of nothing else. There was no need for their knowing how long they should be afloat, nor how long imprisoned, but of these 40 days they *must* be told. For as, from the moment that, wrapped in instant midnight darkness (a fact preserved in Hindoo accounts, though not in the Bible) their hatch-door slammed down, and "the Lord shut them in," it was one unchanging cataract for many hours, or possibly days, as if a return to chaos and primeval night, what could be done or thought of, or how suicidal despair be averted, but by an oracle having limited the very number of days that were to include all the violence their drifting vessel would meet, and the *very day* they were to expect a normal state of calm and sun re-established? And such seems to have been the impression made by that joyful and exact fulfilment, that I believe we shall find an account extant of not merely the years, but the *days* reckoned from the end of those 40, to the era of the Persian King Yesdegird, 16th June, A.D. 632. (Hales's "Chronology," I. 197. The years are Nabonassarean.)

But now, can Mr. Proctor fairly infer that the day Noah is said to have left the Ark (which he errs in making 875 from the Deluge, it was 365, the exact anniversary) this day marked in any special way the return of sea and earth "to their normal condition"? What does he mean by "normal condition," or a "return" to what precise quantities of land and water? What were the antediluvian quantities? Where are they stated? All I find stated is that Armenia had become habitable for eight persons and their cattle. The vast adjoining lowlands of Turan (as I said, p. 230) must have continued a sea for yet some centuries; and so the establishment of *the present* conditions was gradual. But a normal condition, so far as to be productive and sustaining animal life, *such* a condition the story implies land (and, for aught we know, *much* and *many* lands) to have recovered even before the 40 days' storms were over. I say it implies this, because how else could those beasts live whom a *Divine oracle* is recorded to have mentioned, and *not man* (for how could Noah or his sons know of their existence?) in Gen. ix. 10? This difference between oracles and mere statements of the writer (which are only sacred with a little "s") none of the critics seem to note at all. Thus it is quite true, as remarked by "E. L. B.," p. 327, that Shem twice mentions in his journal, the "breaking up" or earthquake and eruptions along with, and even before, the "cataracts of heaven," as if quite simultaneous to his mind, or rather the *unexpected* phenomenon impressing him the most of the two. But does "E. L. B." consider God or Shem the more likely to have given philosophical precedence to cause before effect? Where does he find the alleged *oracles* naming his "No. 1, the fountains of the deep?" Nowhere! The only thing predicted is the rain! Again, *who* said that all the high hills under the whole sky were covered, and by 15 cubits, the draught of the ark; and *who* that every living substance was to be destroyed off the face of the earth? There may have been (without falsifying a word) summits never submerged; but certainly not an olive leaf left, to be plucked (he seems to imply) either 8 or 11 months afterwards! Some expounders, as Professor Birks, make it 11. What leaves does "E. L. B." find, *without* a Deluge, to hang on a tree from November, and be worth a dove's plucking next autumn?

Of course, the fall of steam evolved much heat (which, please to observe, was not first considered by "Sigma," but by me, p. 230). But the same causes that prolonged the time of its fall, spread over far more time yet, and even prevented in great measure the penetration of this heat down to the sea-level. It was the upper strata of air that were warmed, and expanded far above their normal height, and whatever they did not radiate into space would be very slowly conducted downward. This, doubtless, was connected with the physical side of what is described as God causing "a wind to pass over the earth," though this breath or spirit is plainly more a spiritual than physical statement, like the parallel in Gen. i. At all events, there remained even after radiation of much heat, and melting of all the ice—which was more abundant than now—such a change of climates as must have precluded much of winter, except at the poles, for some years. The five months that our fathers were afloat were what would normally have been the coldest in this hemisphere; and the seven following hot ones they were imprisoned aground and being hoisted above the clouds. As our Japhetic Aryan fathers wrote, the same Almighty Saviour, who had appeared as the Shining *Fish*, now made himself a rooting *Boar*, to upheave the land and all its burden out of water, on the point of one of his mighty tusks (*i.e.*, the Great and Little Ararat). The waters, says the Hebrew, "were going and returning till the tenth month"—*i.e.*, the land upheaving and upheaving, by fits and starts, or as our Japhetic brethren learn it, the fire-gods perseveringly churned the sea with a mountain, down whose sides the streams of life afterwards flowed.

When five lunations had elapsed from the catastrophe, which five, owing to the earth passing her perihelion, were long ones, and only five new moons visible in 150 days, then the ark which had been caused, like Magalhaen's vessel at the first crossing of the Pacific to drift clear of all sight of lands, and to a late rising region, suddenly grounded on the upheaving peak, on the day Jews would now reckon 17th of Abib or Nisan. That is the first day their records *dated*, observe for anything good, the 17th of Nisan. When no land had been seen for 40 full days, on the 41st Noah sent forth the raven and dove. He would not have needed any such experiments 40 days after other land, Little Ararat, was visible, as Professor Birk imagines. The story plainly here *reverts* to 40 days from the grounding. The dove returning the same evening (which it would not if other hills were emerged only ten miles off) was kept seven complete days, and sent and brought the olive-leaf the 49th day, as we should call it (but Jews the 50th), from the grounding—*i.e.*, from the 17th of Nisan. No land was visible then, nor became so to Noah, not even Little Ararat, till the 1st of his tenth month—*i.e.*, the new moon of our July or August. He then began to unroof the ark and first saw how much was dry around him, because, till then, from his *lantern* or *clearstory* (mistranslated "window," a sense the word nowhere bears), he could only see the distance, no foreground, it being hidden by the ark's projection. His birth-month, Tisri, passed; and the next came, and the apparent (Umar) anniversary of the Deluge, and still he had to wait for a vision. At length, ten days later, came the command (revealing, perhaps, the true solar length of year, for he may not have been astronomical or one of the antediluvian learned), and on the 365th day he went forth and built his altar, which, like the ark itself (*Argo*), and the divine horned sea-monster (*Capricorn*), and the divine *Bow* of promise (that only we westerns have enlarged into Sagittarius), and other things then memorable, our father Japhet has taught us to figure in the stars. E. L. G.

THE HEAT GENERATED BY METEORS.

[4855.]—The observations of Professor Le Conte, of the University of California, on the heat generated by meteoric stones in traversing the atmosphere, may be of interest to many of your readers, in view of a recent discussion on cometfalls being the cause of deluges. It is well known, says Professor Le Conte, that the observations of Glaisher, Petit, Daubrée, and others, establish the fact that meteoric stones enter our atmosphere with velocities which are truly planetary. For example, the meteorite of Orgueil moved with a velocity of at least 12·48 miles per second, while in other cases velocities have been observed which could not have been less than from 15 to 30, or even 40 miles per second. The enormous resistance encountered by such bodies in traversing the air speedily extinguishes this high velocity, so that they retain but a comparatively moderate velocity on reaching the surface of the earth.

According to the "dynamical theory of heat," this loss of energy is replaced by a corresponding augmentation of heat, and the method of finding the theoretical amount of this increase is given by Professor Le Conte in mathematical language. To obtain a correct estimate, it is necessary, of course, to know the velocity of the meteor when entering the atmosphere, and also when it has approached near to the earth's surface, as well as the specific heat of the stone in relation to water. An estimate sufficiently near for most purposes is obtained by Professor Le Conte, by taking the velocity on entering the earth's atmosphere at about 30 kilometres a second, or a rate nearly equal to the orbitual velocity of the earth. This he assumes as reduced to 500 metres per second when near the earth's surface, and the specific heat is "certainly not under estimated" by putting it equal to 0·22. On these assumptions the Professor finds that the increase of temperature amounts to 492,184 centigrade degrees.

Of course, says Professor Le Conte, by far the larger portion of the heat generated by the loss of energy of the moving stone would be imparted to the air along its trajectory; but assuming that only the hundredth part of it is retained by the stone, it would be more than sufficient to account for the phenomena of fusion and detonation which frequently accompany the transit of such bodies through our atmosphere.

In the case of small masses, it is clear that their high velocities would be more rapidly extinguished by the resistance of the air than is the case with large masses. In the small mass the transformation of energy into heat being accomplished in a shorter time, a greater amount of the evolved heat would be retained by the stone than in the large mass whose velocity is more gradually checked by the resisting medium. Hence, when the smaller masses plunge into the upper atmosphere, the matter may be volatilised or utterly dissipated by the intensity of the suddenly-evolved heat. In this minutely-divided condition the material of the stones would float about in the atmosphere, and ultimately reach the surface of the earth in the form of meteoric dust.

It is well known that the observations of Benzenberg, Quetelet, Herrick, Newton, and others, assign to the so-called "falling stars" velocities equal to, if not surpassing, the velocities of meteoric stones. According to the foregoing suggestion, these may be nothing more than small meteoric stones which are volatilised in the upper regions of the atmosphere long before reaching the surface of the earth. Thus, the phenomena of the occasional fall of meteoric stones and the almost incessant appearance of the falling stars which nightly furrow the celestial vault, may be correlated with the principle of transformation of energy. At all events, all the luminous, thermic, and detonating phenomena attending the fall of such bodies seem to be fully accounted for by the enormous amount of heat thus generated by their passage through the atmosphere. G. J. H.

EXISTING EVIDENCE OF THE DELUGE.

[4856.]—It seems to be forgotten by some of "our" correspondents that the idea of the Deluge is no "pet" or "fancy" of "E. L. G." or any one else, but a matter of ancient history and world-wide tradition, supported, moreover, by much existing evidence. "P. Santalinus" undertook (letter 4240, p. 277) "to cull a few facts utterly subversive of 'E. L. G.'s' fancies"—that is, be it observed, subversive of all history written and unwritten; but these facts on examination turn out to be mainly questions, capable of being easily answered, as they deserve, by other questions. Now, as to existing evidences of the Deluge. It appears from the testimonies adduced by Lyell and others, and still more plainly from the reports of cave explorations in England, that there was a race of men roughly calculated as existing from about 7,000 to about 5,000 years ago, savages, as we would call them, some of them probably cannibals (the earth was filled with violence, says the ancient record), living partly at least in caves, struggling for existence with wild beasts, but getting the better of these by aid of stone and bone weapons; which race of men about 5,000 years ago became extinct, so as to show no trace of connection between them and the later races who gradually come down to historic times. Their bones, their instruments, and all memorials of them perished from view, buried several feet deep under the débris accumulated over them by the action of rain, frost, and air; many centuries passed by, in Britain as much as 3,000 years, before another race of men of superior civilisation came and lived in the same caves, all unconscious of their predecessors buried beneath them. This is the tale plainly told by the caves of Settle, in Yorkshire, of which an account is given on p. 323. The excavations in Kent's Cavern, in the Rhone valley, and elsewhere, lead to the same conclusion; they show the extinction of a race of savage men about 5,000 years ago, and the lapse of many centuries obliterating all traces of them before a new race prior to European history, but merging into it, arrived to people the same regions. And Lyell's evidences, apart from mere conjectures, seem to prove for these primitive men an antiquity of no more than between 7,000 and 8,000 years. All this agrees with the chronology of Moses rightly understood. I say rightly understood, for it is too generally forgotten or unknown that the chronology of the existing Hebrew scriptures, which our English version follows, differs very much from that of the oldest existing translation, I mean the Septuagint or Greek version, made about 300 years before the Christian era, which exhibits what the original Hebrew scriptures were at that date. Josephus also, in the first century of our era, recognises as the correct Biblical chronology, the only one known to him, that of the Septuagint. According to it, the oldest, and in all likelihood the correct version, made before the Hebrew text was tampered with, the date of the creation of man is given at about 7,400 years, and that of the Deluge about 5,000 years from the present time.

This, Mr. Editor, I have endeavoured to set before your readers as no theological question such as should have no place in a journal of science, but as a simple matter of science, of ancient history and modern observation, the one confirming the other in all essential respects. J. M. G. Brookwood.

"THE SEMI-BARBAROUS HEBREWS."

[4857.]—"F.R.A.S." has fallen into an error in stating that we have our account of the Deluge from "semi-barbarous Hebrews." The history containing that account was written by Moses, who, according to the narrative, which is confirmed by much internal evidence in his writings, was, though of Hebrew origin, an Egyptian prince by education, learned in all the wisdom of the Egyptians, and mighty in words and in deeds. He was vastly superior to the mass of the Hebrew people, whose leader and lawgiver he became, but who never quite understood him or heartily submitted to his teaching.

Whether the Hebrews themselves can be properly styled semi-barbarous is doubtful, if we compare them with the other nations of their time. Born in Mesopotamia, nursed in southern Syria, educated in Egypt, finally settled between and in contiguity to Egypt, Assyria, and Phœnicia, partaking of the civilisation and science of all three, and superior to all in their theology and code of morals, they must have had advantages at least equal to the most advanced nations of that age. It is also to be observed that the Hebrew records did not always stand alone as they do now; they were corroborated in their accounts of the early history of mankind, as Josephus frequently reminds his readers, by the most ancient historians of other nations, as Egypt, Phœnicia, Assyria, and Greece, whose writings then extant are now lost.

Perhaps "P. Santalinus" in his last letter (4240, p. 277) means only to talk nonsense in jest when he speaks of "Shem leaving his untouched journal to that accurate Hebrew scribe Samuel, the first of his race." There is no record or evidence that Shem left an untouched journal, whatever that may be; and Samuel was in no respect the first of his race.

Alphabetical writing does not appear to have been known to mankind till about 1500 B.C., that is the age of Moses. But if "P. Santalinus" disbelieves, as he seems to ignore the existence of Moses, what reason has he to believe in the existence of Samuel, or of any one else in particular? J. M. G. Brookwood.

SUNDRIES.

[4858.]—Alas! for all the old superstitions, the nymphs and dryads no longer haunt the fountain and the wood; their progeny, the fairies, have vanished from the glens; the pale ghost never now revisits the glimpses of the moon, or points with outstretched arm and melancholy countenance to the spot at which its mortal coil was rudely shuffled off. And here am I about to shatter another old legend. "H. G. W." (query 12186) wants to know why a shilling suspended from a thread, and hung within a tumbler, strikes the hour. I will tell him.

Hang any moderately light weight in this way, and, fixing your eyes and attention upon it, *wish* it to do anything possible (to swing, for instance, in one direction, weakly or strongly), it will do so; desire it to stop and to swing in another direction, or in a circle, it will instantly do so; put it inside a tumbler and wish it to strike the time, again it will obey, *provided you know the time yourself*; or if you prefer, it will ring a funereal knell. Now place your hand against some fixed substance and try to repeat these experiments; this time you will fail. The whole mystery lies in the fact that when you *will* or expect any motion, you unconsciously produce that motion—instead of fixing attention on the object, fix it on your hand and guard against its moving, and you may hold your shilling till you want your supper before it will tell you the time.

Will Mr. Rodwell (let. 4318, p. 328), who has actually seen the spot at Argostoli where the sea water flows into a cavern, tax his memory as to a few details? Can he say (accurately) the difference of level between the sea surface and that of the surface of the water of the well or cavern, whether the flow is continuous or intermittent, and what is at that spot the actual rise of tide (I know it is small), and whether boats can approach the exact spot at all times, or are stopped by anything like a reef at some little distance? Also, whether there is anything like a race or strong current between that and neighbouring islands?

Does not Mr. Petrie (let. 4345, p. 334) see that the expressions he quotes from Humboldt are pure colloquialisms, mere expressions in accordance with the apparent facts and the common modes of speech, that they therefore are of exactly the same nature as the scriptural statements referred to, and are in no sense scientific descriptions of facts. Mr. Proctor, in the paper commencing the number, uses just such a loose colloquialism when he speaks of the "sun's varying diurnal course." Therefore, we are *not* "to believe in the strict scientific accuracy" of such phrases. But what has this to do with the matter, or how does the fact that modern scientific men drop into commonly received expressions (knowing them to be incorrect) show that ancient similar expressions are to be taken as meaning and giving actual facts literally? Sigma.

CORK LOCK.

[4859.]—I noticed in last week's a lock cork. It reminds me of the way in which the Americans fasten all their pop and ginger-beer corks, and which, in my humble opinion, is a decided improvement to fastening the cork with string as the trade does in Manchester. A is a stout wire hinged in a loop B at each side under the neck of the bottle, said loop being formed of small wire having two or three turns round the neck. It is much easier and safer to open, and saves string and time to the manufacturer of those commodities. Alpha.

"SIGMA" AS A "SEARCHER AFTER TRUTH."

[4860.]—The Editor, blaming me, at page 331, for the term "buffoonish," which I had chosen for its mildness, as applied to "Sigma's" geological reasonings, declares his belief that "Sigma" is "an earnest and sincere searcher after truth," a position that I do not believe I have ever yet denied, though "Derf Errac" has incurred "Sigma's" wrath by doing so, as appears from the latter's first paragraph (letter 4312, p. 326). I have two reasons, then, for deeming it a duty to join "Derf Errac" in raising this question—first, because it does personally concern all readers of "Sigma's" letters to come to some decision whether "Derf Errac" or the Editor has had the better reason for their estimates; and secondly, because it seems I must be rated as "striking out from the shoulder," whether doing so or not, and may, therefore, as well deserve the rating. The following are grounds, I submit, for maintaining that "Sigma's" chief object in this Deluge matter has *not* been searching "for truth," and I am equally prepared to prove this of other correspondents than "Sigma," but that his chief object is the overthrow, anyhow, by sound or unsound means, as they may come to hand, of assumed mischievous error, namely, the error (as he holds) that the Hebrew early records are historical or trustworthy. He has dragged in references to these most revered and most hated of books, and most beslobbered with the slimy praise, "grand old legends," "grandest poem," &c., of those most hating them, on every possible occasion when there was not the slightest call for them. I have written most of the columns he has been at the pains "to measure" about geology, without naming or referring to the Bible; but what single paragraph thereon has "Sigma" written without? Surely, whether I quoted texts or not, my *primary* and *chief* subject has been physical geology, while "Sigma's" has been the Bible-the book that he at least twice endeavours to impress on his readers (letters 4193, 4312, pp. 252, 326) tells of the world being made and stocked in a civil week of time, and of the sun and moon standing still to enable the Israelites to complete a slaughter that the previous verses (11) say was *never* completed by *them*, but by hail. The Bible is dragged in as gratuitously, and these two supposed points thereof singled out to be harped upon exactly as by Voltaire or Bradlaugh. Now, with all deference to the Editor, I must flatly deny that any "sincere searcher after truth" of any kind, would (even if the Bible were the direct subject of discussion) single out these two popular, or rather grandmothers', errors about it, and thrust them forth as facts. A "sincere" truth seeker in these days would at least know that the Hebrew pentateuchist never dreamed of a creation in six human days, and was never supposed by educated *ancients* to have written of such a thing, even as long ago as Augustine in Christendom, or as Berosus and the oldest extant Gentiles influenced by the Hebrew cosmogony. (Neither are Psalms xc., civ., or many Biblical passages consistent with it.) Nor would any one whose chief end was truth be either ignorant enough, or count on such ignorance in others, as to quote the sun and moon "standing still" as a thing anywhere mentioned in *possibly* genuine Scripture. Joshua's miracle (for it *was* a miracle, as much as if Mrs. Guppy came through the ceiling) consisted in silencing for ever the Gibeonite religion, which he and his people had unawares bound themselves *not* to destroy by violence (ix. 19), like the other worships of the country, by calling on God, and saying to their oracular Sun-idol and Moon-idol, "Sun in Gibeon, be silent, and thou Moon of the Vale of Ajalon." His words, as preserved in Hebrew, have not a syllable about "*the* sun" or *standing still*, far less in the midst of heaven; and the two following verses (13, 14) of superstitious legend contradictory to all the rest of the story are from no sacred book, *as their inserter tells you*, but from that of Jasher, a mere lost novel of David's time (2 Sam. i. 18).

I challenge any one to maintain that a "sincere searcher after truth," or *any* matter as a chief end, would thus use long disproved errors that happen to be vulgarly current; and I undertake to demolish, though not so readily, what Mr. Proctor says "is certain" of, at least one or two of the authors he names in p. 327, last paragraph but one. And I beg the Editor to insert this with name or initials as he pleases, if writing anonymously is what he means by striking out, but being "unprepared for reciprocal action" (p. 331, note).

E. L. G.

[As stated last week, this almost fruitless controversy must terminate this week.—ED.]

SPINNING TOP.—UPWARD DEFLECTION OF BULLET.

[4361.]—"A BARRISTER" (4308) and "Vis" (4306) have upset my top, or rather my theory. Many thanks to them; let the truth prevail, and error come to nought. Once convinced that a top can maintain its position in vacuo, I can feel no difficulty in understanding that the duration of the rotary force will be greatly prolonged. Further experiments in vacuo may possibly throw more light on the subject. There is, however, no parallelism between my case and that of the philosophers whom "A Barrister" describes as "wasting their time and energy" in endeavouring to account for a fact before they had ascertained it to be one. The fact that I have endeavoured to account for is one well ascertained—viz., that a top, in spinning, is supported against the action of gravitation by some force as yet unsatisfactorily explained. I did not assume that a top would not spin in vacuo, unless the confidence I expressed in the result of the attempt to make it do so, in favour of my theory, be so interpreted. I deduced a theory from other grounds to account for a known fact, and asked for an experiment in vacuo as a crucial test of my theory. I considered, also, from repeated experiments, that the upward deflection of the bullet was an ascertained fact.

I cannot, however, set my experience against that of Mr. Whitworth, and it needs not, therefore that I should answer "A.'s" inquiry (let. 4305) on this point, or dwell on it longer. Another inquiry of "A.'s" I also pass over, lest discussion should sink into disagreement. I will only say that atmospheric resistance to motion is very formidable, sufficiently so to produce effects which may easily escape observation, as well as those which obtrude themselves on our senses most conspicuously. The rider must experience this resistance to progress as well as the bullet from a gun, in a degree proportionate to the velocity of the motion and area of surface offered to its action. There is, therefore, sufficient *primâ facie* reason for taking atmospheric pressure into consideration, when certain phenomena arise, during the motion of bodies, which, as "A Barrister" justly remarks in the case of the top, "no explanations yet attempted have accounted for." The spinning top shows a remarkable power to the overcoming of gravitation. The schoolboy's hoop remains upright, and can right itself when in motion, but falls as it comes to the state of rest. The bicycle-rider occupies a position which is stable in proportion to the velocity of his motion. We are all dark enough, as to the cause, in the face of these facts, and may well give fair consideration to any suggestion which seems likely, by analogy, to lead to a discovery of the cause or causes. The skimming of a stone along the surface of water, while in motion, and its sinking upon the cessation of that motion, looks like a parallel phenomenon, and, being manifestly due to fluid support excited by projectile force, suggests the idea of atmospheric support in the other cases.

"A.," of Liverpool, has brought his theory of the support of the top to a crucial test when he illustrates it by the cord and weight. We are thus able to deal with the principle in a simple form, and can follow it to its conclusion. Whirled round in a vertical line and let go either at the highest or lowest point of the circle, "it will not then," he says, "fall to the ground." Let go at either of these points, it starts parallel with the ground, and (throwing out atmospheric resistance) it will reach the ground in the same time, though not in the same place, as if it dropped from his hand. Can he possibly imagine that it will remain in a direct line, parallel with the ground, such as that formed by a tangent to his circle of gyration, until it has expended its force? Surely none will hold with him in such a thought. A stone from a sling is dismissed by centrifugal force, and is just as much subject to gravitation from the moment of its dismissal as if shot from a gun. The line of direction is simply a resultant between the direction of projection and that of gravitation.

J. M. TAYLOR.

Seer Green Vicarage, near Beaconsfield.

[4362.]—I WISH that "A Barrister" (let. 4308, p. 308), who rarely misses hitting the nail on the head, would show how the ordinary explanation why a spinning top does not fall is not satisfactory. A top at rest cannot be balanced on its peg, because it is so difficult to place the centre of gravity exactly above a mere point of support, so that it is almost sure to fall on some side or other; not indeed directly, but very soon. If, however, the top is spinning, it has not time to fall in a perceptible degree down towards its heavier side—say the north—before, by the revolution, the heavier side is to the south, and so of any other direction. For the like reason, though, I cannot balance a shilling at rest on the point of a pin, I can do so easily if I make it spin quickly enough to make its centre of gravity change from one side of the point of support to the other faster than it can fall. As the velocity of revolution diminishes, the top or the shilling begins to wobble; before it quite stops spinning, it slips off its support on to its edge, and rolls away along the floor. Thus, also, though I cannot balance a stick on my finger without constantly moving my hand so as to keep the point of support directly beneath the weight, I can make a circular disc spin on the top of the stick so as to keep the centre of gravity always above the point of support by very slight changes of that point. Of course, the weight of the top or of the shilling, or of the revolving disc, is just the same, whether at rest or in motion, only when in rapid motion there is not time for a perceptible fall in any direction before there is a tendency to fall in an opposite direction, and so the revolving body, not being able to decide in which way to fall, does not fall at all, just like the famous donkey that was starved to death between two stacks of hay, that attracted him so exactly equally that he could not decide which to eat first—a story quite as credible as that the Royal or any other learned society ever doubted that to add a fish to a tub of water without making the water run over would increase its weight.

I am obliged to "A Barrister" for supplying his illustration of pistol shooting, which so completely confirms my explanation at p. 204, of the real reason why musket bullets frequently rise in their course.

PHILO.

MR. PROCTOR ON SPINNING TOPS AND GYROSCOPES.

[4363.]—I AM surprised at Mr. Proctor's letter (4310, p. 326). He says, not in precise language, but by implication, that the problem has been solved, and then proceeds to attempt a popular explanation. His attempted explanation contains ideas so similiar to "A.'s," criticised by me in a letter sent you on the 11th, but not in your issue for 14th June—that I feel bound to demur to it as tending to encourage and propagate "A.'s" errors. It is not correct to say "the weight of the top is insufficient to change the direction of the particle's motion in a brief interval," however rapid the rotatory motion may be. I say the weight of the top is always sufficient to change, and is in reality always changing the directions of the particle's motions. In the last sentence but one of his letter, he speaks of a particle which should at one moment move downwards and at the next upwards; but if we are considering the action on a single particle and assume that gravity actually does make it move somewhat downwards at a time when it would otherwise move horizontally, we cannot assume that gravity is suspended the next moment, and if without gravity the particle would then move somewhat upwards, with it it would at least move *less* upwards. In fact, the downward effect would accumulate until the particle reached the ground. Mr. Proctor may, in the sentence be speaking of a top with its axis nearly vertical; but if that is so it ought to have been stated—besides, an explanation is not worth much unless it applies to the case when the top's axis is already sufficiently inclined for all its particles to be to one side of the vertical line passing through its point of support. I am inclined to think some points have yet to be elucidated in connection with this gyroscope question even by mathematicians, and with the view of myself attempting something in that direction, would ask Mr. Proctor to kindly inform me, briefly, what is at present the explanation accepted by mathematical astronomers of the action known as nutation, which is associated with the precession of the equinoxes? I have not access to recent astronomical works, and shall feel much obliged if Mr. Proctor will give the information.

E. H.

Glasgow, 15th June.

SPINNING TOP.—PERSPECTIVE.

[4364.]—IT is a great pity "A." (letter 4305, page 307), did not append the two other letters to his signature and save you the trouble. He says a weight will not, in certain circumstances he supposes, fall to the ground "as long as the velocity is maintained"! Really, he must learn again the rudiments of mechanical science. If the weight starts horizontally, and its velocity be maintained (say in consequence of its moving in a vacuum), it will touch the ground just as soon as if it had been dropped vertically, even with the greatest velocity "A." is able to give it by whirling it as described.

It is quite useless any one attempting to explain the action of a spinning top who has such extraordinary notions as "A.'s" of the ways in which the attraction of gravitation can be nullified or disposed of. The idea involved in his attempted explanation was elaborately worked out in a paper read to the Glasgow Philosophical Society about fifteen years ago, and was afterwards completely exploded.

It really would save time and trouble if "A." and M. Paris would refer to the former series of letters in the MECHANIC. The idea that particles moving (rotating?) in a plane cannot get out of it although solicited by gravitation, is quite a mistake. The very gyration or conical motion of an inclined spinning top is an obvious continuous change of plane. Of course, if the top is vertical, there is no change of plane, but in that case gravity acts vertically through the point of support.

M. Paris is quite in error in saying that a picture is a compromise. If a perspective drawing is to be true to what it represents, and such as to yield the same impression to the eye, it must be mathematically arranged.

E. H.

THE NEGRO.

[4365.]—IN the hope that a few remarks on the Negro may stimulate attention and provoke remark I send this communication. It seems to me in the books of natural history that I have read, that the claims of our black brother have been ignored. I wish, then, that some of "our" learned correspondents who have read the latest intelligence will enable us to form a correct opinion of the origin of the Negro. Josephus gives no clue as to his progenitors, and, like most other writers, leaves us to suppose that, like Topsy, the Negro grow'd, till it is found convenient to introduce him as a large nation with rulers and everything complete to adorn the history. Now, from what I have seen of the Negro, he seems to form a different species of humanity when compared with his white brother. I am aware that the human species, admits of five varieties, but the most distinct from the other four—viz., the Caucasian, Mongolian, American, and Malay—is the Negro—the greatest distinction its black colour and woolly hair; its remaining peculiarities may be found more or less elsewhere, as narrow head, retreating forehead, prominent eyes, elevated cheekbones, large spreading nose, thick lips, compressed chin, and crooked legs. It appears that the cause of the Negro's black skin is a membrane under the skin consisting of minute vessels charged with fluids of the deepest hues. But I presume that there must be a more interior cause than this, probably in the blood itself; analysis might determine this if some of our savants would only do the agreeable. There is another distinct peculiarity, the Negro's offspring is as black as himself, no matter where he emigrates, or under what condition of society he is placed. Now, Josephus and other historians make no mention of a Negro being with Noah in the ark, yet they state all mankind on the whole surface of the earth were destroyed. I am, therefore, unable to form an idea of the origin of the Negro. Some will have it (and this is a general opinion) that the extreme heat of the climate has acted on the surface of the skin and gradually rendered it darker. But I find that the Chinese are white, while the native of Hindostan is black, both existing under the same tropical sun. It is true that India is in some parts further south than China, but Arabia is still closer to the Equator, and the Arabians are anything but black. Does any one suppose that a colony of blacks, located for any length of time in England, would ever become white? But surely the learned world knows sufficient to be able to answer the question—What and where was the origin of the Negro race?

I should presume that if the climate changed the skin black in hot countries that there would be no exception to the rule, and that animals of all kinds would turn black also. Monkeys would be all black. Are they? Better still, the poor pigs, who have no covering, would do with a black *rete-mucosum*, which the East India species possess, not so the Chinese, who are piebald. Allow me to present the white elephant as a final proof that tropical climates do not produce black skins.

FIDDLER.

BALSAMED OBJECT-GLASS.

[4366.]—I RETURN many thanks to "A Fellow of the Royal Astronomical Society" (let. 4276, p. 300) in reply to my query about balsamed glasses, but it is not quite satisfactory. He states, as a rule, only terrestrial ones are balsamed, but I have seen many astronomical ones of 3in., 3½in., 4in., &c., balsamed. I want to know why balsam is used. I have a triplet Barlow lens balsamed, why should it be so?

I have been experimenting with a 2¼in. object-glass of 48in. focus, which I balsamed, and to my surprise it reduced the focus to 36in. focus.

Are glasses balsamed to shorten the focus when they have been worked longer than required? If "F.R.A.S." or some practical optician will enlighten me I shall be much obliged.

C. B.

ENTOMOLOGICAL.—(IV.)—PUPÆ.

[4367.]—Pupæ may decidedly be considered uninteresting things to watch compared with larvæ, for besides there being a great similarity between them very few move except to wriggle. But it is very interesting to notice the different ways that pupæ are found, some being in an earthy cocoon, principally the *Noctuæ* and *Geometræ*; many of these cocoons are bound together with silken fibres. Others, again, are found spun up in leaves of their food plant *A. caju* (tiger), whilst others make a hard cocoon inside the bark of their tree, as the puss and kitten larvæ; many, also, are quite unattached.

The best time for pupæ hunting is from the middle of August until the end of October, and at this season of the year a great number of good pupæ are to be met with in all sorts of places, though the best are open spots with few trees about and a soft soil; clay being very unfavourable, and as far as situations are concerned I think I may say that pupæ may be found from the tops of trees to nearly a foot under the ground. For the convenience of getting pupæ out of the ground a three pronged hand-fork is often used; though some prefer a flat trowel in preference. When pupæ are found attached to anything, if possible, a part of it ought to be retained—as the cocoon should by no means be broken, or the moth will often be crippled—and put in a box with a gauze top out of the way of vermin. Subterranean pupæ will require a box filled with loamy earth, which should be kept damp, not wet, and cool.

It will often be convenient to the collector to force pupæ that are subterranean; this is best done by placing a framework covered with gauze into the box that contains them, freely damping them, and placing them in front of a fire, with a piece of paper attached to the gauze to keep off the direct heat from the imago when it emerges.

Pupæ should never be sent from one part of the country to another unless absolutely necessary, as travelling does not agree with them, and will not add to their vitality. If pupæ are desired for a collection the best plan is to gum the case together neatly after the insect has emerged from it. Ento.

NEWS FROM "EOS."

[4368.]—After a continuation of sea voyages in four large steamships and a small sailing craft (having quitted Calcutta on 15th September last), I find myself snugly moored in one of the inland mountain districts of this beautiful land. Of course, your back numbers have only just reached me, after much erratic circumlocution, and I have consequently been disabled from replying to various pressing queries, which I much regret; but a traveller is necessarily *ex officio*, and subservient to the winds and waves in his communications. And now, in my own sylvan retreat, on a forest-clad slope of the flowery African Highlands (my third sojourn therein), I am teaching the young idea to love birds, and beasts, and flowers; and having the axe, the saw, and the pruning hook often 14 out of the 24 hours in my fist, I am compelled to say that I have no time to do pen work; and for nearly 12 long months to come do not expect to see the "seagirt" Isle of Great Britain.

South Africa, April 29, 1872. Eos.

MICROSCOPE CASTINGS.

[4369.]—A few of our most enterprising opticians supply amateur mechanics with castings of the various parts of model steam-engines, and thus afford them the rich and profitable treat of constructing mechanism, yet although the editor has reviewed the catalogue of one of those opticians on page 270, I fail to discover that any castings of microscopic stands are supplied, and I would suggest to the notice of Mr. Bateman and other tradesmen that if those parts were supplied at a reasonable price it would do much to popularise the microscope with those who can now only afford to purchase those cheap shaky instruments, which seldom fail to make the owner dissatisfied with the study of nature, and certainly never allow him to study unembarrassed the minutiæ of her attractions. I fancy the castings for a first-class stand could be profitably sold for a guinea, and hundreds of readers of the English Mechanic have abundant ability to file, fit, and finish them with necessary perfection.

E. B. Fennessy.

DR. PACKMAN'S STEAM-ENGINE.

[4370.]—Permit me to reply to your able and scientific correspondent "Saul Rymea" (let. 4302, p. 306) by stating that my new steam-engine works perfectly, without noise or anything visible from the steam. The speed is regulated by the furnace, which is controlled as easily as the flame of a lamp. The steam is condensed within one-seventh per hour of the water required at starting, without water or any mechanical means whatever. There is neither smoke, chimney, coals, nor water-tank. It is not protected yet, as there are doubts about the value of a patent, where the laws are made to "keep back the people" from progress, as those concerning road steam-engines in England do at present. Such noisy, cumbrous, frightful, and dangerous things as "traction-engines" require restriction. But, why should engines with silent and invisible machinery not have been exempted? However, the same principles being applicable to all high pressure engines, the promised description may see the light of day in due time.

F. Packman, M.D.

THE MYBORG BEE CABINET.

[4371.]—Ever since the appearance of letter 4187, on the 24th of last month, I have been hoping to see some notice of the interesting suggestions of our Danish correspondent. The "Myborg Bee Cabinet," as I will venture to name it, seems to promise an escape from some of the difficulties of the "Woodbury," but before constructing one I should like the opinion of Mr. Abbott or some other experienced bee master, lest in avoiding some known inconveniences we might be running into other and possibly worse ones. Allow me, though a novice, to ask one or two questions:—

1. Supposing the cabinet complete, and that a swarm has been obtained, how are the bees to be introduced into their intended homes?

2. Would it not be an improvement to interpose blocks at intervals between the two thicknesses of wood so as to have dead air spaces at the sides and front as well as at the back and bottom? (See letter 3162, No. 350.)

3. Might not the frames be made much longer so as to increase the space for the breeding cells? Mr. Abbott finds the ordinary Woodbury too small. (See letter 3533, in No. 359.)

4. But the point which seems of most importance is the waste of heat which would take place in the winter in the upper half of the stock compartment. (See the 3rd paragraph of letter 3162.) Can this be in any way obviated?

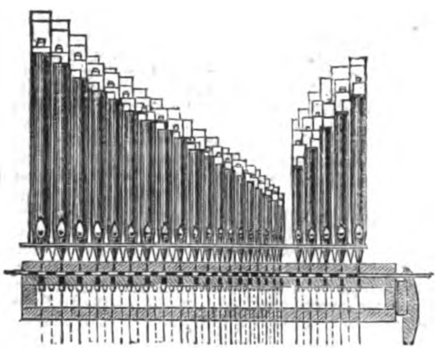
It would be very satisfactory if Mr. Abbott could spare time to notice these or any other points in the Myborg letter which may occur to him. Would he also explain what Mr. Langstroth means by "a tall hive laid down"?

When will our Danish friend give his promised description of his "honey taking machine"?

I hope an editorial note will soon put an extinguisher on the steam comet. E. T. Grays.

AMATEUR ORGAN BUILDING.

[4372.]—In answer to "Draughtsman" (letter 4282, p. 302), I believe many have ventured incautiously, without first knowing or contemplating what they intended to build. It is not necessary to go to CCCC



for a room organ: an ordinary 8ft. stopped pipe is sufficiently powerful for moderate use, which will constitute the same depth of note as a 16ft. open. If amateurs wish to combine reeds on the harmonium principle let them not ascend higher than tenor C, then they might have a 32ft. tone, while above tenor C, pipes being used, they can have every sweetness of tone. I will say more in a subsequent letter on new-shaped pipes, with the measurement appended of some of them. I inclose a section of the usual manner of laying out soundboards.

Joseph William Fennell.

THE HARP.

[4373.]—Will some one take up in our pages this neglected instrument? A few letters on its construction similar to those which have appeared on the piano, the organ, &c., would be appreciated by G. H.

NORTH LONDON RAILWAY.—GOODS TRAINS AND PASSENGER TRAINS.

[4374.]—It seems a great pity that goods trains should be allowed to interfere with passenger traffic to the extent they do by being run frequently in the day time. All passengers who are in the habit of travelling to the city by the North Western train due at Broad-street at 9.22 a.m., must, by this time, be thoroughly familiar with the following nuisance. Every morning, just as the above express train to Broad-street is due at Camden-road, a very long and very slow goods train passes the station on the express line, and crawls along to Broad-street, rarely arriving there till 5 or 10 minutes after it is time for the express train to get there. This has been so ever since the express trains commenced running, and it is often anything but cheerful or edifying to be in the carriage and hear the complaints of the passengers as the train keeps stopping and whistling all the way. What a pity that a train so punctual on the district line and other parts of the route, and belonging to the finest service of trains in existence, should have every journey spoiled by a miserable goods train, which might easily be run on the slow train line, or started a minute or two earlier or later. A Disgusted Passenger.

ON FIDDLES.—To "Fiddler" and Mr. P. Davidson.

[4375.]—"Fiddler" says: "You may bow a fiddle string of given thickness until it shrieks," quite true. That, because you can make your string shriek, therefore, it must be impossible that string can move more than one soundboard made of the same—I presume the same kind of—wood, is not, to the unscientific writer of this, quite self-evident. It may be true for anything experience has taught him to the contrary; for, although, he has some experience in the employment of more than one soundboard in pianofortes, he possesses none of their use in fiddles, his first funny fiddle, conceived in the depths of his consciousness, existing as yet only in imagination. "Fiddler" also says that the new fiddle would "do," if it had but one string to each soundboard, which seems very probable. What seems equally so is, that if the set of strings which generates each individual sound in the pianoforte had a separate soundboard, of sufficient size, it would also "do" admirably well. The question is, how are we, in practice, to provide each string, or set of strings, with a sufficient soundboard, unless each string or strings which generate sounds, whose pitches differ by only one semitone, be placed so far apart from each other as to become quite unmanageable either in a bow instrument—whose strings have to be "stopped" by human fingers of ordinary length—or in one having manual keys, for, unless a whole octave of the latter be within the space of about 6½in., human hands can't perform on it.

I advisedly wrote "a sufficient soundboard," but I really don't know how many superficial inches would be sufficient. Probably, for the necessarily but short treble strings of a pianoforte few superficial inches (say about 8in. or 10in.) would suffice, because mere increase of surface does not, in that part of its compass, seem sensibly to increase the loudness, however much it affects the timbre, of its sounds. Loudness seems to result rather from the ample vibrations of a comparatively small surface than from the very minute vibrations of a large surface acting as a soundboard; and very short strings can't vibrate a large area of soundboard (it is far otherwise in the case of long, thick, and heavy bass strings, hence we make a contra bass somewhat bigger than a kit), consequently, could we connect each set of strings with a separate soundboard, we should soon arrive at the limit of loudness, unless, indeed, we did exactly what I have done in my first funny fiddle, to wit, instead of one, using many and effectually connecting them together; but this is hardly to be termed connecting each string with one, for it is connecting it with many soundboards.

If it were desired to increase the power of strings so as to cause them to induce vibration of larger soundboards, increasing their lengths (supposing their material will bear a greater tensile force than that to which they are now subjected) or their thickness naturally suggest themselves as the means. The former has been done in the piano until their lengths have been about doubled, and their thicknesses more than doubled, nay, it has been increased from four to eight fold. Want of tenacity, even in the very best Roman strings, would, however, soon prevent us from much increasing the length of violin strings. I never had the good fortune to get a first string which did not break before its pitch was raised to G above the lines—i.e., a minor third, besides which, could they be made twice as long (say 26in. instead of 13in.) it must be remembered, that although the change might facilitate "stopping" in the upper octave, it would cause the "stops" to be almost as far apart as they now are on the 'cello. Now, I think "Fiddler" and all his brethren will admit that it is much easier to execute rapid passages on a violin whose strings are but 13in., or on a tenor whose strings are 14in. long, than on the violoncello or double bass; anything to the contrary notwithstanding Bottessini and Company may have "executed."

Increasing the thickness of fiddle strings is not open to the same objection—viz., rendering performance more difficult—as greatly increasing their length is; and, to my taste, the timbre of the sounds of the A string, raised to E, is much more pleasing than the ordinary tone of the first string; but, besides the unpleasant fact that A strings which will bear tuning a a fifth higher are not to be bought every day, I may remark, it is not every one who prefers the timbre of a thick first string. When, at my suggestion, the late Mr. J. A. Turner—who was one of the finest violinists I ever heard—tuned his A string to E, he thought it sounded rather "tubby;" its tone was not so satisfactory when the instrument was held close to the ear, which it ordinarily is during performance; and he thought the character of "tubbiness" was yet more developed when he played on his third string, the pitch of which was raised a fifth to A, although he agreed with me the tone of the D string was improved by employing thinner catgut, and loading it with very thin wire. However, well knowing that neither the organist, pianist, nor violinist are, while performing, best situated for listening, I changed places with my late friend, and let him hear, to the best of my bowing ability, the difference between the tone of the comparatively slack D and A strings at their original pitches, and their tone when tuned a fifth sharper. He then acknowledged that the tone of those strings, when their pitch was raised, "told" much better at the distance of some twenty yards.

I presume "Fiddler" will not deny that the thicker and tighter a string is, the more force—whether that force be applied to it by way of percussion, as it is in the piano, by pulling, as in the harp, the lute, the guitar, or harpsichord furnished with plectra, yea, even in ye fiddle, whose strings are as certainly pulled, by the rosined bow, as those of a harp by the fingers of the performer—will that string bear without shrieking, which is ordinarily the consequence of "cruel" treatment; hence, we may hope long and thick strings will communicate sufficient force to moderately large soundboards to induce their vibrations at a much further distance from that place on which the strings rest, or are attached to them. Consequently, we may reasonably expect that by the use of thicker strings, we may be enabled to employ larger single soundboards in violins, and thereby obtain louder sounds without deterioration, perhaps even with improvement, of their timbre.

I see "Fiddler" also suggests that the breast of the violin ought to be composed of two pieces of wood, because its bridge has two legs; possibly so, but the reasoning seemeth rather of the order which deduced Goodwin Sands from the erection of Tenterden Steeple. If the fiddle's breast ought to be made of two pieces of belly timber—I mean belly wood—why does "Fiddler," and all his fellow fiddle-constructors, glue those two pieces together, and thereby make them one piece of wood? Surely, the two "poor feet" of its biped bridge would "act and react" more perfectly if the two halves of the breast were disunited. When I read this rather odd notion, my original "savage" nature was so roused, that I was strongly tempted to recommend my friend "Fiddler" to perform that "happy despatch" which the Japanese term "Harikaru" (the word literally signifies "belly cut"), by ripping his belly—of course, I mean only that of his fiddle—up the middle.

It is my misfortune that the congenital density of my nervous tissue quite prevents me from clearly realising either my friend "Fiddler's" fiddle reflections—I mean his fiddle sound reflectors—or Mr. Schucht's peculiar theory of the law of vibrations. My ignorance of the latter is, I fear, partly due to your cruelty, Mr. Editor, for he informs me you (perhaps envying its profundity), instead of inserting, returned its lucid exposition to the writer. I can only lament our deprivation of that enlightenment which would necessarily have resulted from its publication in "our" journal, its insertion in which would certainly have saved so much valuable space. Had you printed it, all that space now devoted to the shallow theories of "The Harmonious Blacksmith" and other acoustically ignorant correspondents must needs have been rendered available for far more important matter. Mr. Schucht was kind enough to endeavour to explain his most satisfactory, to himself, theory to me when I last had the pleasure of calling on him; but the attempt was a wretched failure. No doubt the congenital density of my nervous tissue had much to do with the difficulty he experienced in explaining what he assured me was very plain and simple.

May I also suggest to "Fiddler" that when he rested the back of his 'cello against a board, whether of mahogany or other wood, he did something very like putting an additional soundboard to it, or rather putting it to the latter. Sure-ly the convexity of its back must—where it touched the board—have acted like a soundpost—*i.e.*, have communicated its vibrations to it, and caused the said board, so long as it remained in contact, to become a *sound* board. I don't think this 'cello case could possibly be a case of its reflection, but of the additional generation of sound—such, at least, is the result of my "reflections" thereon.

The material of a sound reflector, or, to speak more correctly, of a reflector of those aërial waves which we perceive as sound, ought to have a smooth (not to say polished) surface, just like that of a reflector of heat or light waves. Reflection, however, is mere change of direction: it cannot generate either heat, light, or sound. A sound reflector can no more increase a sound's volume than a mirror can increase the light of the sun; both light and sound may, however, be concentrated by reflection, which is just what I suppose the so-called ear trumpet effects for those who are as hard of hearing as I am of understanding.

THE HARMONIOUS BLACKSMITH.

P.S.—Among fellow fiddlers, whose judgment I solicited when my first funny fiddle was made known, I am sorry to say I omitted to include my fellow correspondent Mr. P. Davidson, who once did me the honour to request me to communicate information concerning violins to him. May I respectfully request his opinion on the probable advantages (if any) and disadvantages of my latest born infant, especially in the matter of what is likely to be the character of its "voice"? Allow me to add, I am trying very hard to understand Mr. Schucht's last letter on the violin (4308, p. 307), but I have failed to arrive at its meaning.

NEW DOUBLE STARS.—To MR. BURNHAM.

[4876.]—YOUR success in discovering close double stars in regions which were considered thoroughly worked up has been much noted on this side of the water. The subject was a matter of conversation amongst amateurs and others at the Royal Observatory Visitation on the first of this month, and every one seemed gratified, and wished you much future success. Touching your letters 4178 and 4258, I had a fair opportunity last night, June 11, of looking up two of the objects referred to—Virginis = L 23106, *s.f.* 6 Comæ, and Boötis = L 27106. The former is, indeed, a very beautiful object, but not quite so difficult as I expected to find it. The small companion was, of course, very easily seen with the full aperture of my mirror (12in.), and continued visible with all apertures down to 5in., which, in the condition of the air and twilight at the time, left it just perceptible by glimpses. I, therefore, conclude that the faint companion is fairly within reach of a good 4½in. achromatic.

Whether this double star is a new one or not I have no means of knowing, having only Struve's "Mensuræ Micrometricæ" to refer to, in which it is not found. I was not so successful with the more difficult pair L 27106; whether from smoke, twilight, or tremor, after long gazing I could not persuade the little companion to show itself. In cases of this sort the imagination needs to be suppressed, and nothing short of seeing the object absolutely and unmistakably ought to be allowed. In this I failed, but shall look again the first opportunity, when I hope to confirm your discovery. Much more interest attaches to close and difficult pairs when in the same field with conspicuous and well-known stars like ξ Boötis. Your fine double in this field is, however, not the only one. Looking over the small stars in the neighbourhood, I met with another, if not as difficult, by no means one of the easiest. It may be readily found thus: Place ξ Boötis at the lower margin of a wide field and low power; the double in question will then be just within the same field at the top, and a line produced from ξ across the star No. 1 of your chart (let. 4258) will almost strike it. I roughly estimated mag. 8·2 and 9·5, D 1·45", and P 170°. I may also mention another pair recently met with worth looking at, not in the Men. Mic.: R.A. 18h. 4m., N. 32° 45', P. 347, D. 1·6", 7·5, and 7·8. The place is only near enough for finding, and the rest approximate. I am sorry to say all the other stars referred to in your letters are now passed out of my range for the season; but I hope to look them up when opportunity serves.

F. BIRD.

INCUBATORS.

[4877.]—IN reply to "Hatcher" (let. 4175, p. 229), I would remind him that eggs require a certain degree of moisture, and so they do better when the hen's nest is on the ground. This should be provided for in any incubator; and then does not "Hatcher" know that when a hen is hatching its chicks they often require a little assistance in breaking up the shell? The chicks break the shell, but frequently have not strength to make the opening large enough. We lost two the other day, simply because we could not get to the nest.

E. T. S.

THE ROBIN HOOD SEWING-MACHINE.

[4878.]—As many of my brother subscribers seem interested in sewing-machines I send you a sketch of one I have invented and made, if you will allow me a

little of your valuable space. It works with ten needles, double-thread lock-stitch. Any needles may be left out or put any distance to suit work. It will make 2,000 stitches in one minute, and more stitches in two minutes than any woman can make in one day. Will any reader of our valuable paper tell me if there is such a machine at work.

R. TANSLEY.

RECENT DISCOVERIES OF DIAMONDS.

[4879.]—NATURE produces nothing more beautiful than the diamond, or more valuable, but it is truly astounding the ignorance that well-educated people show about it. Our emigrants either pass over the genuine stone as of no value, or send home paltry bits of crystal or topaz for the precious gem. It is curious that the constituent material of the diamond is the predominant component of every organic or living thing. As rock crystal is flint in a pure state, so is the diamond carbon in a pure crystallised form. All "our" readers know that crystallisation generally produces brilliancy; for example, carbonic acid gas, combined with lime, when crystallised, form the clear transparent double-refracting or Iceland spar; but when uncrystallised the same compound is opaque, as in various limestones. The diamond is an ingredient of all living things and corundum of soil.

The diamond generally occurs in regions that afford a laminated granular quartz rock called *Itacolumite*, which pertains to the talcose series. The diamonds lie often imbedded in flaky portions of this material like garnets in mica schist. In the collection of the late Mr. Ruskin is a conglomerated mass of quartz, pebbles rounded through having been waterworn, with two crystals of diamond and various grains of gold, the whole cemented together by oxide of iron, thus showing the association of diamonds and gold, and was found in the bed of a river in Brazil. When diamonds were first discovered in the Brazils they were used as counters in playing cards, till an officer took some to Portugal, and found out the value. In 1844, a slave was searching for gold in the bed of a river in the province of Bahia, and discovered diamonds, and it being a new locality, 297,000 carats were found in two years, which produced upwards of £300,000. In the gold mine of Adolph, Siberia, between the years 1833 and 1836, upwards of fifty diamonds were found, but only one of these was of considerable size. The most productive mines in the world are those of the Sierra de Trio, Brazil, which are computed to have yielded upwards of two tons of gems. In an exhibition of native productions held at Melbourne in 1855, numerous small diamonds were exhibited, found in various parts of the colony. In 1866, upwards of sixty diamonds were found at the Woolshed Diggins, in the Ovens district; but were all very minute, weighing from ¼ to 2 grains. Africa is without doubt the largest diamond-yielding country. Dr. Atherstone, of Graham's Town, received a letter from Mr. Boyles, Clerk of the Peace, Colesberg, inclosing a diamond, which was afterward sold to Sir Philip Woodhouse for £500. This was in March, 1867. Soon afterwards, twenty other good-sized diamonds were found along the Orange river; but in May, 1869, the world was startled to hear of a diamond weighing 83½ carats, found near Sandfontein, on the Orange river. Swalboy, the finder, sold it for 500 sheep, 10 head of cattle, and 1 horse. It was purchased by Messrs. Libenfield Bros., and was sent by steamer to England, and insured for the passage to the tune of £30,000. But this was thrown into the shade by a report in September that a diamond had been found in Australia weighing 900 carats, and estimated to be worth £10,000,000, as it would be five times as large as the Koh-i-noor, and the Koh-i-noor's nominal value is £4,000,000. After great excitement, and a thorough investigation, the stone was found to be a topaz, but the resemblance in this instance was very extraordinary. The stone in the Portuguese Treasury, weighing 1,880 carats, is probably, and almost sure to be, a topaz, or a white sapphire stone. But how absurd to report such a stone as the Australian specimen without first investigating. Nothing but a diamond will scratch a diamond; but if the stone is topaz, or white or yellow sapphire, it can be scratched by a splinter of ruby. It is, probably, simply not topaz, but a common bit of quartz worth nearer 10d. than £10,000,000

I will now proceed to give the method of distinguishing the true diamond. In olden times jewellers put a varnish made of ivory-black and mastic to the back of the stone. If genuine, this gave it great brilliancy, but if a sham it made it dull and lustreless, showing the black through its substance. Mr. King says that the "Novas Minas" white topaz of Brazil, better known as the "Slave's Diamond," is now the only stone which has any chance of being passed off as a true diamond. The genuine diamond may always be distinguished by its "single refraction"—a property which is also possessed by the garnet, but by no other precious stone. Others have a double refracting power—that is, to speak plainer, give a double image of a taper, or other object, when viewed through their facets. When diamonds are set it is easy to see whether the refraction is single or double by looking into the stone at the image reflected from the posterior facets. The diamond does not lose its lustre if immersed in water or alcohol; but sham stones will, arising from the inferior refractive power; a commoner method is to touch with the tongue, when genuines feel colder than shams. Pliny, in his "Natural History" (lib. xxxvii., c. 15), says, "a true diamond, if placed on an anvil and struck with a heavy hammer, will not split." Many fine stones must have been sacrificed at this. This would be my last experiment if I was testing a diamond; but diamonds could, it has been said, hardly have been known to Pliny. He must have been mistaken for white sapphire, the next hardest stone to the diamond (*vide* Dr. Billing's "Science of Gems." Diamonds were formerly polished by the East Indians by rubbing them one against the other, as was the case with the Koh-i-noor. Lavoisier made many experiments on the combustion of the diamond. By its first combination with oxygen it is converted into plumbago, by a second degree into common black charcoal, and by complete saturation into carbonic acid gas. Thus, this most beautiful of gems, exceeding by 100,000 times its mass in gold, is but a lump of coal dissipated by combustion into any insalubrious gas. There is, however, good reason for supposing that future discoveries will tend to diminish their cost.

H. B. E.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4880.]—MR. OLDFIELD, in his letter (4149, p. 225), seems to have put the finishing stroke on the crown lens. But before applying the hammer, will he state from these symptoms if he still thinks the case hopeless? It is now four years since I bought my glasses from Messrs. Chance, and paid too little for them. They were, according to Messrs. Chance's tariff, 6in. square plates for cutting up. My object-glass is still an immense puzzle to me, and has introduced me to a host of optical phenomena I never bargained for, some of which I will state for the benefit of other intending adventurers. First, with regard to taking the specific gravity of the glass, I thought that the fragments of the ring of glass cut off the 5in. discs were handy, but imagine my astonishment at finding that not one of these fragments (in the case of the crown lens) gave the same results, but went something after the following order: 2·61, 2·59, 2·57, 2·55, 2·54, 2·44, 2·23, and so on round the square; so that if this is the density of the edge, what is the middle? Secondly, in the *Journal of the Society of Arts* appeared a paragraph on the subject of astigmation; this phenomena is, as Mr. Oldfield and Mr. Vivian may be sure, not wanting in my object-glass. To begin: Put in the eyepiece of the telescope—bad focus, look upwards by tilting the eye piece, I see a focus; look down, I see another. Which of these will-o'-the-wisps must I try to catch? By means of a little patience and the obliging adjusting-screws of the tube, you may catch either of them, not to forget the turning round the object-glass, or tilting its ring or cell a little. Mr. Vivian's suggestion of the best position of the edges of the lenses has not been forgotten; every little helps. But when got, best is bad. Its astigmation is an imperfect circle within the focus, either a badly-formed ellipse or a flattened circle. In pushing in the eyepiece, a sharp orange red point darts out of a star on each side, and lengthens. I am sure that my optical centre is very near the point; but, on the other hand, the cone of rays as cast from the object-glass is a wonder to the eyepiece, if not to me also. Why does it move round the eyepiece in that erratic manner, a good central focus appearing so near and yet so far? I must conclude by stating that the optical centre was got by running the lens on a small lathe, it being cemented to a piece of metal held in a six-screwed bell-chuck. A sharp point of brass was closely watched by a convex lens as to itself and its reflection, the edge being treated in the same way. The edge and surface next the headstock got true, the other was ground true, then all reflections stood still, and all seen through also.

It is possible, as Mr. Oldfield says, one of the surfaces is not true—most likely one of the first done. I have only one brass tool in my possession, having re-turned them up as I went on, so am free to start fresh. Some years ago I ground some lenses on soft hematite cast-iron tools. Could I use this metal again, or are they obliged to be brass? I do not wish, while thanking Mr. Vivian and Mr. Oldfield for their kind offers, to trouble them or take up their time with bad material, but shall start with 63in. focus and a piece of new crown glass, if this is really bad.

W. H. Cash.

SELENOGRAPHY.

[4381.]—Selenographical sketches are of general interest when they are neatly shaded, as that by Mr Birmingham (page 277); a mere outline, as those usually given by Mr Birt (see page 292), are only profitable to those who have large telescopes. Many readers, like the writer, who are not possessors of great telescopes, have a constant desire to understand how celestial objects appear when viewed through them, and however incomplete the best drawn sketch may be, it is comprehensive and of marvellous interest to us compared to the dry puzzling diagram of outline often given, which is perplexing to all but the astronomer. To him, as to the general reader, the more carefully-drawn selenograph would be pleasing, and equally, if not more, useful. I hope Mr. Birt will take a hint from

E. B. F.

NITROGEN IN PLANTS.

[4382.]—Mr. Lawes (p. 314) has, I think, proved by decisive experiments—first, that plants do derive much more nitrogen than is supplied from manure in the soil; and secondly, that it is not derived from the air itself, but from what is mingled with it. The first point he established by growing wheat crops for a long succession of years upon the same plot of land without supplying any fresh manure, with the effect of obtaining, first, a gradually decreasing crop, as the soil became exhausted, and afterwards a nearly regular one, the nitrogen of which must have been obtained from the air or the rain, or from something contained in them. The second point was proved by growing wheat plants under air-tight glasses, in soil containing the ashes of wheat plants but no nitrogenous matter, supplied with water and air containing carbonic acid, but no ammonia or other nitrogenous matter, the seeds germinating and forming stalks, and a leaf or two, which would wither and another form, there being nitrogen enough, but not more than enough, for a leaf or two at once. The air was deprived of nitrogenous matter by passing it through an acid solution, which absorbed ammonia or any nitrate or nitrite. Some have found it difficult to account for plants growing on land not manured obtaining more nitrogen than appears to be contained in the rain and dew supposed to fall upon them. I believe the explanation is that very much more dew is deposited upon the leaves of plants than upon artificial surfaces, and that therefore the quantity of dew falling is much under-estimated, while much of the nitrogenous matter in the air is obtained from it by the dew. This subject needs experimental investigation.

Philo.

THE DISTRIBUTION OF ANIMALS AND PLANTS.

[4383.]—I do not regret the revival of the comet question, notwithstanding "E. L. G.'s" arguments in favour of future collision with a comet, but I must protest against any direct or implied misrepresentation. I do not know whether a comet ever existed, or could exist, composed of steam, and doubt whether "E. L. G." has any better foundation, judging from what we have yet received. But "E. L. G." brings forward the wide diffusion of many fresh-water plants and animals as one proof of the occurrence about 5,000 years ago of a universal deluge of fresh water! Now, it is very easy to set aside the facts brought forward by Darwin in explanation of this wide diffusion; but people must judge for themselves whether "E. L. G.'s" hypothesis or Darwin's explanation be most reasonable. Birds frequenting the vicinity of water do get muddy feet, and it is quite possible for the seeds of aquatic plants, &c., to be conveyed by that means. But whether "E. L. G.'s" universal deluge would result in diffusion or destruction seems to me, at least, questionable; but supposing the former, should not the result have been more complete than we actually find it? But are the rivers and lakes of fresh water such isolated localities as "E. L. G." would lead us to suppose? The sources of the tributaries of many streams are frequently separated by short spaces of land, so they may be described as a network of ramifications, and I am under the impression that, as a rule, water plants are more tolerant of removal than land plants; the mouths of rivers form a means of communication, for a great many seeds will bear immersion in salt water for a shorter or longer time. It is very easy to see how such fish as the salmon, &c., would gain access to new rivers by this means. "E. L. G." expresses surprise at Darwin's statement that the condition of oceanic islands accords with his theory (that wide spaces of sea or deep narrow channels form effectual barriers to the free migration of species), and asks the question whether, according to his hypothesis, the terrestrial mammalia might not have been developed there. Certainly, but time and favourable circumstances are necessary to bring it about; assuredly a much greater length of time than "E. L. G.'s" 5,000 years.

J. C.

THE WONDERFUL GUN-BARREL.

[4384.]—Looking over some back numbers of the English Mechanic, I found a wonderful gun, or rather a somewhat deficient description thereof. What can this wonderful gun-barrel (mentioned in let. 3887, p. 38) be made of? The writer says it was "cast" on the Bessemer principle, whatever my old acquaintance's "principle" of casting may be. N.B.—He is far from being a man "without principle;" but as regards iron and steel, I always thought his principle was the reverse of casting, it being to render iron malleable. The writer also says: "If a bad ingot, it can stand a heat equal to any iron—no small heat, by the way, in the case of nearly pure iron—and bear rolling down to the thickness of No. 32 wire-gauge for conversion into a locomotive tube." He also says his barrel can be produced cheaply. Now cheapness, when not associated with nastiness, is, according to the French wit, the characteristic of modern civilisation, to which in all probability rifled gun-barrels contribute. Will Mr. Minshes be so kind as to inform us what the cheap material is in which this gun is cast which, like Sir J. Whitworth's compressed steel castings, stands so much greater an amount of strain than any gun in her Majesty's service ever could be subjected to in actual warfare?

The Harmonious Blacksmith.

SCIENCE AND EDUCATION.

[4385.]—The following remarks on this subject are by Dr. Cobbold, F.R.S., in his concluding lecture of the Swiney course for 1872, in the Lecture Theatre of the Geological Museum, June 1. He commenced by remarking how much of the general teaching given in certain forms in this country is opposed to the teachings of science in general, and of geology in particular. It is not pleasant to any man of science to have to oppose men who, perhaps, in their private life, are better than himself; but in the interests of truth it is necessary that one should stand up for what is true, quite independent of all personal feelings whatever. Further, the methods by which children are trained are such that when they grow up they are unable to draw conclusions for themselves quite independent of all dogma and authority.

The method of science is in itself attractive, simple, and grand; there is nothing difficult in science. You ask for a definition of it, and you have Professor Huxley's "Science is organised common sense," or Sir J. Herschel's "Science is the knowledge of the many, orderly and methodically-arranged, so as to become comprehended by one." Every subject is capable of being regarded in the light of a science, all that comes within the cognisance of the human mind may be classed under one or other of the heads of the following scheme:—

Constituents of the Universe.				Human Knowledge.
	Organic.	Vegetable (Botany) Animal (Zoology)	*Biology.*	
	Inorganic.	Mineral (Mineralogy) Aqueous (Hydrology) Aërial (Pneumatology)	*Abiology.*	

We first speak of everything of which the human mind can take cognisance under the term "Constituents of the Universe," and then, by a process of analysis, proceed to subdivide it into various subclasses, which subdivision can be carried out as far as desirable; the whole may again be synthetically combined, and come ultimately to what we started from.

I will commence my remarks on education with a general proposition, the truth of which will become clearer as we proceed; all real superiority, whether national or individual, depends upon the degree of culture of the human mind. Reflect, if with all our wealth as a people so stupendous, with our love of liberty so unshaken, and with a religion so patronising, we are advancing, even at the slow pace of our much-abused German neighbours. If it were a mere question of brain power we could point to Mills, Carlyle, Tennyson, Huxley, &c., than whom there are not abroad men who are more than their equals, at all events. If our advancement depended upon these few bright intellects, then undoubtedly we should be proud of our position as above, and, probably, beyond all other nations. But it must be allowed to any one who looks at things broadly, that as a consequence of the not general diffusion of high intelligence, the national chariot wheels are clogged with vices, one of which is intemperance. While this implies a want of intellect, it displays a want of mental and moral culture. People combine—honestly combine and form societies—temperance societies, amongst others, with a view of crushing these follies. Legislators seek to stamp it out by restrictive measures, but to what purpose? Some little good is effected, but the cancer remains. The remedy lies in our hands; alter the conditions of existence of any living thing, and you can alter its character *in toto*. Take the case of the apple; who does not know that the most delicious apple will become a crab when removed from the genial culture of the garden and subjected to the wild influences of the atmosphere. The apple and pear will revert to the old crab-tree when these gracious influences of culture are removed from them. Or, take the case of an animal: say dogs, when they run wild, as they were allowed to do years ago in Australia, they revert to the wolf. The Australian dingo is scarcely different from the wolf, the parent of all dogs. And so it is in the higher forms of life. Place a child in an artificial condition, and what developments do you not see! Look at the features of fashion. The child, which in itself is so beautiful and so expressive of much that is lovely, is taken and brought up in a way in which it shall, before it is grown a woman, have all the airs and ways of a grown up person. It becomes artificial, its manner spoilt, and those elements in its constitution which are altogether lovely are effaced from its character. We are all creatures of circumstances, and our outcomes are the consequence of the conditions in which we have been placed or in which we have placed ourselves. Unfortunately there is, in too many cases, no desire to depart from these circumstances. This is a large subject, and one which leads us in many directions. I feel with Mr. Carlyle in regard to this that those who would stamp out these features which are so agreeable little know what misery they entail upon future generations. The object of man in life is to be honest and straightforward, and what we want is not less sound religious principles, but less of those surroundings about which people trouble themselves, and which are scarcely worth the trouble. As to remedies, it is not by the building up of systems, or devising of methods, that people will become more honest and more intelligent, but by encouraging in every way and in every direction all sorts of progress, both mental and material. There are at the present time some large-hearted people in authority with abundance of power, who would like to see such gatherings as this every Saturday evening. Those gentlemen would like to see it carried out on a scale infinitely larger than at present obtains, who would like to see the places of intellectual improvement open to the public on the only day when many of them, for honest reasons, can avail themselves of them. To see these classes read, mark, learn, and inwardly digest the glorious truths laid open to our view by the study of Nature. But some will say, why do not these men use their power? The fact is they cannot; they are opposed by a party more powerful in point of numbers.

There are other helps more material, which may be employed to bring about a better state of things than obtains at present. Look at the conditions of existence in which multitudes are brought up; much of this ignorance and debasement might be spared if only the conditions could be altered. Now, these conditions cannot be altered by a *revolutionary* process suddenly, they may be by an *evolutionary* one. One of the factors concerned in this eventual improvement, I believe, would be obtaining the assistance of recognised men of great power and capacity to organise a system by which the great and glorious truths of science should be diffused throughout the land more effectually than at present. I do not wish to disparage the honest efforts of those who are working so energetically in the matter, but I think that whilst at present it is necessary there should be compulsory education of the young, when the value of the practical results are realised by persons who have grown up under a better system there would be no compulsion necessary—it would be a matter of course and delight.

A museum is grand, no doubt, in itself, and is instructive, as it gives people a general idea of the nature of the various forms of life, &c., which exist on the earth; but, unless you have living and earnest men capable of explaining the value of the treasures of the museum, nine-tenths at least of the value of the museum teachings is lost. I have ofttimes wandered through the British Museum, and have noticed the wonderment which appears in the eyes of our country friends as they pass too and fro, and thought "You get an idea, certainly." But might not that instruction lying in the museum be turned to account in the way I have mentioned. In this the most splendid museum in the world there positively is not a lecture room, and no means of getting instruction except by going round a few at a time.

But another objection will be started. Where is the money to come from? To that I answer, scientific men are very modest in their requirements; a little satisfies a man if he has an honest desire to convey a knowledge of truth. I think there is no doubt but that if the people do but express their desire on this account with sufficient firmness, not only the education, but the money and the men, will be forthcoming. I have no interest in disparaging the present existing machine at all; I merely wish, knowing the great results which must at length accrue from science, to see these principles gradually diffused until the whole mass is permeated. A few years' space of action in the direction I have spoken of would do more to put down ignorance and vice than all the compulsory measures of legislation. As sure as our planet revolves on its own axis, and also circles round our great luminary, so sure is it that science and reason will one day have their ends.

We may regard science in this aspect at present as a little cloud no bigger than a man's head. But it will increase; it will grow and form cumuli and nimbi, and will at length descend in refreshing showers upon the earth. We have the proof of this in the facts of development in time. Place yourself in ancient Siluria: can you realise the possibility that the organisms of Siluria will culminate in the development of man? Doubtless, by-and-by precious fruits will be reaped, but there are rewards now for all, and those are the rewards of independence; it is no fabled reward, I assure you, to pass through life doing your duty in that particular area or sphere of action to which you are called, and one which no dogma can destroy. Therefore

Let us all be up and doing,
With a heart for any fate:
Still achieving, still pursuing.
Learn to labour and to wait.

W. H.

ON EDUCATION.

[4386.]—I WISH to make a few observations on the practical part of this important subject. I consider that our public school and university systems have two serious faults, they are unnecessarily expensive, and from their prestige and the advantage to be derived from them being much overrated, they educate more men than there is suitable employment for, either in this country or the colonies; learning is a drug in the market; the supply of educated men is largely in excess of the demand; this leads to two evils, firstly, from the severity of the competition to obtain situations: those who are successful must accept terms, which remunerate them very inadequately for their expenditure of time and money. A public school education costs about £500, perhaps more, according to circumstances. The expense of graduating at Oxford or Cambridge is about £500, this makes a total of £1,000. The writer took his passage to Australia some years ago, willing to do any work he could find, and yet he had taken a better degree than five-sixths of our graduates, and in a practical point of view he not unnaturally looks at university education as little better than time and money thrown away. I extract the following from Dilke's "Greater Britain" (fifth edition), p. 244:—"Another account says that none but members of the older English universities are admitted to the force (the Gold Coast Police). There are here upon the diggings many military men and university graduates, who generally retain their polish of manners, though outwardly they are often the roughest of the rough." I conclude my letter by asking what practical benefit have these men derived from wasting a moderate capital on a useless education.

ROBERT LYON, B.A.,
Ex-Scholar of Clare College (7th senior op., 1865).

PERFORMANCE OF TELESCOPE, &c.

[4387.]—I DESIRE to express my thanks to "F.R.A.S." (let. 4224, p. 274), and also to the Rev. H. C. Key (let. 4248, p. 279), for their kind replies to my questions. I shall feel much obliged to either of those gentlemen for a little information so as to clear up the following difficulty. We are told that the separating power which ought to be possessed by a first-class telescope may be calculated by dividing the standard number 4·83, by the diameter of the object-glass or speculum in inches. According to this, my 5¾in. speculum ought to divide stars whose distance is not less than about 753·0″. I should like to know what magnitude the stars experimented on should have, and also what power should be expected to produce the result desired, also whether the experiment should be tried on a clear night in the absence of the moon, or by moonlight, twilight, or daylight, or with the field of view artificially illuminated, or with a slight fog or haze. What I wish to convey is that on the clear night with no moon, no artificial illumination, and no haze, the spurious discs of the stars will be larger than under any other of the conditions specified, and consequently more difficult to separate. As an instance in illustration, I may mention that "F.R.A.S." has frequently specified δ Cygni as a crucial test for a first-class telescope. I have therefore looked at this star on several occasions without distinguishing the small companion with my highest power, which I find is 250 (not 270, as I supposed). On one occasion, however, I believe I saw the companion during a rather dense haze, which rendered the principal star scarcely visible to the naked eye.

Another point also suggests itself to me. In referring to any catalogue of double stars, we find it remarked respecting some faint companions of bright stars that they bear magnifying remarkably well, or, on the contrary, that they are extinguished with a high power. Some of these objects are used as light tests, and therefore it seems worth while to seek an explanation of this peculiarity. First, I would inquire whether the stars in question behave similarly with all telescopes. If so, the difference must be in the stars themselves, and those that bear magnifying well are single stars seen as spurious discs, while those that are extinguished with high powers are either aggregations of much smaller stars, that is to say, minute clusters at such a distance as to appear like single stars, or possibly nebulæ, or they have real discs. In any of these cases the increase of magnifying power would produce a corresponding dilution of the light.

On the other hand, if the objects in question behave differently with different telescopes, then we must look for the cause in the instruments. Here we touch upon the great question of the relative merits of reflectors and refractors. I can see no reason, other than those enumerated above, why one star should bear a higher power than another in a well-figured reflector. We, however, know that the spectra of the bright stars are not all alike, and it is fair to presume that the spectra of the faint stars also differ among themselves.

We also know that the best (so-called) achromatic object-glasses are only partially corrected, and that with all there is some outstanding light or secondary spectrum.

Now it seems to me, that if the light of a certain star consists principally of those rays that are well corrected in the object-glass used, that that star will bear magnifying better than another apparently similar, but whose light is composed principally of those rays that go to form the secondary spectrum. Hence, I should suppose it possible that one of two stars might bear magnifying better than the other with one object-glass, and the state of matters be reversed when another object-glass is used. I should also suppose, that those nebulæ or comets whose light is found to consist of two or three bright lines would bear magnifying or not, according to the position that those lines occupy in the spectrum.

It would seem to follow as the result of the above considerations, that in the case of minute stars the magnitudes assigned by observers who use refractors will vary according to the particular object-glass employed, and that a very difficult object for one telescope may be comparatively easy for another.

T. Godfrey, (query 12112, p. 314), says that he tested his 10¼in. mirror on Arcturus with a power of sixty diameters only, and did not use a high power from want of light. It may interest him to know that I tested my 5¾in. mirror before silvering, but with a silvered plane with a power of 250, and with that power divided ε Boötis and λ Ophiuchi. I had, however, the advantage of having the telescope and stand complete and in perfect order.

Godalming. A. WOOLSEY BLACKLOCK, M.D.

MUSICAL-BOXES ON SOUNDBOARDS.

[4388.]—NOT having tried the experiment, I am unable to inform "E. B. F." (query 12175) if the resonance would be more powerful were "its innards" taken out of his musical-box and affixed to a soundboard. Probably it would, because the less matter is interposed between a vibrating body and the soundboard to which we desire to communicate its motion the less the transmission of its vibrations can be obstructed, so we may reasonably expect the motions of the soundboard would be more ample and the loudness of its sounds increased in proportion; but this don't seem a very easy thing to do as musical-boxes are ordinarily made.

Theoretically, the elastic bars or springs which form its "comb" ought to be directly connected with the soundboard, as they would be if affixed to it; but this is manifestly impossible. They might, however, be affixed to a transverse wooden bar glued on the soundboard, which happens to be the very means employed in Mr. Goldsworthy's pianoforte without strings. (See his patent, No. 6498, price, with drawings, 6d.). This would, perhaps, induce the greatest possible resonance; but it may be doubtful if even beech wood would resist compression enough to afford a sufficiently firm surface unless a plate of metal, by which that compression was distributed over a large surface, were interposed between the wood and the vibrating spring bars, were the latter in single pieces. This is the method adopted in my small portable pianoforte without strings, whose compass, by the way, is but three octaves from tenor C to C above the treble staff. It is also, I believe, the method employed in Mr. Crawford's so-called "bell" pianette. Of course, it could not be required for the comb of a musical-box, which might just as readily be screwed on the transverse wooden bar as on its ordinary support, assuming its proper position in relation to its pinned barrel be maintained. The transverse wooden bar might, probably to advantage, be made of pine wood (which, I think, transmits vibrations more readily than beech), for, from its necessarily great thickness, there could be no want of strength.

I don't think it desirable to make the soundboard very much larger than 30in. × 20in., because I doubt if the (comparatively to those of violin, harp, and piano strings) feeble vibrations of the prongs or teeth of the comb of any musical-box I have yet seen—and I have seen some pretty big ones—could excite the sonorous vibration of a surface much exceeding 600in.; but as I know no harm which can ensue from augmenting its size, "E. B. F." can, if he prefers doing so, make his soundboard (say) 10in. or 12in. longer and (say) 8in. wider, but certainly not any thicker (I have a suspicion it would act better if yet thinner), and glue two more belly-bars of the same section on its under surface. I should prefer them to be placed one at each of its edges. This will increase the superficial area to 1120in. or 1176in.—quite as large as we can expect to be put into "audible" vibration by any musical-box simply standing on it. Probably, however, were its comb screwed on a pine wood bar glued on its middle, we might hear sounds whose loudness would be "pretty considerable, I kalkalate."

THE HARMONIOUS BLACKSMITH.

CO-OPERATIVE STORES.

[4389.]—"F. C. S.," in a very clear and clever letter (Vol. XIV., p. 608), asks why a village co-operative store does not yield the satisfactory results expected—viz., a profit on a return of £30 per week, where the estimated profit of 10 per cent. produces a loss, although the expenses are under forty shillings.

A great many answers have appeared to this letter, some very well written, and containing useful information; but I think I am right in my thought that not one word has been written in answer by any one who has had the practical experience of employment in such a store. In my early life I passed some years in the management of a business of exactly the same description. I can hardly expect to obtain space in the ENGLISH MECHANIC to give all the information "F. C. S." requires. I will take one of the most important articles first—viz., flour. I will suppose the store is buying at 39s. per sack of 20 stones, and selling at 2s. 2d. per stone, leaving the apparent profit of 10 per cent., as stated in the question, and so it would if the sack of flour was sold whole just as received, but let us trace the sack of flour from its entrance to its exit. The miller delivers and empties the sack of flour from his sack into the flour-bin; the sack, if shaken quite clean, would only weigh 5lb., the tare allowed for it; but the process would cover everything in the shop with dust, so that it is more advisable to fairly empty the sack and make less dust, and the sack of flour in the bin would now be very nearly two pounds short weight. The customers are now served as they require, some with larger, some with smaller, quantities, not one will be satisfied unless they see the turn of the scale in their favour, and with the best scales you could obtain, and with only fair average care in weighing, and in the twenty, thirty, or forty turns you would find three or four pounds weight loss, and the case, with common second-hand scales, which for cheapness (! ! !) were very probably provided in this case, would be worse than I have stated, and if the store is not provided with a flour-bin the waste would be much greater in weighing direct from the miller's sack. How does the case now stand? Why, the first two pounds loss, and the next four pounds waste, at 2d. per lb., just reduces your apparent profit 25 per cent. I have in the above instance taken one of the best articles in your store, and one in which there is the smallest waste. Had I taken cheese, or soap, or treacle, the result must have been not a small profit, but a direct loss of from 7 to 10 per cent. To make it pay the store must either charge a higher rate of profit to meet the unavoidable loss and expense in supplying goods in the very small quantities the customers require them, or refuse to sell except in larger quantities, when they could not buy them at all; but by going between the two alternatives you can make the store pay—viz., refuse to sell ¼oz. of tea, ¼lb. of cheese, ¼lb. and ½lb. of treacle, for this article, if sold in these small quantities, would, I have no doubt, entail a loss of more than 20 per cent. R. R. SMITH.

ARE ANTS PIRATES?

[4390.]—I AM afraid your readers will think me an awful bore with my reiterated queries about the habits of ants, but the fact is, being rather shortsighted and without spectacles, I am compelled to take the opinions of others, instead of observing for myself. Horace, I think, sang of the "little ant with great labour" storing up food for the winter, and the moral of the little creature's life is enough to make one pause before rashly destroying it. I find, however, no less competent an authority than the Rev. W. F. Radclyffe, writing in the *Gardeners' Chronicle*, that "ants are one of the greatest fruit scourges I have to contend with. I have this spring killed legions with hot water and by hand, yet they still swarm. I am uncommonly obliged to 'C. L.' for his recipe. Immediately on reading it I got some sweet oil and put a little in a saucer in my vinery, where there is a nest under the wainscoting; in a few hours the saucer, sunk in the mould up to the brim, was replete with dead ants. It is a most valuable recipe. The whole horticultural world will feel obliged to 'C. L.' I am truly sorry to destroy them, but they make the first impressions on wall fruit, and blue-bottle flies, hornets, bees, and woodlice, take advantage of the first impressions." The recipe above referred to is as follows:—"Fill small phials two-thirds with water, and add sweet oil to float on the water to within half an inch of the top. Plunge these upright in the ground, leaving only half an inch standing out, near the nest or runs of the ants Every ant will come for a sip, and go home to die. No insect can exist with oil in its throat, yet ants are very fond of it."

I am obliged to "J. C." for his attention to my question; but with all the inclination to think as he thinks, I am continually upset by these repeated assertions of the piratical habits of the ant. SAUL RYMEA.

CANADIAN WATERCOURSES, HOUSES, STOVES, &c.

[4391.]—MANY thanks to "Tubal-Kain" for his full and careful reply, with drawings (p. 103), to my query "Water-Power to Work Saw Bench," I hope soon to turn the same to advantage. Ontario presents a large field, overrun in all parts with water-courses, falls, &c., well supplied from the several inland lakes; offering abundance of driving power, which would open up the largest manufacturing district, to be found in no other country. Railways are now making great progress throughout the north-west of Ontario, amongst those districts containing so much available water-power; thence they will connect with the great North-West Railway, the line of which is now being surveyed through British territory to Vancouver's Island—a port that in no very distant day will be the market of the world. Lake Simcoe—on the shore of which I am now writing—has the greatest elevation; its waters flow through the course of the river Severn, which contains seven waterfalls, into Georgian Bay and Lake Huron, 595ft. above the sea; thence along Lake Erie 564ft. high, on through Niagara River, over the falls, into Lake Ontario, 235ft.; and finally down the noble river St. Lawrence into the ocean. These falls denote a rocky country, and four-tenths of which is unfit for cultivation. In places where the rocks abruptly terminate the soil is rich and very productive. The densely wooded bush abounding on such lands furnishes the most correct example of its produce. The wealth of Canadian soil is prominently illustrated above the earth; the yield of minerals has as yet been few; coal there is none. Nature has produced wood in superabundance to counteract the effect of long and severe cold seasons; but the most durable production of heat has been withheld from the soil. Nine-tenths of the dwelling-houses here are built entirely of wood; frames are covered outside with weather-boards, inside match-boards, with "shingle" roofs; shingles are sawn from pine, about 16in. to 18in. long, one end being ½in. thick, the other end 0in., and varying in width from 4in. to 8in.; they are nailed on a close boarded roof, breaking joints, and exposing some 4in. of thick end to weather; very much resembling plain tiles on roof, but laying closer like slates. These shingles will last some thirty to forty years on a roof. Fireplaces in houses are not required, as the cooking stoves in use have pipes run through roof, or one side of house, in an opening surrounded by air-chamber. These stoves stand independent on one side of room, having oven, hot-plate, with several openings and covers, whereon the cooking pots are placed; are heated with wood sawn into various lengths of 18in. to 24in., giving out great heat through the house—in fact, saving all that "waste of fuel" in English houses passing up the chimney. (See pp. 436, 514, 561, 589, 609, Vol. XIV.) The flues from these stoves may be carried up through ceiling, with elbows about the upper rooms, and give the whole house a genial temperature. These stoves are also constructed in the United States for burning coal. They have a good draught, no smoke escaping; are clean, as no ashes come from them during the day; and they are the greatest utilisers of fuel and heat. They have seventeen articles of furniture with them at the time of purchase, and cost from to 20 to 30 dollars, or £4 to £6. Canadian farmers know well how to economise everything to advantage; the ashes from these stoves are carefully preserved for the purpose of making soap. The maple trees growing in the bush are tapped, and rough hewn troughs are placed to catch the sap for making sugar; and other trees also for vinegar. The bush produces abundance of fine wild strawberries, cherries, plums, nuts of various kinds, all of which are of larger size than grown in cottagers' gardens in England.

Canada, May 30. GILLEM.

THE RECENT DISASTROUS EFFECTS OF LIGHTNING.

[4392.]—It is worthy of notice that lightning has latterly been more destructive than has been known for upwards of half a century. Various physical commotions of serious import have also occurred—such as the earthquakes in California and at Antioch, in Upper Asia, Australia, and Iceland. The commotion of Vesuvius, too, has been notable, and still we find hurricanes, as at Zanzibar and Madras, and the lightning in this country more destructive than usual. It is recorded no less than thirteen churches have been struck by the electric fluid in less than two months; the most notable are, for instance, Bampton, where the fluid struck the spire, and the force displacing ten courses of stonework on the north side, or about 15ft.; the church at Mashbury, Essex, was set on fire, and with difficulty subdued; and at Rainham, East Kent, the spire, I believe, was completely destroyed. Several people have been struck and injured; the most notable case being the detachment of volunteers at drill who were caught in a storm somewhere in Dorsetshire on Whit Monday, and several more or less injured and paralysed. Trees innumerable have been levelled to the ground in various parts. Houses, at several places, as at Tamworth and Deptford, have also been struck and set on fire by the electric fluid. H. B. E.

COMPRESSIBILITY OF THE ATMOSPHERE.

[4393.]—Under the above heading (letter 4040, page 151), Mr J. M. Taylor asks an explanation concerning "the well-known phenomenon the rise of a bullet from a gun above the line of aim," having also previously stated in same letter "that the bullet fired horizontally from a gun must be deflected upwards." Is Mr. Taylor referring to the line of sight or to the axis of the barrel? If to the former, he would be right. All guns are thicker at the breech than at the muzzle, and the line of sight, therefore, taken along the outside of the gun, is not parallel to the axis of the bore. This, though not very apparent in a rifle, is plainly manifest in a great gun, and the consequence is that the bullet crosses the line of sight at a greater or less distance from the muzzle according to the disparity of thickness between the breech and muzzle. But if Mr Taylor imagines that the bullet, after discharge, is really deflected upwards, that is to say, rises above a prolongation of the axis of the bore, he is labouring under a great, though possibly a popular delusion. If Mr. Taylor will refer to "Rifle Exercises and Musketry Instruction," pp. 155 to 168, or to "Gunnery Instructions, Great Guns," pp. 32 to 35, he will find everything fully explained with diagrams which will soon disabuse his mind of such erroneous ideas. Either of the above books, price 1s., can be obtained from any bookseller who keeps military books. I observe that Mr. Taylor (letter 4250, page 279) states that he has by experiment satisfied himself about this upward deflection. I am curious to know the nature of his experiments, and strongly suspect he has been practising with the old "family blunderbuss," of whose capabilities I am willing to believe anything. T. S.

COLOURED SUNS.

[4394.]—In the article on Mr. Proctor's "Essays on Astronomy" (No. 376, p. 291), five misprints which occur in that volume are given. I find, also, an error in the essay on "Coloured Suns," reproduced in your No. 376, p. 297, where the components of that beautiful double star (Mirac) ε Boötis, are given as "nearly equal." Webb, in "Celestial Objects," gives the magnitudes as "3 and 7," which accords with Mr. Proctor in that useful little book for beginners, his "Half-hours with the Telescope," p. 60. The merest tyro with the telescope has only to examine them to discover that they are unequal.

We all know how easily errors creep into the most carefully-written book, and the wonder is how so few are found in Mr. Proctor's works, from the great number of papers which have emanated from his pen; as you truly say in the above article, "Scarcely are the sheets of one of his books dry from the press, when he is again before us with another." LINEA.

THE SUN.

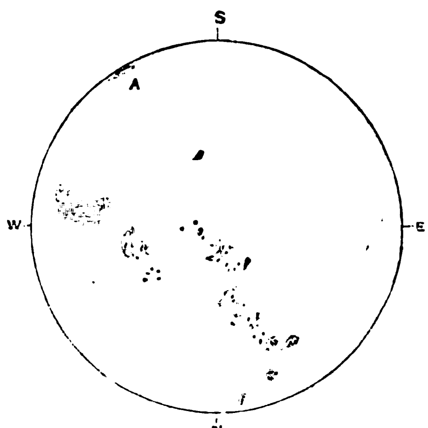
[4395.]—The faculæ observed on the sun on May 27, and of which I gave a description in letter 4284, p. 302, have given place to a large and scattered group of spots in their return at the opposite edge of the disc. Through continued bad weather I was prevented from seeing their first appearance, and even on June 8, doubtless the third day from their arrival, I was only for a few minutes enabled to observe them. The group is headed by a large and oval-shaped spot containing 6 (?) umbræ, followed by a confused mass of light penumbra. Round these are a quantity of small outlying fragments detached from them. The group is closed by a second and smaller oval spot also containing several umbræ.

The time which I was allowed for observation was too short to enable me to see much detail; but I could, however, distinguish that the neighbourhood of the group was still brilliant with luminous matter.

P. W. WYATT.

SUN SPOTS.

[4396.]—I beg to send you a sketch of the sun, taken June 9, 1872, 4.30 p.m. Greenwich mean time, with a 2in. achromatic, 90 diameters.



The three groups were very beautiful and well defined. The spot marked A was nearer to the edge of the disc than I have before seen one, in fact, it appeared like a rent in the usual sharp outline of the edge of the disc. T. H. F.

PIANOFORTE BELLYING AND BRACING.—II.

[3497.]—With regard to the thickness of soundboards, I may remark those constructed by different makers of good instruments vary considerably. Some makers prefer rather a thick belly, others a very thin one, rather stiffly barred. Probably, the latter affords the loudest sounds, especially while the instrument is new, and it is its tone—next to the beauty, *alias* gorgeousness, of its case—which sells the piano; occasionally, the purchaser also. Some men, like the Cremona fiddle-maker of old, work for posterity; they are content to sacrifice some power of sound, and to produce great present excellence, combined with durability, and the capability of improvement in the future. Such men make pianos with rather thick soundboards, others (who are disciples of the wise Irishman, who said, "Posterity never did anything for me, so I can't see why I should do anything for it") prefer making more noise in the world (or rather that their instruments shall), so they make pianos with thin bellies that their sounds may be as loud as possible at first, wisely leaving posterity to take care of itself. Probably, they are not far from being (commercially) right, thinking their instruments will last their time—at least, long enough for them to make their fortunes.

The thickness of soundboard ought, I think, to be in proportion to the hardness of the wood of which it is made, as well as in proportion to the weight and tension of the strings with which it is to be connected. Probably, the kind of wood employed is of far less importance than is generally supposed, but I believe good proportions to be of far greater importance than is generally known. I once saw a belly made of good beech wood, barely three-sixteenths of an inch thick, which yielded very pleasing and powerful sounds, and I have heard excellent pianos whose bellies were made of clean spruce deal, also others with American pine bellies. As a rule, the softer the wood, the thicker it should be. I think it would be preferable to make soundboards for trichord instruments a trifle thicker than for bichords, besides increasing the depth of the belly-bars for the former, and for very thick strings I opine the soundboard ought to be thicker than for thin strings, just as the soundboard of a harpischord, the middle C of which was of No. 6, or at most No. 8 wire, was made much thinner than the belly of a modern piano is, whose middle C is strung with from No. 17 to 19 wire. It should also be more stiffly barred because—supposing the down bearings, or rather the amount each string is deflected to remain the same—it is obvious three strings of the same length and thickness must press on the bridge with 50 per cent. more force than two can do, but, strange to say, many pianoforte makers use the same bellies for both bichord and trichord instruments, which may account for the trebles of so many of the latter being inferior to those with only two strings to each note.

The soundboard of the instrument represented by Fig. 1 (p. 618, No. 362) was to have been made of best Swiss pine for about half its height, three-tenths of an inch thick, for about the two upper octaves, and its thickness gradually reduced to two-tenths of an inch at the lowest bass. I don't think I can improve these proportions. The grain of the wood seems best horizontal, or nearly so, say at the angle of 90, with the strings of pitch C. Assuming this belly to have ten bars, I should make them of ⅞in. spruce deal, their sections 1¼in. by ⅞in., and taper them pretty regularly, not suddenly, as is commonly done, from beneath the bridge to their ends, which I should leave about two-tenths of an inch thick. The form of their top surfaces should be a circular arc, not two straight lines meeting at the bridge. As I before stated, I think it would be an improvement to introduce two more belly-bars in the high treble. If this be done, probably they would be quite rigid enough if made ¼in. shallower, but it is far preferable to err on the side of excessive stiffness, especially in the treble, because a weak soundboard is quite incompatible with fine quality of tone in that part of the compass. Should the belly be found on trial to be too stiff for the strings, the application of the chisel or a small thumb-plane to its bars will readily correct that fault. On the contrary, as I know from old experience, to my sorrow, it is far more difficult to correct weakness of the belly, in pianofortes, for this can only be done by the judicious employment of additional belly timber, applied either to the old bars to make them deeper, or to the belly itself in the form of additional bars, not very easily jointed to it.

With regard to the adjustable down-bearing of the strings on the solid metal bridge (on the wrest-plank) mentioned, I should have thought my remarks could only have been understood as referring to the bridge on the wrest-plank. A solid metal bridge is now often cheaply made by grooving the wooden bridge to fit and receive half the circumference of a brass—or what, perhaps, is preferable, a copper—wire, from three to four-twentieths of an inch diameter. To make the best possible job of this, the wire should have a flat (whose breadth is about half its diameter), filed on that part of its lower surface which is not imbedded in the wooden bridge. N.B.—This flat ought to extend up to the highest part of its circumference, so that the strings cannot possibly touch the wire bridge below its centre. The purpose of making this flat is to prevent the possibility of the strings chattering against the bridge below the centre of the latter. Unless this flat be made, they sometimes do so to an extent which (although, perhaps, not recognisable by the unpractised ear as chatter) is readily recognisable as impurity of tone. So the writer—who is a man of few words—hereby cautions an intending constructor to take the precaution to file this flat (which prevents what other flats are often guilty of) on his wire bridge, so that neither he nor the writer may be annoyed by what the latter detests—"mere chatter."

If this wire bridge be well fitted in its groove, and sunk therein about four-sevenths of its diameter, there is no risk of its coming out before the strings are put on; and, considering every one of them helps to press it down in its groove, it can't well come out of it after they are on. It may, however, be yet further secured by a few wire pins about one-twentieth diameter, driven through holes bored in it into the wood beneath it. Or, yet better, by a few staples which embrace it similarly driven. I prefer not trusting entirely to the carefulness of the workman—usually, rather a doubtful quantity—who "routs" out the groove for the wire; he may not "bed" it perfectly throughout it's length, so I think it preferable to divide it into pieces about 6in. long, and introduce into the groove a moderately thick coat of my "patent adamantine cement." See article on Bracing in No. 362. Before fixing the wire bridge, it is also desirable to subject it to pressure, by go-bars, or otherwise, until the cement has become hard; but as that pressure should be applied throughout its length pretty equally, not locally, which might bend it, a piece of thick wood ought to be interposed between the ends of the go-bars and the wire bridge.

I know no good reason, but only a very bad, if sufficient, reason, why the strings of a piano should not rest on, and be confined to the belly-bridge by the same means. If short pieces of half-round wire, each just long enough to support the strings of one note, be fixed on the belly-bridge, and a small wood screw—about ⅝in., No. 6—employed to deflect, or what would be far preferable, to clamp the strings on this short transverse wire, they might be firmly held to the bridge without deflecting them any more than is needful to give them the proper amount of down bearing, which, for very heavy strings, may be very small indeed—not more than 2 to 1½ per cent. of the tensile force at middle C, and below that note. I have repeatedly advocated this simple and cheap method of connecting piano strings with their belly-bridges, but the pianoforte manufacturers, who employ tuners, say the latter can't be trusted to slacken the clamping screws, which affix the strings to the bridge when it becomes necessary to "pull up" the piano, and that if this be neglected, they must needs "pull up" the bridge and the soundboard along with its strings. Probably, the pianoforte-makers are not far wrong. *Experientia docet*, they should know best how far tuners are to be trusted; but to an outsider like the writer, it seems no more than just that any tuner who neglected to slacken clamping screws ought to be "pulled up."

If it be preferred to cause the strings to bear firmly on the wire bridge, by deflecting, instead of clamping, them to it, which I think it generally would be, at least, on the wrest-plank, it may be done several ways. By far the cheapest, simplest, and most effectual method I have yet seen is that employed by our ingenious fellow-correspondent Mr. Schucht, which I now proceed to describe.

Mr. Schucht inserts a common rose or cheese-headed wood screw between the strings of each bichord note, and deflects them to any desired extent by turning the screw. No doubt, as he don't employ any washer or cross-bar, he rounds the edges of the under surface of its head, so that its original sharp edges may not injure the wire. Probably a metal, a hard leather, or a vulcanite cross-bar, with its lower surface which touches the strings rounded, or formed a segment of a cylinder, would be preferable to the employment of the naked screw-head; but, so long as its position remains unaltered, it cannot much matter. It is obvious that the lower the head of this screw is the more it must deflect downwards the strings which are supported on the wire bridge, so he thus obtains the "adjustable down bearing" very cheaply—in fact, you may increase it to your heart's content. By the same means, if a cylindrical-faced washer and two screws be employed, trichord notes may have their strings deflected—nay, this may be done effectually with only one rather stronger screw, say No. 10, if the washer be of metal, and long enough to press on the six strings of two adjacent notes. Sooth to say, this is the very method intended to be employed for all the trichord notes of the piano partly specified on p. 562, o. 360.

It must be obvious that this method might be applied to the strings of a piano throughout its compass to great advantage, instead of single or double pinning the wrestplank bridge and trusting to side bearings for determining the lengths of their vibrating portions, and keeping the strings firmly attached to their bridges; indeed, Messrs. Erard actually employ almost identical, but rather more costly, means in their pianos with upright strings. It might add a trifle to the cost of construction, but the instrument thus made would certainly be well worth the small additional expense it entails. There can be no difficulty in carrying it out when used for the single strings of the lowest bass notes for one screw, and a cross-bar or washer would as certainly deflect or clamp the strings of two such notes as it would the six strings of two adjacent trichord notes. No doubt this is but the old transverse pressure bar cut into short lengths, but the doing of this is attended by the advantage of not obstructing the putting on of new strings in lieu of broken ones, for they can just as easily be passed under the transverse washer as passed alongside a bridge pin.

I notice "T. C. L." represents the wooden brace in his drawing in No. 364, p. 665, with a portion of its material removed extending from the centre of its back nearly to its ends. May I request him to inform us the purpose of this? Certainly it cannot be to make the brace any stronger, for addition to, rather than subtraction from, its material would be required for hat purpose.

THE HARMONIOUS BLACKSMITH.

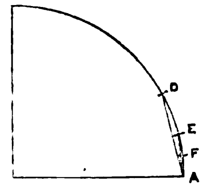
A WONDERFUL CRATER.

[1398.]—AT p. 95, of the second London edition of Tyndall's work, "Heat as a Mode of Motion," is the following note: "Professor William Thompson has recently raised a point which deserves the grave consideration of theoretic geologists. Suppose the constituents of the earth's crust to contract on cooling, solidifying, as the experiments thus far made indicate, a breaking in and sinking of the crust would assuredly follow its formation. Under these circumstances it is extremely difficult to conceive that a solid shell should be formed round a liquid nucleus." In reference to this matter I would say that, on this island there is an active volcano, in the crater pit of which I have seen phenomena that would certainly go to corroborate any experiments, the result of which would indicate a breaking in and sinking of the crust. Allow me to describe a wondrous scene. The crater of "Kilanea" is a huge black pit, the walls of which are 1,000ft. deep. Its diameter is three miles. The floor and walls are formed entirely of lava. In this gigantic laboratory of Nature I saw seven "lakes" of boiling lava—in its action as free as water. In the largest of the lakes the lava was rolled and tossed into waves just as is the ocean by the wind. Entranced, for hours I stood and watched the wondrous sight, the night being dark and fine. In the other lakes the agitation I have spoken of was absent—*i.e.*, the rolling and tossing into waves; there was some action, however, but not of anything like the same intensity. And now let me speak of what I especially desire to call attention to. Ever and anon the surfaces of these six lakes would cool, and as the heat radiated the brilliant red of the molten lava became less bright and the thin liquid state changed for one of rigid solidity. The lake, in fact, became crusted over by rock. This condition lasted but a few moments, the cooling and contracting proceeded so rapidly. What but a few seconds before was brilliantly red molten rock, was suddenly transformed into dark, black lava. This immediately cracked in a hundred directions. The crust broke up into innumerable pieces, toppled over, and sunk into the molten mass below. Again, it became a lake of liquid fire, only after a few moments to be crusted over as before, which incrustation in its turn cooled, cracked, and sunk. And so the process continued. When the surface cracked, the eye felt smitten with the vivid beauty of the scene—the intensity of the light streaming through the breaking lava with electric brilliancy.

Hawaii, April, 1872. C. F. HART.

GEOMETRICAL APPROXIMATION TO $\frac{\pi}{2}$.

[4399.]—YOU may, sir, think the following result worth communicating to your readers, if I state that, after careful study of the subject, I know of no *geometrical* approximation to the quadrature of the circle, combining in an equal degree simplicity of construction with an extraordinary degree of approximation. It is one result of a theory which I published some years ago, and with which I will not further trouble your readers.



Let A D B be a quadrant of a circle, A E D one-third of it; bisect the latter at E, and A F E at F; join A D, A E, A F, then shall the expression 17 A F $- 3\,AE + \frac{AF + 5\,AE + AD}{15}$, which, in the form given here, is of very easy geometrical construction, exceed in value the quadrant A D B by less than $\frac{\pi^8}{5040 \times 24^6}$, or one-1001840000th of it.

To form an idea of the degree of approximation thus obtained, imagine the construction applied to a quadrant ten million metres in length (equal to an earth-quadrant), and the error committed would be less than one centimetre, although the smallest chord used in the construction would exceed 800 kilometres in length.

Denoting the ratio of the chord of an angle α at centre to the radius by *chd.* α (which means simply that *chd.* $\alpha = 2 \sin. \frac{\alpha}{2}$), it follows that $17 \text{ chd. } \frac{\pi}{24} - 3 \text{ chd. } \frac{\pi}{12} + \frac{1}{15}\left(\text{chd. } \frac{\pi}{24} + 5 \text{ chd. } \frac{\pi}{12} + \text{chd. } \frac{\pi}{6}\right)$ exceeds $\frac{\pi}{2}$ by less than $\frac{1}{10^9}$ of its value. C. J. RECORDON.

SOME THOUGHTS ON THE DEFECTS IN HARMONIUMS.

[4400.]—THERE are a few little defects to be met with, and improvements wanted in the generality of cheap and even good harmoniums. If these defects were remedied and the improvements carried out, these instruments would be much more pleasing and popular than they are at present. The following are the most noticeable imperfections:—

1. The Reediness and Harshness of Tone.—The tone of the harmonium depends principally on the voicer; a good and proper quality of the brass for the reeds, and a suitable pressure and supply of wind are indispensable.

2. The Preponderance of the Bass.—This is a serious fault, in most instruments we find the bass is much too powerful for the treble. I think that the reason of this is, that if the bass reeds were made softer, they would be slow in speech. How often do we hear people say that the harmonium is so "noisy," or that it makes such an unpleasant "buzzy" sound; now, if a little more care were given to the reed work, these remarks would seldom be heard. If the tone of the instrument is bad it is not only offensive to the player, but also to the hearers, whereas, if the action is at fault the player only feels its effect.

3. The Forte Stops.—The utter uselessness of these stops in many instruments is very apparent. The principal object seems to be to increase the number of the knobs over the keys; in other words, for "display." I have seen and tried several instruments where they do not make the slightest alteration in the volume of sound.

4. The Sourdine.—This stop is for a somewhat similar purpose as the forte stops—viz., "display." The principle of it is bad, as the supply of wind to the reeds is of such a limited quantity as to prevent the full articulation of an ordinary four-note chord in the bass; and if the valve is opened enough to supply a chord of four notes, it becomes similar to the stop from which it borrows.

5. The footboards are frequently placed at a very inconvenient angle for the foot; this is easily remedied by lengthening or shortening the connection from the boards to the lever. The springs inside the feeders are often too strong, causing fatigue to the player.

6. The drawstop action is frequently noisy; the stops fly in with the least touch. If there were less play at the centres this would be remedied.

7. The Rest for the Music.—The want, and in many cases the utter absence, of a proper rest for the music is easily to be rectified, and it would conduce not a little to the comfort of the player; for what is more annoying than for the book to slip down on to the keys, or for the leaf to turn over in the middle of a page.

I next come to consider briefly a few improvements which might be introduced with good result in the cheap harmoniums, at a very little cost.

1. The shape of the cases might be much improved by letting the keys stand out (say) 6in. from the front of the case; this would bring the keys into a very convenient place for the performer, and would enable him to play without having to stretch so far. If the centre part of the lid were made to slant similar to a "secretaire," the shape would be much more elegant. Messrs. Mason and Hamlin have introduced some great improvements in the form of the cases in their American harmoniums.

2. The introduction of a wind indicator is a great boon to the player; it enables him to tell the quantity of wind in the reservoir. This contrivance is placed over the keys.

3. It is very desirable that in instruments where there are two or more sets of reeds, the tone of each set should vary. As a rule, the bourdon and clarionette stop (especially the bass) is much too heavy in comparison with the other stops. I think that the 16ft. stop should form the *third* set of reeds, and not the *second*, as is generally the case. If there is but one set of reeds in the instrument, of course it should be of 8ft. pitch; if there are two sets, they should be of 8ft. and 4ft. pitch, the latter voiced softly. This plan is carried out in the Mason and Hamlin harmoniums with good effect.

The drawing-room models by Alexandre, and the cabinet harmoniums by Mason and Hamlin, are very free from the defects I have noticed. The tone is very fine. The two-knee swell pedals in former are immense improvements, one is applied to the treble, and one to the bass. The swell in the Mason and Hamlin instrument has a fine crescendo, as nearly approaching the swell of the organ as possible; these instruments have castors on the bottom, on which they can easily be moved to different positions in a room. PNEUMATIC LEVER.

ANTS IN THE ISLE OF MAY.

[4401.]—As I have lately seen in your paper some correspondence about getting rid of ants, I think that it may interest many of your readers to hear that in the Isle of May, off the coast of Fifeshire, the whole soil is simply swarming with ants, of which there are, I believe, two kinds on the island, neither of which is common on the mainland. A short time ago a trip was made by some of the authorities, together with some scientific gentlemen, to try various methods of getting rid of this pest. Dilute carbolic acid was found to answer well in killing the ants, but, of course, the whole island could hardly be irrigated with this mixture. A suggestion was made, of a more practicable nature, to turn up the soil to the rain and frost of a winter, at the same time applying lime. I have not, however, yet heard whether any plan has been finally settled upon.

N. OR M.

FINDING INTERNAL RESISTANCE OF A BATTERY.

[4402.]—I SEND the following method of finding the internal resistance of a battery, which, as far as I am aware, has not yet been suggested, and which recommends itself from its simplicity and accuracy. If a battery be connected up in circuit with a galvanometer to any resistance R, and the deflection be observed, then if R be reduced in value to r, and at the same time a shunt S be adjusted between the poles of the battery b, until the deflection is the same as before, we have between the resistances the simple and readily proved algebraic relation $b : S :: R - r : r$. Hence, by a device, we may make $R = 2\,r$, in which case $R - r = r$, and therefore $B = S$. The following simple rule, therefore, presents itself by which the resistance of a battery may be at once found by simple inspection: Connect the battery up to any convenient resistance with a galvanometer in circuit, noting the deflection; then take out one-half the total resistance (if the resistance of galvanometer be comparatively small it may be neglected practically), which includes that of galvanometer, and adjust a shunt between the poles of the battery until the same deflection as before is given; then the resistance of the shunt equals that of the battery. One advantage of this plan is that being a null method (it being merely a question of equal deflections) any galvanometer, even one without an accurately graduated scale, suffices; also, no calculation is required—the operation may be performed in a few minutes. I have also practically proved the accuracy of the method by means of a Thomson's reflecting galvanometer and accurately adjusted resistance coils, the correctness of the principle being further checked by comparing discharges of a condenser connected first with the insulated pole of the battery, and, secondly, to the same pole after being connected to the resistance found, when the value of the throw of the needle in the latter case was ex[illegible] half that in the former. If any of your readers w[illegible] like the algebraic proof, I will send it for your [illegible] number.

S.[illegible]

BRANNAN'S SYSTEM OF MONOLITHIC BUILDING.—To "KHODA BUX" AND OTHERS INTERESTED THEREIN.

[4403.]—WHEN, about a year and a half ago, I put forth—in Nos. 291, 296, and 320 of the ENGLISH MECHANIC—my notions how carriage wheels, chairs, sashes, and other articles of utility might be cheaply constructed by forming their skeletons of steel wire, placing them in metal moulds—which might be heated to any temperature found desirable—filling up some of the interstices with fibrous materials, and then cementing the said materials and wire skeletons into single masses, whose forms are those of chairs or wheels, which would, for all practical purposes, be without any joints (and joints, however carefully made, almost certainly yield to the strains chairs and wheels are subjected to in ordinary use), I only published an idea which had long been familiar (at least to myself), for the method of construction I suggested is but a modification of the manner in which articles have been constructed in *papier-mâché*. Certainly I had no thought that my suggested application of that old principle, on which all mill boards and papers are made, deserved to be termed an invention in the sense of being sufficiently novel to be the subject of maintainable patent right, although it must be admitted it was—to the best of my knowledge—a novel application of old and familiar means to the cheap production of many articles of domestic utility and personal comfort which, when thus made, would be almost everlasting. I may remark, *en passant*, that this kind of furniture might be made in the most elegant forms—a thing of beauty is said to be a joy for ever—which our æsthetic taste, or the want of it, is capable of designing, for as little, or even less, cost, than the usual cost for which our ordinarily very ugly furniture is now produced. That some younger man, with more energy and enterprise than a life of labour—at least of brain work—has left in the writer, will in time improve on and work out his idea—probably with great commercial profit to himself and, he hopes, with some social benefit to his fellow-humans—the writer feels a confident hope. He, however, never anticipated the application of wire skeleton-framing to the construction of the walls, floors, stairs, and roofs of houses, although this really bears about the same relation to its employment for chairs, &c., as the door-mat is popularly said to be to the doorstep; it being, in truth, but a step farther in the same direction. Now, I am glad to find this "stepfather" has been taken by Mr. P. Brannan, C.E., who constructs not only the walls of houses on this system, but also their internal and external stairs, their sashes, floors, doors, roofs, and even their architectural ornamentation on this same principle.

In Mr. Brannan's system the floors, instead of being supported on beams or joists (which can only resist pressure and percussion by their strength and rigidity, the latter depending, *cæteris paribus*, on their depth) are, if I rightly understand, simply a network of wire filled in by concrete, which resists those forces by its tenacity. To obtain sufficient rigidity the thickness of the floors is increased far beyond what is necessary for mere strength. They are yet, however, but from one-fourth to one-third as thick as wooden floors and ceilings of the same area. So remarkably rigid and tough are the floors he constructs that one only seven weeks old, measuring 14ft. × 10ft. (which was supported on but three of its sides, it being attached to walls on three sides only and one side left without any support) only communicated a slight jar to the hand held against its under surface when an anvil, weighing about 2cwt., was suffered to fall on it from the height of about 2ft. This is a trial few cottage-floors may I not say few of those of even high-class houses—would bear without a dangerous amount of vibration being induced. After this *experimentum crucis* a large wood fire, which well-nigh filled the room, was lighted on this floor (whose flames played against the ceiling) and kept alight for more than two hours, but, the materials of this house being quite uninflammable, no damage was done excepting that the steam generated caused some flaking off of portions of the new ceiling which had been plastered too recently to have become dry. The floor and walls, so far from being damaged, were rather improved by this not very gentle experiment, they being semi-vitrified.

As I before stated, I fully expect chairs, wheels, &c., constructed on my system would come out at a much lower cost than those made of pieces in the usual manner, because those pieces of wood must be cut out of timber previously sawn into planks with much waste of labour and material, besides which, their jointing, carving, smoothing, finishing, and polishing by hand is necessarily expensive, and likely, from that general rise of wages which now prevails, to become yet more so. Now a chair or wheel, literally *cast* in a smooth metal mould, could at most only require the two latter operations—perhaps only its polishing done by handwork to prepare it for use; and if this be the case with chairs, doubtless Mr. Brannan's moulded sashes, chimney-pieces, and doors may be produced at comparatively little cost by the same means. Like my chairs and wheels, they could hardly tumble to pieces, seeing they are not formed of pieces, but in one piece only. In fact, as he expresses it, perfectly monolithic, like the houses he constructs.

With regard to the cost of the latter, we may expect—from their cheapness and the comparatively small quantity of materials required for walls of given strength—it to be low. He states it to vary from 15 to 40 per cent. less than that of building with brick and timber, according to local facilities for procuring materials; he also says no "skilled" labour, using that word in its ordinary sense, is needed for building walls, &c. Sure-ly, as my correct cockney friends pronounce the word, something like this must eventually be a boon to us of the "great middle middle" class, who find our families, rents, and "income tax" so heavy; not to mention that if three labourers' cottages, enormously more durable and of a quality vastly superior in sanitary qualities to the hovels they now—I was going to write live—well, exist in, can be erected for perhaps rather less than two of such "suburban villas" now cost, we may hope to effect both sanitary and some moral reform also, for then our agricultural population need hardly continue to rival their pigs in the matter of sleeping "accommodation." In other words, the young (human) pigs might "enjoy" a separate dormitory, and no longer "pig in" along with their remarkably "moral" piggish parents.

I am informed some erections on this system have been made on this system at Bell Busk Village, Edmonton, and some others near Bow (where eighty houses have been commenced), an extensive reservoir near Durham, and a large villa near Sunderland. It is also intended to build about thirty houses on this system at Islington, so we have, or shall soon have, ample means of testing its work, although I think "it stands to reason," as the ladies say, that a wall or floor in which the tensile strength of iron or steel wire is employed to resist force must needs be much stronger than one which depends for its power of resistance on the tensile strength (query weakness) of mortar.

THE HARMONIOUS BLACKSMITH.

P.S.—May I request the favour of "Khoda Bux's" opinion on this method of monolithic construction; also the criticisms of others of my fellow readers who "knaw zummat aboot" building, which is, alas, a very expensive luxury, when our notions are carried out for us by architects and builders who only know how to employ stone, or brick and timber, in their constructions, some of which—even when in the desired form of suburban villas—are not quite so tough as wire, or even so strong as first-class concrete, without wire ties, not to mention that, being extremely inflammable, they are occasionally burned, and have to be insured, which adds something to their cost, and also, of course, to the rent we have to pay for the privilege of inhabiting them, besides which, I have found the keeping of ordinary houses in repair cost just a "little something" of money.

USEFUL AND SCIENTIFIC NOTES.

Distillation of Wood.—Mr. Watson Smith gives the result of his experience in the distillation of wood, principally oak, on the large scale, as follows:—Using retorts from 6ft. to 7ft. long and from 3ft. to 3½ft. in diameter, which were charged every morning, the distilling operation lasted eleven hours; using old oak timber, cut in pieces 2ft. to 2½ft. long by 3in. or 4in. square, the yield was, of charcoal 327 parts, of wood-acid 509 parts, and of tar 55 parts from a thousand of wood. To carbonise a ton of wood required 10½ cwt. of coal. The wood-acid has a specific gravity of from 1·025 to 1·027, and contained acetic acid in the proportion of 20 parts for each 1000 parts of wood distilled. Of wood-spirit, 1000 parts of wood yielded from 56½ to 85 parts. This, after two rectifications from lime, constitutes the wood-naphtha of commerce with a specific gravity of 0·880.

Continuous Battery. — In the cell contrived by Herr Kohlfurst the negative plate is formed of a truncated hollow cone of copper, closed at the top. The inside of the cone being protected with varnish, it is filled with sulphate of copper in crystals and inverted in a glass vessel deeper than itself. The cone is notched around the rim, and the apex is pierced with a small hole. For the positive element, a thick cake of zinc is used (suspended over the face of the cone); it has a hole in the centre, through which is passed a covered wire connecting with the copper. The glass cylinder is then filled with water, and the sulphate of copper begins to melt, the rapidity of the deliquescence varying with the access of the water through the notches in the cone; and so long as this latter maintains a uniform rate, the current will be uniform in power. If common or Epsom salt be used in the water, the current will be intensified. The inventor states that 1½ pounds of the copper salt will continue the battery in operation for a year.

A Pretty Parlour Ornament.—An interesting ornament for the sitting-room or parlour may be easily obtained by growing one of the club moss tribe under a glass shade. Procure an ordinary glass shade, such as are used to protect small vases and other articles, and of any size that offers—also a china dish that is two or three inches deep, or a common flower-seed pan. Fill the latter with light soil, as vegetable mould or sand, and get from a nurseryman or florist a plant of one of the common varieties of club moss—place this on the soil in the pan, and then the glass shade over it, pressing it down a little into the soil. The earth being kept moist, this moss will grow rapidly, and will climb up and fill the inside of the glass. It requires to be kept in a window near the light, and soon becomes a pleasing object from the delicate texture and form of its ramifications. Although the moss requires to have a constantly moist atmosphere within the glass, yet it takes but little water, because the evaporation from the soil condenses on the inner surface of the glass shade, and descends in the form of water down it again. The shade should never be taken off. When the water is needed, a small quantity may be poured between the outside of the shade and the side of the pan, which will find its way under the edge of the glass to the earth which is inside.—*Cor. Country Gentleman.*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10478.]—**Pork Diet.**—In the first place, I ask "Sarah" seriously is she playing a joke with her fellow correspondents? if so let her refrain from doing so again. I might partly believe her about shell-fish, which I never eat, not that I think them unfit for human consumption, but do not like them. What cause has "Sarah" to imagine that the meat of the pig is not fit to eat? Perhaps because the Jews do not eat it, or perhaps because the pig is a dirty animal; and why does she consider rabbits also unfit to eat? Why does she not include the hare, which tastes much the same as the rabbit? I hope "Sarah" will bring forward some proofs evident of the unfitness of pork and rabbit meat and shell-fish for human consumption. I hope there will be many letters on this subject, at the same time hoping my letter may find room in the widely circulated ENGLISH MECHANIC.—A. H. COOKE, Cologne, Prussia.

[10661.]—**Angle of Reflection and Incidence.**—With all due deference to "F. N.," I think "Billiardist" has established his theory (p. 100). Will our kind correspondent oblige me with the details of the experiments of M. Athanase Dupré with balls suspended by threads, striking each other horizontally?—JACK THE FLUKE-MAN.

[11378.]—**Stings of Bees.**—Amongst the various cures for stings, I have not seen the leaf of the common dock mentioned. Now this I have always found very effectual. As boys we used to say a nettle sting did not matter, as where nettles grew we were sure to find docks to cure the sting at once. And so with wasps, &c. Some time ago a wasp stung me in the neck when I was out; I got a leaf of dock and applied it and felt no more. When stung take care the sting is not left in. Bruise a fresh dock leaf and rub it on the place.—E. T. S.

[11554.]—**Pedestrian Tour.**—"Hedera" asks me if canvas shoes will stand a walk through wet grass, or a ford across a stream. The canvas lets the water in, but some do not object to that if they have dry stockings to change and slippers. I soak into mine a preparation of oil, wax, and lamp-black, used for rendering leather shoes soft and waterproof, and my feet keep as dry in my canvas shoes as in my leather ones. Stockings are more frequently made damp by perspiration than by water from the outside. My canvas shoes have triangular pieces of elastic at the side. "Hedera" is quite right in preferring flannel to linen shirts, or even to cotton or merino, any of which are preferable to linen for a pedestrian. He may, if he likes, wear a linen front, but a linen shirt will probably give him a cold.—PHILO.

[11564.] — **Blackberry and Strawberry.**—"E. L. G.," on p. 307, speaks of the red raspberry being produced from seeds obtained from a barrow skeleton. I can inform him that in the neighbourhood of King Alfred's Tower, visible from the railway between Salisbury and Templecombe junction, near Wincanton, Wiltshire, this kind of raspberry grows abundantly, as also a wild strawberry of good flavour. The locality is reputed to be the scene of a great battle between the famous Saxon King and the Danes, who suffered a defeat on the slope of the hill, where the slain were buried in great trenches. When travelling between Keswick and Penrith, just after rising the hill beyond Greta Bridge, I once enjoyed a banquet of raspberries growing wild in a large patch of bushes on the wide open road, and apparently indigenous.—P. FRANCE.

[11589.]—**Dry Steam.**—I do not think that either "Caloric" or "E. L. G." understand my position correctly, so I will endeavour to explain more fully. If we take a boiler with steam at 8lb. per inch and pass that steam through tubes in a furnace, it becomes what is popularly called superheated, but what I term higher pressure steam; and if the communication is open to the atmosphere, it will fly out, because of the pressure above that atmosphere in the boiler; but if we close the valve it will rush into the boiler, but will produce little, if any, increase in the pressure, because the area of boiler is so much greater than the surface of pipes, and the loss by radiation so great, added to which the diminishing power of conducting heat due to its smaller quantity of water in a given volume prevents its being generated sufficiently rapid to counterbalance these losses. Let me ask "Caloric" to put some water in a pipe and stick in the fire (having previously effected a policy upon his life in favour of next of kin), does he imagine that when all the water was converted into steam, he could go on increasing the heat without also increasing the pressure? As for "E. L. G." he carps at terms, but evades my statement, that in a given volume of low pressure steam there is more water than in the same volume of high pressure steam. If he places his hand in the steam issuing from a high pressure boiler he will find that it is very hot, but being a bad conductor, owing to the small quantity of water contained in it, it does not burn like the low pressure does. Although well aware that the temperature is lowered as the steam escapes into the atmosphere, I have not observed any considerable blocks of ice about the safety valves of high pressure engines lately.—A., Liverpool.

[11632.]—**Debility.**—Noticing a few remarks made by Charles Rooke upon the above subject, on p. 308, I beg leave to ask him if he can put some of us in the way of curing indigestion, arising from the above complaint. I have suffered more or less from it for years, and have tried nearly everything, but I think hydropathy did me more good than anything. I only tried home treatment, and now it seems to lose its effect upon my system—I suppose from continued treatment. I am now trying cold baths upon rising (5.30), and take a glass of cold water, and at bed time every other night two pills, composed of 1 part quinine (sulphate), 1 part sarsparilla (extract), and 2 parts of a root that comes from Susquehanna, but I cannot pronounce a judgment upon them yet. If Charles Rooke would give me a few hints he would greatly oblige.—AROMA.

[11656.]—**Boiler for Small Steamboat.**—I stated the dimensions of the boat as 21ft. × 7ft.; it should have been 21ft. length and 4ft. beam.—W. SHEPHERD.

[11656.]—**Boiler for Small Steamboat.**—In the boat you have mentioned the tonnage by the old builders' way of reckoning is about 8¾ tons. In the best examples of modern steamships, both large and small, the proportion of indicated power to the tonnage ranges from 1 to 3 to 1 to 6. Now, in the design I have given I have the nominal power as 2 and tonnage 8¾, so that the ratio is 1 to 4½, about. But I stated that the engine would develop probably 3 or 4 horse-power, so the ratio would be as 1 : 2, which would produce a very fast steamer indeed, probably about five knots an hour. This would be a satisfactory performance for so small a vessel. Mr. Shepherd is quite right in his surmise about the error. It must have been a slip of the pen. As for the double eccentrics, they are for link motion with an elevation. I could not show the link. Where the two rods appear to meet is their junction, one with one end of the link and the other with the other. If there is any difficulty about any detail I will send another drawing. In the drawing I did not go into any detail of the engine, because from the wording of the query I thought that it was only a secondary feature. That was how I omitted to shew the fly-wheel. This should be solid to save room. It should weigh 2cwt., or 1cwt. might do if pinched for space. A governor might be used with great advantage, but in so small a vessel it is questionable whether the extra room, weight, and attention, that it would require would not overweigh all its advantages.—P. W. H. J.

[11663.]—**Steam Power.**—I must claim the pardon of "T. W. J." for not replying to his question sooner. The reason is this, I appear to have lost the number in which his query appeared, and I have forgotten the substance of it. As far as I see, there ought to be four brass tubes ¼in. or ⅜in. diam., ordinary brass or copper pipe. When I used to make models, I tested the boilers in this manner. I got a small brass boiler about 1½in. diam., and 1¼in. high. In the centre of this I drilled a ⅜in. hole, and tapped it. I then screwed a pipe firmly into it, 3in. long. I also screwed another ⅜in. pipe near the top for the supply. From an optician I bought 5ft. of glass tubing that would just fit inside the brass tube; this is then made steam tight with red lead. From a joiner's I obtained a piece of mahogany 5ft. 6in. long, and 2½in. wide, and made a groove along it for the glass tube to fit in, and likewise made an excavation for the small brass reservoir to fit in, to be level with the glass tube. Every 20in. I drove into the wood clasps made of wire to secure the tubing in its bed. I also had two clasps for the reservoir; I then got two strips of paper 1in. wide, and pasted them on each side of the glass tube on the mahogany. On one side I divided it into inches, and every 2in. reckon as 1lb. pressure. On the other side was marked the temperature corresponding to that pressure. The reservoir is to be filled with mercury. It will then test boilers up to 30lb., which is as far as models generally go. The way that I used to do was this—I connected pressure gauge by union joint to boiler, and the boiler with the water tap, which had generally sufficient pressure for my purpose. This is a safer way than testing by safety valve, but would hardly be worth while if the inquirer had not a number to be tested. The model makers sell very fair got-up pressure gauges as regards appearance, but I never heard any one who had one, and who was practically acquainted with its working—which, by the way, with these amateurs is another thing—speak well of them. They may be regarded as wonders if they are correct to 10lb. The fact is, they are got up so cheaply—that is to say, considering the rate at which most opticians charge—that they can't apply first-class labour to them. In the "bent-tube principle," which is *the* form, the tube requires a deal of experience in its manufacture. If there is the slightest variance in its composition, a good maker would throw it aside, but not so these knowing opticians. If they bend a common brass tube, it is almost enough for them. From experience they know that the general run of amateurs buy things to look at, or be put under a glass shade, or be worked only once or twice a year. I would advise "T. W. J," not to have a pressure gauge at all, to be a permanent fixture. If studying appearance, make one of wood nicely painted. For models rely upon the safety valve, and that only; model pressure gauges, which are model in every sense but the right one, only give a sense of false security.—P. W. H. J.

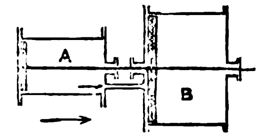
[11711.]—**Time at our Antipodes.**—For the last word, "same," I should have written "third."—E. L. G.

[11711.]—**Time at our Antipodes.**—In an American atlas, called "Johnson's Family Atlas," I find that both the maps of the world, bicyclar and Mercator's, have a dotted line seemingly intended to mark the boundary "between Sunday and Monday," that has so puzzled your querists. But it only extends from 40° N. to 50° S., leaving it doubtful which of the Aleutian Isles, and those about Behring Strait, follow the American or Asiatic day date. It starts from 40° N., in 160° W. from Greenwich, and takes a SE. course to the equator, which it meets in 108° W., or thereabout, and then southward along that meridian, whereon no land is known to exist between California and the South Pole. The nearest islands it leaves as American, beginning at the N., are I. de Paxaros, Copper I. (very near), Gallego I., and Sal-y-Gomez (called Salas on some maps). These it leaves on the Asiatic side. Proceeding northward, are Easter I., Waihou (the nearest), St. Paul's, "American Group," Mellish's, and Donna Maria Laxara. It would seem that what Mr. Birt calls the "absolute day" must begin when Waihou Island (about 109° W. of Greenwich) begins to call it day (whether at midnight or sunrise). But what a pity that "Easter Island" is a few miles behind it! Could not these two islands exchange names? or could not Waihou become Sunrise I., or Dagmar, or Dayspring? This is 16h. 40m., at least, before the day of the same name begins at Greenwich, and the date continues to be used till the sun has set, and midnight been reckoned by the westernmost habitation (or place ever to be inhabited) in Alaska that the Russians have lately sold to Jonathan, say Cape Prince of Wales, about 167° W.—that is more than 11h. after Greenwich has begun the next day, or 35h. after it began to use the same date, and 51h. 40m. after Waihou Island did so. Consequently, there can be no moment when (as Mr. Birt fancies) it is Tuesday all over the globe. For 3⅓h., between Waihoo midnight and Behring midnight, it is Monday, Tuesday, and Wednesday at different places. For the remaining 20⅔h., it is but two days, always two, because whatever day it be at Sal-y-Gomez I., it is the succeeding day at Easter I., about 100 miles west, and when it is about 1 a.m. of both (the former calling it Tuesday and the latter Wednesday), it is still Monday evening to the whole of California, Oregon, Vancouver, Sitka, Queen Charlotte's I., and Alaska (whenever it shall have settlers).—E. L. G.

[11746.]—**Coil Construction (U.Q.).**—All the power "Zeta" will get out of his coil will not be much, but he can increase the effects by using a stronger battery.—W. BOLTON.

[11787.]—**Electric Signal Bell (U.Q.).**—As this has appeared in the list of unanswered queries, I take the liberty of answering it as well as I am able, although addressed to Mr. Tonkes. "H. G. N.'s" magnet is probably not made of soft iron, and therefore retains its magnetism. I am afraid this could not be remedied without getting a new core for the magnet. I take this opportunity of thanking Mr. Bottone for his reply to my query about the brass springs.—GLATTON.

[11792.]—**Compound Engines.**—The proportion between the areas of high and low pressure cylinders in compound engines varies with the pressure and distribution of the steam. Some makers employ one proportion, others another, thus, in the engines of the *Elbe*, one of the P. and O. boats, the diameters of the cylinders are, high pressure, 42in.; low pressure, 68in.; or areas as 1 : 2, nearly; whilst in those of the *Sir Bevis*, of the Union Company, the diameters are 26in. high pressure, and 52in. low pressure, or areas as 1 : 4. With regard to the steam receiver, my advice is don't employ one at all. If a compound engine is indispensable, exhaust as direct as possible from the high to the low pressure, and also exhaust into the condenser from both high and low pressure. The receiver is not only useless, but wasteful, the steam in passing from the high pressure into the receiver must expand, or there would be no motion, and during this expansion it loses so much power of performing work. This is seen in the space between the diagrams of compound engines, indicating the pressure not utilised when passing between the cylinders. I will illustrate roughly the principle that has been applied with advantage, without employing an intermediate receiver. Suppose the engine to be horizontal; A, high pressure cylinder; B, low pressure cylinder. The engine is about to make a stroke in the direction of the arrow. A is filled with steam that has propelled the piston of its cylinder in the opposite direction. At the commencement and (say) during one-half the stroke, A exhausts direct into B. The communication between A and B is now closed, and A is opened to the condenser. The steam in B is expanding works till the end of the stroke if desirable; it is then exhausted into the condenser, &c. But why will "Falstaff" employ compound engines? They are by far more expensive to construct than single high pressure condensing engines, and it is exceedingly doubtful whether they are so economical. Did "Falstaff" see an account of the trials between the *Swinger* and *Goshawk* at Plymouth on Saturday fortnight (*vide Engineer* or *Engineering* two weeks back), the one employing compound, and the other simple engines? If not, let me tell him the result was by no means in favour of the compound system.—C. E. STEWART.



[11801.]—**Question in Trigonometry.**—In answer to the queries of "Triangle" and "Theodolite," I have much pleasure in stating that both the construction and calculation are adapted to the general problem, whatever be the values of the angles about P. Provided that it is situated within the triangle on which all its angles will be = 360°, only the triangles must be isosceles, with the angles at their vertex = supplement of their opposite angles at P, from the centre of which describe circles through A B C, the point of whose intersection will still determine the point P, as in the present instance. Through a blur in the printing I mistook 1044 for 1040, and calculated as such, which will account for the small discrepancies between the solutions. Those of "Triangle" and "F. M." are right. "F. M.'s" solution would only be applicable when all their angles were 120°. The following, perhaps, is as concise and elegant solution as the particular case mentioned admits, but not applicable to the general problem of different angles about P. Thus, the construction and figure as before, since sin. A P B : A B sin. A B P : A P, and sin. A P C : A C sin. A C P : A P. Then A B : A C sin. A B P : : sin. A C P. Also

$$AB + AC : AB - AC :: \tan. \frac{ABP + ACP}{2} : \frac{ABP - ACP}{2};\ \text{but } ABP + ACP = 120^\circ - BAC.$$

Whence, calculating B A C = 51° 57′ 26·4″ = A B P + A C P = 68° 2′ 33·6″, A B P − A C P = 2° 57′ 24·2″, A C P = 35° 29′ 58·9″, A B P = 32° 32′ 34·7″, and A P = 700·0363, B P = 600·0297, and C P = 499·9216.—W. H.

[11825.]—**Testing Bleaching Powder.**—According to the researches of Kolbe (Ann. de Chim. et de Phys., 1867), bleaching powder contains water as an essential ingredient, and a carefully prepared specimen gave numbers corresponding to the formula

$$(Ca'')_3H_6O_6Cl_4.$$

Theory: Chlorine, 39·; lime, 46·2; water, 14·8.

Muspratt also found water as an essential ingredient, but places the theoretical amount of chlorine at 48·9 per cent.; but he says "the best commercial product rarely exceeds 36 per cent., and generally averages 30 to 33 per cent." The general average found by the writer, on testing some hundreds of casks by different makers, was 33 per cent., and rarely fell under 30 per cent. The bleaching powders examined by S. Bottone must have been very inferior if they yielded only 20 per cent. of available chlorine. His method of testing bleaching powder is valueless.—BRIDGETON.

[11825.]—**Testing Bleaching Powder.**—Mr. S. Bottone's reply to this query is calculated to mislead. He says that he has never found a sample of bleaching powder to contain more than 20 per cent. available chlorine. Permit me to state that a good commercial article contains 35 per cent., analyse it which way you will. I have analysed hundreds of samples, and reject all below that mark.—ANALYST.

[11825.]—**Testing Bleaching Powder.**—On the appearance of this query I meant to have replied, giving the arsenious acid method, but was unable to do so in consequence of a pressure of business. However, I find that the subject has been ably taken up by two correspondents. My object in writing is to disabuse Mr. S. Bottone's mind on the strength of commercial bleaching powder, and also the theoretical quantity of available chlorine contained in it from the formula given by him $\left(Ca \begin{cases} Cl \\ OCl \end{cases}\right)$. He asks "Ethyl" where he obtained samples of chloride of lime containing 35 per cent. available chlorine. The writer is in works where 120 tons are manufactured weekly, and can assure him that 98 per cent. of it tests from 35 to 37 per cent. available chlorine as it leaves the works; if under, buyers refuse it. I will forward him a sample provided he pays carriage. As regards the theoretical quantity of available chlorine being less than 35 per cent., I beg to remind him that from his formula of chloride of lime, I find it to contain 71·7 per cent. The two atoms of chlorine are available to the consumer when acted upon by sulphuric acid. (See Fresenius' "Chemistry," fourth edition, page 603). We take CaO, ClO, CaCl + 2HO as the symbol of chloride of lime, which gives 48·96 per cent. available chlorine. You will observe that we take two atoms of water over and above that which Fresenius gives, as it requires the lime to be in a state of hydrate to form bleaching powder.—A PRACTICAL CHEMIST.

[11826.]—**Tinning and Soldering.**—"A., Liverpool" (page 309, No. 376), recommends resin for soldering lead and zinc. I have been 24 years in the trade, and find resin and grease is best for lead (it can be wiped off when hot), muriatic acid for zinc. Any amateur will do best to keep chloride of zinc corked up in a bottle (best known in the trade as killed spirits), that will suit any purpose he may want. Tin, zinc, brass, copper, Britannia metal, wrought iron, and even cast iron with a little trouble.—TOM THE TINKER.

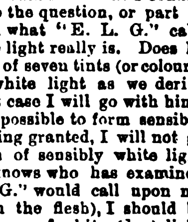
[11826.]—**Tinning and Soldering.**—I have to apologise to "W. T. M. D." for inconsiderately controverting his statement that "clear water will remove the stickiness of the hands caused by using chloride of zinc," as I find now that if there has been no oily or greasy contamination used in conjunction, that this peculiar sensation can be removed by washing the hands in plain water.—A., Liverpool.

[11842.]—**Indiarubber Gig Apron.**—I suppose no one has answered this query, because no one knows how easily to prevent an indiarubber apron from sticking together when sat upon. The only way to do it is to cover the indiarubber surface with some powder—such as French chalk or silex—or keep it thoroughly wet with water. These articles are not meant to sit upon; but if you must sit upon it, *don't* try oil to prevent it sticking.—Saul Rymea.

[11855.]—**Hygrometer Motive Power.**—Hair, catgut, and ordinary string are the substances usually employed in the so-called hygrometers, which are nothing more than hygro*scopes*; that is, they indicate when the air is moist (some little time after it has become so, though), but do not measure the amount of the moisture.—Saul Rymea.

[11875.]—**Spectrum Colours.**—The remarks of "E. L. G.," in criticism upon my reply to "Utile Dulci," are not intelligible to me as a criticism. A careless glance at my reply would show that I confine myself to a simple answer to the question, or part of it. I don't quite understand what "E. L. G." calls white light, or what his white light really is. Does he mean to say that the mixture of seven tints (or colours) will not produce the same white light as we derive (say) from the sun? In this case I will go with him; but if he means that it is impossible to form sensibly white light, pure pigments being granted, I will not go with him. The composition of sensibly white light differs widely, as every one knows who has examined into the matter. If "E. L. G." would call upon me if he happen to be nigh (in the flesh), I should be happy to show him that a beam of white (day) light may be passed through white substances, and although sensibly unaltered, so far as regards ordinary vision, shall yet have the larger proportion of its colours extinguished, as shown by the presence of innumerable black bands in its spectrum. Of how many colours that white light which I would show him was composed, I would leave him to discover, but I would convince him, at any rate, that the presence or absence of a large proportion of the different waves does not sensibly affect the whiteness of the light, provided the withdrawal of the different colours will be according to a well-defined law of proportion. At the risk of "catching it," I "make these few remarks."—H. P. H.

[11891.]—**Contents of Cistern.**—This query has been badly treated. If the arc cannot be referred to a circle, the area of section could be found by the method of "Equidistant Ordinates," as given by Chambers, Elliot, and other writers on "Practical Mathematics." In the case of a circular segment, having ascertained whether the segment be greater or less than a semicircle, the following method may, perhaps, satisfy the querist:—To make the matter as plain as possible, an example in numbers may be necessary. Referring to diagram, having given the chord DE = 16, and versed sine AC = 0, to find the area of the segment DAE. Eucl. 1·47, $DC^2 + AC^2 = AD^2$, or AD (chord of half the arc) = 10. By the rules of Mensuration, arc DAE = $\frac{1}{3}$ (8AD − DE) = $21\frac{1}{3}$ nearly. Euclid III. 35. AC × CB = DC × CE, or CB = (DC × CE) ÷ AC = $10\frac{2}{3}$. AB = AC + CB = $16\frac{2}{3}$. Hence radius DF or AF = $8\frac{1}{3}$. AF − AC = $2\frac{1}{3}$. The area of the segment will, therefore, be (approximately) $\frac{1}{2}$ (DAE × AF − DE × CF) = $70^2/_9$. This for the lesser segment. The area of the greater segment DBE = 218·16 − $70^2/_9$ = $147^{17}/_{18}$ nearly. Taking the lesser segment to illustrate the method, it only remains to multiply the area of the segment by the depth of the vessel, and for gallons, to divide the product by the capacity of a gallon. Taking the area of segment = $70^2/_9$ square inches, and depth of vessel = 4ft, the contents in gallons would be $70^2/_9$ × 48 ÷ 277·274 = 12·1564 + gallons. Now, to show the fallacy of "C. B.'s" rule, take the above example as an illustration. The rule, as given, may be expressed thus $(3(\text{radius})^2 + \text{height}^2) \times \cdot 5236 \times$ depth ÷ 277·274 = gallons. Or $(3(8\frac{1}{3})^2 + 6^2) \cdot 5236$ × depth ÷ 277·274. Or 127·93293 (area of segment) × depth ÷ 277·274 = contents in gallons. But the area of this segment has been shown to be $70^2/_9$ nearly, while "C. B.'s" rule gives 127·93293 for the area of the same segment.—Jas. Hastie.



[11924.]—**To Millers.**—In the last issue of "ours," at p. 310, three correspondents have answered this query; but, as I think, erroneously. Each size of stone, from 3ft. 8in. to 4ft. 8in., has its peculiar advantages as well as disadvantages; a 4ft. stone is, undoubtedly, a good useful size, but it is not necessarily the most powerful. Your correspondents seem unaware that the 3ft. 8in. is fast coming into use, and assuming their point of reasoning (if mere assertion can be so called), the latter size must perforce of necessity be the most powerful. There can, however, be little doubt that small stones will eventually supersede the large; they are lighter to move, occupy less space, and their first cost is much less—three most important points; they also occupy much less time in dressing. The dress will, not, however, last so long, and they must be driven at higher speed, consequently the saving in driving power consumed is very questionable, although the dead weight of stone is less; they will, however, do a good share of work. A good speed for a 3ft. 8in. stone is about 120 revolutions per minute; 4ft., 100 revolutions per minute; 4ft. 6in., 80 revolutions per minute. This produces a speed at the skirt (the real point in question) of about 1350ft., 1220ft., and 1100ft. per minute. Under these conditions, all things else being equal, the powers are so nearly equal that there is scarcely a choice between; but it nearly all depends upon three conditions—viz., the quality of the stone, the dressing, and the condition of the grain; some grain will bear double, or even more, speed than others, and a judicious foreman in a large manufactory will ever endeavour to suit his different classes of grain to the nature of the stones. In small country mills, where this is not possible, we overcome the difficulty by speed and dress, damp tender grain working best in a free open stone driven slowly. Where the grain is dry and strong, the stone rather fine-grained and hard, the speed may be raised almost indefinitely. It is sheer nonsense to talk of a large stone being more likely to heat the meal and kill the flour than a smaller one; the fault lies in the workman, not in the stone. Drive gently, feed lightly, and you never need fear doing mischief to your goods. A general fault amongst millers is over-driving and over-feeding. As a matter of simple opinion, I greatly prefer a large stone for real excellence of work; the time revolutions being slower, the grain is less lacerated on entering the stone, owing to the low speed at the eye, consequently, the grain is crushed more, and less torn, and is thus better prepared for the actual grinding. Our object is (or should be) to thoroughly disintegrate the flour and clean the bran without tearing it to pieces, otherwise the colour of the flour will be deteriorated. As a general rule, large stones do not require laying so close to accomplish their work as smaller ones do; the dress consequently lasts longer, and the stone works cooler, and throws the bran in larger flatter pieces; but so many circumstances will vary the results that no absolute rule can be laid down. The nature of the soil on which the grain grew exercises a wonderful influence on the successful working of the manufacture. I would respectfully caution all the readers of "ours" against implicitly receiving all the statements put forth by "our" numerous contributors. We are thankful for ideas put forth, but each one should judge for himself if they will bear the scrutiny of common sense, as it is quite evident that too many of our number avoid exercising their own natural gifts of one of the most useful of nature's endowments.—Epsilon.

[11945.]—**Leaky Tap.**—This is probably caused by frost. The remedy is to allow the water-way to empty itself. This may be effected by boring two pin holes half through the plug into the water-way, one above the other; one to let the air in, the other to let the water out.—T. S. U.

[11946.]—**Imitation Bronze.**—Well clean the articles to be bronzed; if old, to be boiled in soda or potash lye, to free them from the old lacquer, &c.; if new, to be pickled in diluted or stale aquafortis for leaf work; filed and papered up for plain work; and scoured with sand where required; tubes, &c., may be cleaned with emery cloth and then dipped (or a brush used, if more convenient) in the bronze solution, composed of one quart of the best vinegar and 4oz. of corrosive sublimate, washed in clean water and dried in sawdust, or a mixture of about a gallon of sawdust and 4oz. of blacklead is better; well polish with dry blacklead and lacquer with green lacquer, heating the articles on a hot-plate to about 180°. Tubes are easier done by steam, a common tea-kettle will do almost as well as anything. Use a camel's hair-brush for the lacquer, which you had far better buy than attempt to make; most wholesale chemists and drysalters sell it, or wholesale gas-fitters.—W. Bolton.

[11960.]—**Brewing Query.**—The reason why the copper is dark after boiling is from the sulphur used in the growth, and also curing of the hops, forming a compound with the metal. Compound formed would be sulphate of copper, I should think. All hops that act thus upon the copper should be avoided if possible, as your yeast is liable to get out of order from the effect of the sulphur acting upon the fermentation.—Aroma.

[11985.]—**Machine to Cut Leaves.**—A machine almost exactly similar to the circular saw and bench would cut the leaves as "Anon." wants. The outer rim to be furnished with flat steel knives placed a few inches apart, and the wheel to revolve in bearings underneath the bench or table. Two handles may be attached to the axle, or one, as may be deemed suitable. One boy may feed it with small bundles of leaves, which fall down an inclined platform when cut, while the other is working as "Anon." suggests.—Rat-Tat.

[11987.]—**Draft Holes in Fireplaces.**—Used so that the smoke may be consumed by admitting a constant supply of air, as in the patent louvre arrangement and other more simple plans, where the draught is regulated by a system of chains, weights, and levers. "The green tea leaves" are more rapidly and efficiently dried by passing over and through the trays a current of heated air, which is found more beneficial than exposing the damp leaves to the direct action of the fire. Kilns of damp corn are also occasionally dried by tubes of heated air. The pipes are pierced with small holes and stand upright, or empty spaces are formed with wire netting.—Rat-Tat.

[11991.]—**Focal Length of Lenses and "F.R.A.S."**—No one is under any obligation to reply to a question he thinks need not have been asked, but those who do reply should reply civilly, and correctly if they can. "F.R.A.S.," at p. 300, tells "Anon." that he might have found his question, which he calls "so ridiculous," answered in any fourpenny catechism on optics, and then proceeds to answer it inaccurately. No doubt "Anon." asked the question because he wished for information, perhaps did not know any more than I do anything about fourpenny catechisms, or possibly he preferred paying twopence for the English Mechanic, which would give this and other information, to giving fourpence for a catechism which would answer this one question only. I submit, Mr. Editor, that it is very undesirable that inquirers who ask for information should be snubbed because they have not the information they seek. It is desirable, also, that the answer should be accurate, which that of "F.R.A.S" is not quite. The focus of a camera lens is not, as "F.R.A.S." well knows, the point at which the rays of the sun would be converged to form a distinct image, and the plate holder must not be placed at that distance, but generally at a considerably greater distance—namely, at that at which the actinic rays (not the luminous rays) from objects at a small distance will converge—*i.e.*, the congregate focus of diverging rays. Neither is it quite accurate to say that the eyepiece of a telescope has to be placed in the principal focus of the object-glass, for its distance has to be adjusted according to the distance of the object and the eye of the observer, as of course "F.R.A.S." is quite aware. He disclaims any attempt to give a scientific answer to such a question, and none was needed, but he might at least have given a civil one or none at all, and an answer may be incomplete without being inaccurate. Originally, by the focus of a lens was meant the point at which the heat rays of a lens used as a burning glass converged, lenses being at first used as burning glasses, being fit for little else, and the point of greatest heat was naturally called the focus, the hearth, or fireplace. It does not exactly correspond with the point at which either the light or the actinic, or photographic (light drawing) rays converge.—Philo.

[11994.]—**Instrument for Measuring and Recording the Amount of Light for Photographic Purposes.**—The most simple way to make an actinometer is to take a piece of cardboard and double it into two leaves like the covers of a book, then paint one of the outsides with a kind of chocolate colour, as nearly as possible of the same tint as albumenised paper assumes when exposed to the light; then cut a hole about the size of a shilling through the centre of the painted part of the card. Now, to use this, open the leaves and place between them a piece of sensitised paper, close them again, and expose to the light. Now, as the paper will darken quickly or slowly, according to the chemical power of the light, it is only necessary to note the number of minutes required to darken the paper to the same shade as the surrounding card, and the difference of time occupied at different times, and in different places, will give the difference of actinism in the light, which does not correspond with illumination; or the card-leaves can be made large enough to have half a dozen or more holes, and a scale of tints, then expose for a fixed length of time, and see with which of the tints the paper matches and the same end will be gained. But no rule can be laid down for the exposure of the plate in the camera, because some subjects will require a longer exposure than others, whatever may be the nature of the light.—W. Marquand.

[11995.]—**Patent Rights.**—Errata.—For second patent, read said patent, and put another s to worthless.—A., Liverpool.

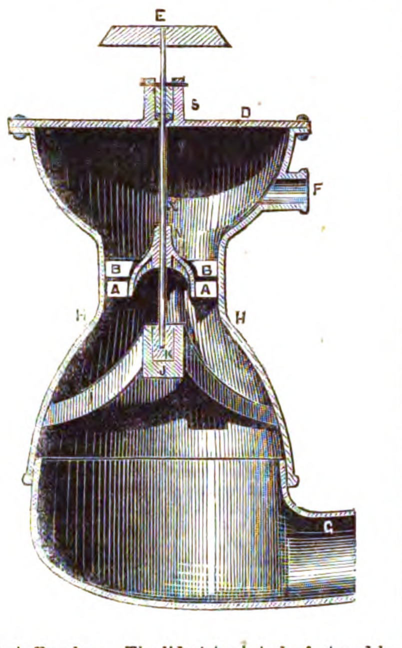
[12000.]—**Insects in Tables and Chairs.**—Have the furniture newly varnished. A little camphor dissolved in the varnish used will prevent the recurrence of the depredators. Tobacco juice driven into the holes with a syringe will also destroy the insects.—Rat-Tat.

[12002.]—**Zinc for Aquarium.**—In answer to "A Three Years' Subscriber," I beg to offer the following advice how to make, stock, and preserve it:—Various kinds of receptacles are used for both the marine and the fresh water aquaria. The square or rectangular glass tank is the most expensive, while an ordinary propagating glass turned upside down and placed in a stand forms a very good shaped and even elegant vase, especially for fresh-water animals. It may be purchased cheaply at almost any glass warehouse. Next comes the filling and stocking. First, a substratum of soil in which the plants may grow is necessary—just enough of sand, stones, and clay to cover the bottom; but no mud—nothing that is easily removable or apt to discolour the water. Then the weeds, and, lastly, the animals. Ordinary pond water will do admirably for fresh-water aquaria, while good sea water is necessary for the marine tank. Weeds require very little soil. One of the most successful plants for the fresh-water aquarium is the *Anacharis alsinastrum*, the weed which so often chokes our canals and rivers. It can be obtained in Covent Garden Market, or, indeed, of almost any gardener. It is a pretty moss-like plant. But almost any weed may be naturalised in the aquarium—the water crowfoot (*Ranunculus aquatilis*), for instance, may be transplanted from almost any pool during April and May, and placed in the tank; it takes root and flourishes abundantly, as also do most of the pond weeds. Now for fish:—The ordinary stickleback, if kept by themselves, are most amusing inhabitants, or the gold fish, the carp, or the minnow may be profitably introduced. But in order to keep down the green *conferræ* a few snails are absolutely necessary. To these may be added water newts or efts, or a good-sized toad, which is by no means so repulsive an animal as is by many believed. But you must be careful not to introduce some kinds of water beetles, but the diving spider (*Argaroneta aquatica*) will be found a most interesting addition. The aquarium is a scientific toy that costs nothing beyond the first expense of purchasing, and it provides an almost endless source of delightful study.—R. C. T.

[12004.]—**Nitrate of Soda.**—This valuable ingredient for the agriculturist may, as stated by S. Bottone, be procured in slight quantities on the frontiers of Chili and Peru, but the bulk of the supply, which is unlimited, is obtained in the interior of Bolivia (see Darwin's Travels), and shipped from the port of Iquique, whence a railway of ordinary gauge runs to Tarapaca, the great mining centre. Narrow gauge lines of 30in. connect here, and both systems are worked with powerful Fairlie locomotives; the larger ones made at Bristol and the others at Warrington. Continuous and heavy inclines extend from the coast to the mines, and the difficulties of the line serve to illustrate the special and admirable qualities developed by this improved kind of engine.—P. FRANCE.

[12008.]—**Cork Cutting.**—If "Cortex" can spare a visit to the Mechanical Department in the Crystal Palace, London, he may there see different working models of cork-cutting machines. It would be difficult to say which machine for the purpose is best.—RAT-TAT.

[12012.]—**Water Power.**—The reply of "Philanthropist" is of no use practically, I am sorry to say, although I will do him the justice to say that he appears to be perfectly correct in theory. He has calculated the natural effect due to a fall of water, but he has not gone any further; of the four horse-power stated, above three-quarters of it will be absorbed by friction of one kind and another. The reply of J. Gillaird is more to the purpose, but superficial. The actual power will in some measure depend upon the length of pipe from the reservoir to wheel. This would act by diminishing the velocity, and consequently the power, on account of the friction entailed by the greater length of pipe. The theoretical velocity due to that head, regardless of friction, is 1,180ft. per second; so, being ignorant of the length of pipe, we can conveniently suppose the actual velocity to be 1,000ft. This, of course, will only give an approximate result, but it will not be very far from correct. The diameter of pipe = 3in., so that area $= \frac{9 \times 11}{14}$ square in., ∴ number of cubic inches $= \frac{9 \times 11}{14} \times 12000$, or $\frac{9 \times 11}{14} \times \frac{12000}{1728}$ cubic feet of water supplied per minute. That is, $\frac{9 \times 11 \times 12000}{14 \times 1728 \times 60}$ cubic feet per second. The cheapest plan, as regards first cost of utilising this power, would be a water-wheel; and, considering the small amount of fall available, I think that an over-shot wheel would be best. This would have a cheap first cost, but would not give as good a modulus. It would probably give about ¼ horse-power. It would have to be 6ft. diameter, and 3in. broad between the sides. There are to be 12 buckets. It could be made of either wood or iron; but I prefer iron axle and bracings, and the rest wood. It is then easier to repair, make, and it costs less. The wheel itself would cost from £5 to £15, dependent upon the locality. The other descriptions of water-wheels would cost about the same, but would not be so efficient. For a motor that will last for ever, and be able to increase its power when the fall increases from a heavy shower, &c., give me the turbine. The fall can't be too high for it within reasonable limits, and this is one of the advantages that it possesses over all other wheels. The greatest disadvantage is the speed at which they run, necessitating long bearings and care in fitting. Nevertheless, I think that the manufacture of this one would not be difficult to a tolerable mechanic, with a foundry handy, and set of tools. The speed which I have designed this one to run at is 420 revolutions per minute. The cost is a variable quantity, depending upon the country that the inquirer is in. The price might range from £10 to £30. With that head of water, it would be about ½ horse-power, but it would be strong enough for all additional heads, so that in the rainy season it might be upwards of 2 horse-power. I send sectional drawings of turbine that will last a long time, all the parts being easily replaceable. I will describe parts. N is a bell-shaped iron casting, of straight cylindrical pattern, for 2in. from bottom, and then sweeps up with an easy curve of section shown, to the top of casting. It should be a semicircular curve of 5⅜in. external radius, and 5in. internal radius. The casting to be ½in. thick in curved part, and ⅜in. thick in straight part. The top straight cylindrical part is to be 1½in. diameter and 3in. long, with ⅝in. hole bored and key way filed, or what is better, slotted ⅛in. deep, and ¼in. wide. There is also a flat to be filed on shaft ⅛in. deep, and length of boss. The buckets to be ⅛in. thick, 1½in. deep, and 5¾in. long. They are to be made by taking a strip of sheet iron 7in. long, and bending it at right angles at 1¼in. from one end. This has then two three-sixteenths of an inch holes to be bored in it at the smaller end in order to rivet it to bell casting. They are to be placed at an angle of 24° with the horizontal line. The best number of buckets or vanes is 49. They are to be riveted with three iron rivets each, and corresponding holes are to be bored in the bell casting. The guides are to be made of same thickness of iron, and in the same manner to the buckets, and cut to correspond to the curvature of the bell casting. They are to be at an angle of 66° with the horizontal, and to be riveted to the inside of the main casting. In the main casting there rises three arms or ribs to support. The ribs to be 1in. by ⅜in., step block to be 2in. diameter, and 4in. long, having hole eleven-sixteenths of an inch diameter bored in it for reception of the gun metal step. The step to be eleven-sixteenths of an inch diameter, 3½in. long, with flange turned at top, neatly turned about ¼in. thick, to fit on top of step block. It is then to have hole bored seven-sixteenths of an inch diameter, and 3in. deep for shaft to work in. The main casting is to be 20in. internal diameter at top, with flange 1½in. wide, ⅜in. thick all round. The lid, or cover, to be cast 23in. diameter, and ⅜in. thick, with stuffing box in centre, to be of section as shown. The stuffing box is to be 1½in. deep, and 1¼in. diameter. To be ⅜in. thick in flange where the bolts go through. The stuffing-box gland is to be 1¼in. diameter, and 1⅜in. deep. This is to have flange ⅜in. thick and ⅜in. wide, and fastened by three ¼in. bolts to the stuffing-box. The bolts might be cast in



top of stuffing-box. The lid at top is to be fastened by six ⅜in. bolts on main casting. It is to be fitted to top with steam-tight joint. It would be best turned, but a very fair joint can be made with the rough casting, if the scale is taken off by roughly grinding for a few minutes with river sand. The cementing materials are red lead and an old rope. References: E, bevil-wheel to communicate power; G, stuffing-box; D, cover; H, casing; I, arms supporting the step block J, which supports the step proper K. The axle X works in it, and the bell casting N is keyed on it. B B are the guides, and A A are the buckets or vanes. C is the elbow for carrying away tail water. F, the supply pipe.—P. W. H. J.

[12013.]—**The First Watch and Clock Made.**—The invention of the coiled spring in watches dates from the close of the fifteenth century. It is claimed for Nuremburg, then famous for watches, but the priority is much disputed. Their introduction into England is equally uncertain. The watch of Abbot Whiting, dated 1536, is of accredited antiquity, and Count D'Albanne's silver watch, of English workmanship, is dated 1529. Henry VIII. had a watch that went for a week; Anne Boleyn possessed another, as well as a small gilt clock, now in Windsor Castle. Edward VI. had, in 1542, a "watch of iron." Mary Queen of Scots possessed a death's-head watch and a skull watch; one in a case of crystal, coffin-shaped, and another in which a piece of catgut supplied the place of a chain, but all these were foreign watches. A watch was found on Guido Fawkes; and of this period is a curious oval-shaped watch, in a silver case ornamented with mythological figures. In 1635 the value of a brass watch was forty shillings. In 1658 was constructed the spiral or pendulum spring, invented by Dr. Hooke and improved by Tompion. Next, Jaare, by applying the pendulum spring, added (to the hour hand) minute hand and wheel hand. He also added the repeating movements in watches; one of the first presented by Charles II. to Louis XIV. of France. Jaare also made repeating watches for James II. and William III. From 1698 all makers were compelled by law to put their names on their watches. In 1724 was invented the horizontal escapement by Graham, who also invented the mercurial compensation pendulum. At the beginning of the last century was invented jewelling the pivot holes of watches to prevent friction. Arnold made the smallest repeating watch ever known, for which George III. presented him with 500 guineas. Among the celebrated French watchmakers was Brequet, who paid some of his workmen 30fr. a day, and none less than a Napoleon. He invented the touch watch, by which a spring touched at any time struck the hour and minute; one cost the Duke of Wellington 300 guineas. Amongst the earliest of the wheel clocks seen in England was that of St. Paul's Cathedral, London, in 1286. In the year 1869 the good citizens of Beauvais placed in its Cathedral a memorial clock, composed of 14 different movements, and 90,000 pieces (weighing 35,000lb.), and costing £5,000. The body of the clock is 36ft. high, of carved oak.—ANCIENT AND MODERN DURSTON.

[12020.]—**Tireing Cart-Wheel.**—The best way to tire a dished wheel is to shut the tire up the size you require it on the smallest edge of the wheel, and dish the tire by hammering the edge you want largest inside the tire, which is very easily done.—T. G. R.

[12022.]—**Forests and Rainfall.**—Those interested in the relations of the above are referred to "Des Climats et de l'Influence qu'exercent les Sols Boisés et non Boisés," par M. Becquerel. Paris, 1853. 8vo. Boussingault, J. B., "Economie Rurale," 2nd Edition. Paris, 1851;" or the English translation, published by Bailliere. "Man and Nature, or Physical Geography as modified by Human Action," by G. P. Marsh. London, 1864. The last-named is a work of extraordinary merit.—G. J. SYMONS.

[12036.]—**Engine.**—A boiler 3in. diameter by 9in. long would drive it. At 30lb. pressure, with the piston making 1,000 strokes a minute, it would be ·1192 horse-power.—AMICUS.

[12040.]—**Navigation.**—I could procure a Norie's, second-hand, of a friend of mine who has left the sea in disgust, if querist 12040 wants one and will advertise his address.—AROMA.

[12047.]—**Radius of Sector.**—I am sorry that I did not put it plain enough; what I meant by curves is the arc A F B and C F D by chords from A straight line to B and C to D, in No. 363, p. 650, query 11161.—T. E. G.

[12048.]—**Trip to Ireland.**—"A Wanderer" can procure all the maps he requires, including the geological sheet, from Stanford, of Charing-cross, who is the agent for the ordnance sheets. I would recommend him to procure the illustrated guide books to Wicklow and Dublin, published by the Graphotyping Company. This season they have issued a guide to the Shannon and Limerick, which, as "A Wanderer" intends bending his steps towards Parsonstown, may be useful to him. This guide supplies the most recent information, is nicely illustrated, and most agreeably written, and is furnished, too, with a good map of the South of Ireland.—E. B. F.

[12052.]—**Rust in Brewing Water.**—Pass the water through a tube containing a layer of fine sand or charcoal. The last is the best filtering medium for "Cromwell."—RAT-TAT.

[12056.]—**Echo.**—Does J. T. Oakley mean what is commonly known as an open roof—not ceiled? If so, I would recommend its being ceiled about 6ft. or 8ft. from top of wall or eaves. If ceiled, put in an end gallery opposite the pulpit; or if the pulpit is standing against the wall move it out about 6ft. These remedies have been successful in removing the above, which, to a public speaker or preacher is most unpleasant.—BERKS FARMER.

[12056.]—**Echo.**—Put in false ceiling, which generally effectually stops the complaint.—AROMA.

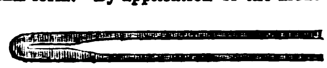
[12058.]—**Bees.—Swarm or Brood.**—Is "C. R. H." certain there were no living bees in his hive when he removed the intruders he mentions? I was deceived once or twice myself, until by accident I examined the comb of one I thought dead. I then, and since, have proved that when very weak, the remaining bees, either for warmth or safety from mice, beetles, &c., insert themselves in the half-empty cells; and when examined, and enemies removed in time (*i.e.*, before hatching commences), I have had stocks recover, and do well, when not a bee could be seen without breaking up the comb. The time of examination I refer to is March and April. If he is certain the old ones were dead, he may rest assured it is a swarm, either one of his own or a runaway; for if the larva was not destroyed by the cold (consequent on the absence of bees) or vermin, it would be impossible for them to rear themselves; for, according to Hubert, Kirby, and Lardner, vide "Museum of Science and Art," the infant bee requires the greatest care and constant attention of that class of the community known as nurses. As to advice, if they are busy working, you can do nothing, let them work on. I do not know if it is punishable to leave empty hives on the stands during swarming seasons, but on three occasions I have thoughtlessly done so, and each time they were tenanted, once, I know, by a strange swarm. I knew a beekeeper in Oxfordshire who always kept a spare hive for visitors, and he has told me (in confidence, of course) he always has one runaway swarm, and sometimes more in the season. I suppose a house ready furnished has attractions.—BERKS FARMER.

[12058.]—**Bees.—Swarm or Brood.**—As a cockney who has lived but three years in the country, I accept Mr. Abbott's scolding on the score of ignorance; but I plead "not guilty" to the charges of wilful neglect, and for setting a trap for my neighbour's bees. It has been a bad season, even in this mild country, for bees; my neighbours were losing theirs at the time I thought I had lost mine, about the middle of April. My query (p. 313) was written, I believe, on May 27, a bright day, on which I found, for the first time, bees swarming about the mouth of the hive. Since I first wrote the bees have been always more or less visible, but I don't think they have done much work; certainly the weather is against them. But yesterday and to-day, (June 14th) have been bright hot days, and the bees are in such numbers that they will hardly let me get near them. Some seem to be returning from the fields, and to be attacked, and, if possible, robbed at the entrance. I don't think there can have been any honey in the old comb from the light weight of it, but I think it might have contained brood which the warmth hatched. At all events, the bees a month ago let me lift out all the boxes from the case and wipe out the floor with a feather, without once stinging me. I may be able to report progress if this warm weather continues; meanwhile, I am much obliged for the cautions contained in Mr. Abbott's letter.—C. R. H., North Devon.

[12060.]—**Glass Blowing.**—The following may be of use to the querist. Professor J. Lawrence Smith recommends a Bunsen burner, flattened at its extremity so as to give a thin, broad flame, for bending glass tubes. This is certainly a great improvement on the commonly employed burner, but an ordinary fish-tail or batswing gas-burner will be found to give, if possible, still better results. Mr. H. Carrington Bolton says that he has employed for some years an ordinary batswing burner attached to a small, short stand (8in. high, burner included), so as to rest low upon the table, in order that raising the arms inconveniently high may be avoided. Such a burner insures a broad flame, by which the tube is heated for two or more inches in length; the tube is turned while in the flame, and removed for bending as usual. The deposit of carbon which at first sight might seem an objection is really one of the chief advantages of using this burner. On placing the glass in the flame the deposit begins immediately, and prevents too rapid a rise of temperature and consequent cracking of the glass; during the heating the carbon tends to distribute the heat equally over the surface of the tube; and finally, on withdrawing the glass from the flame, too sudden cooling is prevented, and the glass is, as it were, annealed. The black deposit is readily removed by a dry cloth. This plan was commonly employed in Hofmann's Laboratory, Berlin. In bending tubes of more than ⅝in. in diameter one end should be closed tightly with a cork (or wax), and air blown into the other end at the moment of bending the tube; by regulating judiciously the pressure of the air upon the sides of the somewhat softened tube, the latter will neither bulge out nor collapse, but will retain its proper calibre. This cannot be effected, however, with very large tubes, or with very thin ones, which require the nice manipulation of the professional glass-blower.—A. M.

[12060.]—**Glass Blowing.**—Heat tube in spirit lamp, turning it round and round, but neither stretch nor compress it; when warm enough, bend. For bulb heat as before, twist until the tube is stopped, take it out of the flame and break it, then heat again, and blow in the end of the tube. For a bulb with two orifices stop one end of tube, heat where the bulb is to be as in bending, and blow as before. If you cannot get heat enough with your lamp, use your blow-pipe, the great secret in the use of which is to keep your cheeks tightly puffed out while you inspire through the nose.—Henry Newman.

[12060.]—**Glass Blowing.**—Thin glass tubes are most easily bent in the common batswing flame. Hold the tube so as to expose an inch of it to the heat at once, which will be completely covered with soot. When it softens, it may be, with careful handling, neatly bent to any angle without flattening. Care must be taken not to bend too soon or too quickly. To blow a bulb on ¼in. glass tubing, if at the end of the tube, close the tube in the blow-pipe flame, and by prolonged heating cause it to thicken till it has assumed this form. By application of the mouth at the open end, and careful blowing, at the same time keeping the tube constantly revolving, an even and strong bulb may be blown of any size. For full particulars, refer to Williams's "Chemical Manipulation." If it be required to blow the bulb in any other part of the tube, one end must be closed, the glass thickened in the same way, with like precautions to keep the tube constantly turned.—Analyst.



[12060.]—**Glass Blowing.**—Glass blowing is only excelled in by practice. See that your tube is perfectly dry, hold the part to be bent over the flame, gradually bringing it down to centre of flame, so as to warm it gradually, then turn the tube constantly round until the part is red hot, and then the glass will bend generally from its own weight; don't use much pressure, as the glass will buckle in and almost stop the pipe up. For blowing a bulb, blow with blowpipe on the middle of your tubing, also turning it round; make it as hot as you can, then pull the two ends apart, then blow on one of the ends, which will stop it up; get it to a great heat, put the cool end in your mouth and blow gently at first, increasing pressure as it cools; also turn it round while blowing; you ought then to get a bulb. Cannot say more in limited space. Spirit lamp hardly gives enough heat, gas better.—A. R.

[12061.]—**Chemical.**—Chlorate of potash may thus be distinguished from chloride of potassium. With a solution of nitrate of silver, chloride of potassium gives a white curdy precipitate. Chlorate of potash gives no precipitate if pure; commercial chlorate generally gives a slight precipitate, owing to the presence of a trace of chloride. Chlorate of potash, treated with hydrochloric acid, evolves chlorine, which may be detected by paper soaked in a solution of iodide of potassium with starch, which is coloured blue. Chloride of potassium does not evolve chlorine under like circumstances.—Analyst.

[12062.]—**Induction Coil.**—"J. B. P." must coil the secondary in the same direction as the primary, and insulate the secondary from the primary with six or eight layers of tissue, and each layer of the secondary with three or four layers of tissue, well saturating each layer with shellac or sealing-wax varnish, but a mixture of ordinary black rosin and beeswax, about four parts rosin and one part beeswax by weight, and poured on hot with a spoon or ladle, is far superior, but more difficult to apply; when finished, the whole to be covered with eight or ten layers of tissue before the ornamental covering of silk or velvet is put on.—W. Bolton.

[12065.]—**Paint and Varnish for Portable Engine Boiler.**—The material used is a sort of paint and varnish in one, called varnish green or enamel green, made specially for such jobs, to be had at any paint and varnish warehouse; the price is about 1s. 8d. per pound. If too thick thin with turps.—B. R. B.

[12066.]—**Washing Baliste.**—Use fuller's earth, and only moderately warm water, rinse in cold, and before drying dip in a strong solution of common salt. This will prevent it running during drying.—Tnetap.

[12068.] — **Surgical Dentistry.** — "Joe" had better apply to Messrs. Jno. Churchill & Co., publishers, New Burlington-street, London, or, let him purchase Tome's "Dental Surgery" from that firm; he will find the work the one he wants. No man can efficiently practice dentistry unless he is thoroughly conversant with the contents of Mr. Tome's work. There are many other valuable works on surgical dentistry which I could enumerate; but grind well at "Tome's," and "Joe" will have the principle of dentistry, and with a few years' practice he may be able to fill a tooth with gold in a proper manner. That branch of the profession once acquired he may rely on a good practice; a small percentage of our English dentists fill teeth with gold, as they should do.—Tom.

[12069.]—**Trip to Australia.**—Speaking from eight years' experience of life at the Diggings, I may mention that a cousin of mine was supposed to be in a consumption, constantly lying on the sofa with clear water dribbling from the mouth. He tried a trip out to me, accompanied with a small cargo of notions, somewhere about the year 1854. Want of Colonial experience caused the venture to be a dead loss, but after sojourning with me for a few months he returned, and has since enjoyed capital health. I would advise any person in delicate health to take a trip there if possible. But take no ventures there in the expectation of making by them, as I was enabled to live very nearly as cheaply all through the height of the gold fever, by purchasing other people's ventures at less than they cost at home. If tolerably active, and (this is the rub) willing to work without being afraid of what Mrs. Grundy would say, you can get along very well there, as long as you keep out of the public-houses.—A., Liverpool.

[12070.]—**Electric Kite.** — The above may be made out of a common calico kite, in the following way:—Twist some wire on the belly-band. Now, fix some metal points (large pins will do) on the top of the kite, and connect them with the wire on the belly-band. The kite-string should be soaked in strong brine to make it conduct; or, better still, should have a fine wire interwoven with the strands throughout its length. A metal ring or a key must be tied to the end of the string, and to the ring is fastened a yard of silk cord to insulate the apparatus. In raising the kite, care should be taken to pass the string under an iron railing, or some conductor connected with the ground, lest the fluid should pass through the operator's body. You cannot be too careful in using the kite, as it is a most dangerous toy. Oiled silk is superior to calico for the material, as it is more waterproof.—Glatton.

[12073.]—**Scarlet Runners.** — If T. A. Slater will take the roots of the scarlet runners up in November, and place them in moderately damp mould in a cellar, away from frost, and plant out in single rows, 1ft. asunder, in April, the crowns being ½in. below the surface, they will come in bearing a month before scarlet runners sown at the same time.—M. N.

[12077.]—**Pyrethrum Parthenium: the Common Feverfew.**—In the double variety, the yellow tubular florets of the disc disappear, and are replaced by white quilled florets. It is very common in gardens, and seed may be procured of any seedsman.—William.

[12078.] — **Cabbage Planting.** — The cabbage tribe are gross feeders; they like fresh rank manure, and plenty of it, at the time of planting out. George Richardson should sow from March till August, so as to have always at hand thrifty young plants for planting out. The March and July sowings are the most important, as on these depend the supplies during winter and spring. The finest and earliest I have grown are Sutton's Imperial. I began to cut on the 13th of April. I have also fine cabbages of Sutton's Drumhead, Blenheim, and Early York. By taking the finest plants out of the seed bed as soon as fit to plant out, and a fortnight after taking the next finest, and so on—the cabbages will come in one after another. Savoy cabbages.—I prefer Sutton's Golden Globe for winter and spring use; main crops, Dwarf Green Curled. Autumn is the best time for planting rhubarb; plant in rows 4ft. apart from root to root each way; make a deep hole where each plant is to stand, and into it put a barrowful of rank manure; put over it a little earth, and on the earth plant the rhubarb with its crown level with the ground. In the course of next May you will get stalks worth looking at. I like Mayatt's Victoria for main crops; Mayatt's Linnæus for early crops.—M. N.

[12086.]—**Velocipedes.**—"Bob C." can try a trick with his velocipede which I have seen tried with success. Remove the iron tire; saw away about three-quarters of an inch deep of the felloe all round. Substitute for the wood cut away a ring of rubber, and screw on the tire again, using longer screws than before. Do not pack the rubber tightly; the flat kind is best, and its elasticity will be preserved, while the tire and rubber will last a longer time.—Rat-Tat.

[12088.]—**Cleaning Jewellery.**—The best way I know to clean gold jewellery is to use a soft brush and jeweller's rouge; but for gilt or Brummagem jewellery no brush must be used, the film of gold being so delicate that it would be injured or entirely destroyed. That sort of work must be dipped in a solution of cyanide of potassium and water, with the addition of a few drops of ammonia. When taken out to be well washed in pure water, and dried in box sawdust.—Tom.

[12088.]—**Cleaning Jewellery.**—The liquid is "liqua potassi"—*i.e.*, potash dissolved in water.—J. T. B.

[12089.]—**Felt Hats.**—The bad stuff used in stiffening has been driven out like oily matter by the heat of the head. It can be removed with a soft brush, decoction of logwood, and soda-soap.—Rat-Tat.

[12094.]—**Preserving Caterpillars.**—Having killed the caterpillar in spirits of wine, make a small hole in the tail, and gently press out the contents of the skin. Then fill the skin with fine dry sand, and set it aside to dry. When dry, in about three hours, shake out the sand, and gum it on to a piece of paper to set in the cabinet. The skin can, if preferred, be filled with coloured wax. Or else, having emptied the skin, fit a small tube to be drawn to a point into the hole in the tail. Blow through the tube into the skin, turning it round over a fire. A charcoal fire is best; but if you have not got one, and cannot make one, a lamp or an ordinary fire will do. When the skin is dry take it off the tube, and fix it in the cabinet. Caterpillars prepared by either of these ways may be anointed with a solution of resin in oil of spike unless they are hairy ones.—G. S. E.

[12096.]—**Copying Music.**—If the music has been registered, the teacher cannot use or copy it for circulation even among his own pupils without first obtaining the permission of the composer. See "Every Man His Own Lawyer," price 3s. 6d., published by law stationers in London and elsewhere.—Rat-Tat.

[12102.]—**Lightning.**—The speed of the electric spark has been measured by an ingenious apparatus, fully described in a back number of "Household Works" (but I regret I have not the number by me), and has been found to vary with circumstances, but these, I think, are not yet accurately known. Light is said to be the quickest traveller in existence; but, from mine own unscientific observation I should feel inclined to bet on the lightning.—Henry Newman.

[12105.]—**Equation.**—In Hamblin Smith's "Algebra" (p. 191), a similar question is worked fully. By question (1) $x^2 + x\,y = 28$. (2) $x\,y - y^2 = 8$. Let $y = m\,x$. Then (1) becomes $x^2 + m\,x^2 = 28$; (2) $m\,x^2 - m^2\,x^2 = 8$. Dividing (1) by (2) $\frac{x^2\,(1 + m)}{x^2\,(m - m^2)} = \frac{28}{8}$. That is, $\frac{1 + m}{m - m^2} = \frac{28}{8}$; or $28\,m^2 - 25\,m = -3$ (solving the quadratic one of the values of $m = \frac{3}{4}$). Thus from (1) $x^2 + \frac{3}{4}\,x^2 = 28$, $7\,x^2 = 112$, $x^2 = 16$, $x = \pm 4$, one value of x; and, using this value, a value for y can easily be found.—C. H. W. B.

[Solutions have also been received from W. H., Maica, Excelsior, A. R., Molison, W. L. G., Nemo, J. F. E., S. J., E. Slaughter, J. Hastie, W. S. & H. M., W. Bush, C. P., H. G. M., Thetamu, W. K. Hall, F. B., P. Carmichael.—Ed.]

[12110.]—**Silver Plating.**—To recover the silver evaporate the solution to dryness, and fuse the product in a crucible. As for the faulty deposition, remember that the surface of the silver-plate should be about equal to that of the article to be plated. If the plate of silver be of the proper size, and yet the deposit be dark, add a little cyanide of potassium.—W. L. G.

[12111.]—**Hot-house Boiler.**—There is no boiler better than the saddle, where little depth of boiler-house is a consideration. But to get clear of the water "W. E." can get a wrought-iron tank, say about 8ft. long by 4ft. wide, by 18in. deep, fix top of tank a little above the height of spring. If the boiler is not very large, "W. E." may fix his present boiler in one end of tank. If it takes up too much room through bricks in setting, "W. E." can purchase from makers one that would do without brick-work, and not take up more than 3ft. square at one end of tank.—H. Hargreaves.

[12118.] — **Gold Quartz.** — Taking the specific gravity of quartz at 2·66 (say 2⅔), and that of gold at 19·25 (or 19¼), we shall have the following equation. Let x = the quantity of gold in grains, ∴ $306 - x$ = the quantity of quartz.

$$\therefore 306 \times 3\tfrac{1}{4} = (19\tfrac{1}{4})\,x + 2\tfrac{2}{3}\,(306 - x),$$

$$994\tfrac{1}{2} = \frac{77\,x}{4} + \frac{8\,(306 - x)}{3},$$

$$\frac{1989}{2} = \frac{77\,x}{4} + \frac{2448 - 8\,x}{3},$$

$$11934 = 231\,x + 9792 - 32\,x,$$

$$199\,x = 2142.$$

Whence x, the number of grains of gold, $= 10\frac{152}{199}$ grains (say 10¾ grains).—Excelsior.

[12113.]—**Gold Quartz.**—Let W, w, w' denote the weights of the compound and the two ingredients, and S, s, s' their respective specific gravities, s being that of the denser ingredient. Then—

$$w = \frac{(S - s') \times s}{(s - s')\,S} \times W$$

$$w' = \frac{(s - S)\,s'}{(s - s')\,S} \times W.$$

By these forms, if W = 806, S = 8·25, s = 19·3, s' = 2·6, then w = 70·686 . . . . w' = 235·008, very nearly.—W. L. G.

[12114.]—**Dye for Cricket Cap.**—No remedy; the colour is faded, and cannot be renewed.—J. T. B.

[12116.] — **Hydrogen Lamp.** — In answer to "H. H. G." In his hydrogen lamp, the first effect is that a mixture of hydrogen and air impinging upon the spongy platinum, by slow combustion first raises it to a red heat. The mixture of hydrogen and air surrounding the platinum is an explosive one, which at a certain high temperature is ignited, and the flame is communicated to the jet of hydrogen issuing from the lamp. The explosion is caused, therefore, by the ignition of the small quantity of the mixture immediately surrounding the platinum.—ANALYST.

[12118.]—**Organ Construction.**—In using harmonium reeds, have a separate pan for your reeds, not on the same soundboards as your pipes; use the pipes in a manner described in a letter in this number. JOSEPH WILLIAM FENNELL.

[12122.]—**Driving Bands.**—From twelve years' experience I can unhesitatingly recommend leather bands as by far the best and cheapest in the end, and regarding all weathers. Have your bands made to order, and where you can depend on the leather being well seasoned.—BERKS FARMER.

[12123.]—**Worn Waterproof Bands.**—Boiled linseed oil, followed by boiled oil and lampblack, and thoroughly dried out of doors, is good; but whether the best is a matter of opinion.—HENRY NEWMAN.

[12124.]—**Voice Weakness.**—Try a mild course of galvanism to the throat, and I should recommend you to bathe the chest with moderately cold water upon rising and going to bed.—AROMA.

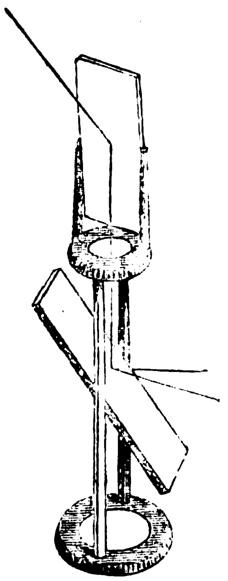
[12125.]—**Cover Plates.**—I don't exactly understand what "Excelsior" means by cover plates, without he means all the plates, both top, bottom, and sides. There are two kinds of plate girders, one of section of two tees joined at their bottom, and the other of the box form. In practice, the most usual plan is to have the depth one-twelfth of the length, but this varies according to the moving load.—P. W. H. J.

[12128.]—**Portable Dark Tent.**—The following description of a dark tent, taken from Hardwick's "Photographic Chemistry," might, perhaps, suit "Occasional Photo." The edition is ten years old, so, perhaps, something better has been invented since, but such as it is, I will give it:—1. Two boards, each 30in. × 15in., are hinged together by strong hinges; in the outer corner of each a hole is bored. 2. Four poles of light strong wood; each pole is formed of two parts, fitted together by a brass tube; the bottom part, 41in. in length, has an iron point to plant in the ground; the top part, 35in. long, has a smaller iron point at the end; the covering of the tent is formed of two thicknesses of yellow calico, and one of black; the seams must not correspond. This covering must have the shape of a cube, open on one side, which side must have the form of a sack, with a piece of elastic to go round the waist of the operator. In the bottom part of this cube are four openings, fitting exactly the poles, and corresponding to the holes at the corners of the boards; on the opposite side of the cube are four other holes precisely fitting the iron points at the top of the poles; all these holes ought to be bound with leather; the tent is packed by putting the eight half poles on the closed table, surrounding them with the covering doubled up, and strapping the whole together. To mount it, the table is opened with the hinges downwards, the bottom half poles are passed through the holes at the corners of the table and the holes at the bottom of the calico cube, a peg being inserted for the table to rest on; the four top poles are then put inside the covering, and each one fitted on to the corresponding bottom pole, and the iron points at the top being inserted into the superior holes of the calico, the whole now forms a convenient table on which all the operations of photography may be performed; a window may be cut out, which can be filled in with adyactinic silk. This tent appears to me to be portable and convenient, and I do not remember seeing any account of a better one.—P. SANTALINUS.

[12130 and 12131.]—**Electricity.**—A current from a machine is the same as one from a battery, but it is produced by a higher electro-motive force, and is very small in quantity. The suggestion of "Philanthropist" as to engraving was made by Spencer in the first paper announcing the discovery of the electrotype, and was one of the experiments he made in originating the art. It is also the basis of the well-known art of glyphography, which reverses the process. The copper deposited in relief, is, however, useless for printing from as suggested, because it cannot be obtained of sufficient evenness.—SIGMA.

[12131.]—**Electricity applied to Engraving.**—I am very doubtful whether in "Philanthropist's" proposed process the copper would adhere with sufficient tenacity to the metal plate to withstand the "sucking" action of the inking roller. At any rate the plan would be useless for copying "fine" work, although it might do for producing facsimiles of letters, &c.—*if* the writing on the plate was done "backwards"—a rather awkward contingency. But then, Cui bono? The lithographic process is considerably cheaper than "Philanthropist's" could possibly be.—SAUL RYMEA.

[12132.] — **Polariscope.**—"Needy" will succeed better if he takes two pieces of plate glass, backed with black velvet, and set in frames as in figure. The upper frame should be set in a collar, that it may be set at any azimuth as regards the lower frame. The frames in the figure are supposed to set at such an angle with the vertical that the incident beam shall strike at about 56°, the angle of total polarisation by single reflection from a glass surface. If "Needy" will consult the indices of back volumes, he will find directions for the construction of polariscopes where polarisation by refraction is made use of. The tubes, when made use of, should be blacked.—H. P. H.



[12132.]—**Polariscope.**—In answer to "Needy," I am surprised he cannot succeed in the way described. But he seems to use the transmitted instead of the reflected light, and should therefore use his plates at an angle of at least 70° instead of 56°. The angles are measured from the perpendicular to the surface of the glass, which "Needy" may not be aware of. If calculated from the surface of the glass the light should fall at angle of 33° 45' to obtain the best effect by reflection, and at not more than 20° when the refracted rays are to be used. I have a polariscope in which only glass plates are used, and it answers admirably, but it is next to impossible to get total extinction of a bright light such as a lamp or gas flame gives. "Needy" must remember that crystals only produce effects of colour when viewed in certain positions, and when not too thick. By arranging his analyser for darkness and trying thin films of mica and selenite in different positions, success will soon be achieved.—ALFRED H. ALLEN.

[12133.]—**Hard Water.**—Boil some of the water for ten minutes in a glass vessel (such as a test-tube), but without letting it evaporate. If it becomes turbid and forms a deposit on the glass, the water may be much improved by the addition of a small quantity of lime or some clear lime water. This will cause a deposit which must be allowed to settle, and the clear water decanted or siphoned off for use. Too much lime will make the water taste soapy. If too little has been used, a further addition will occasion a fresh turbidity. Practice will soon teach the requisite quantity of lime water to be used.—ALFRED H. ALLEN.

[12155.]—**Suspended Shilling.**—Entirely due to what may be considered a form of unconscious cerebration. Let "H. G. W." vary the experiment thus. Allow all the other conditions to remain as they are; but place the tumbler on three half-crowns of the reign of William IV., and he will find that the suspended shilling will strike eighteen at the hour of twelve, or nearest thereto. He must not omit the half-crowns.—H. P. H.

[12157.]—**Smell of Paint.**—Hay, sprinkled with a little chloride of lime, and left for an hour in a closed room, will remove the smell of new paint.—F. A. E.

[12168.]—**Lime Light or Electric Light for Magic Lantern.**—1. First cost of single lantern for use with lime or electric light from £5 to £8; double lantern from £8 to £15. Lime-light apparatus for single lantern (including blow-pipe, gas-bags, retort, &c.) about £5 to £7; for double lantern, £7 to £10. Electric light apparatus (including reflector, holder, and forty cells), from £12 to £20. These estimates are exclusive of slides and objects, a good collection of which can be had for £10 or £12; they are also lent on hire. 2. Dependent on the time in use; a few shillings an hour. 3. The lime-light is far cleaner, and more readily worked than the electric light. 4. The advantages of the lime-light are cleanliness, ready preparation, ease in using, constancy of light, cheapness, portability, easy removal after use. The advantage of the electric light is only one—intensity of light when in a good temper. Its disadvantages are—trouble in preparation, messing with acids and fumes in working, unmanageability in use, inconstancy of light, expense, and absolute necessity of careful and tedious washing up after use. 5. To get a really satisfactory electric light, at least thirty or forty cells should be used; Bunsen's and Grove's are the only batteries worth having, and the former is much the cheaper. 6. The lime-light will answer for every purpose, except a few experiments in spectrum analysis and radiant heat, for which the electric light is better, though, of course, the battery used for the electric light may also be employed for all the experiments in galvanic electricity. I use the former myself, almost invariably. By all means choose the lime-light, and use it for all possible purposes in preference to the electric light. I speak from experience. If "Hon. Sec." will write No. 1, Surrey-street, Sheffield, I can help him still further.—ALFRED H. ALLEN, Sheffield.

[12171.]—**Utilising Chemical Products.**—The products would never pay any one to separate; the most profitable use of them is to throw them away; if thrown on a manure heap they would render good service by the nitrates they contain, and by preventing the escape of ammonia.—SIGMA.

[12171.]—**Utilising Chemical Products.**—"Subscriber" is right in supposing his stripping solution to contain nitrate and sulphate of sodium and potassium; but he cannot extract the caustic alkalies by means of lime, nor in any other way that will pay. "Subscriber" speaks of using nitre. If he used nitrate of soda instead, he would effect a considerable saving, 85lb. doing as much work as 101lb. of nitre. He would then have only sodium in his liquor after treating with salt, and if he has any waste heat it might possibly be worth while to evaporate the solution, and sell the solid sulphate of sodium (or bi-sulphate of sodium, as it would really be) to a soda manufacturer. He would at the same time get off nitric acid, which he might readily condense and utilise. If "Subscriber" adopts this plan he should avoid a great excess of salt.—ALFRED H. ALLEN, Sheffield.

[12172.]—**Constipation.**—In answer to "H.S.A.," I would recommend him to try what I have tried myself, and treated patients successfully, as follows:—Early in the morning drink a tumbler of cold water, then go into a garden lawn and cut or roll the grass for half an hour three times a week, with an easy mowing-machine, as I possess, the Archimedian one; and I think after a short trial of this system, "E. B. F." will find what I have personally found, constipation to cease and nature act with comfort. The rationale of this treatment would occupy too much space to describe it professionally in your valuable journal. I inclose my card for further inquiry if "H. S. A." desires it.—PHYSICIAN.

[12176.]—**Hydrogen Flame.**—Take a small and wide-mouthed glass vessel and invert it over the tube whence the gas is issuing. When this is full, test it by applying a light, keeping it inverted, and of course, at a safe distance from the generating apparatus. If it explodes, try it again and again. When the hydrogen burns quietly in the glass it will be safe to apply a light to the tube.—CERVUS.

[12176.]—**Hydrogen Flame.**—Your mistake is simply that you do not wait long enough for the air to escape. For a half-pint bottle you should wait quite three minutes before lighting, and four or five minutes would be better.—GLATTON.

[12177.]—**Algebra.**—This is only an application of the rule which says that the numerator and denominator of a fraction may be multiplied by the same quantity without altering the value of the fraction. Here each of the three fractions is treated by 1 in this way, which has the effect of altering the sign of the number of each, and of one of the factors of the denominator (since by multiplying any one of the factors of a quantity we multiply the whole quantity), thus making the factor $(a - c)$ in the denominator of the first fraction become $(-a + c)$ or $(c - a)$; and the same in the others. We might, without altering the signs of the numerator, change the signs of any two of the factors of the denominator since multiplying twice by − is the same as multiplying once by +, on the principle that two negatives make a positive. The probable object of the operation in this case is to assimilate the denominators of the three fractions, and thus make it easier to find their L. C. M.—CERVUS.

[12177.]—**Algebra.**—I suppose "W. M." is aware of the fact that $a - b = -(b - a)$. Now, if he will examine the two expressions given in his query, he will observe that the only changes are in the signs prefixed to the fractions, and in the substitution in the denominators, firstly of $(c - a)$ for $(a - c)$, secondly of $(a - b)$ for $(b - a)$, and lastly $(b - c)$ for $(c - b)$. He will then perceive that the two changes balance one another, and that Mr. Todhunter's reasoning is legitimate.—NEMO.

New Disinfectant.—Mr. W. Crookes has taken out letters patent for a new disinfectant and deodoriser, which is claimed to be superior to any known agent hitherto in use. The invention consists in mixing together or passing sulphurous acid into carbolic acid in order to produce a compound possessing disinfecting, deodorising, and antiseptic properties of a nature superior to those of the constituents when employed separately. Cresylic acid or other similar homologue of carbolic acid, or the liquid known as creasote, may be employed for mixing with the sulphurous acid.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. Bolton has answered 11746; "Glatton," 11787.

11794 Clutch for Driving-wheel of Veloce, p. 210
11795 Rough Pitch, &c., 210
11802 Date of Patent, 210
11803 Euplectella Spinosa, 210
11804 Estate Agencies, 210
11805 Extracting Gelatine from Bones, 210
11807 Preserving Heat and Boiler, 210
11815 Fishing-rods, 210
11817 Portland Cement, 210
11819 Roof of International Exhibition Building, 210
11820 Gas Bags, 210
11822 Slide-rest, 210
11823 Holtz's Electrical Machine, 210
11824 Punching Machines, 210
11829 Tackle Poles, 210
11830 Indicating Tablets for Electric Bells, 210
11837 Organ Bellows, p. 211
11838 Clock Pallet, 211
11843 Iron Castings, 211
11844 Rabbits-skins, 211
11849 Printing in Canada, 211
11851 Supercargo, 211
11852 Pallet Springs, 211
11854 Raising Salt-water, 211

QUERIES.

[12179.]—**To Electricians.**—I should feel grateful to Mr. Tonkes (who is silent of late) or any other electrician who would kindly answer the following questions, or say in what recognised work I may find this particular subject treated, either practically or theoretically:—1. What office does hair fulfil in the human system? Is it a good conductor of electricity, and is the hair on the head, which is usually supplied from the earliest infancy, to be understood as a conducting medium whereby electricity, or a similar ethereal fluid, is transmitted to the brain placed directly underneath, and through it to the nerves and ganglions, which act immediately on the blood vessels, causing the circulation of nervous and other fluids synchronously through the body, one regulating and counteracting the other so as to maintain life in its normal state? Has not a fluid electrically excited a tendency to scatter and project through almost imperceptible openings and channels by the agitation and separation of its component molecules? Is this in part explanatory of the circulation of the blood, and how far does it accord with well-known and established theories? 2. Suppose an opening was made through the skull of a dead man immediately after death, and a wire leading from a powerful galvanic battery inserted chemically through the membraneous covering of the brain, and if at the same time warm, healthy blood was injected into the heart and artificial respiration commenced, would life be restored, even during the limited period a current would be generated and transmitted by the wire into the brain and nerves? 3. If one in a number of men forming an unbroken circuit, and to whom shocks are given simultaneously by an electrical machine, were to die suddenly while forming a portion of the circuit, would his death affect the remainder in any way? 4. If a number of men or animals, some having an infectious disease, are similarly connected and treated, would the disease be carried with the current from one to the other; or does atmospherical electricity act any part in the transmission or spread of infectious diseases?—Rat-Tat.

[12180.]—**Seasoning Pear Wood.**—Will some correspondent kindly inform me how long I ought to let a trunk of pear season? Would a hay-loft be too warm, for I have it in one at the present time? Does it turn well—if not, what could I use it for?—A. H. Cooke, Cologne, Prussia.

[12181.]—**Violin Case.**—Would any of your readers give me a few practical directions for making a violin case? I made an attempt at one, but failed in endeavouring to bend a piece of pine round the circular ends, by means of a number of saw cuts about half through. The wood broke in some places and sprung in others. I should like to know the best sort of wood for the above.—J. E. D.

[12182.]—**Roses.**—Could any of "our" horticultural readers give me a short outline of the sticking down process for rose bushes, how and when it is done, and the best varieties for same?—Aroma.

[12183.]—**Mottled Cary Wood.**—I have recently seen some fine cabinet work, made of a beautifully marked light brown wood. I am told it is a New Zealand wood of great value, called mottled cary, and the best wood grown in that country. Has any reader heard of this wood and can he give me any idea of its price here?—Yaah.

[12184.]—**Brown Varnish for Baskets.**—Can some kind reader inform me how to make it?—B. B. M.

[12185.]—**Madnip and Wood Laurel.**—What are their virtues and botanical names?—B. B. M.

[12186.]—**Cheap Farming.**—Which is the least land impoverishing method in farming? Is milking cows not so?—B. B. M.

[12187.]—**Repolishing Chimney Piece.**—I have a marble chimney-piece, which an unusually stupid servant has blackleaded. With an infinite amount of washing and scrubbing, I have succeeded in taking off all traces of the black lead, but have also destroyed the polish of the marble. Can any reader of "ours" give me a simple method of restoring it?—Ajax.

[12188.]—**Canoe Club.**—Would some reader of "our" valuable paper kindly give me some information about the canoe clubs (if more than one) established in London? What qualifications are necessary for enrolment?—H. R. H.

[12189.]—**To Mr. Tonkes.**—I desire to thank Mr. Tonkes for kindly answering my questions respecting 12 Smee cells (plates 3in. by 2in.), and shall feel grateful for advice on the following:—1. On starting these 12 cells at first they gave twice as much power as they now do with double the quantity of acid. Not requiring the full power, I put one-twenty-fourth of acid at first, and now one-twelfth. I am afraid I filled the cells before the liquid was cold, if so, are they ruined, or what is the remedy? The silver plates appear thoroughly platinised, and the zinc plates and connections are all right. 2. I have made a coil (primary), three rows of No. 16 cotton-covered wire. Contact breaker acts well, but the platinum wears away very quickly, soon becomes foul, and stops. Is there too much zinc in the cells? 3. Will Mr. Tonkes kindly explain to me clearly, how and of what Mr. Halse's coils are constructed?—Intensity.

[12190.]—**Trios for Male Voices.**—Will some one give me the names of connected works (if any) for two tenors and a bass, also, a few good trios for the same voices?—Trio.

[12191.]—**Surgery Abroad.**—I should be much obliged to any traveller of "ours" who could advise me as to the best place to emigrate to where a surgeon is likely to succeed, having a large family of growing sons, and the competition being so great at home it is hard to make ends meet. I am highly qualified and registered, and have had extensive army practice abroad, but wish to leave it now and settle down where I can get a fair amount of support, and be able to look after my (four) boys, who are motherless. My age is thirty-four, strong and healthy, but I should not like too hot a country. Can any one let me know the prospects of a good surgeon relatively in North and South America, Australia, Cape of Good Hope, or other favourable place. Is it necessary to have introductions? Any reliable information will much oblige—Mark Htwsstks.

[12192.]—**Concrete.**—Can any one tell me how to make and apply a concrete for flooring stables and sheds? It must not be more expensive than the ordinary pitching. Any information will be thankfully received by—J. W. F.

[12193.]—**Magenta.**—Will any one inform me how this colour can be made more permanent? I have been using it on paper, but find that after a few days' exposure to the light, it almost wholly disappears.—A. W. H.

[12194.]—**Enamelling.**—Will "Proven," "Ethel," or some other jeweller, please to give me some instructions in the above beautiful art, more particularly with regard to the composition of the different colours, the fluxes, and the preparation of the articles to be enamelled, such as monograms, &c., on lockets, studs, &c.? I would invite the attention of our jewellers to this question (it has been asked before, but not answered), as I have no doubt it would interest many others besides—G. P. B.

[12195.]—**Ventilating and Warming Buildings.**—I should feel obliged to any correspondent who could inform me what is the best modern work on the ventilation, lighting, and warming of buildings. I also wish to meet with a book giving the principles on which rooms are constructed with regard to the conveyance of sound.—P. Santalinus.

[12196.]—**Rendering New Rope Flexible.**—Can any one inform me how to soften a new 4in. Manilla rope? It is now so stiff that we find it impossible to use it in the pulley blocks.—W. B.

[12197.]—**Roses.**—As the budding season is coming on, would some subscriber well up in the subject, kindly give me a list of some of the very best roses in cultivation? I would be glad also, of the names and addresses of two or three of the largest rose growers in England.—Peacefield.

[12198.]—**Extracting Iodine from Seaweed Ashes.**—If not troubling you too much, could you find space for the following:—Seeing "A Barrister's" answer to query 11736, p. 209, I got some seaweed and dried it, but not being able to get it to burn, I put it in an earthenware pot and put it on the fire, and burnt it that way, and then followed out his instructions as near as I could, but did not succeed in getting iodine. I think, perhaps, I burnt the weed too much. Is the black oxide of manganese right, and how much kelp should it take to make (say) ½oz.? Is not the weed obtained already burnt, and do not the glass manufacturers use something of the sort? If "A Barrister," or any of the subscribers who answered "J. R." would kindly help me, I should feel obliged.—Kelp.

[12199.]—**Speeding Pulleys for Gut.**—How can I obtain a correct ratio between the large pulley of (say) 4 speeds and the small one of 4 speeds as generally used on foot lathes? I want them so arranged that the gut can be slipped from one speed to another, and be equally taut.—E. Williams.

[12200.]—**Levelling.**—Will any of your readers enlighten me on the following:—50·76 is a ground level. Is the 50 representing feet and the 76 the seventy-sixth part of a foot, supposing the foot to be divided into 100 parts?—Bricklayer.

[12201.]—**How to Reduce Pith to a Pulp.**—Can any subscriber kindly inform me how to reduce pith to pulp? Should any acid or alkali be used?—Janus.

[12202.]—**Boat Building.**—Could the editor of the English Mechanic or any of his numerous readers, tell me the name and price of any good work on boat building? I also wish to know the name and price of a good work on making and rigging model vessels.—A New Subscriber.

[12203.]—**Pictures.**—A friend of mine has a painting (a summer landscape), the dimensions of which are about 13in. by 10in., and the name of the painter is, I think, Van Brughols. Does the name suggest that the picture may be of some value. I also saw a lithographic print in colours (41in. by 18in.) of the ceiling of the Sistine Chapel by Michael Angelo, executed at the lithographic institute of Winkelmann and Sons, at Berlin (1852, 1853). Where can it be had in England?—Barbaros.

[12204.]—**Pansies.**—Which is the best way to strike slips of pansies? Will they strike in any common garden soil, or do they require to be a ruck under glass, as I have a small frame of glass about 3ft. long 2ft. wide? In getting a stock of pansies is it best to get slips or to get seeds? What kind of soil is best to raise them on?—One Anxious to Learn.

[12205.]—**Double Rockets.**—Are there any flowers now in cultivation of the double white and yellow rocket? How are they propagated, by seed or by slips? and when is the best weather to sow the seed or to get the slips?—One Anxious to Learn.

[12206.]—**Geraniums and Fuschias.**—Which are the best two scarlet geraniums, and the two finest foliaged fuschias among those that have been out for the past two or three years? Their price must not hinder a poor man from getting them.—One Anxious to Learn.

[12207.]—**Light.**—Could any of your numerous scientific correspondents enlighten me on the following points:—1. Can a beam of light by means of the rotation of plates of any polarising mineral, such as tourmaline, Iceland spar, mica, &c., be entirely intercepted? 2. In the progress of obscuration thus effected, from the maximum of brightness to the minimum (or to perfect darkness), does the diminution of light proceed in regular ratio with the regularly increasing angle of rotatory position? That is, while the second plate or analyser rotates on the first plate or polariser, through 1, 2, 5, 10, 20, 30, &c., degrees of the quadrant, up to 90°, the maximum of darkness, is the diminution of transmitted light equally regular? 3. If so, what is the polarising subject that will effect those desiderata in the most perfect manner?—Iris.

[12208.]—**Gold Fish.**—I have had a number of gold fish die lately full of spawn, and I am informed that the reason of their death was because they could not spawn. Can any brother reader inform me of a remedy?—Tripod.

[12209.]—**First Railway.**—Which was the first railway opened in England for public passenger traffic, and at what date?—H. L.

[12210.]—**The Manufacture of Blacklead.**—Will some correspondent inform me of the manufacture of blacklead for stoves, how manipulated from the raw plumbago, how adulterated, mixed, moulded and finished?—A. R.

[12211.]—**Sea Mouse.**—Will some kind subscriber furnish me with some account of this animal?—Scrutator.

[12212.]—**Yacht Building.**—I am about to build a small sailing yacht, 15ft. long, Carvel built, with bent timbers. Having got the keel, stem, and sternpost together, but do not know how to draught out the timbers to the curves required, before bending them. Perhaps some of your talented contributors can enlighten me.—J. U., Glasgow.

[12213.]—**Coffee.**—What is the cheapest, easiest to manage, and best machine for making coffee?—An Aggrieved Householder.

[12214.]—**The Game of Quoits.**—Will you kindly inform me as to the following things through your journal? 1. In the game of quoits, when wooden pegs are used, supposing the quoit pitches on the top of the peg and splits it down through the middle and "rings" half of the peg, would that reckon as a "ringer," or should it ring the whole of the peg to count? 2. What is the correct distance to play when the quoits are 4½lb. per pair? 3. How is the distance measured from the peg to the quoit—from the nearest part of the peg or from the bottom of it to the quoit? 4. Where can I get a set of rules for the game?—Tom-Tit, Pembroke.

[12215.]—**Fettling Materials.**—An article in the English Mechanic some time ago relating to Danks's puddling furnace states that a revolving pan or grate is coated with marbella, blue billy, ilmenite, or other suitable stuff. Would some reader please give the composition of the above three substances?—E. M.

[12216.]—**Transferring Marble Paper on Book Edges.**—Can any of your readers let me know something about the transferring of marble paper on book edges, if it is much practised, and if the edge has a good appearance when done? I have tried the marble paper prepared for the purpose—by dipping it in muriatic and other strong acids, and then pressing it on the edge of the book—but I cannot make it answer at all.—Bibliopegia.

[12217.]—**Violin Tuning.**—Will "Fiddler," or "The Harmonious Blacksmith," or any correspondent of "ours," please say if violinists tune their violins in just fifths, or how they tune them in each key?—W. Meek.

[12218.]—**Momentum.**—We have a very old bridge over the Ouse here, and the approach is very steep, I should think four or five degrees. Men who are taking a load up often put their horses to a quicker pace just before ascending this incline. Do the horses get over the difficulty any the better for a start at a quicker pace before ascending?—W. Jagger, St. Ives, Hunts.

[12219.]—**Turning Ivory.**—Is there any softening process required? If so, how is it done? Can it be turned in an ordinary lathe? Any information as regards speed, tools, &c., would oblige.—Charlie.

[12220.]—**Superheater.**—I wish to put in a superheater to my boilers (three 30ft. by 7ft. 6in.), and shall be obliged if some of your correspondents will say which they consider the best and cheapest.—Superheater.

[12221.]—**Brass Screws.**—Could any of "our" readers tell me the number of threads requisite for brass screws? I have a hydraulic pump to make, some of the screws of which are upwards of 2in. diameter. I am at a loss to know the number of threads per inch they should have.—Falstaff.

[12222.]—**Iron Castings.**—In letter 3996 of the 19th April last, "Proven" describes the method of making fine castings from airtight moulds. I shall feel greatly obliged if he or any of your contributors will tell me if iron can be cast in the same way; and if so, whether it comes out clean and without scale. I want it for very fine iron moulds.—Caster.

[12223.]—**Wheelbarrow.**—May I ask one or more of your correspondents to give a drawing of a wheelbarrow constructed so that the wheel runs in the centre instead of the end of it, if such are made?—C. T.

[12224.]—**Cemented Object-Glass.**—I have lately purchased a 2¼in. achromatic by Dallmeyer, with a cemented object-glass; and as I believe the latter to be of first-rate excellence, I am naturally most anxious to preserve it in the best possible condition. I note with much interest that "F.R.A.S.," in his reply to "J. R." on p. 300, gives it as his opinion that "the sun ought not to melt the balsam, as it transmits heat rays pretty freely." Will "F.R.A.S." have the goodness further to state what he believes to be the cause of the cement becoming disturbed or cracked, as it has been often known to do? and, also, whether he considers a cemented object-glass as durable and as good, with proper care, as an uncemented one? Will "F.R.A.S." kindly say if there is any perceptible loss of light in using a terrestrial pancratic eyepiece with the above for astronomical purposes?—ALBIREO.

[12225.]—**Lead in Sulphuric Acid.**—I have a quantity of sulphuric acid, which is of a dark brown colour, owing to the presence, I believe, of lead from the chambers in which it is prepared. Can any fellow reader inform me of a simple process whereby I can separate the lead, at the same time retaining the properties of the acid for chemical purposes?—TONY WHITE.

[12226.]—**The Portuguese Language.**—As I wish to learn a foreign language, a letter from "A Harrow Fellow" (8805, March 22) came very opportune (at least so I thought). I followed his advice, and went to Longmans for a handbook of the "Mastery" system, the pages of which I eagerly perused, and felt convinced that the "Mastery" system would of all systems be the best. Consequently, I went once more to Longmans to procure the volume I needed, which was the Portuguese language; but I was doomed to disappointment, as this language is not published in Prendergast's Mastery series. Now, can "A Harrow Fellow" or any of the obliging correspondents in "our" journal kindly tell me what to do under the circumstances, whether it would be of any use to study Spanish, or if I should get a Portuguese book of any other system? An answer to this would greatly oblige. Perhaps some of my fellow readers would join a class for learning Portuguese. My own intention is, after having learnt Portuguese, to emigrate to Brazil. I have heard that Brazil would offer very good advantages to emigrants. Perhaps some of my fellow readers could throw some light on this question. —CARL.

[12227.]—**Astronomical.**—I should feel much obliged if some of your numerous correspondents would inform me what are the inclinations of the axis of the following four planets to the plane of their orbits—Mercury, Venus, Mars, and Jupiter.—COUNTRYMAN.

[12228.]—**Wood Engraving Tools.**—In p. 288, Vol. IX., of the ENGLISH MECHANIC there is a short description of wood engraving with illustration of the tools used. I have bought a set from a private party, and the handles are not same as figured in Vol. IX., being about 8½in. long, and like an ordinary bradawl handle. The tools are the right shape, but about 4in. long, which makes, with the handle, nearly 8in. How is it possible to use the tools same as illustrated in Vol. IX.? The party I bought them of says they were supplied to him as wood engraver's tools. Would any reader tell me if it would be advisable to substitute shorter handles.—ZOO ANDRA.

[12229.]—**Telescope.**—I have for some time wished to purchase a telescope, the question being the size, and whether reflector or refractor. I see I can get a 6½in. reflector (silvered glass) for about £30; can I expend that amount better in any other way? In the article on "Coloured Suns" in the ENGLISH MECHANIC for June 7, frequent mention is made of the result produced by a powerful telescope. What size and kind of telescope does this mean? Of course, I want a good instrument for general use—sun, moon, and planets, as well as fixed stars; for instance, what would Mr. Birt recommend for his "telescopic work for moonlight evenings"? Information from Messrs. Proctor, Birt, and "F.R.A.S.," or others, would be received with many thanks.—CANIS MINOR.

[12230.]—**Platinum Solution.**—How can I make and use the solution of platinum for producing the black on microscope work?—AMERICAN AMATEUR.

[12231.]—**Iceland Spar.**—How can I cut and polish the Iceland spar for polarising prisms.—AMERICAN AMATEUR.

[12232.]—**Secret Spring or Lock.**—Will any one of our numerous correspondents furnish me (through the columns of the ENGLISH MECHANIC) with a drawing of a secret spring or lock for the purpose of fastening a clothes box. I should, of course, require to know how to open it myself when necessary.—AN EMIGRANT.

[12233.]—**Red Varnish for Patterns.**—Would any brother reader kindly inform me how to make a red varnish that will resist heat and moisture when in the sand.—ENGLAND.

[12234.]—**Hairspring.**—I should be obliged if some of your kind readers would tell me if watchmakers use a gauge for finding the different sizes of hairsprings. I have got a verge watch and I have tried above a dozen hairsprings in it, and not one of them will do. Which is the best way to put them in?—B. H. J.

[12235.]—**Carpenter's Tool Chest.**—Will "R.A.B." oblige me with dimensions, size of tills, &c., of chest described on page 311, No. 376.

[12236.]—**Glowworms.**—When and where should these be looked for? I live in the neighbourhood of Richmond Park, and remember finding them there many years ago, but I do not know the time of year.—CITRUS.

[12237.]—**The Organ.**—To "PNEUMATIC LEVER."—I am now in a dilemma. I have made pipes, bellows, wind-chest, and frame, and have put the last three together ready for the pipes, but when I fill the bellows they run down again in about ten seconds. I have carefully examined every corner of the bellows, and have placed fresh springs on the pallets, and still the wind rushes out of the holes where the pipes go in, and apparently all over the stock boards. "Without any joking 'tis very provoking," after having worked for about twelve months to get an organ, and surely I have got one, for it whistles all over without any pipes. But I am not yet utterly cast down; I have been very careful in the work, and with a hint or two from "Pneumatic Lever," or some other of my MECHANIC friends, I anticipate success. I advertised my address to "Pneumatic Lever" in the number for week ending May 31, but I think my friend did not see it. If he remembers, I inquired about voicing pipes and another question or two (query 11836) which I could not trouble our kind editor to insert again.—ALEPH.

[12238.]—**Honey Taking Machine.**—"Beekeeper," letter 4167, p. 351, promised a description of a honey taking machine; I for one should like to see it, as I intend to adopt his hive.—COTTAGER.

[12239.]—**Hens' Eggs.**—Some of my hens lay soft eggs, one in particular, laying them every day in all sorts of shapes, some eat their eggs while sitting; can some one give me a remedy.—COTTAGER.

[12240.]—**Photography.**—Would any reader of the ENGLISH MECHANIC inform me of the cause and reason of the following? I have tried several times to prepare dry plates; I use the ordinary wet plate collodion, and thirty grain bath solution, and then wash well in three dishes of pure distilled water, and preserve them with malt, I then dry them well and expose twice or three times, as long as I do with wet plates, and then soak the plate for a few minutes in a weak silver solution, I then apply an iron developer, but not a trace of a picture or any sign that it has been exposed comes out.—NOTURB.

[12241.]—**Organ Pipes.**—I am now making a set of stopped pipes for pedals. I made one 4ft., mouth cut up one-fifth, but as it did not give a tone so loud as I wanted, I cut it up to one-third; it now makes a very much less sound, whether I give it more or less windway, but if I put a piece of wood on the top of the cap and throw the wind more into the pipe, it then sounds very well. The block and lip are perfectly true. Will "Adept," or "J. D.," or any one kindly come to the rescue, and say where the fault is? Does the block want bevelling off, as "Adept" recommended for pipes when cut high up?—W. H.

[12242.]—**Piano Construction.**—We have had many really good and valuable suggestions from our old friend "The Harmonious Blacksmith" on the construction of pianos, which, to those of our readers who have some knowledge of the subject, would be very acceptable, but to those who, like myself, have little or no knowledge of the various parts of a piano, they are rather bewildering. We have had in "our" columns many lessons on the construction of the organ and harmonium. But I do not remember ever seeing any lessons on the construction of the piano—viz., a series of papers, with diagrams, and every other necessary information as to materials, &c., from first to last. Presuming on the kindness of "The Harmonious Blacksmith," I would beg to suggest to him that to contribute such a series of lessons, with diagrams showing the framing of struts, &c., and every important point, would be highly appreciated by very many of our readers, especially those who, like myself, are in the cabinet and wood-working trade, and who have long had an aching tooth for the piano, to purchase which would cost, with cabinet-work (which seems unseparable from a really good instrument), about £40—a sum which few working men would be able to spend.—B. R. B.

[12243.]—**Turpentine and Wood Naphtha.**—Can any of your readers inform me through the medium of your paper what spirits of turpentine and wood naphtha are principally used for, and also give me full particulars of how they are both made and what kind of timber they can be made from? What would be obtained by distilling fir or pine wood in a retort? Are there any books published that tell how, and what, can be obtained from different kinds of timber by distillation?—D. T. L. R.

[12244.]—**To Harden Lead or Zinc Type.**—Will some kind reader tell me how to harden lead or zinc type sufficient to resist the heat of gas about eight or nine hours per day? The lead type which I use melts in about half an hour after being in the gas. Brass type being so expensive, this is wanted as a substitute for brass type for printing metal leaf. The lead type is bought ready cast.—J. B. SHARPLEY.

[12245.]—**Chemical.**—Will Mr. Davis or Mr. Bottone be so kind as to give a method of separating olefiant gas from coal gas, or all the illuminating constituents leaving the marsh gas?—R. TERVET.

[12246.]—**Seven-Keyed Tuning Fork.**—Would any of your numerous correspondents inform me how I could make a seven-keyed tuning or pitch fork? I have tried one, but I could not get it to work at all, and I would like to know what key to set the fork on before I put on the slides.—A BARITONE SINGER.

[12247.]—**Sewing Machine.**—Could any reader of the ENGLISH MECHANIC tell me if a brake can be made for a Wheeler and Wilson sewing machine to stop the wheel from going backward; if there can, how is it made? Also, how can I attach a vertical engine to the machine; if attached, how can it be stopped or set going. Would a 2½in. stroke engine do to work it?—W. H. T.

[12248.]—**Sheet-Iron Fireproof Deed Box.**—Would any of your scientific readers inform me of a fire resisting material to fill up the space between outside and inside lining, to be of a light substance, such as sawdust?—TOM THE TINKER.

[12249.]—**High Pressure Fire-Box Boiler.**—I am in want of a boiler that will stand a working pressure of 80lb. to the square inch. It will be required to drive a 25 horse-power (nominal) compound engine turning (say) 100 horse-power. Also to warm a four-storied mill 40 yards long, and at some future time to feed a dye-house; 80lb. pressure of steam will be ample to heat the mill and feed dye-house. Any information from your able correspondents which will enable me to get out a specification will be esteemed, such as the length and diameter of shell and flues, thickness of plates, length of fire-grates, and how the boiler ought to be stayed, &c.—495.

[12250.]—**Chemical.**—Could any brother reader of "ours" tell me the original method of Gay Lussac and Thenard for making an alloy of potassium and sodium, which is liquid at ordinary temperatures? Also the chemical action between this alloy and water when brought into contact, and what is left behind after the action has taken place?—VULCANITE.

[12251.]—**Electrical.**—Supposing I had two plate glass electrical machines, one having only one-thirtieth part of rubbing surface of the other—could I by working the small one thirty times faster than the large one get the same amount of current out of each?—VULCANITE.

[12252.]—**Electrical Machine.**—Is there any machine invented that would give a stronger current with the same weight—that is, suppose a plate-glass electrical machine weighed 10lb. and gave a certain amount of current, is there any other electrical machine invented that weighs 10lb. and gives a current greater than that of the plate-glass machine?—VULCANITE.

[12253.]—**Organ Construction.**—Will some of the readers of this journal kindly inform me how to make the couplers, swell to great, swell to pedals, great to pedals? Also, which stops will be the best to use for an instrument of two manuals and pedals? The number of stops must not exceed eight.—AMATEUR.

[12254.]—**Aerostatics.**—Will some one of your correspondents give me the reasons why the weight of any steam engine so far exceeds its motive power as to render it incapable of raising itself (by means of suitable mechanism) in the atmosphere? Also state why, for the same reason, galvanic electricity is useless. Have any experiments ever been tried with a view of determining this point? if not, what are the theoretical proofs?—CYCLONE.

[12255.]—**Hair.**—Can any of your readers inform me of a cure for the following disease of the hair? The hair of my beard breaks off as soon as it is about half an inch long, and has always done so for the last ten years; that is, ever since it began to grow. On examining the hair, I find it bent, and covered with little white knots, like nits, and it breaks off at one of these white places during brushing or washing. I have tried several lotions, but nothing has hitherto done me any good.—C. WATSON.

CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The arrangements in connection with the match by correspondence between the chess clubs of London and Vienna have been definitively concluded, and play will commence forthwith. This important match will cause some excitement in the "Chess World;" and, owing to the celebrity of the players engaged on either side, great interest is sure to be manifested as to the result.

TO CORRESPONDENTS.

R. A. P.—No. 1 is rather too easy, and the idea is old. No. 2 admits of another solution in two moves commencing with (1.) Q to Q B 8 (ch.). No. 3 is a neat little problem, and it shall appear on the conditions announced in your letter. We shall be glad to hear from you again.

G. V. G. (Gateshead).—Look again at your attempted solution to No. 1, and you will find that you have overlooked the interposition of the B P at the right moment. Thanks for your good wishes.

ARGO.—Your problem admits of the following solution: (1) B. to B. 6; (2) K. Kt. 2. Send us another specimen of your composition, &c.

T. J. MILLER (Fakenham) and W. COOK (Penge) are thanked for the interest they express in the welfare of our column.

F. OWDEN (Hoxton) and R. H. MACLEOD.—Re-examine Kling's problem attentively, and you will find you are mistaken. Don't take it for granted that the Black King has only one move.

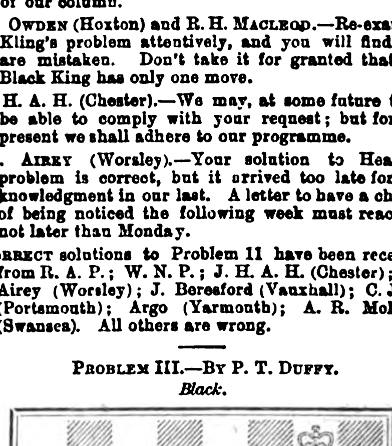
J. H. A. H. (Chester).—We may, at some future time, be able to comply with your request; but for the present we shall adhere to our programme.

W. AIREY (Worsley).—Your solution to Healey's problem is correct, but it arrived too late for acknowledgment in our last. A letter to have a chance of being noticed the following week must reach us not later than Monday.

CORRECT solutions to Problem 11 have been received from R. A. P.; W. N. P.; J. H. A. H. (Chester); W. Airey (Worsley); J. Beresford (Vauxhall); C. J. L. (Portsmouth); Argo (Yarmouth); A. R. Molison (Swansea). All others are wrong.

PROBLEM III.—BY P. T. DUFFY.

Black.



White.

White to play and mate in three moves.

SOLUTION TO PROBLEM II.

White.	*Black.*
1. R to Q B 3	1. K moves
2. B to K 6	2. K moves
3. R mates, acc.	

USEFUL AND SCIENTIFIC NOTES.

The ivy when viewed through the Nicol prism and a pink selenite, appears as if covered with blossom.

The cabbage moth has already made its appearance, and will visit the young cabbage and cauliflowers as soon as the plants are large enough to hold the eggs which produce the larvæ called cabbage worms. A capital remedy for these voracious fellows is that used by Quinn, of New Jersey. The mixture is:—1 part carbolic powder; 2 parts quicklime; 20 parts fine superphosphate. Dust the plants once or twice a week, when the dew is on the leaf.

Grease in Billiard Cloths. — Procure at the chemist's some powdered fuller's Earth (a very cheap article), form a paste by adding genuine spirits of turpentine. Rub the paste well in with tips of fingers and continue rubbing till the turpentine has evaporated and but a powder remains. This can be at once brushed off and all will be free from soil. Pitch, tar, or paint, shares the same fate as oil. The paste may be scented with essence of lemon if need be.

Abolition of Steamer Funnels.—According to the *Swiss Times*, two Austrian marine officers and a marine engineer have discovered by united experiments a method of conveying away under water the smoke from the steam-engine, instead of through a funnel into the air! They make use of double ventilators, which compress the smoke and force it overboard. For propelling these ventilators they employ, according to circumstances, either water-power—that is, the pressure of the water between the surface of the water and the place where this apparatus is fixed, or, for smaller vessels, steam power. A chief advantage of this discovery will be the greater security of ships of war, as, in armour-plated ships, the only vulnerable part, the funnel, will be taken away! For submarine and torpedo ships and monitors this discovery, it is said, will be of great value.

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Amount previously acknowledged	£335 16 1
E. Williams	0 0 6
	£335 16 7

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 81, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, June 18, and unacknowledged elsewhere:—

Capt. A. Leslie Kaye.—Geo. Awford.—J. C. Crowther.—R. O. Berry.—A. P. Compton.—Gordon Douglas.—C. Townley.—Frances and Co.—Olley and Miller.—T. C. Rylands.—Evan Leigh.—Joseph Newton.—Isaac Sim.—Cunliffe and Croom.—H. Pallexfen.—John Bellows.—H. T. Casini.—Alfred Crofts.—T. Stanners.—Wm. Ibbetson. — J. Robinson.—Philo.—Sigma.—Plough.—Cometary.—Edward Watkins.—Capt. Hans Busk.—A. Wake.—Dr. A. McGregor Croft.—Lockwood and Co.—T. Fletcher.—Rev. W. W. Garrett.—J. D. Purvis.—John Murphy.—Jack of All Trades.—M. A. B.—C. J. B.—Youngster.—M. A.—T. W.—Excelsior.—A Constant Reader.—Charles Hopkinson.—John Wallace.—David Morris.—Trovatore.—E. S. T.—R. A. Proctor.—The Rev. T. B. Armistead.—E. G. H.—The Harmonious Blacksmith.—F. S. Beachey.—A. M. C. D.—M. Burns.—Scarborough.—Peerless.—J. H. Bushel.—J. W. Cook.—Henshaw and Son.—R. K. Blessley.—Old Ford.—H. J.—Artillery Captain.—E. L. G.—T. P. Lilly.—W. E. D.—Pinky Tone.—J. Marsden.—W. H. Skelton.—J. H. C.—Samuel Cook.—J. C. S.—J. E. Devlin.—Rat-Tat.—James Levesque.—A Leeds Subscriber.—Farmer.—A. D.—Edgar.—Devonshire.—Cornubiensis.—C. J. Recordon.—K.—Bron.—H. B. E.—Jno. Purday.—C. T. B.—Rev. H. C. Key.—S. D.—A Three Years' Subscriber.—M. G. C.—Houblon.—Ixion.—C. K. J.—M. Paris.—W. W. Still.—M. N.—A. T. C.—B. L. G.—Charles Corfield.—H. D. Plimsoll.—A. H.—F. F. C.—B. S.—L. M. F.—Derfla.—T. H. T.—An Apprentice.—Tablet.—Nottingham Sub.—W. M. Mitchell.—W. R. Birt.—Westward Ho!—J. B. Wilde.—Reporter.—Eye-piece.—Plumbago.—E. R. T.—T. W.—J. B. H.—C. C. R.—Musical.—W. H. Andrews.—T. W. Reynolds.—E. T. Greys.—T. S. Usborne.—Jonathan.—J. W. Fennell.—J. Pearson. — Suffolk Amateur. — Quercus. — T. H. Buffham.—Un Irlandais.—M. S. W.—Dundalk.—Afternoon.—King Cotton.—John B. Lindsay.—Sceptical.—Smithy Steying.—T. H. F.—J. G. W.—C. H. Wingfield.—Rev. J. Lukin.—A., Liverpool.—Inventor.—Saul Rymea. — Charles Lahee. — Sciolist. — A. Wake.—A. Williams.—W. H. Neal.—W. M. Parker.—B. Smith.—W. E. Hockling.—W. B., Lymington.—Mrs. Hodgson.—Edward.—J. C. J.—Vent Peg.—Beauty.—Caloric.—J. E. B.—E. Barker.—Finger Post.—Glasgowegian.—J. Roskell.—J. W. Morris.—Beginner.—R. B.—E. B. F.—A. G.—Wondering Willie.—Jacques Erick.—J. Eldridge.—J. W.—Francis & Co.—Wilson Irwin.—S. J. H.—W. F. W.

COMETS AND THE DELUGE.—E. K. says:—"In closing the discussion under this heading, you will consider it pertinent to the subject to remind your readers that, while 'E. L. G.' contends that the world was drowned by a comet, Sir Isaac Newton says comets are the fuel which supply the sun with heat and light, and that the comet of 1680 is approaching the sun, and will ultimately fall into it, and whenever that happens, the world will be burnt up and at an end."

ACHILLES.—1. If none of the methods of extracting glass stoppers given on pp. 48, 77, of the present volume are effectual, we are afraid you will have to give it up as a bad job. Every known plan is mentioned on those pages. 2. With regard to French polishing the paint box, you will find all the directions you require on pp. 444, 468, and 521 of Vol. XIII. 3. The village of Lexden, two miles from Colchester, is probably the site of the British Camulodunum, and, although Maldon was once regarded as the Roman Camulodunum, there is now but little doubt that Colchester is the true site of the Roman colony. 4. The book you mention is published at £7 8s. for the five volumes, and 31s. 6d. for the supplemental volume.

CONFIDENT is referred to "Hints to Correspondents."

"OLD RED CAP."—You are certainly entitled to the invention, but whether you can claim it after thousands of articles have been made on the plan, and without its being patented, is not so certain. Can't you arrange with your employers before you leave.

PH.D. — Means doctor of philosophy. The degree is obtained in Germany.

YOUNG HOPEFUL.—See "Hints to Correspondents."

PEACEFIELD.—Consult a medical man at once.

T. H. HOWE.—Apply to a racing paper.

FALSTAFF.—Your reply would give Messrs. Tangye and Co. an advertisement gratis.

FIDES.—See another query on the same subject.

GRAHAM HAMILTON. — Something like an advertisement. Inquire in Belfast.

A. W. L.—Consult a medical man.

A SHEFFIELD BLADE.—You must consult some local guide book. It is unreasonable to expect us to insert queries of such limited local interest.

SHEFFIELD, X. Y. (Birmingham), W. S., F. Chalk (Ipswich), T. R., J. Marsden, Rambling Tom, June Rose, W. O. K., are referred to indices to back vols.

Communications which can only appear as advertisements to hand from W. T. Wright, Bisnatus, Gaucho, J. Y., M. C., Manus, Midshipman, J. E. Bird.

W. H. SKELTON.—You have evidently a fair share of confidence as well as ignorance. Read and try to understand the discussion at present going on about "Time at our Antipodes." See also an article on the "Pathway of the Eclipse," of August 7, 1869, in the ENGLISH MECHANIC, of September 3, 1869, p. 521, Vol. IX. Your chess query is a very absurd one. Do you really require to be told that if black *could* avoid being checkmated in the given number of moves it would be no problem.

A FOREMAN. — Bourne's "Catechism of the Steam Engine" (Longmans).

JOHN HOPKINS.—We cannot insert your long reply to "F. R. A. S." It is little else than a repetition of your previous statements, and is characterised throughout by an evident inclination on your part for controversy for its own sake.

ANCIENT AND MODERN DURSTON.—It was a hoax; the same query was recently asked and answered in our pages.

YOUNG STUDENT.—Write the Secretary to the Council, and see indices to back vols.

A SUBSCRIBER.—Leroy's composition would suit you. See advertisement.

ASSOC. INST. C.E.—The information was obtained from a German source. You had better communicate with the inventor, whose address was given.

DANE AND WONDERING WILLY.—Inquire of any optician. We cannot spare space for such queries.

LEIBLICH.—We should be glad to receive the proferred working drawings—preferably in two parts as suggested.

OLD COINS.—Your rubbings are too indistinct to engrave.

GEORGE.—Write to the secretary of any insurance society, or ask any insurance agent.

A NOVICE.—Your query was an advertisement, and therefore not inserted. Why not read "Hints to Correspondents," and act accordingly.

P. SANTALINUS.—Yours in answer to "E. L. G." came too late, and the controversy is now closed.

RECENT READER.—Early rising, cold ablutions, regular but pretty good living, patience, and virtue. Those who sin *must* suffer. If you cannot repair the ravages of the past, you may assist in preserving tolerable health in future.

J. H. HALL, John Hopkins, and M. A.—The controversy on "Is Light Invisible" is closed.

J. T. SPRAGUE.—Second article on "Electro-metallurgy" next week.

T. B. S.—Consult last index.

S. LINWOOD.—The subject of Earthquakes and Volcanoes is, as you may see, continued this week.

E. L. W., Stopgap, Turner, J. M. Williams.—Your queries and replies are advertisements.

LENA BURRUT.—We don't remember hearing from you before, and from the tone of your letter do not wish to hear from you again.

HEWITT AND CO.—Your letter on Patent Laws contains nothing but what we have said again and again.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JUNE 11, 1872.

1680 W. Stother and G. Milton, Manchester, for improvements in "folding desks" suitable to be employed in schools.

1681 A. McKenzie, Renfrewshire, N.B., for improvements in restoring heat to steam boilers or other furnaces.

1682 A. Dugdale, Paris, and J. Mingrat and A. Vansteenkiste, Brussels, for improvements in the manufacture of steam cocks, water cocks, and gas cocks.

1683 T. Hack, Hammersmith, for improvements in pipe connections.

1684 G. Thomas, Stoney Stratford, for improvements in portable cooking apparatus.

1685 G. Shaw and T. Shaw, Dukinfield, Chester, for improvements applicable to rotatory brushes and burnishers.

1686 J. Atkins, Birmingham, for improvements in metallic bedsteads and cots.

1687 R. Carey, Radcliffe-villas, Brixton, for improvements in rotary pumps, applicable also as fluid meters.

1688 J. Hayman, Poole, for improvements in brushes and in apparatus connected therewith.

1689 J. Sullivan, Boston, U.S., for hydrostatic safety apparatus for the rollers on rolling mills or other machinery.

1690 W. Riddell, Bishopsgate-street, City, for improvements in the manufacture of paper pulp from vegetable fibres and in apparatus therefor, which apparatus is also designed to be employed in making chloride of lime for bleaching pulp and in other similar processes.

1691 G. Westinghouse, jun., Southampton-buildings, for improvements in apparatus for working brakes and communicating signals on railway trains by compressed air, parts of which improvements are applicable generally for retarding locomotives.

1692 M. A. Clark, Chancery-lane, for improvements in ladies' bustles or tournures. A communication.

1693 J. H. Johnson, Lincoln's Inn-fields, for improvements in apparatus for applying colouring or mucilaginous solutions. A communication.

1694 G. S. Fleming, Oxford-street, for improvements in stoppers for bottles.

1695 J. Stevenson, T. Carlile, and J. Stevenson, Glasgow, for improvements in the manufacture of bicromates of soda and potash.

1696 I. A. Timmis, Manchester, for improvements in the manufacture of tarpaulin.

1697 E. Orr, Dublin, for improvements in the manufacture of gun cartridges.

1698 J. Hartley and Z. Sugden, Halifax, for improvements in boilers for heating or warming buildings.

1699 J. T. Dann, Cowley-road, North Brixton, for improvements in the manufacture of phosphorus. A communication.

1700 R. Faulkner, Kensington-gardens-square, for improvements in the production of photographic pictures from negatives, and in the means employed therefor.

1701 R. Hall and J. Hobson, Bury, Lancashire, for improvements in looms for weaving.

1702 G. B. Northcote, jun., Feniton, Devonshire, for showing the level of the liquid contained in a vessel, and for a proportional measurer.

1703 A. A. Bois, Paris, for improvements in the construction of ships or vessels, and in the means or apparatus for lading and unlading their cargo.

1704 J. H. Brown, Exeter Hall Hotel, Strand, for an improved principle and method of securing corks and stoppers in bottles, jars, and other receptacles for wine, spirits, beer, ale, aerated compounds, corrosive acids, and other liquids.

1705 J. Hinchcliff, Bromley, Middlesex, for improvements applicable to printing machinery.

1706 A. V. Newton, Chancery-lane, for an improved manufacture of bale tie or coupling. A communication.

1707 D. Vincent, Erith, for improvements in apparatus for distributing liquid, particularly applicable to gas scrubbers.

1708 C. W. Harrison and A. H. Harrison, High Holborn, for improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein.

1709 L. Scala, Clerkenwell-green, for improvements in dyeing when indigo is employed.

1710 W. M. Brown, Southampton-buildings, for improvements in dyeing animal or vegetable textile fabrics or yarns aniline black, or other fast colours derived from coal tar. A communication.

1711 D. Hunt, Serle-street, Lincoln's Inn, for an improved motive power machine or apparatus. A communication.

1712 J. Hough, Manchester, for improvements in apparatus for coupling or connecting and disconnecting railway waggons.

1713 C. F. Clark and G. Bruerton, Wolverhampton, for improvements in coffee mills.

1714 W. R. Davis, Store-street, Middlesex, for improvements in graining wood and other surfaces.

1715 A. Greenwood, Leeds, for an improvement in the construction of screw gill machinery.

1716 A. Greenwood, Leeds, for an improvement in the construction of screw gill machinery. A communication.

1717 J. Conlong, Blackburn, and J. Smith, Clayton-le-Moors, Lancashire, for improvements in counting apparatus suitable for hank-winding machines and for other purposes.

1718 T. Telford, Newcastle-upon-Tyne, for improvements in the manufacture of bass and other brooms.

1719 W. S. Hodgson, Wortley, Leeds, for improvements in machinery or apparatus for dressing and finishing leather by the processes known as "levanting," "momelling," "glassing," "skiveing," and "whitening."

1720 P. Charpentier, Paris, for improvements in apparatus for heating by gas.

1721 W. C. McBride, Belfast, Ireland, for improvements in machinery for scutching flax.

1722 T. Gray, New Wandsworth, for improvements in the means of treating vegetable fibres for the manufacture of paper.

1723 J. J. Harrop, Manchester, and W. Corbett, Bradford, Lancashire, for improvements in puddling iron and in puddling furnaces.

1724 J. Cole, Great Portland-street, for improvements in breech loading arms.

1725 H. P. Holt, Leeds, for improvement in machinery and locomotive engines for driving tram cars and other road vehicles, parts of which improvements are applicable to other steam-engines.

1726 J. Dorrell, Westbourne-park, for an improved apparatus for containing coal, corn, or other commodities.

1727 J. N. Colby, Glasgow, for improvements in the glands of stuffing boxes for piston and other rods.

1728 J. Morris, Liverpool, for improvements in and connected with machines for finishing printed sheets of paper.

1729 W. E. Newton, Chancery-lane, for improvements in nocturnal telegraphic apparatus. A communication.

1730 A. Moseley, Newcastle-on-Tyne, for improvements in the construction of fire escapes.

1731 C. H. Russell, Regent-street, and J. Sax, Great Russell-street, Bloomsbury, for improvements in apparatus for marking or scoring at billiards, and for indicating the number of games played, and for other similar purposes.

1732 A. G. Speight, Spencer-street, Clerkenwell, for improvements in the manufacture of collars, cuffs, shirt fronts, and like articles for personal wear.

1733 C. J. Mercier, Paris, for improvements in the manufacture of indiarubber tissues for clothes and similar articles of a waterproof nature.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 28, 1872.

ARTICLES.

NEW EVIDENCE ABOUT STAR SYSTEMS AND STAR DRIFT.

By RICHD. A. PROCTOR, B.A., CAMBRIDGE,
Honorary Secretary of the Royal Astronomical Society,
AUTHOR OF "THE SUN," "OTHER WORLDS THAN OURS," "ESSAYS ON ASTRONOMY," &c., &c.

IT will be already known to those who read these columns, that on Thursday, June 13, Dr. Huggins announced to the Royal Society that among several other important discoveries he had found that there are systems of stars travelling bodily, or *drifting*, in definite directions through space. He had applied to these stars the spectroscopic method of determining stellar motions of approach or recession, and he had found (what no other method of determining stellar proper motions could have shown) that certain groups of stars are travelling with equal velocity towards or from the earth. Among such groups he mentioned one, the group formed by the stars, β, γ, δ, ϵ, and ζ Ursæ Majoris, respecting which I had announced more than two years ago not only that they form a drifting set, but that whenever Dr. Huggins applied the new method of research to them he would find that they were either all receding or all approaching at an equal rate. He has found that these five stars are actually all receding at the rate of about 30 miles per second. Moreover, he has found yet further evidence of their forming a single family or set of stars: for they all have similar spectra, with the lines of hydrogen strongly marked; whereas the stars Alpha and Eta Ursæ have spectra differing in character, the lines of hydrogen being scarcely discernible at all in the spectrum of Alpha, and not nearly so intense or broad in the spectrum of Eta as in the spectra of the other five stars.

I cannot but esteem myself most fortunate that within a few days only from the publication of my researches into the laws of stellar distribution and motion, such striking evidence in favour of one of the cometary theories should have been obtained by so skilful an observer and so eminent a physicist as Dr. Huggins. To say, indeed, that I am in a special manner gratified to find that my vaticinations respecting certain stars should turn out to be just, would be inexact. I had expressed no greater degree of confidence than I actually felt when I said that those stars would be found to move in a certain way, whenever the new method of research was applied to them; and I should have had abundant reason to be ashamed if so confident a prediction had been shown to be erroneous. For I hold that though every student of science must expect to fall into errors, and to have from time to time to withdraw or modify his published *opinions*, yet that it indicates a grave offence against scientific morality to be convicted of error where a theory has been announced as demonstrably true. It very seldom happens that a student of science is able to assert his *conviction* as distinguished from his *mere opinion* that a theory is sound. When he does so, he may be said to have staked his reputation on the result. If the theory is shown to be erroneous, it is demonstrated that either he spoke untruly in expressing conviction, or that he had yielded to an almost equally culpable fatuity. In either case he has lost thenceforth all claim on the confidence of other students of science.

Wherefore, in passing, I may lay down this general rule, that the student of science should rather fail on the side of caution than of confidence; that he should prefer to say "the evidence points to the belief" than "the evidence convinces me;" that he should be careful not to say "I have *shown* such and such a theory to be true," when in reality he has only gathered some evidence in its favour; and, lastly, that he should test a view in every possible way, and examine it in every possible light, before he announces it as a demonstrated theory. Or rather—in ninety-nine cases out of a hundred, he should attend to all these matters, and then *not* announce his theory (as demonstrated). As a rule, it will not lose by waiting. The exception is, when by so announcing it, the help of others may be gained for further inquiry in the same direction, or when the promulgation of some erroneous theory is injuriously affecting the progress of scientific inquiry. In either case it becomes the bounden duty of the student of science to speak plainly, if he really has deduced from sound evidence a demonstration of such and such facts.

The misfortune is that a line of reasoning which may afford a real demonstration may not be convincing save to a few. Michell proved, for instance, that certain stars lying close together must really be physically associated; and he very properly announced the discovery. A quarter of a century later Sir W. Herschel demonstrated the same fact by evidence which every one could understand. But Michell's demonstration, though more subtle, was as complete. If every person who read his paper had mastered certain branches of mathematical research, every one would have admitted Michell's reasoning as unanswerable. But because the majority could not appreciate Michell's reasoning, the world waited until Herschel had *watched* one star moving round another. This was a demonstration every one could understand; and thus the discovery is very naturally (though incorrectly) attributed to Herschel instead of Michell.

Hence the student of science may learn a second lesson. If he has demonstrated a certain fact and has occasion to announce it, he should take care to present it in an acceptable form. For instance, he should prefer pictures (when he can give them) to tabular evidence. The world has not time to examine tables of figures in order to see whether they really bear out such and such statements. He should remember, too, that though the world is not unwilling to be convinced,* a subject must be rendered to some degree attractive before it will gain general attention.

This, however, is a digression. Let us return to Dr. Huggins's discovery.

It can be shown that the spectroscopic method of research into stellar motions—if it can be extended to stars of the lower orders of magnitude (I mean the fainter stars), is likely to throw much light on the subject of real star magnitudes.

Thus we have seen that the stars included in the dotted line in the accompanying figure form two companions, are farther away than α and η, or the reverse? I conceive that we have, in the proper motions of these stars on the celestial vault. The direction and magnitude of these proper motions are indicated by the small arrow attached to each star, the point of the arrow showing the place on the heavens which will be occupied by the several stars at the end of 36,000 years.* Now, it will be admitted that the nearer a star is to us the more likely is it to be affected (apparently) by the proper motion of the sun, in such sort that a portion of its apparent proper motion would be due to the sun's real motion. We may, indeed, assume, without improbability, that that solar proper motion which causes a general prevalence of stellar proper motions in a certain direction, has reference to that portion of star-space which lies nearest to us. On this view we have only to inquire whether the stars β, γ, δ, ϵ, and ζ on the one hand, or α and η on the other, shift on the heavens more strictly in accordance with the effects due to the sun's proper motion in space, in order to ascertain whether the former or the latter are nearer to us. The answer comes in no doubtful terms. The stars α and η are moving in the star-vault almost exactly as they should if the sun's motion were alone in question, whereas β, γ, δ, ϵ, and ζ are moving in almost the exactly contrary direction. It can scarcely be questioned, then, that the latter are far the most remote.

Now, it is worthy of inquiry whether the direct spectroscopic analysis of these stars throws any light on this subject of distance.

Since β, ϵ, and ζ are not very unequal in apparent magnitude to α and η, it follows that if β, ϵ, and ζ are very much more remote they must in reality be very much larger than α and η.

Thus, suppose ϵ to be twice as far away as η (a very moderate assumption under the circumstances), then, since these stars are equally bright, or very nearly so, ϵ must really give out four times as much light as η. Hence, assuming equal intrinsic luminosity of the surfaces of these stars, it follows that the star ϵ is eight times as large as the star η. And similar reasoning applies to the other stars. As, however, it is altogether in better accordance with known analogies that the distance of the more distant drifting system should exceed many times the interval between the sun and the stars η and α, it would follow that the stars β, γ, δ, ϵ, and ζ are not eight or ten times, but *many* times larger (several hundred times larger, for example) than η and α.

Now, we might be led to the inference, as at least probable, that since the stars β, γ, δ, ϵ, and ζ

a single set or scheme. It follows as extremely probable that the stars α and η do not belong to the same region of space as the scheme formed by the other stars. In this case, they either lie very much nearer to us or very much farther away. It is true, indeed, that we might conceive the stars belonging to one drifting set to be carried into another set drifting in another direction. But it is altogether more probable that one set drifts one way because it has been exposed to such and such attractive influences, while the other stars, seemingly intermingled, have no such drift, because, being far removed from that region of space, they have been exposed to different influences.

Now, have we any evidence to show whether the five stars, β, γ, δ, ϵ, and ζ, as well as ζ's which thus exceed so largely the stars η and α (themselves certainly as large as our sun), the spectrum which is common to those five stars is in itself indicative of exceptional largeness. For it is manifest that when a star or sun is exceedingly massive, the gaseous envelopes which surround it must exist at a degree of pressure far exceeding that prevailing among the corresponding envelopes in the case of smaller orbs, like our own sun. And though it would by no means follow that the dark lines due to certain vapours would therefore be strengthened, yet there are some vapours whose lines we might expect to find broader and stronger. For instance, the vapours of the metallic elements would probably not produce stronger lines, or lines so strong, as in smaller suns, simply because a greater proportion of these vapours would occupy a position where their heat would be as great as

* Whenever a student of science asserts that he has been unfairly treated, and that the world is in a conspiracy against his views, it may be pretty generally taken for granted that the fault is not with the world at large. There is a considerable fund of generosity and kind-heartedness in human nature, and a man who works out his facts honestly and patiently will seldom have to complain of want of sympathy. Only he must not expect all men to give their attention solely to him. Some few may have other matters to think of.

* I adopt this arrangement here as in "Other Worlds," and elsewhere, as it gives a convenient scale for the arrows, and an easily remembered relation between the length of a degree on the sphere and the unit of measurement for these arrows. A star which would move over one degree of arc in 36,000 years would move over one second of arc in ten years, or a tenth of a second per annum.

that of the photosphere, and where, therefore, they would not cause absorption, or, rather, would radiate as much light as they absorbed. But the lighter gases, and particularly the gas hydrogen, might be expected to produce very strong and broad absorption lines, because a relatively greater portion of such gases would be in a position where it would act absorptively on the light from the photosphere. Now, it is the case, as we have seen, that the lines of hydrogen are remarkably strong in the spectra of the five stars β, γ, δ, ϵ, and ζ Ursæ, whereas in η the hydrogen lines are not nearly so strong, and in α they are somewhat remarkably weak.

Here, then, at any rate, is a suggestion of a certain view as to the significance of stellar spectra, which, should it be confirmed by future researches, could not fail to throw a considerable degree of light on the subject of the constitution of the heavens. Let us pause a moment to inquire how far it is confirmed by other known facts.

The star Sirius is one of those which has a spectrum with remarkably strong and broad hydrogen dark lines. Now, this star is certainly much larger than our sun, or, rather, it certainly gives out much more light. It is exceedingly probable that the intrinsic lustre of its photosphere is greater than that of the solar photosphere—yet not very greatly, we may suppose, since the researches of St. Claire Deville and others tend to show that there is a limit to the light and heat which matter can give out, under whatever circumstances. Now, assuming that the intrinsic luminosity of Sirius is equal to that of our sun, it is demonstrable that if we take the limiting determinations of the annual parallax of Sirius and of his absolute lustre as compared with the sun's, his orb is greater than the sun's in a proportion ranging from a minimum of 2,000 times to a maximum of 8,000 times. Taking the highest conceivable estimate of the inherent luminosity of Sirius, the lowest estimate of his absolute lustre, and the maximum value of his parallax (which, of course, gives the least value for his distance and for his magnitude, so far as its calculation depends on his distance), we cannot suppose that the volume of this star falls short of 1,000 times that of our sun. Here, then, is evidence strikingly in favour of the inference that a spectrum with strong hydrogen lines is indicative of relatively enormous magnitude.

Other stars which show this spectrum—as Altair, Vega, Rigel, and Regulus—are certainly very large stars, since we are certain that our sun, removed to a distance where, like these stars, he would have no measurable annual parallax,* would not shine nearly so brightly even as Regulus, the faintest of the four just named. It is a remarkable fact that Secchi has found this spectrum in the case of about one-half of the 600 stars he has examined. Unfortunately, Secchi's observations are somewhat rough, and have not always been confirmed by the more trustworthy researches of our great countryman, Dr. Huggins.

It will tend then greatly to throw light on the subject of the constitution of the heavens if it can be shown that, as Secchi asserts, the stars in certain regions exhibit similar spectra. We have seen that Dr. Huggins has confirmed this in one special instance. But if he can show that it is true in several cases, we shall have a means of, as it were, *placing* certain star groups. For when once we know that certain groups form a set (and can distinguish them from other stars seen in the same direction) we have only to inquire whether their average proper motions on the heavens imply relatively great distance or the reverse, whether their spectra imply great bulk or not, and so on, to gain an insight into their probable position, as a system, in the stellar universe.

The extension of the new method of determining motions of recess or approach to the fainter orders of stars, if it could ever be accomplished—and I conceive that at an elevated station, where the atmosphere was clear and pure, this might be done—would also afford an insight into the average *real* motions of the stars, which would cause the observed proper motions on the heavens to be much more significant as to stellar distances than at present.

* Vega is included among the stars whose parallax has been estimated. For my own part, I must admit that after noting the discrepancies in the estimates of the parallax of Sirius, and even of 61 Cygni, by the best observers, I find myself unable to place the slightest reliance in the actual measures of parallax, with the single exception of that of Alpha Centauri; and it is only in the cases of Sirius, 61 Cygni, and one or two other stars, that I can believe that an observable but not accurately measurable parallax exists.

It is very necessary, however, that we should have the heavens gauged with telescopes of different aperture, after the manner indicated in my "Essays on Astronomy." This is a work in which every possessor of a good telescope could take useful part, and it could not fail to throw important light on the subject of the constitution of the universe. Let it be remembered that Sir W. Herschel gave but a minute portion of his time to the work of star-gauging—that what he did was, as he said, "only an example to show the spirit of the method;" that Sir J. Herschel did only about as much work in obtaining certain gauge-fields in the southern heavens, and that Struve has pointed to the absolute necessity of systematic gauging, and with telescopes of different aperture. The work is by no means difficult, and it would "tell" quickly if the results of the gauging were duly (even though very roughly) charted.*

There is, indeed, an immense mass of work to be done towards advancing our knowledge of the stellar universe. Instead of being an explored field, as so many imagine, this field of research has scarcely been more than entered. What Dr. Huggins has just done proves that those peculiarities of structure on which I have so long insisted have a real existence. I venture to hope that the processes of research I have so long been advocating may now be entered upon. I have before me as I write the words of Sir John Herschel, the greatest astronomer of our age, and of the Astronomer Royal, the highest living authority on subjects astronomical, in confirmation of my opinion of their extreme importance.

* My star-gaugings with the telescope placed at my disposal for the purpose by the Royal Astronomical Society, have extended only to the region between Pleiades, Capella, and Betelgeux. (I propose next winter to renew them under slightly changed conditions.) This region is singularly interesting: it shows a very remarkable vacancy near the Bull's horns. This vacant space extends beyond my telescopic range: I should much like to know *how* deep (telescopically).

ASTRONOMICAL NOTES FOR JULY.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE right ascension of the Sun at Greenwich mean noon on July 1st is 6h. 42m. 57·46s., and his declination 23° 5′ 20·5″ north. Hence he will be found between the two stars ϵ and 36 Geminorum, at about two-thirds of the distance from the former. He rises in London on the 1st at 3h. 50m. a.m., and sets at 8h. 17m. p.m.; his rising and setting on the 31st taking place at 4h. 24m. a.m. and 7h. 48m. p.m. respectively, in the same locality. Twilight still persists from sunset to sunrise up to the 21st, on and after which there will be a very short (but, of course, gradually increasing) interval of real night. The equation of time is additive during the whole of July, increasing from 3m. 34·62s. on the 1st to 6m. 4·58s. on the 31st. The semi-diameter of the Sun at the instant of his Greenwich meridian transit on the 1st is 15′ 46″, this semi-diameter occupying 1m. 8·75s. of sidereal time (convertible into mean time by the subtraction of 0·19s.) in its passage over the meridian. On the 31st his apparent semi-diameter will have increased to 15′ 47·8″, and this will occupy 1m. 6.68s. of sidereal time (convertible, as above, into mean time) in its transit. The Sun will attain his minimum diameter on the 2nd, at noon, on which day he will be in apogee, or at his greatest distance from the earth. The sidereal time at mean noon is, on the 1st, 6h. 39m. 22·87s., and on the 31st is 8h. 37m. 39·59s.; the mean time at sidereal noon, or mean time of transit of the first point of Aries being 17h. 17m. 46·65s. and 15h. 19m. 49·31s. on those days respectively.

The Moon will be New at 6h. 24·9m. in the evening of July 5; enter her first quarter at 7h. 48·1m. on that of the 13th; be Full at 1h. 53·3m. in the afternoon of the 20th; and enter her last quarter at 7h. 18·7m. a.m. on the 27th. She is 25·4 days old at Greenwich mean noon on the 1st, and 29·4 at the same hour on the 5th. After this she will at noon on the 6th be 0·7 day old, and so on until the 31st, when her age will evidently be 25·7 days. At 11 a.m. on the 14th Libration will render more of her south-east quadrant visible, while at 3 p.m. on the 26th more of her south-west quadrant will be turned towards the earth from the same cause. The observer will, however, very evidently indeed, be unable to avail himself of either of these phenomena. The Moon will be in conjunction with Mars at 2h. 34m. in the afternoon on the 4th; with Venus at 11h. 30m. a.m. the next day; with Mercury at 11h. 20m. on the night of the 6th; with Uranus at 2h. 35m. in the early morning of the 7th; and with Jupiter afterwards, 11 minutes before noon. Lastly, she will be in conjunction with Saturn at 8h. 13m. in the evening of the 19th.

Six actual occultations of, and six close approaches of the Moon to, various fixed stars will take place during the month of July. Beginning with the evening of the 9th the moon will, as viewed from Greenwich, pass quite close to ι Leonis at 9h. 37m., and at 9h. 32m. on that of the 14th will also be almost in contact with 2 Libræ. The first real occultation will take place on the 16th, when BAC 5395 will disappear at the Moon's dark limb at 9h. 42m. p.m. to reappear from behind the bright one at 10h. 54m. At 11h. 28m. the next night (that of the 17th) the moon will almost touch 39 Ophiuchi, and at 1h. 5m. the next morning her dark limb will occult θ Ophiuchi; the star will, however, have set ere it reappears at the bright limb afterwards at 1h. 49m. During the early morning of the 21st at 4h. 6m., BAC 7197 will disappear at the Moon's bright limb, reappearing (below our horizon) at the dark limb at 4h. 42m. On the night of the same day, the 21st, BAC 7550 will disappear at the bright limb of the Moon at 11h. 38m., reappearing from behind the dark limb 37 minutes after midnight. On the 22nd, at 2h. 27m. a.m., τ^1 Aquarii will be occulted by the Moon's bright limb, and will emerge from behind her dark one at 3h. 37m. Subsequently, at 3h. 56m., τ^2 Aquarii will disappear at the bright limb, and reappear at the dark limb at 4h. 47m. Finally, the moon will make close approaches to 64 Ceti at 1h. 46m. a.m. on the 27th, and an hour afterwards to ξ^1 Ceti; as also to 121 Tauri at 4h. 14m. a.m. on the 31st.

Mercury sets after the Sun during the entire month, and during the latter part of it will be in a tolerably favourable position for observation. He will be on the meridian on the 1st 38·5m. after noon, and on the 31st at 1h. 50·7m. in the afternoon. During the middle third of the month he may be picked up near the west-north-west part of the horizon immediately after sunset. Mercury will be, as previously stated, in conjunction with the Moon at 11h. 20m. on the night of the 6th. He will further be in conjunction with Uranus at 8h. 34m. in the evening of the 7th; with Jupiter at 6h. 42m. in the afternoon of the 10th; and with Regulus (α Leonis) at 2h. 43m. on that of the 24th.

Venus is, for all practical purposes, invisible during the whole of July, from her proximity to the Sun; with which she is in superior conjunction at 5h. 47m. a.m. on the 16th. Her conjunction with the Moon at 11h. 30m. a.m. on the 5th has been before adverted to, and we may add that she will also be in conjunction with Uranus at 6h. 3m. a.m. on the 22nd, and with Jupiter at 2h. 22m. a.m. on the 29th. There are obvious reasons why none of these conjunctions will be observable.

Mars is a morning star, rising on the 1st at 2h. 52m. a.m. and southing at 11h. 12·2m., while on the 31st he rises at 2h. 25m. a.m., and is on the meridian at 10h. 41m., evidently setting in bright daylight. He is travelling through Gemini during the whole of July, but does not go near to any very conspicuous star. As his diameter is now only some 4″, and he is almost exactly circular, he possesses not the very slightest interest as a telescopic object. We have spoken above of his conjunction with the Moon at 2h. 34m. p.m. on the 4th.

Jupiter is now rapidly departing for the season, but during the earlier part of the month may be caught near the north-west horizon soon after sunset. He is on the meridian on the 1st at 1h. 46m. in the afternoon, and on the 31st only 14·7m. after noon. He is travelling through a portion of Cancer. His conjunction with the Moon at 11h. 49m. a.m. on the 7th; with Mercury at 6h. 42m. p.m. on the 10th; and with Venus at 2h. 22m. a.m. on the 29th, have been noticed under other heads.

It is just possible that the beginning of the transit of satellite 4 at 9h. 8m. in the evening of the 1st; that of satellite 2 at 9h. 18m. p.m. on the 2nd; and the reappearance from eclipse of satellite 1 at 9h. 23m. 20s. on the 3rd may be perceptible; but from July 3 to August 28 the satellites of Jupiter are invisible, from his proximity to the Sun.

Saturn is really the chief object of attraction in the night sky; but he continues in Sagittarius in the same deplorable position for observation which he has so long occupied. He rises on the night of the 1st at 8h. 37m., is on the meridian at 38·7m. after midnight, and sets at 4h. 40m. (after sunrise) the next morning. On the 31st he rises at 6h. 32m., souths at 10h. 31·6m., and sets at 2h. 32m. a.m. on August 1st. He is in opposition to the Sun at 11h. 13m. on the night of the 9th. His conjunction with the Moon at 8h. 13m. p.m. on the 19th has been previously spoken of.

Uranus is much too close to the Sun to be now observable.

Neptune rises some quarter of an hour after midnight at the beginning of the month, and about 12 or 13 minutes past 10 p.m. at the end of it; his southing and setting both taking place in brilliant daylight. He will be found *just* to the north-east of *o* Piscium. He is in so-called "square" with the Sun at 5h. 11m. in the afternoon of the 18th.

It may be interesting to note, in connection with this month, that on July 1st, 1770, Lexell's Comet came within 1,400,000 miles of the earth (the nearest approach of which any record exists). Perhaps it will tend to reassure some of those whose faith in the constancy of Nature may have been shaken by some recent very blatant assertion, if we add that (although we have the fullest details of the resignation of the Duke of Grafton, the succession of Lord North to the office of Prime Minister, the growing discontent in America, and the sensation created by the Letters of Junius) not one syllable has come down to us about a Deluge, universal or partial; nor were the most able trigonometricians of that day able to detect the slightest sign of an ark.

Watch should be kept for shooting stars between the 26th and 29th of July, as there would seem to be tolerably good evidence of the existence of a recurrent shower at this period.

THE CAUSE OF CONSUMPTION.*

SO long ago as 1855 Dr. Mac Cormac published the first public statement of the theory by which he seeks to account for the origin of consumption—tubercular disease of the lungs, the "fell destroyer," as the novelists term it, which decimates the populations of Europe. We say seeks to account, because although Dr. Mac Cormac considers the arguments he advances as "all cogent and conclusive," professional rejoinders have not been wanting, which show that many of those "learned in medicine" refuse to accept his hypothesis, while others, probably inclined to look favourably upon it, regard it as simply "not proven." It is abundantly evident from the book before us that our author has seen no reason to modify the theory first broached by him in his work on "Consumption as engendered by Rebreathed Air;" and while contenting ourselves by expressing the opinion that, in a common-sense point of view, there is much of truth in the argument put forth by Dr. Mac Cormac, we proceed to lay before our readers a brief résumé of its principal features. Stated in a few words, the theory is that tubercular disease of the lungs is caused solely by breathing air which has already passed through the lungs of either brutes or human beings, or air that is deficient in oxygen. If we assume the quantity of air in the chest at about 230 cubic inches, and that from twenty to thirty cubic inches are changed and removed during each respiration, about ten breathings will suffice to renew or exchange the gaseous contents of the chest cavity. At each inspiration from 4 to 5 per cent. of the oxygen inhaled is, or should be, replaced by about the same quantity of carbonic acid, an amount which in a few hours would be represented by an appreciable weight of solid carbon. If any portion of the inhaled air be pre-breathed air, says Dr. Mac Cormac, the dead metamorphic carbon will be retained *pro rata* unoxidised within the organism. This effete unoxidised carbon — this "detritus of degradation" being retained—speedily becomes "tubercle." It is not to be supposed that the unoxidised carbon left after two, twenty, or a hundred inspirations of pre-breathed air, or air in which there is insufficient oxygen, will result in the deposition of tubercle; but "one condition of things, to wit, the habitual respiration of already breathed air, having begun, the sequence of the other, namely the deposit of tubercle, follows as a matter of necessity." Such, in brief, is Dr. Mac Cormac's theory; the facts on which he bases it being ably gathered together, and brought to bear from his point of view. Our author, naturally enough, is opposed to the idea that consumption is hereditary. He holds that the same causes which produced it in the father may produce it in the son, but that those causes are avoidable and the disease preventible. In several places in his book he asks pertinently, What *is* tubercle? if not the dead carbon which has been left unoxidised by impure air; and as yet he has certainly not received a satisfactory answer.

Dr. Mac Cormac says that without adequate ventilation we cannot possibly get rid of the ten or twelve hundred cubic inches of carbonic acid which the lungs eliminate hourly. No air—at least no respired air—ought to contain a larger amount of this poisonous gas than the infinitesimal proportion of one or two parts per ten thousand. Now, as a matter of fact, it will be a difficult matter, we think, to find air so free from carbonic acid as Dr. Mac Cormac requires, for De Saussure found near the Lake of Geneva an average of five parts in 10,000, and Dr. Angus Smith found a mean of 332 parts in a million on the tops of such mountains as Ben Nevis and Ben Lomond. But this is a detail. Dr. Mac Cormac appears to have left no stone unturned to find facts to support his theory, as is evidenced by the opinions of eminent foreign medical men quoted by him. He has also been at some pains to obtain the average death rate from consumption in various parts of the world. We learn from him that in the Austrian capital phthisis prevails to such an extent as to have been named *morbus Viennensis;* but he traces the cause readily enough to close stoves in stuffy chambers, to doubly-glazed and padded windows, which are never opened, ventilation being entirely unthought of. A similar state of things he finds to exist nearly everywhere, the deaths being from 28 per cent. in some parts of America to 10 per cent. in Paris, while in S. Petersburg, out of 5,000 deaths, 1,900 are occasioned by phthisis! "Double doors and windows, every interstice being carefully closed with wadded cloth or *voilok*, exclude the current, and, along with the close stove or *petch*, render stagnant utterly the stinted breath-fouled atmosphere, effectively hindering its replacement from without, and, in fine, entailing the direful scourge of tubercle, from which no class or condition of the community finds escape." On the other hand the North American Indian and the Patagonian, who as frequently sleep in the open air as in their rude cabins, enjoy an immunity from consumption which in civilised quarters is only exhibited by the inhabitants of the West Highlands and the Hebrides, amongst whom tubercle is unknown. And yet Scotland as a whole is decimated by consumption. Every luxury that wealth can purchase, the most nutritious food, and the most careful nurture fail to keep it at bay; but in the Hebrides, where the scanty fare, the wretched huts, and the hard life would, popularly and medically, be considered productive of phthisis, "no scrofula, no consumption, in short, no tubercle-engendered malady whatever is to be seen." How account for these undoubted facts, save on the theory of Dr. Mac Cormac? He ridicules the idea which has been mooted that the West Highlanders obtain immunity from the disease by the inhalation of peat smoke, which, he points out, is abundant enough all over Scotland without awarding a like immunity elsewhere. The Hebrideans, in fact, live in ceilingless, partitionless hovels, each provided with a hearth on which a fire is continually burning. There a hole in the roof answers at once as a chimney and as a most efficient ventilator, and as the door of the hovel is rarely shut the air of the "room" is never stagnant and is never fouled. To imitate this state of things is the preventive means which Dr. Mac Cormac recommends to avoid creating the terrible disease; for if his theory is right it is certainly created. Therefore draughts and open windows are to be encouraged, especially at night, for if the body is well covered no harm will accrue; he speaks of entering his boy's bedroom and finding a fringe of snow on the coverlet, while the sleeper slept the sleep of health, all uninjured by the cold. The closely-curtained bedstead of our forefathers is a thing of the past; how long before it becomes the rule and not the exception to sleep with the windows open! "The respiration of unpolluted air by night will even go some way to neutralise," says Dr. Mac Cormac, "the evil influence of any vile pernicious atmospheric environment when we are constrained, as we too often are constrained, to breathe it by day." There is, however, one flaw in the doctor's theory which will occur to most of our readers, and that is that consumption does not come with "equal foot" to all our doors. True, it visits all *classes* tolerably equally, but of two men, working and living under exactly the same influences of "pre-breathed" air, one may fall an early victim while the other may live to the allotted span. It is true Dr. Mac Cormac acknowledges that, "once deposited, supposing only that there are no additions to it, tubercle may subsist long years latent; it may be eliminated speedily, or it may become cretaceous;" but this does not meet the case; for if the hypothesis is not baseless every one who continually breathes pre-breathed air for any length of time *must* contract tubercle. Is it so?

The subject of the present volume is one that is of more or less importance to every family in the kingdom, and readers of all classes will find much to interest them, even if they fail to profit by the teachings of a man so evidently in earnest as Dr. Mac Cormac. We regret to see the eccentricities of printing which, some will probably consider, disfigure the volume; because a man who exhibits crotchets in spelling and punctuation renders himself liable to be summed up as crotchety altogether. Of late years medical men have been great offenders in this respect.

* Consumption and the Breath Rebreathed. By Henry Mac Cormac, M.D. London: Longmans.

NOTES OF FRENCH SCIENCE.

DR. BEDOIN recently examined a lead Chassepot bullet taken from the body of a suicide. After passing through the softer parts it had been stopped by the vertebral column, and its *vis viva* changed into heat. As it showed signs of fusion, the temperature must have reached 315°.

M. Cailletet has investigated the influence of pressure on the spectra of gases. He fixed two platinum wires in the end of a thick glass tube, into which the gases were passed. The spark from an induction coil connected with three Bunsen elements passed between the wires. At ordinary pressure, the bright lines of the spectra of the gases appeared on a slightly illuminated ground; and as pressure was increased they grew brighter, but they by and by became merged in a continuous spectrum, whose brightness also increased with the pressure. At a certain pressure (between 40 and 50 atmospheres) the discharge suddenly ceased; and though the battery power was increased, and the distance between the platinum wires reduced to ½ millimetre it was not possible to obtain the spark beyond this point. It is thus seen that a spark which passes easily in the rarefied gas of Geissler tubes, or the electric egg, meets with considerable resistance in compressed gas. The brightness of the spark at the point beyond which the discharge is unobtainable is 200 times greater than at ordinary pressure.

Palmieri states, in a communication to the Paris Academy of Sciences, that on the night of April 26 a fissure opened on the south-west side of Vesuvius, the lava from which raised the scoriæ of previous years, and made a sort of hillock about 60 metres high. At the base of this the lava flowed with wonderful tranquillity, without noise or projections. None of the usual eccentric or adventitious cones were formed at the side of the fissure. Another curious fact is that the lava in the Fossa della Vetrana, flowing with a breadth of 800 millimetres, made successively three veritable eruptions, throwing out globes of vapour and incandescent scoriæ. The smoke from these was darker than that from the lava. Each of the eruptions lasted half an hour. The Professor made electrometric observations on the cloud of vapour, cinders, and lapilli which was carried over the Observatory. The vapour alone, without cinders, showed positive electricity; the cinders alone, negative; when mixed, they gave various results. Lightning flashes appear only when the vapour is largely mixed with cinders; and it is not true that the lightnings are without thunder, as some historians of Vesuvius relate.

M. Dufour has made observations as to the rate of growth of the nails. Here are some of his results: The nails of the little fingers grow more slowly than those of the other fingers and the thumbs. The difference is about one-ninth. The mean rate of these (excluding the little fingers) is about one millimetre (100th part of an inch) in ten days. The rate of growth on the thumbs is probably greater than that on the six longer fingers. There is little difference between the rates of growth in different animals. The nails grow at about the same rate on both hands. The rate of growth is not constant throughout the length of the nail; it is greater near the base. The rate of growth at the side parts is probably the same as in the middle part. The substance of the nail advances equally throughout its breadth. The rate of nail growth in an individual at intervals of several years shows sensible differences.

A. B. M.

CRYSTALLISED IRON.

IN opposition to a commonly-received idea that wrought iron becomes crystalline and brittle when subjected to vibration, M. Caron recently brought before the Paris Academy the result of observations he had made on certain railways, which showed that the fracture of axles had in every case been occasioned either by the bad form of the pieces, or the faulty nature of the iron before it had been used. He contests the assertion that bar iron becomes crystalline and brittle under the influence of winter cold. This idea has arisen from the crystalline appearance of iron pieces that had been broken in such low temperatures. It is undoubted that there is more breakage of railway axles, and more breakage in the bones of men and beasts in winter than in summer, but the cause of such accidents is to be found in the greater hardness of the ground, the stiffness of joints, and the greater violence of knocks and shakes to which the pieces are subjected; and the fact of a crystallised appearance in the broken parts does not necessarily show that such crystallisation arises from the lowering of temperature. To prove this satisfactorily it would be necessary to show that a bar of iron which was crystalline at (say) — 20°, resumed its fibrous structure when the temperature was raised to + 20° C.

In order to test the influence of cold on iron, M. Caron experimented as follows:—Several pieces of good bar iron were exposed for four months in the ice factory of M. Tellier at Auteuil, to temperatures varying from 0° to — 18°. Others were allowed to remain throughout the cold of last winter at a temperature of about 20° in the open air. M. Caron then caused the pieces to be broken, both in their cold state, and after the temperature had been raised several degrees above zero. In no case was there any appearance of crystallisation. Of course, he had assured himself of the good quality of the iron beforehand. Iron of inferior quality acts differently; its brittleness is perceptibly increased through cold.

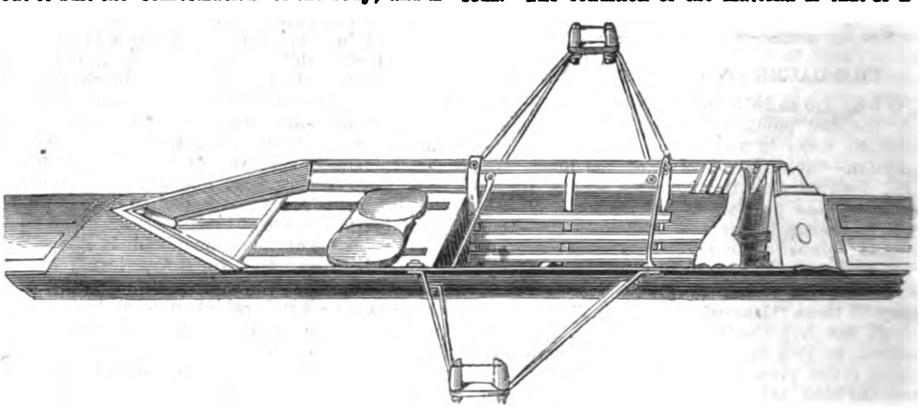
The experiments of M. Caron seem to prove that when a bar of iron breaks, through vibration or shocks, and the fracture presents a crystalline appearance, this crystallised state was that in which the iron was previously to its being used; and it is to be attributed to faulty manufacture, not to usage or cold after the piece was completed. From this it follows that the testing of *e.g.*, 4 or 5 per cent. of a large number of pieces of wrought iron does not supply a proper guarantee of the good quality of the remaining pieces, because of the varying care bestowed on the pieces, and various treatment of them as regards temperature and other points. A. B. M.

NEW MATERIAL FOR BRICKS.

DURING the last few years experiments have from time to time been made with the view to utilise in some way the mounds of shale (the refuse of the coal-mines) which cover an area of several thousands of acres in South Staffordshire, by converting them into bricks. Several enterprising firms have already embarked in this novel but profitable business. When properly pulverised the shale is found to be an excellent material for the purpose, the bricks produced being hard and durable, resembling in colour the fire-clay bricks of the Stourbridge district, although for furnace and such like purposes they are not so valuable. For ordinary building, however, they are found to be of equal practical value to the ordinary red bricks, the only possible objection to the former being their colour, which is somewhat too light for a smoky district like South Staffordshire. This objection, however, could only apply to their use for buildings of architectural pretensions ,and such buildings in the black country do not predominate. There is every reason to believe that this method of utilising the innumerable dusky hillocks which disfigure the South Staffordshire landscape will gradually develop into an industry of some importance. The material is to be had in any quantity for a mere nominal sum, and its exhaustion in those parts of the district where the collieries are worked out would be doubtless followed by a restoration of the landscape to a much nearer resemblance than it now bears to its former beauty.

NEW SLIDING SEAT FOR RACING BOATS.

THE principal features of the new sliding seat for outriggers and racing boats generally, which is believed to have contributed in no slight degree to the success of certain crews in recent matches on the Thames and elsewhere, will be readily understood from the accompanying illustration of the form recently registered by Messrs. Searle and Sons, the eminent boat-builders. This device has formed the subject of much discussion pro and con. amongst the "knowing ones" of the aquatic world, and the advantages which one side claims are fiercely disputed by the other side. Be this as it may, sliding seats have been used by many winning crews lately, and in the race between the Atalantas and the London Rowing Club, both boats were fitted with them. We believe that Elliott, the New York boatbuilder, was the first to make the suggestion of constructing the seat to slide, and he probably derived the idea from our North-country rowing men, who formerly constructed their boats with broad seats, which they liberally anointed with grease. By this means they considered that the weight of the body could be thrown into the stroke with more facility, and that the muscles of the legs could be brought into greater play and the stretcher utilised to the full extent. It is asserted for the new sliding seat, which is really only the mechanical adaptation of the principle underlying the Tynesiders' use of "grease," that it enables the rower to get further forward, and by utilising more effectively the muscles of the legs, equalises the effort from the beginning to the end of the stroke, at the same time relieving to a great extent the strain upon the arms. In the design registered by Messrs. Searle the seat is hollowed out to suit the conformation of the body, and is



attached to two hard-wood runners, which travel with a minimum of friction in grooves lined with brass or other metal in the under seat. The President of the Cambridge University Boat Club is said to have thoroughly tested the new contrivance, and to have highly approved of it, while many other noted scullers have also expressed the same opinion. The illustration, which shows the device applied to a sculler's outrigger, explains itself.

PAPER FROM WOOD.

IN a case placed in the section of the International Exhibition devoted to paper manufactures, Mr. Houghton displays the results of his processes for converting wood into pulp for paper. It appears that he has succeeded in overcoming the difficulties which have hitherto beset the employment of wood. We learn, from the *Paper Makers' Journal*, that the chief of these difficulties, hitherto regarded as little less than insuperable, has been the necessity for using such large quantities of alkali, in the progress of disintegration by boiling, as to make the cost too great to bring the material into the market in such quantities and of such quality as to satisfy the requirements of English makers. In other words, the evaporation and waste of the alkaline liquor, and the necessity for using such large quantities of caustic soda or soda ash for every fresh disintegration, made the cost of production of a high quality of half-stuff from wood too great to admit of its adoption as a cheap substitute for higher-priced material. This necessity Mr. Houghton has superseded, and that by a process which also removes the dreaded danger from the heat or pressure required in the preparation of the fibre by some other methods. Patents for the requisite machinery and processes have been taken out, and a company is, or will shortly be, formed for working them, or granting licenses for them, in England, Sweden, and Norway. They are now being placed in operation on a large scale in France, Austria, and Belgium; and with a view to explain and demonstrate the various operations Mr. Houghton himself has established a small working plant at No. 40, Borough-road, where we were invited to inspect the very simple machinery.

To begin with the wood itself—the pine wood of Norway, Sweden, America, and various parts of the world. It may be premised that the cuttings from the ends of planks, misshapen portions of trunks and limbs, misgrown timber, and what may be termed forestal waste, are completely adapted for the purpose. The cutting is effected by means of simple machinery, working a series of knives, which slice the timber in a diagonal direction, so that the fibre easily separates by the splitting of the grain. These slices are broken with the utmost facility into small pieces, and are then delivered to the factory as the material to be rapidly converted into paper pulp.

To this end they are first consigned to a patent boiler, so constructed as to endure great pressure, being composed entirely of welded rings upon welded rings double riveted together transversely. They are heated entirely by hot water circulating in pipes which traverse them in sections throughout their length, and in which the heat can be so regulated from the external apparatus as to raise or lower the temperature to a single degree. The pressure employed in the process of treating the fibre is 180lb., and the boilers are tested to 360lb. to the square inch. The wood is introduced into the boiler in wire cages running upon a set of rails, so that while one batch is being removed another is ready for disintegration. When the boiling is completed, the small pieces of wood—which may be called fasces of wood-fibre—are quite soft, and of a dingy colour, not dissimilar in appearance to a piece of rather coarse field rhubarb after it has been cut up and baked in a pie. The material is now ready for bleaching in a vat, where it is treated with chlorine, pumped into the liquor in such quantity as not to injure the fibre; and the operation is afterwards completed by the use of permanganate of soda. The condition of the material is that of a soft, pulpy, highly-fibrous mass, which having been subjected to the action of a hydro-extractor, or, more simply, a "wringer," comes forth in the shape of a damp, fleecy mass, in which only a microscopic eye could detect the pristine wood fibre.

In point of fact, one of the constituents which existed in the wood has been so completely removed that it affords a separate operation in the process of treating the alkaline liquor, a process which is, we understand, the achievement by which this system claims to inaugurate a new era for wood pulp.

When taken from the boiler, the liquor with which the fibre has been treated is of a dark colour, and somewhat resembles "double brown stout." In this state it is pumped into a vat, where it is subjected to the influence of carbonic acid gas, which has the effect of coagulating, or, to some extent solidifying, the resinous particles; so that it changes in appearance from brown stout to muddy coffee. In this state it is transferred to a copper, where it is heated exactly to boiling point, the result of this being a complete coagulation of the resin, which is at once precipitated, or, in plain English, falls to the bottom, in large masses, not unlike great flakes of peat. For this resin, doubtless, some commercial or manufacturing use will soon be found; and, at any rate, it cannot fail to be a source of profit.

The liquor is now of a clear brown colour, about the tint of moderately strong tea, and is destined not to be thrown away as waste, but to be used again, after the balance of the alkali absorbed by the fibre has been restored to it. This is effected by the use of sulphate of soda, so treated with coal as to produce a combined substance capable of restoring the necessary constituents. The material used for this purpose costs less than £5 per ton, and about 10 per cent. of it will restore the lost alkali, for which it is substituted weight for weight—a trifling cost when compared with that of making up the deficiency with either caustic or carbonate of soda at the present prices. By this process the liquor is made fit for re-introduction to the boiler, and on being removed is treated as before, so that it may be said to be constantly renewable.

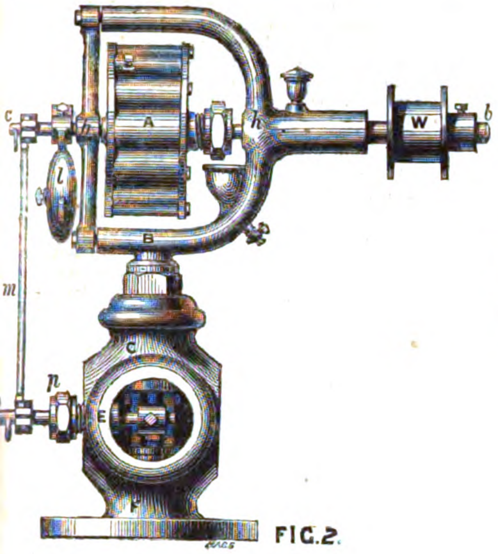


FIG. 2.

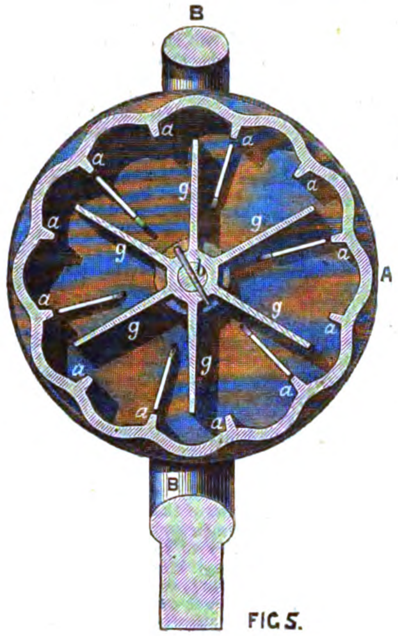


FIG. 5.

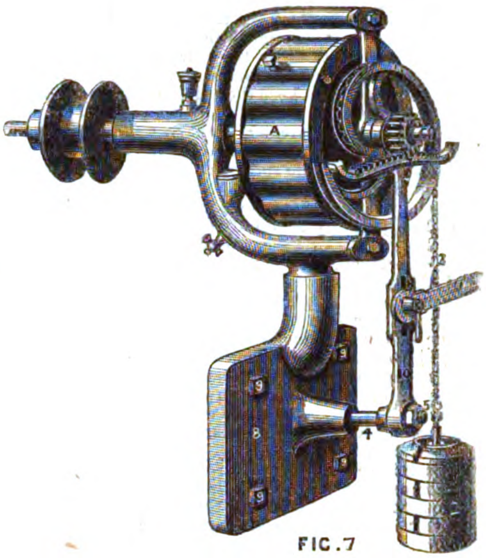


FIG. 7

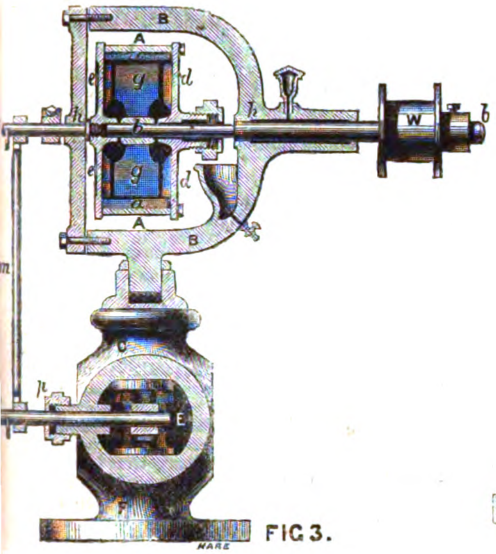


FIG. 3.

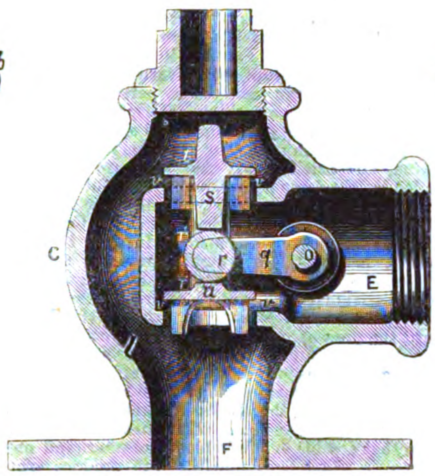


FIG. 6

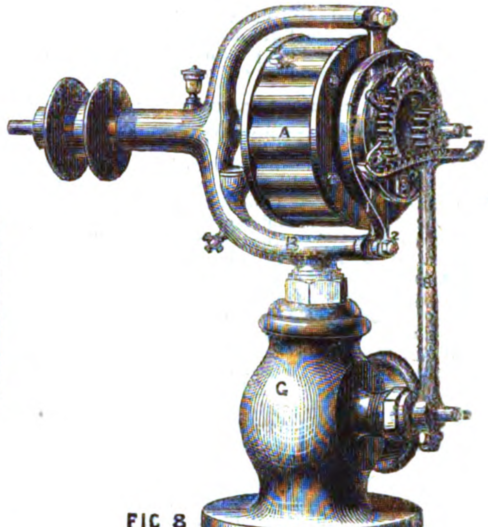


FIG. 8

ALLEN'S PATENT GOVERNOR.

ALLEN'S PATENT GOVERNOR.

THE improved form of governor shown in the accompanying engravings is the invention of Mr. R. K. Huntoon, of Boston, Massachusetts, and has been employed for the last three or four years in America, where, under different circumstances, it has given equally good results, and earned in actual practice the high encomiums passed upon it by the principal mechanicians of the United States. In this country it is known as the Allen governor, from the name of the proprietor of the English patent, and forms one of the exhibits in the International Exhibition of Whitley Partners, Leeds, who are the sole licensees and makers in Europe. Very few of these governors have been fixed in this country at present, but those that are in operation have given unqualified satisfaction. In the United States, however, the Allen (Huntoon) governor has had an extended trial on various descriptions of engines and in different kinds of work, and has been awarded a high character by firms so competent to judge as those of Messrs. Sellers and Co., of Philadelphia, and Messrs. Baird, of the Baldwin Locomotive Works, besides others too numerous to mention. The Allen governor, the construction of which will be tolerably well understood on inspecting the accompanying engravings, consists essentially in a revolving paddle-wheel working in a chamber partially filled with oil. The chamber is a corrugated cylinder with small projecting ribs on its interior periphery. Within this chamber is a paddle wheel carried on a spindle, to which a rapidly revolving movement is imparted by means of a belt on the fly-wheel shaft. The tendency of the revolving paddle-wheel throwing particles of oil against the internal ribs of the cylinder is to cause the latter to revolve in the same direction, a motion which is partially checked by means of a weighted lever attached to a trunnion on the cylinder spindle. Connected to the trunnion, but moving in an opposite direction to the weighted lever is a short lever which by means of connecting rods opens and closes the throttle-valve according to the load on the engine. The peculiar action of this governor enables a valve of large area to be used, by which means the greatest possible boiler pressure can be brought to bear on each stroke of the piston. The governor valve is also of peculiar construction, and is perfectly balanced. In Figs. 2, 3, 5, A is a cylindrical drum, having on its inner periphery a series of flanges or ribs *a a*, arranged at or about equal distances apart. This drum moves around the shaft *b*, which enters through the end *d d*, but is fixed to the shaft *c* at the end *e e*. Attached to shaft *b*, within the drum, are a number of paddles, or flat wings, *g g*. The two shafts are supported in bearings *h h* in a standard B, mounted on the valve-case, C. To the shaft *c*, which moves with the drum, a lever with an adjustable weight *l* is connected by the trunnion mentioned above, and the shaft is also connected by a short arm and the rod *m* to a lever fastened on the shaft *o*, which enters the valve-case C through stuffing-box *p* into the induct E. An arm *q* (shown in Fig. 6) carries an anti-friction wheel *r*, and projects from the portion of the shaft within the steam-passage E of the valve-case, entering a slot r^1, made in the shank *s*, connecting the two valves *t u*. These valves are arranged as shown, with the ports or openings *v v* made in opposite sides of the tubular induct E, which is closed at its inner end. F is the educt, leading out of the lower part of the case C.

The drum A being filled about two-thirds with best sperm oil, a driving-belt is passed from a pulley on the fly-wheel shaft to the pulley W on the shaft *b*, so as to insure a speed of the paddle-wheel of about 400 revolutions per minute, by which means the oil is thrown against the flanges or ribs *a*, causing the drum to turn in the same direction as the paddles. By this action the weighted lever is raised, and the shaft *o* turned through the action of the connecting-rod *m*, the valves being, consequently, held in a position governed by the amount of work or load on the engine; the rotary motion of the drum is, of course, resisted by the weighted lever *l*. By operating the valves by the arm *q* applied to the connecting piece there is no pressure on them like that experienced when a stem extends through a stuffing-box, and they are in reality "balanced" and easily moved by the governor.

Fig. 7 shows the application of the invention to engines with variable "cut off." Here the lever and weight are replaced by a fusee or scroll, 1, and a weight, 2, suspended from the periphery thereof by means of a chain, 3. A pinion, 6, fixed on the shaft C, works into a toothed sector, 7, moving freely on the stud, 4, but secured by the nut, 5. The stud, 4, is screwed tight into plate, 8, which is fastened to any convenient part of the engine by bolts, 9. In the arm, 10, of the sector, 7, is a slot, 11, for adjusting the connection of the valve gear. The weights suspended to the scroll have a tendency to roll the pinion, 6, to the right, actuating the sector, 7, from right to left, whilst the paddle-wheel in the drum A actuates it from left to right, causing thereby the arm, crank, or other device fixed to the slot-hole, 11, to move in these opposite directions, according to the prevalence of the power of the paddle-wheel upon the weights, or inversely; and giving the means of a self-acting motion on the cut-off valves, according to the variations of speed of the engine shaft. In this governor the resistance to the action of the revolving paddle increases with its speed in a manner calculated to open the partially closed valves as rapidly as possible when speed falls down, because of the scroll causing the weights to act upon increasing radii as they are lifted up.

The Allen governor is also adapted for marine engines, in which case, however, it is, of course, modified, as shown in Fig. 8; for it is necessary to dispense with all levers and weights liable to be moved by the motion of the vessel. These are replaced by a strong spiral spring, 1, one end of which is bolted at 2, to the arm B, and the other fixed to a loose socket provided with six wings, 3. One of the wings carries a catch piece, 4, which acts upon a pinion, 5, fixed to the shaft C. A smaller pinion, 6, also fixed to the shaft C, engages in a toothed sector 7, with an arm, 8, fixed by a friction socket to the spindle, 0, of the valve G, which it regulates. The spring, 1, having been tightened to the required speed by turning the wings, 3, from right to left, is secured tight by the catch piece, 4, its tendency being to roll the pinion, 6, up to the left end of the rack, 7, and keep the valve wide open. But as soon as the speed of the paddle wheel in the drum A becomes greater than required, its action upon the interior ribs of the drum A will overcome the resistance of the spring and cause the shaft C and pinion 6 to revolve from right to left, thereby causing the rack, 7, to move from left to right, and to close partially or totally the valve G, according to the greater or lesser speed of the engine. On the other hand, as soon as the number of revolutions of the paddle-wheel in the drum A, and consequently of the engine-shaft, becomes less than required, the action of the spring overcomes that of the paddle wheel, and the valve G opens wide. In this governor the resistance to the action of the revolving paddle increases with its speed in a manner calculated to open the partially closed valves as rapidly as possible when speed falls down, because of the greater resistance of the spring as it gets tightened.

Such is a description of a form of governor which is comparatively new to this country, only one or two having been fixed. All that need be said now is, that in no single instance has an Allen (or Huntoon) governor been removed from an engine, and no engine has yet been found which it cannot govern. Of the various forms shown in our engravings, it is probable that Fig. 7 will be found the one in greatest demand, as well as most useful; though of course that will not detract from the equal merits of the others in positions and circumstances to which they are suited and adapted.

WALL-PAPERS AND DISEASE.

A LETTER drawing renewed attention to the poison-dust given off by wall-papers appeared recently in the *Pall Mall Gazette*, from which we gather that, in the opinion of the writer, the evil is much more widely spread than is generally imagined. There is but little doubt that very many of the papers used for covering walls are coloured with pigments which contain considerable quantities of arsenic, which finds its way to the lungs in the shape of dust, it may be in infinitesimal amounts, but still sufficient to exercise unpleasant, if not dangerous, influences. The writer of the letter referred to, however, considers that arsenical wall-coverings are poisoning our population wholesale. The dangers of sewer gas have deservedly attracted much attention and inquiry in consequence of the alarming illness of the Prince of Wales, but the danger of arsenical wall-coverings remains unnoticed; although, if the truth were known, their ill effects would be found to rival those of sewer gas. There is a peculiarly close smell, rightly described as "fusty," from all papers containing arsenic; and the writer called attention especially to that very point in an article published in the *British Medical Journal* of September 30, 1871. This smell appears to be due to the evolution of arseniuretted hydrogen gas, and may be easily detected by most persons possessing sensitive olfactory nerves in nearly all rooms where the paper contains a trace of arsenic, but is more distinctly observable after the paper has been soaked previous to removal. As a rule, the workmen employed to put up or to remove arsenical wall-coverings suffer severely from doing so, but they often hesitate to own the fact, because their livelihood depends on their powers of endurance, and their employers endeavour to conceal the danger and make light of it for reasons of their own.

It is also said that in paper manufactories the sickness and mortality among the workmen is very great; but the truth in this matter appears to be studiously concealed from the public, because, as arsenic yields a great variety of brilliant colours, and is exceedingly cheap, it is the interest of the manufacturers to employ it. The correspondent says he has seen workmen in his house sick and faint from working a few hours at removing a single paper from the walls, and it is easy to understand how far more dangerous the work must be where papers piled one over the other have to be removed, and where consequently the amount of arsenic would be much greater; while, owing to the accumulation of papers on the walls, the usual precaution of soaking the papers cannot be effectually carried out.

If medical officers would exercise close observation as to the colouring of the papers removed in the various houses where there has been sickness, valuable information might be obtained; for although arsenic is used more or less in papers of all colours, those with green in the pattern generally contain larger quantities than other papers, and, the arsenic being combined with copper to produce green, the dust of copper as well as arsenic is inhaled, thus involving a double source of poisoning. Blue papers also appear to be especially injurious, whether they contain arsenic or not, some being covered with blue verditer and others with Prussian blue (also used very extensively in distemper wash for walls and cornices), both of which appear to have very injurious effects. There is also a blue pigment in use for such purposes, which contains a great deal of arsenic. As all unglazed papers and distemper washes give off more or less dust into the atmosphere, though often imperceptible to the naked eye, it requires no very great stretch of the imagination to realise that poisonous dust thus inhaled cannot fail to do harm; and physicians are well aware (though in this matter they have hitherto ignored it) that poisons are still more deleterious when inhaled than when swallowed, being more rapidly taken up by the blood. Consequently, as a variety of poisonous and medicinal ingredients are used for colouring wall-papers and washes, it would appear that our whole system of wall-coverings is probably one of the most gigantic errors in hygiene that has been committed in modern times.

The writer says that after several years' experience he is convinced that diseases of various types haunt those rooms and houses where the wall-coverings contain arsenic or other poisons; and he affirms, as the result of observation and inquiry, that arsenic when inhaled, either as dust or in a gaseous form, poisons the blood and seriously affects its circulation, weakening the action of the heart, and producing general and local congestions; that it produces inflammation of the entire mucous membrane (thereby affecting every organ of the body by degrees), and notably of the stomach and intestines, giving rise in many cases to gastric or enteric fever, but that its action is so subtle and uncertain that the effects may vary to an almost inconceivable extent according to constitution and temperament; that this mode of poisoning, which dates from the commencement of this century, may account for many of the mysterious ailments of the present day, especially among women, from which the past generation was exempt. Further, it is well known that arsenic produces eruptions of various kinds, and it appears to be the case that persons occupying rooms where there is arsenic are especially liable to attacks resembling diphtheria, and also to eruptive complaints which so closely resemble measles, scarlatina, and chicken-pox, that they are frequently called by the same names, and yet do not appear to be infectious, like the true types of those diseases. A severe spasmodic cough, hardly to be distinguished from whooping-cough, is also produced by the same cause. Is it not, then, highly probable that the apparently frequent recurrence nowadays in the same individual of disorders called by the above-mentioned names—a recurrence comparatively rare until the present century—may be, at least in some measure, attributable to the fact that our walls are reeking with poison? If we regard epidemic disease as the result of some poison in the blood, of which eruptions are but the outward token—the effort of nature to expel the poison—what can be more natural than that arsenic, a subtle blood-poisoner (and one, moreover, which is acknowledged to produce eruptions, while it also cures them in some cases), should have this effect? Every medical man in the kingdom is treating day after day numerous cases of disease originating in irritation of the mucous membrane, which simulate almost every morbid condition under the sun, the true diagnosis of which would be "arsenical poisoning."

ON EARTHQUAKES AND VOLCANOES.*

By Augustus Le Plongeon, M.D.

(*Concluded from p. 348.*)

6.—Cataclysms of the 13th and 16th of August, 1868.

THESE cataclysms are some of the most terrible known in the history of mankind, as much for the ravages they have occasioned as for their duration and the extent of country they have visited, spreading dismay and consternation, death and ruin among the inhabitants. Beautiful and densely populated cities have been levelled to the ground, flourishing seaports swallowed by the sea, whole towns, together with their dwellers, have disappeared into the bowels of the earth. In Peru the shock was felt over a radius of 1,670 miles. In Ecuador, 43,000 human lives were destroyed in a twinkling of the eye. The centre of the earthquake of the 13th appears to have been the volcanic zone comprised between Arequipa, Tacna, and Moquegua, where are situated six volcanoes—the Cailloma, the Misti, the Ubinas, the Huaina-putina, which made an eruption on the 13th of February, 1600; the Tutupaca and the Candarare. The focus of the second, that of the 16th, in Ecuador, was in the volcanic fields of Ocampo, surrounded by the three volcanoes, the Cotacachi, the Imbabura, the Pasto.

The prefect of Arequipa, Dr. Francisco Chocano, in his report to the Secretary of State, says:—That on the 13th of August, at 5.15 p.m., a very severe shock of earthquake was felt in Arequipa, when within five minutes the whole city was levelled to the ground. The oscillations, from S. to N.E., shook the soil with tremendous violence during seven minutes; they came accompanied by gushes of air charged with electricity; the motion of the earth was such as to make it next to impossible to keep a firm footing or remain standing. The soil heaved up and fell as the surface of the sea during a gale. A sudden obscurity spread over the city, adding to the horrors of the event. The waters became muddy in an instant. During the night of the 13th, thirty-five shocks were counted, but the soil was in continuous motion. Loud detonations were heard every instant and in rapid succession, like the rattling of musketry during a battle. Rents were opened in the earth; sources sprang forth through them so abundant as to inundate many places; others have sunk and disappeared. The shocks continued at intervals. The Misti sent forth enormous columns of smoke in the midst of horrid detonations. Such were the events of that memorable afternoon of August 13th, 1868, that were witnessed by the inhabitants of Arequipa. All these phenomena I have reviewed and tried to explain are effects of volcanic action. Arequipa is built on the slope, nay, at the very foot of the Misti, and has at periods nearly equidistant been destroyed. On the 2nd of January, 1582, an extremely severe earthquake shook that city to its very foundations; another, equally terrific, occurred in 1587; then another, in 1590, that laid to the ground the city of Camaria, an immense tide wave invading the ground, inundating the Peruvian shores; again, on the 18th of January, 1600, when the volcano Huayna-putina made an eruption; again, on the 25th of November, 1604; again, in 1605, when the city of Arica was destroyed; again, on the 13th of May, 1647—the shock was that time felt along the whole coast; again, on the 22nd of August, 1715; again, on the 6th of February, 1716—day of the destruction of the city of Torata; again, on the 27th of March, 1725—this earthquake shook the whole southern coast, and the port of Callao was submerged by the sea; again, on the 13th of May, 1784. I merely mention these earthquakes as they are the most important, passing in silence hundreds of others of minor intensity, that at short intervals have occurred, warning the inhabitants of these regions that under their feet was a focus of electro-chemical action, whose living activity continually threatened their existence.

Commandant Thomas Layseca, of the forces stationed at Torata, informs us that the earthquake was felt at 5 p.m., lasted twelve minutes; and that from the 13th to the 15th, date of his official report, 600 shocks had taken place.

In Tacna, on the 13th of August, a general oscillatory motion of the earth occurred at 5 p.m., lasting five minutes. At that place, for several days previous to the 13th, subterranean noises were heard, and some light shocks felt. When the earthquake occurred the day was cloudy, and shortly after it began to rain (a strange phenomenon in a country where it never rains), to the 16th of August, that is, during three days 64 vibrations, accompanied with subterranean noises, were felt; large and deep rents opened on the surface, and gushing through the openings. In Palea and La Portada, on the road to Bolivia, the shocks were most violent. Large portions of hills became detached, and rolled down the valleys—the mountains being split open with frightful noise.

I will call your attention to the fact, that in this place the motion of the earth was different from that at Arequipa, being oscillatory, instead of undulating, as it was at the latter place; notwithstanding its violence at both places, being such that men could scarcely keep their footing, the results were quite different. The strongly stone-built city of Arequipa was levelled to the ground, while in Tacna only 40 houses were destroyed. This fact would tend to show that the oscillatory motion causes less ravages than the undulating. Again, the premonitory symptoms of the impending castrophe were distinct, but passed unheeded. Electro-magnetic disturbances took place also in the atmosphere, causing rain to fall—an occurrence which seldom or ever takes place in this part of the country. In Chocorento, a village in the valley of Acari, the earthquake took place at 4.30, destroying all the houses in the valley. The shocks succeeded each other in rapid succession; the sea rose mountains high, and ran inland one and a half miles; all the watercourses became dry; the ground opened in many places, and water gushed up through the fissures in large bubbles; continuous noises, resembling the roaring of cannons in a battle-field, were heard incessantly. It would seem that the phenomenon manifested itself at this place thirty minutes in advance of the other localities; but this is evidently an error of computation of time on the part of the observer; for this valley is in close proximity to the other places.

In Moquequa, the earth began to shake at 4.45 p.m., five minutes in advance of Arequipa and Arica, about 90 miles to the south-west of the former city. There the vibrations were always preceded by electric discharges, louder than the heaviest cannonading; were from east to west, alternating with vertical shocks, and succeeded each other with frightful rapidity during five to six minutes. The hills of limestone were split, the rocks rent in small pieces. The soil opened, and through the openings issued streams of blackish and pestiferous water.

With Arequipa and Moquequa, the city of Arica is that which has suffered the most. Situated on

* From *Van Nostrand's Magazine*.

the sea-coast 40 miles to the south-west of Tacno, it is the most important port of Peru, next to Callao. At 5 p.m., a very severe earthquake was felt on shore, says the commandant of the ill-fated frigate *America*, which was stranded that day. "All the houses in the city surged, and with an ominous crash fell to pieces; then the earth was seen to open, a rolling, rumbling noise was heard, and gases, stifling gases, emanating from the fissures, soon filled the atmosphere, severely oppressing all living creatures, causing them a sensation of suffocation. The shocks lasted ten minutes, and succeeded each other at short intervals, and were accompanied with subterranean explosions. The hills themselves were seen to stagger like intoxicated beings. Large boulders, detached from their brews, rolled down their slopes, while their sides were seen to give up the dead bodies of the Aymarcis, that for centuries had been intrusted to their safe keeping, and had so long peacefully slept in their solitary resting-place, the slumber of death. These mummies seemed to have emerged from their graves, as if to witness the convulsions of mother earth; and their lifeless mouths appeared to laugh, exhibiting gumless rows of white teeth, at the terror of the living seeking refuge in open places, and flying to the top of the high lands for their lives. The shocks came from the south; the skies were stormy, a very light wind blew from a southerly direction. The whole soil of the country, as far as it could be seen, was moving; first like a wave, from north to south, then it trembled, and at last upheaved heavily.

During that time a very strong current from the south set in in the bay. The current was so strong as to set adrift the boat of the frigate *America*, sent to shore for the commandant, notwithstanding the efforts of the crew. It measured 5¼ miles an hour, lasting five minutes. Then came a second current from the opposite direction; this left the bay nearly dry. Currents, now from the north, then from the south, succeeded each other with great frequency, and became so rapid as to make it impossible to send boats to rescue the people who were seen floating on the palisade and imploring help. The frigate began to drag her chains and anchors. At 6.45 p.m. the currents increased to 9¼ miles, their duration being from five to ten minutes; at 7.5 p.m. a current came from the south, its rate 10¼ miles. Then the sea began to retire slowly from the shores, leaving the boats dry. It receded about to the line of extreme low tide, when at once it rose again and invaded the land. It reached a height of 34ft. above high-water mark, overflowed the town, and destroyed everything that the earthquake had left standing. The waters rushed back in the ocean, and rose again to the same height as before. Several times did the advancing waves wash over the doomed city; several times the force of the waters carried all the débris of the ruined habitations of men, until at last, retreating about two miles, it returned as an immense wave 50ft. high, carrying the frigate *America* more than a mile beyond the railway tract, in a place called Chinchero, and the American ship *Wateree* about a mile further up the beach.

Eleven tidal waves occurred; the intervening time between each invasive wave was three minutes, the third invasion having occurred soon after the first, and the last and largest twenty minutes after the first. At Iquique the earthquake lasted five minutes, the sea rose 30ft. above its ordinary high-water mark, and covered the town to the extension of 600ft. At Ilo, north of Arica, the sea retired, leaving the ships completely dry, and rising again in a wave 40ft. high washed away all the houses and everything else. At Islay the waves obtained also an altitude of 40ft. over their natural level, and covered three times the wharf without doing much injury. The town, being built on the summit of a very high cliff, escaped destruction. Caracas, a small landing place near Jisco, was swallowed by the sea, and the boats that were in the bay carried away and left two miles inland. In Callao the earthquake was felt at 4.48 p.m. It came with an oscillatory motion—a motion similar to that of a boat in calm weather; it lasted ten minutes; at 6.30 p.m. another shock was felt, of five minutes duration. A few minutes before seven high-water was to take place. The water, instead, began to recede; at 10.30, for the first time, the water reached a higher level than it was ever known to have attained before, within the memory of man; at eleven a tremendous wave, 18ft. high, invaded the land to upwards of 600ft. from the beach; currents set in from opposite directions at a velocity of three to four miles an hour; at the time a soft breeze from the south-west blew; the atmosphere was perfectly clear.

These are, in as few words as possible, the phenomena that were noticed during the terrible cataclysm of the 13th of August, 1868; the greatest, perhaps, on record, with that of the 16th of the same month, which visited the province of Imbabura during our historical period.

Following the great tidal wave which originated on the coast of Peru, on its way across the Pacific, and taking into account that the difference in longitude between Arica and New Zealand is approximatively 9 hours, we shall find that the wave having reached the New Zealand coast at 6 a.m. of the 15th has employed 29 hours to travel 6,120 miles. Its velocity may, therefore, be computed at 211 miles per hour. Its violence, even then, was extraordinary. The Island of Chatham to the eastward suffered greatly, for the wave that struck it was of such magnitude as to completely destroy the colony of Tupinga on the North.

The tidal wave reached Hokodadi (Japan) at 10 a.m. on the 15th, presenting itself by a series of waves that caused the sea to recede and be depressed until 3 p.m. under its level, and rise again above it with great velocity. During 10 minutes per watch a difference of 5ft. was measured; the constant elevation and depression of the tide at that place being only 2½ft. to 3ft. It reached the Sandwich Islands on the 14th at 8.46 p.m., and continued to manifest itself during the 14th, 15th, and 16th, by a series of waves, rising and receding 3ft. to 4ft. every 10 minutes.

From these data a comparative table showing the time employed by the tidal wave to reach the different places may be thus formed:

	Greenwich Time.		Local Time.	
Places.	Dates.	h. m.	Dates.	h. m.
Peru	13 ...	9 40 ...	13 ...	5 0 p.m.
Sandwich Islands	14 ...	2 6 ...	14 ...	3 46 a.m.
New Zealand......	14 ...	7 6 ...	15 ...	7 0 a.m.
	14 ...	13 6 ...	15 ...	10 30 a.m.

Fifty-six hours after the ruin of Arequipa and other cities of Peru, another terrible cataclysm visited the northern provinces of Ecuador. The volcanic fields of Ocampo seemed to have been the focus of the electro-chemical action whose effects culminated in the destruction of 40,000 human lives, and the ruin of the cities of Otabalo, Ibarra, Atmitaqui, Catacachi, Perucho, San Antonio, San Pablo, and many smaller towns and villages, besides part of the city of Quito, the ancient capital of the Seyris, or Kings that governed the Empire of Quito, before its conquest by Huayna-Capac, and the modern capital of the Republic of Ecuador. Quito, built on the slopes of the volcano Pichincha, is elevated 9,500ft. above the level of the ocean. Several times it has suffered from the eruptions of the Pichincha since the conquest, the most remarkable being those that occurred in 1575, 1587, and 1660. The cataclysm of the 16th of August seems, however, to have been the most disastrous that has afflicted these regions, the most volcanic known on the globe. Here are found grouped on a plateau about 200 miles long by 80 broad, a great many volcanoes, which, for the most part, at different epochs since the conquest, have given the most unmistakable proofs of activity. The Chimborazo, the Cotopaxi, the Pichincha, the Altar, the Illinaza, the Corazon, the Cayambó, the Riobamba, the Sangai, and many minor ones, are here gathered nearly within sight of each other. The earthquakes that visit Chili, Peru, Ecuador, and California, within the five days that elapsed between the 13th and 19th of August, notwithstanding their synchronism, did not originate from the same centre of action. Each had a distinct focus, to which a greater activity was communicated by coming in contact with some of the points of the voltaic arch formed, in those days, by the relative positions of the sun, moon, and earth. In Quito meteorologic disturbances occurred on the 15th: heavy showers of rain and hail, and heavy thunder; at 1.20 a.m. of the 16th a severe shock of earthquake was felt, then the earth continued to shake at intervals to the 19th. All the principal churches were levelled to the ground.

In the district of Catuchi two towns were totally destroyed without leaving a trace of having existed. The town of Atmitaqui was destroyed; in that of Ibarra, the capital of the province of Imbaburi, 13,000 persons perished; rents were opened and closed; huge pieces of rocks were seen tumbling down the sides of the mountains, hills sank, carrying with them sugar-cane plantations, houses, and everything on them. That where the city of Otalavo was built sank and was replaced by a lake. Where Cotacachi once stood is now a swamp; large quantities of stone were hurled from the Cotacachi; from the Imbabaru issued a torrent of mud, the flow of which was followed by that of water; from the crater of the Ocampo were ejected large quantities of butiminous matter. The Sangai was seen in a state of constant eruption. Dark clouds of dust and a heavy rain of fine powdered earthy matters fell; a total darkness prevailed and covered the country as a pall, the obscurity of which was illuminated at intervals by flashes of light from the volcanoes, amidst continuous detonations that resembled the roaring of a distant cannonading.

Resuming all these data, I came to the conclusion that the production of these phenomena had its origin in four different centres of action. Those felt in Peru had for centre the country between Moquequa, Arequipa, and Arica, encircled by the four volcanoes—the Misti, at the foot of which is situated Ariquipa; the Huayna-putina, the Ubinas, and the Tutapaca, forming part of the chain of Cordilleras immediately behind Moquequa.

The earthquake that shook the greatest part of Chili seems to have originated in the volcano of Leullallco, situated 240 miles from Copiapo. It was reported to have broken out in a violent eruption, its crater vomiting lava, ejecting large stones; the ground at the base of the mountain opened in numerous places, and through the rents spouted forth currents of water impregnated with sulphuretted hydrogen gas; these occurred on the 14th and 15th of August.

The earthquakes that destroyed the northern parts of Ecuador had their centres of action in the fields of Ocampo, and in some of the numerous active volcanoes that are strewed all over the great plateau of Quito. They took place on the 16th of August.

The earthquakes that occurred the 16th of August in San Francisco and various other places in California had probably their origin among the numerous volcanic fields that are so frequently met with in that country; and their centre of action may have been the same that has produced lately the earthquakes of Sacramento, Inyo, and other places.

MECHANISM.*

IN the spring of the year 1869, a course of Cantor lectures was delivered by John Anderson, Esq., of Woolwich. The subject was "Applied Mechanics," and the complete course will be found in Vols. IX. and X. of the ENGLISH MECHANIC. Mr. Anderson closed those lectures with the following sentence:—"It will be found that so long as any of Nature's secret laws remain unexplored, well-directed irrepressible thought will alight on new discoveries one after another; and to the endless variations of mechanical combinations there is practically no limit." To some of the elementary forms of "these endless variations of mechanical combinations" our attention in the present course of Cantor lectures is to be directed. It may appear disheartening to enter upon an inquiry which at the outset is said to consist of "endless variations;" but by classification and division, not only all the inhabitants of the world, but all of which the world itself is made, and even the very universe, has been brought under careful and minute examination. The words—animal, vegetable, and mineral—comprehend the world and its inhabitants. Division and sub-division have so placed these that those with similar distinctive features are soon classified side by side.

A digression upon these words for a few minutes, even thus early, will not be out of place. To Aristotle, who was born about 384 years before the Christian era (he died 322 B.C.), we owe much in respect of a development of the system of classification and division. When Aristotle was classifying natural history, and seeking for some distinctive feature by which to distinguish men from every other animal placed in the same class, he selected for him a name appropriate at this day—he called man "a tool-making animal;" for man was the only animal in the creation that made tools for his own special purposes. Had Aristotle lived now, how much more appropriately would this characteristic have applied, and yet our surroundings might have deprived us of the man; for Aristotle was appointed tutor to a youth then fourteen years of age—that youth is afterwards known in history as Alexander the Great; but Lord Bacon, in his "Advancement of Learning," writing of Alexander the Great, says "that he does not choose to consider him Alexander the Great, but prefers to call him 'Aristotle's pupil.'" In these days, and in this country, more indebted as it is than any other in the old hemisphere to the scientific development of the tool-producing faculty, and to many other science faculties, we may look in vain for such encouragement. Alexander did not forget his science tutor, for history records that he allowed Aristotle 800 talents per annum (a large sum, however the talent may be estimated) with which to prosecute his studies in natural history. May it not be that in England in the present generation there are no Aristotles because there are no Alexanders?

By a like law of broad classification we may say of our present subject there are two marked groups, under one or other of which may be arranged all our mechanistic contrivances. These groupings are comprehended in the words structures and machines. The considerations which present themselves vary considerably, according as one or other of these divisions is under notice, and unfortunately for the science and practice of mechanics in the full acceptation of the term mechanics, modern usage has disjoined what should always have been united. The class of men whose business requires that they should attend to the branch called structures disregard the branch called machines. The compliment is repaid. The mind of the man who thinks of structures is ever dwelling upon contrivances for securing stability and perpetual rest, whereas the thoughts of the mechanical engineer dwell upon contrivances for securing motion, and he sometimes dreams of making motion, and not rest, perpetual. Although each of these men look to mechanical aids for accomplishing his purpose, they look at them from two very different

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

standpoints, and in very different coloured lights. The man who deals with structures is always thinking of struts, tensions, pressures, and frictions, and he adopts those means which seem most likely to secure what he calls stability and immobility. The other man considers that to put the machine in a state of rest, to so proportion the powers as that each elementary part of that machine shall be in equilibrium, is to put a machine in a state of absolute idleness. Now, idle machines, like idle people, do us no good; they destroy themselves, they rust, they in fact decay, and, to borrow the phrase from the workshop, we may say of idle machines that they really "eat their heads off." The true state of a machine, as those who are concerned with them know well, is a state of motion. So completely is this idea of motion impressed upon mechanists, that rest as accomplished by struts, and stays, and rods, forms no part of the mental employment of the mechanician. A mechanician has no faith in the machine requiring rest. If a mechanician wants a piece of machinery to pause in its work, in order that another part of that machine may go through some operation or other, he accomplishes it by establishing such a relation between and amongst the motions of the respective parts as shall produce the result he requires. As two waves of light or of sound in opposite phases produce, by coalescing, darkness or silence, so two motions can be so mechanically combined as to produce absolute rest. The owner of a machine considers a machine worthy of room on the floor of his factory only so long as it can move and is moving; and, indeed, nowadays, that is hardly sufficient for manufacturers and owners of machinery. Machines are expected to be not only diligent when they are at work, but to go back, when they have done their work, with a speed which no employer has ever yet considered too great. There is no law upon a labourer to return an empty spade to the ground at twice or three times the speed with which he lifts a full one. A machine, however, is expected to do this. It is expected when it has done one stroke of work, literally without turning round, to run backwards at twice or thrice the velocity at which it does its work in order to start and do another stroke. Nor is it in readiness to return to its work at an increased speed that any great triumph of mechanistic skill is noticed. There is hardly a plan or device for the saving of bodily labour, nay, there is hardly a scheme for saving mental thought, that mechanism is not both expected and requested to undertake. Mechanism burrows in the earth, it builds our houses, it conveys us by land and by water, it clothes us, it supplies us with teeth, it will even do a large portion of the work of digestion if we wish, it counts for us, it determines the weight of our gold and silver coins, accepting or rejecting those coins, as, in its mechanical judgment, it deems best; and, to crown all, it thinks for us; it calculates, it sets up its own type, it prints its own calculations, and and if by any accident it makes a mistake, it rings a bell and tells us it has done so.

Thus, not only English society, but all society depends upon mechanism, and it is, therefore, singular that educational books, and even treatises upon mechanics, lay the foundation of all the information and instruction that they give, not in states of motion, but in states of rest. To put levers, pullies, inclined planes, wedges, and screws in states of perfect equilibrium, to demonstrate by tedious and complicated reasoning what is called the parallelogram of forces, to be poring over problems for establishing equalities by both geometric and analytical formulæ—these constitute a large portion of the so-called scientific mechanical knowledge contained in our treatises upon machinery for students—at least for those who are beginning to study. If a few advance beyond elementary knowledge, they are generally confronted by still more complicated and uninviting discussions upon the laws which have much to do with motions in the universe, but little or nothing to do with motions on the earth or in our machines.

In 1788, when Lagrange published a great and fine example of analysis, he wrote in the preface of the book (it was upon machinery):—"The reader will find no figures in this work; the methods which I deliver do not require either instruments or geometrical or mechanical reasoning, but only algebraical operations." Lagrange herein made mechanics subservient to analysis. Analysis ought to have been made subservient to mechanics. Our books of mechanical science deal with questions chiefly of rest or of celestial motion only; hence the man who wants a machine for a given purpose, who wants to combine certain motions, turns in disappointment from volumes that he considers are delusions and snares. So far as power, and so far as strength of materials are concerned, he is satisfied that these are ample for all his requirements. Until he can obtain such a combination as shall secure a special end, questions of construction and equilibrium are not felt by him as matters really of even momentary consideration. He knows that if the motions he needs are won, he will have no difficulty whatever in producing the rest. To modify control, and regulate the motions of connected materials, constitutes the chief object of study with those who hope, by machinery, to improve upon manual labour. This study is clearly independent of the building of the machine; it is clearly independent of all those parts of the machine that are comprehended under the word "structure." It is also equally independent of the source whence the machine derives its power; and, further, it is quite independent of the work to be done by that power, after it has passed through the machine. What it does involve, however, are any mechanistic contrivances by which motions may be changed, or constrained, or diverted, and that, appearing in one form, existing for a specific purpose, they may be transformed into another exactly adapted to the purpose required. Thus it will be for a pre-arranged object, and to follow a predetermined law. This is that which is comprehended under the word mechanism, and it is in consequence of the development of this aptitude in the few minds given to the special study—and they have been but few—that England owes all her present manufacturing industries.

Having thus explained what is comprehended under the word mechanism, it may be well to regard what it is that is excluded. All our experience tells us that motion is a consequence of force. So sure are we of this, that we say that whenever force acts motion ensues. If, however, it is wished to arrest an ensuing motion, it is usually done by the introduction of an opposing force. Thus, even in this aspect, rest, observe, is the result of a combination of motions.

The branch of mechanical studies which thus considers force as compelling rest, or preventing a change of motion, is called statics; and states of rest produced by opposing forces, except when the mechanism is called upon in the interval to perform some special operation, do not concern us, and further allusions to questions of statics may be put aside.

But force may produce change, either in the amount or direction of motion, and the branch of mechanical studies which comprehends this is called dynamics. The term dynamics is a marvellously comprehensive one. To say of an operation that it is a dynamical one, gives just about as much information of the operation as to say of a substance that it belongs either to the animal or vegetable kingdom. Division and sub-division must enter, in order to an accurate and instructive investigation of questions of a dynamical character. Two of these divisions are so intimately related in the branch of dynamics to be treated of in this course of lectures that a distinction must be drawn between names much alike. M. Ampere, in the year 1834 (for that is about the time when this subject first began to attain special consideration), wrote:—"Long before I employed myself upon the present work, I had remarked that it is usual to omit, in the beginning of all books treating of sciences which regard motion and force, certain considerations, which, duly developed, must constitute a special science." He then proceeds to describe the science, and calls it kinematics, from a Greek word, κινημα, which signifies motion. Further, he makes a proposal which was taken up by others, and the progress of the idea is interesting. He (M. Ampere) defined a machine, not as it had hitherto been considered—an instrument "by means of which we may change the intensity and direction of a given force," but as an instrument "by means of which we may change the direction and velocity of a given motion," hereby excluding force from all considerations of mechanism. Mr. Willis, to whom I shall have occasion to refer again, proposes another definition, namely, to consider a machine as an instrument "by which to produce, not motion simply, but relations of motion between parts, thus setting aside M. Ampere's definition that a machine is an instrument to change the direction and velocity of a given motion. Dr. Whewell, in his "Philosophy of the Inductive Sciences," in the first volume, page 144, has a very short chapter indeed on "Motion," and he was well competent to write a long one on the subject. He wrote in that chapter, in 1840:—"Motion should be considered quite independent of its cause—force. The science might be termed 'pure mechanism,' in contradistinction to 'mechanics proper,' or 'machinery,' in which force is taken into consideration. Such a science is the science of mechanism independent of force, and I consider it to be the solution of a problem which may be expressed in these words:—'To communicate any given motion from a first mover to a given body.' The necessity of this separation (says Dr. Whewell) has been seen by those who have taken a philosophical view of the sciences." Dr. Whewell, it will be observed, excluded force, and in this respect he follows M. Ampère's views, expressed just six years previously.

Thus has arisen the distinction between two very similar terms, kinetics and kinematics. Each term involves considerations of motion, but in two very different aspects. In kinetics it is not mere motion which is considered, but the relations that motions bear to forces. Hence questions in which the expenditure and nature of force, and the motions produced, are considered belong to kinetics. Kinetics comprehend the laws of energies, and the modes by which men may best avail themselves of these laws. We are too prone as a people to generalise laws; and what we find to be true under one set of energies, we assume to hold good under another set. Such is not the case. The energies of gravity, electricity, vitality, affinity, light and heat, require different treatments, in order that each may be most advantageously utilised.

An example or two may make clear the distinction now insisted on.

The velocity and penetrative or destructive effects of a cannon ball, in relation to the character and explosive consequences of the energies of guncotton, gunpowder, nitro-glycerine, dynamite, or whatever other elements are used, would be a question in kinetics.

Again, that singular calculation, that if a man were engaged in producing a certain motion, as, for example, drawing water from a well, by the expenditure of his muscular energies through the period of his manhood, he would raise by the mechanism of his bodily frame no more water than could be raised by one load of the best Wallsend coal, hence completing the parallelism, and reducing it to the form of money value—and it is wonderful how much more we appreciate these things when they are put in a money value—the life energy of a man acting through the mechanism of his muscular system does not exceed the energy of a load of coals employed through the mechanism of a scientifically-made engine. In other words, given the two mechanisms, the life of a man is not worth more than about 60s. Had man been created for no higher destination than this, we may depend upon it he would have been put together as a piece of mechanism very different from that on which he is now constituted.

In kinematics these elements of force occupy no attention whatever. Neither the force that produces the motion, nor the forces impending the motion, nor the forces that these two motions call into action, none of these belong to the division of the subject with which these Cantor lectures have to deal. Kinematics, therefore, is a science of mere motion; even elements of strength are not considered in it. The galloping tortoise which we see advertised in the windows in the streets of London, and that tricky little mouse that you see creeping up the hands of men in Oxford-street or Lombard-street, claim from mechanicians quite as much attention, and involve questions of mechanism perhaps quite as curious as Babbage's calculating machine, or those singular things, the orreries of the last century. It is, therefore, the division of the subject called kinematics with which the present course of Cantor lectures is chiefly concerned.

(To be continued.)

HEATING STEEL.

WE believe that overheating has condemned splendid steel more frequently than anything else. "Make it well hot that it will work easier" is a common saying, and sounds well in the shop; but when heating steel, don't follow the advice, for although it may seem to work easier when overheated, the error committed thereby will soon become apparent. All cast steel (excepting the comparatively new article, "chrome cast steel," which has properties entirely its own) requires the most careful heating. The fire must be regulated by the size of the work; and in heating the steel, beat the coals around the outside of the fire as soon as the flames begin to break out in order to prevent the heat from escaping. To save fuel, damp the coal and throw water on the fire if it extends beyond its proper limits.

To ascertain the heat of the steel, says *The Hub* (U.S.), draw it out of the fire, and that often; for it requires to be well watched to heat it properly, and if not hot enough, thrust it in quickly again; but be careful not to use a higher degree of heat than is absolutely necessary to effect the desired purpose, and to use as few heats as possible. Steel is essentially iron with a larger ingredient of carbon; therefore, too frequent heating or overheating burns out the carbon, and thus spoils its valuable character. Many smiths have the idea that so long as the steel does not fly to pieces when they strike it with the hammer it is not too hot; but this is an erroneous idea, and easily proved when it comes to be hardened, and when it is brought into use. We therefore say again, that no forger can be too careful in the heating process, and when he takes the heats. The practical eye will soon learn when it is heated properly for forging. But few forgers will admit that they spoiled the work by overheating, and yet this is unfortunately most frequently the case.

For welding cast steel, a flux is required in order to prevent oxidation of the surfaces to be joined. For this purpose, use a composition consisting of sixteen parts of borax and one of sal ammoniac, which has been boiled together over a slow fire for an hour, and when cold, ground into a powder. The steel is first heated a little, then dipped in the flux, and the heating continued until the metal has attained the proper heat. The flux is then fused over the surfaces, and has dissolved any oxide of iron which may have formed. The two surfaces to be joined are laid together and struck continuously, working toward the edges in order to expel the flux and insure a perfect union of the metal. Shear steel is joined to wrought iron without difficulty; but when cast steel is to be welded to wrought iron, the greatest care is required, or else no sound welding will be effected. By using the above mentioned flux, it can be done; but in all cases where steel is to be joined to iron, the steel—no matter what kind—should never be heated to so high a degree of temperature as the iron.

IMPROVED SCREWS FOR WOODWORK.

THERE are but few persons who have not experienced the difficulty of driving home a screw into hard wood. This difficulty is overcome by an improved form of screw recently patented in the United States by Mr. E. S. Willis, of Philadelphia. The first part of his invention relates to a spoon-shaped point to the screw for forming a boring and tapping device, so as to dispense with the necessity of boring soft wood previous to the insertion of the screw. The second part relates to a central bore in the screw from the concavity of the point throughout its whole length for the passage of the borings. The accompanying engraving fully explains the device. This screw will not split the wood, as the spoon point cuts through the fibres, and the central bore allows ample space for the chips. Machine screws made on this principle are found to operate well. They are made with a square head instead of the slotted head represented in the illustration. In putting ordinary screws into hard wood, the friction attendant upon the thread crowding the fibres out of place is very great, and it is hard work to drive the screw. With the improved screw, the fibres are cut through by the tapping point sufficiently to remove a portion of the friction and to secure easy driving, but not enough to prevent the screw retaining a tight hold on the wood.

USEFUL AND SCIENTIFIC NOTES.

Preserving the Polish of Steel Instruments.—For this purpose the *Lancet* confidently recommends a mixture of equal parts of carbolic acid and olive oil, smeared over the surface of the instruments. The plan is much used by medical officers in the navy, and is found to preserve the polish and brightness of the steel, however moist and warm the climate may be.

Washing out Locomotive Boilers.—The "Report of the Committee on Boilers and Boiler Materials," on page 17, of Fourth Annual Report American Railway M. M. Association, contains the objections to blowing off boilers, and allowing them to cool before washing out. As the heat retained in the boiler after blowing out bakes or hardens the mud or other deposit, a proper method is to blow off steam, and, after the pressure is off the boiler, to run in cold water, while hot and impure water is run off, thus gradually cooling the boiler until it is cold, after which time washing out with cold water will not injure it.

Improvement in Fractional Distillation.—Linnemann has successfully applied to laboratory purposes the principles of a method largely used in the arts, in the construction of the so-called dephlegmators. This principle consists in partially condensing locally the vapour which rises from a boiling liquid, in such a manner that the vapours which subsequently rise shall pass through the condensed liquid, and thus in a certain measure be washed. The apparatus employed consists simply of a vertical tube, attached to the flask in which the liquid boils, and containing six or eight little caps of platinum wire gauze separated from each other by small intervals.

Liquid Lenses.—A lecture experiment adopted by Professor Henry Morton illustrates very forcibly the action of refraction. A magic lantern is arranged vertically in connection with suitable mirrors to throw the image upon the screen. An empty watch glass is substituted for the usual objective lens. If now we introduce an object, as, for example, a photograph on glass, of course, no image will be produced on the screen, but only a nebulous patch of light. On pouring water into the watch glass, however, a well defined image is produced. On replacing the water by alcohol, muriate of tin, or other more highly refracting liquid, a lens of higher power is obtained.

Submarine Railway.—The railroad bridge which has been planned to extend across San Francisco Bay, from the mainland to Goat Island, is of a submarine character. It is an immense iron tube intended to be sunk from 28ft. to 30ft. below the surface, and held in its place] by its own buoyancy and by cables and mushroom anchors. The tube is to be 20ft. in diameter, and made of boiler iron, strengthened by an internal framework of iron beams. The invention is based upon the idea that the buoyancy of the tube will be equal to the weight of a train of cars. Anchors are to hold the tube in place.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE last meeting of the Session was held on Friday, June 14, the President, Professor Cayley, in the chair. The meeting was well attended, and there was a considerable influx of valuable papers. That on

Photographic Irradiation,

by Lord Lindsay, attracted much attention. His lordship—after having remarked that in the photographs taken on the occasions of the late eclipses the dark limb of the moon is *eaten into*, and that the image of a luminous object is surrounded by a border of light which it is difficult to separate from the edge of the image, and beyond which there is an outer fringe of light, the separation between the two fringes being more definite—described at some length the experiments which he had instituted for illustrating the phenomena, principally with a view of eliminating the effects on the apparent diameters of the heavenly bodies produced by irradiation. A plate of zinc having been prepared of about a foot square, with an aperture of a triangular form in the centre, across which a wire was stretched from the apex to the base, and a gas flame being placed behind it so as to entirely fill the aperture with light, the triangle of light thus produced was photographed in the usual way. A large number of photographs were taken, the normal time of exposure being *one* minute, but extending, for comparison, in some cases to twenty minutes. After an exposure of one minute, the image on plain white glass was sharp and well defined, but with an exposure of ten minutes, Lord Lindsay found the image to be surrounded by a halo—in fact, the appearance was that of a round spot of light, and not a triangular spot. Experiments were made with a great variety of surfaces, glass ground on one or both sides, or backed so that the image could be seen by reflected light only, and some photographic impressions were taken on slate. The best substance, that which gave the least extension of the image with the longest time of exposure, was found to be the yellow glass ordinarily used for glazing dark rooms. The greatest extension of the image occurred when and where the light was strongest. It thus appears that, by taking certain precautions, these effects of irradiation may, to a great extent, be eliminated.

Dr. De La Rue, in commenting on Lord Lindsay's experiments, said that it would be difficult to overrate the value of them: they were of the greatest importance, especially at the present time.

Planetary Markings.

JUPITER.—Mr. Browning exhibited drawings of Jupiter selected from a collection which he had made during the late apparition of the planet. The specimens selected represented the most striking intensifications of colour.

VENUS.—A very interesting communication relative to the markings on the planet Venus was read by Mr. Langdon, a "station-master" on one of our lines of railway. It appeared that the author, wishing to devote some portion of his leisure to astronomy, became possessed of a 6in. silvered glass reflector with which he observed the planet Venus from May to November, 1871. At first he had some difficulty in obtaining good views of the planet, but by inserting a diaphragm of card perforated with a fine hole by means of a red-hot needle, in the eyepiece, and thus shutting off all extraneous light, he brought the planet into perfect subjection, and pursued his observations with ease and comfort. Having read some time last spring that doubts had been cast on the existence of markings on the planet, he referred to his notes and sketches, and compiled from them the paper now communicated. In May, 1871, he noticed a dull cloudy mark on Venus, which was seen by some men to whom he showed the planet. One of them, a mason, declared that the object he was looking at was the "moon," and he knew it to be so, because of the dark mark upon it. On one occasion Mr. Langdon saw the southern horn rounded off, the northern horn being quite sharp, and ending in a fine needle-like point. On another occasion both horns were sharp and pointed, and once the northern horn appeared *bent*, and turned inwards towards the centre of the disc of the planet. The appearance of the terminator is described as being jagged, very like the moon, but sometimes hazy; the author comparing the moon's terminator to net-work, he said that of Venus appears like fine lace. Near the time of inferior conjunction the dark body of the planet was well seen. In concluding his paper, Mr. Langdon returned his thanks to Messrs. Proctor, Norman Lockyer, Browning, and others, for having sown the seeds of knowledge broadcast, some of which he had picked up, and endeavoured to turn to account.

Tables of Uranus.

Mr. Dunkin announced that Professor Newcomb had nearly completed his "Theory of Uranus." There were but a few Greenwich observations to add. It is expected that the observations will be well represented by the theory, and that the errors will be very small.

New Planet.

The discovery of a new minor planet (121) by Professor Watson, on May 12, was announced.

Jupiter's Satellites.

The Rev. R. Main, Radcliffe Observer, Oxford, communicated observations of the eclipses of Jupiter's satellites. As compared with the times given in the *Nautical Almanac*, the errors were as follows:—1st Satellite *nil*; 2nd satellite *twenty seconds*; 3rd satellite *one minute*; 4th satellite *three minutes*.

Meteors.

Italian astronomers having succeeded in observing several meteors last November, on the 14th and 15th, Mr. Proctor considered it desirable that a careful watch should be maintained in November of the present year.

A paper was communicated by Mr. Greg, in which he had collected and arranged all the existing observations of radiant points of meteors, and found the arrangement very satisfactory and instructive. This paper was characterised by Mr. Glaisher as a "very valuable and important paper." The details were so numerous, and the table so extensive, that the paper was not read, and we are consequently unable to give that analysis of it which we could wish.

Orbit of the Double Star Castor.

An interesting and valuable paper on the orbit of Castor was read by Mr. Wilson, from which it appeared that the orbit of the companion star is hyperbolic, and not elliptic. In the year 1845, Mr. Hind computed the orbit, and found that the elements differed entirely from those previously computed by Sir John Herschel and Dr. Mädler, and attributed the difference to the effect of the then recent measures by Mr. Dawes, made at Mr. Bishop's observatory. Mr. Hind's period came out 632·27 years. Herschel having found a period of 253 years, and Smyth one of 240 years. In 1846 Capt. Jacob computed the orbit, his period being 658·1 years. By the assistance of Mr. Gledhill, Mr. Wilson became possessed of a list of measures from 1740 to the present time, from which he obtained eleven points of the orbit, ranging from 1740 to 1866. These points lie nearly on a hyperbola of eccentricity of 2·2. This result is exceedingly interesting. The component stars are nearly of the same magnitude (3 and 3·5), and the companion star appears to have approached the primary from the depths of space in a hyperbolic path, and will recede further and further from it in a similar path, never again to revisit it. Castor is the only star known to have a companion moving in such a path; the components cannot, therefore, be regarded as forming a binary system. [Instances of hyperbolic motion are very rare, two comets only—those of 1771 and 1824—are known to have moved in hyperbolas, and we believe the last to be doubtful.—REPORTER.]

Stellar Motions.

Dr. Huggins gave a *vivâ voce* account of the subjects treated in his paper lately communicated to the Royal Society. In one portion of the paper the Doctor gave the results of his researches with his large instrument, bearing on the motions of certain stars. He had re-examined spectroscopically the motion of Sirius, and found reasons for reducing its rate of recess from the sun of 25 miles per second to 18, or, at most, 22 miles per second. Dr. Huggins mentioned the names of several other stars, the motions of which he had examined; some were receding from the sun and others were approaching him. The velocities mostly quoted of the receding stars were about 18 or 22 miles per second; and amongst the approaching stars, Arcturus, with a velocity of 55 miles per second, and α Lyræ moving at the rate of 54 miles per second were specified. In explaining these motions, the Doctor called attention to three circumstances capable of modifying them. A portion of the motion results from the transference of the Solar system in space, this occasions an apparent proper motion of each star; the motion of groups of stars in given directions as set forth by Mr. Proctor; and the actual motion of each star in space. In referring to the motions of groups of stars, Dr. Huggins took occasion to notice the confirmation of Mr. Proctor's views by means of spectroscopic observations, and mentioned that he had found five of the seven principal stars of Ursa Major exhibiting motions precisely as indicated by Mr. Proctor. In illustration of these remarks of Dr. Huggins, Mr. Proctor exhibited a map on which he had drawn arrows, by the directions and extents of which the direction and extent of the proper motions were indicated, and he hoped that Dr. Huggins would honour him by using the map in selecting his stars for observation. We believe there is a great probability of the map being published. Dr. Huggins's paper appears to be opening out to us a most interesting field of stellar astronomy of equal, if not of greater, importance in the study of the physics of the heavens than that of binary stars so intimately connected with the name of Herschel.

Constitution and Distribution of Nebulæ.

A portion of Dr. Huggins's paper before alluded to treats of the further spectroscopic examination of Nebulæ, particularly the Nebula of Orion. In adapting his large instrument to these special observations, the Doctor found it necessary to produce the light, giving the comparison lines, within the tube, and by an ingenious contrivance he succeeded in obtaining it in the axis of the telescope, so that the light from the Nebula under examination and that from the gaseous element with which it was compared traversed the tube. The three bright lines of the Nebula were referred to the hydrogen lines, of which the brightest is well known to be double; but Dr. Huggins could not succeed in doubling the brightest line of the Nebula, so that the real character of the brightest line of the Nebula is still uncertain.

Mr. Proctor read a paper on the distribution of the Nebulæ in the rich region of Virgo and Coma Berenices, in which he directed attention to relations that appeared to exist between the gathering of stars and the scarcity, or otherwise of Nebulæ in their neighbourhood, indicating the existence of a connection between the stars and the Nebulæ.

Improvement of Tripod Stands.

Mr. Lecky exhibited and explained an improved tripod, to which, by the addition of certain cross braces forming ties and a brace in front of the nature of a strut, a remarkable firmness was given. It could be used for a variety of purposes. Before explaining the principles of his improvement, Mr. Lecky exhibited the first double tripod made in England.

The large number and important character of the communications read contributed to render this, the last meeting, one of the most interesting of the Session.

THE CHEMICAL SOCIETY.

The Faraday Lecture.

THE Faraday lecture founded by the Chemical Society was recently delivered by Professor Cannizzaro, of Palermo, who chose for his subject the form which the theory of chemistry should take at the present time. Whilst giving a broad sketch of the progress of modern chemistry, he showed that the atomic theory had become more and more intimately interlaced with the fabric of chemistry, so that it is no longer possible to separate them without rending the tissue, as it were, of the science, and that up to the present time we have been unable to enunciate even the empirical laws of chemical proportion independently of that theory; for those who employ the term "equivalent" in the sense that Wollaston did, commit an anachronism. Consequently, in the exposition of the value and use of symbols, formulæ, and chemical equations, not only are we unable to do without the atomic and molecular theory, but it is inconvenient to follow the long and fatiguing path of induction which leads up to it. By one of those bold flights of the human mind we can at once reach the height whence we discern at a glance the relations between facts.

He then went on to show that the solid basis, the corner-stone of the modern molecular and atomic theory—the crown of the edifice of which Dalton laid the foundations—is the theory of Avogadro and Ampère, Koenig, and Clausius, on the constitution of perfect gases, to which chemists, unknown to themselves, have been led in the progress of their science. He thought the time had arrived for reversing the order which had hitherto been followed in teaching chemistry, that instead of setting out from the criteria for determining the weight of the molecules, and then to show their ratio to the vapour densities, they ought, on the contrary, to commence with the latter, with the theory of Avogadro and Clausius, demonstrating it from physical considerations; to found upon that the proof of the divisibility of simple bodies—that is to say, the existence of atoms; and to show, as occasion presented itself, that the weight of the molecules and the numbers of the atoms deduced by the application of this theory are in accordance with those which are deduced from chemical criteria. By this means we can measure the degree of confidence to be placed in the latter criteria, since so-called compound equivalents do not suffice to determine the weight of molecules, or even to prove their existence, although they may be deduced from a single principle—the theory of the constitution of gases: this is the natural transition from physics to chemistry.

The Professor then stated how he applied in detail the principles he had laid before them. He introduced his pupils to the study of chemistry, in endeavouring to place them on the same level as the contemporaries of Lavoisier, and to teach them to appreciate the importance of the principle of the conservation of the weight of matter, showing them that this is quite independent of any idea of its nature or constitution; they are thus led to examine the ponderable composition of substances, so that the student passes rapidly from the epoch of Lavoisier to that of Proust, and then to that of Berzelius, at the time when he commenced his researches on proportions. At this stage the same impulse is given to the pupil as Berzelius received on becoming acquainted with the hypothesis of Dalton. The latter is laid before him without any accessory, the use of symbols and formulæ being introduced dogmatically. There will now arise in his mind the same doubts and difficulties that assailed Berthollet, Sir Humphry Davy, and Wollaston in the application of Dalton's theory, and at the same time a desire for an explanation of the simple relation which exists between the vapour volumes of bodies which react on one another, and of the products which are obtained. Now is the moment to state or recall to mind the physical theory of the constitution of the perfect gases, commencing with a rapid glance at their general and special characters. He insisted that in this part of the instruction the mind of the student should not be diverted from the numbers expressing their relations, by consideration of the variations caused by changes of temperature and pressure. In applying the theory of the constitution of gases, it will be perceived that the molecules of simple bodies are not always the atoms of Dalton, and a certain confusion will thus be produced in the mind of the beginner in the conception of the ideas of atoms and molecules. The hypothesis of Dalton can now be laid aside, substituting, as a starting point, the theory of the relation of molecular weights to the vapour densities. A table must be prepared of the vapour density compared with that of hydrogen as 2—that is to say, the weights of their molecules compared with the weight of the semi-molecule of hydrogen taken as unity. We must then compare the composition of the molecules containing the same element—including, or not, the molecule of the element itself—and thence deduce the law of the existence of atoms, that is to say, the amount of each element which always enters by whole multiples into the molecules which contains them. We here have the atoms of Dalton, which in the present state of the science, express not only all that Dalton discovered, but also the composition of equal volumes of their vapours, and in the choice of which those doubts can no longer arise which embarrassed Davy and Wollaston. The ideas of molecules and atoms suggested to the student by this law are devoid of all considerations of form, size, continuity, or discontinuity; the only property indissolubly connected with them is that of ponderability, the very definition of matter.

Recollecting that no physical theory of the constitution of matter had yet been advanced which thoroughly conformed to chemical ideas, he insisted upon the advisability in teaching the molecular and atomic theory to keep it free from all that is not absolutely essential, so that it may preserve sufficient plasticity to adapt itself to the progress of our physical and mathematical knowledge. For this purpose he thought it useful to allow the student, in the first place, to glance at the changes in the hypothesis of the constitution of matter, and then to cause him to estimate the degree of confidence they merit in the actual state of our knowledge. Having thus placed upon a solid basis the fundamental notions of atoms and molecules by the comparison of the composition of equal volumes of the bodies in the gaseous state, it becomes necessary to consider the difficulties which arise in the application of these notions when the vapour densities are wanting. He explained and justified the use of various auxiliary criteria to which we have recourse in these cases, proving them, in the first instance, by the touchstone of the theory of Avogadis and Clausius by showing that they gave results in accordance with that theory whenever the two methods can be employed simultaneously.

He believed that we should never lose sight of the starting point, nor give the formulæ of all compounds as of equal probability. "It is not by concealing the obscurity of these questions that we shall enlighten the student; on the contrary, we should estimate each fact at its true value by showing him that our science does not merit an equal degree of confidence on all points." This forms the introduction, the preparation for the study of the transformations which matter undergoes—the real object and aim of our science.

The comparison of the atomic composition of molecules has led chemists to the law of substitution, to the theory of types of Dumas, then to that of Williamson and Gerhardt, and, lastly, to the theory of the different mobility of atoms and their modes of union, or the so-called theory of atomicity, which includes the former. Although at present it is impossible in teaching chemistry entirely to eliminate this latter theory, which gives a summary of several laws, and guides us ordinarily in the co-ordination and even prevision of a large number of facts, yet it is difficult to keep it within just bounds, so as to avoid infusing into the mind of the beginner illusions which are dangerous for their intelligent education. In order to avoid this, it is advisable to bear in mind the progress of this doctrine, and the actual phase of development which it has at present reached. It is still far from being a complete and well established theory, but it is in a state of transition, for although doubtless, it embraces a large number of facts, as yet it does not embrace them all. It is only a partial representation of the reality, and that from a restricted point of view, showing but little relation to our views of the constitution of matter, for it is the result of a comparison of diverse facts expressed by means of the atomic and molecular theory. It is convenient, therefore, to consider each point of this doctrine exclusively in relation to the group of facts which has suggested it.

It is unadvisable to define the valency of atoms as a property inherent in them, and then to deduce as a corollary their different modes of union; on the contrary, it is preferable to regard each portion of this doctrine as a deduction from the observation and comparison of a determinate group of facts, until an opportunity offers to unite these fragments into one whole, not forgetting, however, to notice the gaps which exist; never going beyond what the facts themselves suggest, and never applying to all bodies indiscriminately the laws which suit only a single group. For instance, we must not pass over in silence the fact that whilst certain elements are bi-tetra or even hexa-valent, others are tri and penta-valent; but the pupil should be prevented from acquiring mechanical and geometrical ideas from the cause and effect of the valency of atoms by frequently reminding him that chemical facts show nothing about the size, form, continuity, or relative disposition of atoms. If we are sometimes obliged to employ the expression "relative position of atoms in the molecules," and even to represent them graphically, we must warn the student that these are only artifices to express certain transformations, and that we are really ignorant of the relative position of the atoms either in space or in the mutual action of different portions of matter. With these reservations, it is possible in teaching to derive considerable advantage from the theory of atomicity, and at the same time avoid its inconveniences.

In the study of the transformations which matter undergoes we should direct the pupil's attention, not only to the ponderable changes in the composition of molecules, but also to the electrical and calorific phenomena which accompany these transformations. Even from Lavoisier's time it has been recognised that we cannot separate the study of matter from thermic considerations, and every day the connection which exists between chemical and thermic phenomena becomes more apparent. As in the study of ponderable changes we were guided by the law of the conservation of weight, so in the connection between chemical and dynamical phenomena we are guided by the law of the conservation of force; the two studies mutually supplementing and illustrating one another; and not only will the atomic and molecular theory and that of atomicity help us to compare dynamical phenomena, but the study of dynamical phenomena will show us analogies and differences between chemical actions which would not be observed in the ponderable equations. We should, therefore, instruct the student in the little definite knowledge which we at present possess concerning thermic and electric phenomena, and especially fix in his mind the fundamental notion of a mechanical equivalent, and the manner of comparing it with chemical action, as expressed by the atomic theory. In this we should be aided by the previous or simultaneous instruction of the student in physics, under the form and language of the thermo-dynamic theory.

The lecturer concluded by observing, that in the choice of methods and of matter for a course of chemistry, it should always be borne in mind that it was eminently a progressive science, and that even at the time of its most rapid development. The student should start not only with a knowledge of certain definite and fixed principles, but with an aptitude and sufficient preparation to enable him to follow the science in its unceasing transformation and progress; whether he intends to expressly cultivate chemistry, or has only learnt the elements of the science as an auxiliary to other studies or professions; moreover, the end of chemical instruction for both these classes of students is not only to fix in their memory a certain amount of knowledge, but to assist in their intellectual education. For this, chemistry, of all sciences is one of the best, offering, both in verbal and practical instruction, excellent occasions for the exercise and harmonious development of all the faculties of the human mind.

Dr. Williamson said that there was scarcely anything of greater moment in the scientific education of youth than the rightly setting before them those wonderful transformations of matter which it is the province of chemistry to explain. These great and growing truths—for, as the lecturer had said, they were growing truths—should be set before youth in such a manner as to form a coherent whole.

Professor Tyndall said he had heard the discourse with deep interest, for it showed that the lecturer knew the importance of a teacher's vocation, and that his province was not merely to communicate knowledge, but to do it in such a manner as to arouse an interest in and love of the subject in the pupil, by presenting it in its proper relations. He would have welcomed the lecturer to that institution even had he come to tear in pieces the notions which he cherished regarding atoms and molecules. How pleasant it was, then, to find such a broad agreement between their views. The chemist cannot halt at equivalent proportions, he *must* ask himself whence they arise, and the inevitable answer is some form of the atomic theory. This theory, however, cannot be confined to chemical phenomena. The motions of those atoms and molecules underlie all our explanations of the physical cause of light and heat, and it is already taking up the field of magnetism and electricity. Consider, for example the heat of gases, both as regards the motion of translation of the molecules which produce temperature, and the motions of rotation and vibration of their constituent atoms, which, though they do not express themselves as temperature, constitute a portion of the heat. The lecturer had also referred to atoms of the same kind combining together, so that free oxygen and free hydrogen being considered as composed of molecules, each containing a pair of atoms, has certainly simplified the results. But it must not be forgotten that this combination of like atoms is generally different from that of unlike atoms. The union of oxygen with oxygen or nitrogen with nitrogen produces no such effects upon the luminiferous ether as the union of oxygen with nitrogen. With the same quantity of matter the amount of *vis viva* sent forth as radiant heat may be augmented a thousandfold—perhaps a millionfold—by the act of diverse combination. This act seems to carry with it a condensation of the ether to a dense atmosphere around the atoms. In the same way the diverse atoms vibrating in the denser atmosphere formed on combination, show their vast superiority as radiators over like atoms, which, except in such special cases as ozone, &c., are incompetent to produce similar condensation.

THE METEOROLOGICAL SOCIETY.

AT the ordinary meeting, the last of the Session, held on Wednesday, June 19, the President, Dr. Tripe, in the chair, Captain Toynbee, Marine Superintendent of the Meteorological Office, explained the system of procedure in constructing the series of oceanic wind and weather charts now in progress in his department of the office. Four monthly charts were exhibited, January to April, of which the January chart is lithographed. It is intended to circulate this chart among meteorologists with the view of eliciting expressions of opinion previous to the publication of the portion of the series now ready. The geographical extent of the four charts exhibited embraces 10° of latitude and longitude so chosen as to illustrate the best longitude for crossing the equator. Each chart contains 100 2in. sub-squares of 1° of latitude and longitude, in which are arranged the *results* of all the records in each sub-square of wind, direction and force; barometric heights; temperature of air, dry and damp thermometers, also the temperature of the surface of the sea; direction and rates of currents and specific gravity of sea water. In each sub-square concentric circles are drawn, within which certain results are recorded, the central space containing arrows indicating the winds met with in the particular latitude and longitude to which the sub-square relates. The arrow, representing the largest number of wind observations, extending to the *centre*, shows the prevailing wind in the sub-square. The ratio of calms to winds is pointed out by a shaded segment of the same ratio to the whole circle. In addition to the sub-squares are marginal squares which contain the sums of ten sub-squares running in the same degree of latitude or longitude. They also contain the percentage of *wind* and its mean force for each quarter of the compass—N.W., N.E., S.E., and S.W., the percentages of *variables* and *calms*, and the percentage and mean rate of *currents*, and also the percentage of *no current*. In addition to this information the marginal squares include the summings-up of *weather* and *cloud* for ten sub-squares.

The explanation of Captain Toynbee was very lucid. Having sailed over the locality, he very ably pointed out the best route for sailing vessels, specifying with great distinctness the sub-squares they should avoid—those in which they would meet with the largest number of calms—and he showed on the chart for April that on the most easterly strip of longitude calms were much more frequent than on the most westerly; also that the wind gradually increased in force in proceeding from east to west, so that a ship in the more westerly longitudes would meet with greater wind propulsion than one further east. The Captain also pointed out the differences existing between the January and April charts. In connection with the air and surface temperatures, upon laying down the isotherms it was found that the surface of the sea was invariably 1° warmer than the air above it.

Mr. Glaisher spoke in very high terms of the great value of the charts now in progress, and congratulated the country generally, and the maritime community in particular, not only on the establishment of the Meteorological Office, but on the highly important character of the results which it had produced—results enabling the seaman to choose his route, for with such charts in his possession, extending over the twelve months of the year, he had no difficulty in selecting his course so as to avoid detention on the one hand, and avail himself of advantageous winds on the other. If the Meteorological Office had produced nothing beyond the four charts now before the meeting, it had fulfilled its mission and had fully answered the expectations of its promoters.

Towards the conclusion of the meeting, the residential address was read; it was ordered to be printed and circulated among the members. We may probably return to it on a future occasion. This being the annual meeting, the Fellows present balloted for officers and council to serve during the ensuing year. Upon the report of the scrutineers, the following gentlemen were declared to be elected:—

PRESIDENT.—John W. Tripe, M.D.

VICE-PRESIDENTS.—Arthur Brewin, F.R.A.S.; Robert H. Scott, M.A., F.R.S.; George James Symons; Charles Vincent Walker, F.R.S.

TREASURER.—Henry Perigal, F.R.A.S.

TRUSTEES.—Sir Antonio Brady, F.G.S.; Stephen William Silver.

SECRETARIES.—Charles Brooke, M.A., F.R.S., F.R.C.S.; James Glaisher, F.R.S.

FOREIGN SECRETARY.—Lieut.-Col. Alexander Strange, F.R.S.

COUNCIL.—Charles O. F. Cator, M.A.; George Dines; Henry Storks Eaton, M.A.; *Rogers Field, B.A., Assoc. Inst. C.E.*; Frederic Gaster; Robert James Mann, M.D., F.R.A.S.; *William Carpenter Nash*; Thomas Sopwith, M.A., F.R.S., M. Inst. C.E.; *Rev. Fenwick W. Stow, M.A.*; *Captain Henry Toynbee, F.R.A.S.*; Samuel C. Whitbread, F.R.S.; E. O. Wildman Whitehouse, Assoc. Inst. C.E.

The names given in italics are those of new members of the Council.

USEFUL AND SCIENTIFIC NOTES.

Improved Method of Laying Footwalks.—A new process of laying footwalks is being tested on a portion of the footway in front of the Municipal Offices, Dale-street, Liverpool. On a foundation of gravel, grouted with composition cement, is laid, by means of self-acting machine (having a roller with a pressure of about 40lb. to the square inch), a layer of cement, which forms the footwalk. The roller has projecting ridges, and these produce a number of grooves, which carry off the rain, thus insuring the footwalk being always dry. The composition gradually dries, and in a few days after being laid becomes, it is said, a hard, solid mass, more durable than stone, and not in the least liable to chip or break up. There is another advantage, that if a portion of the footwalk has to be temporarily removed it can be taken up in sections. The process can be applied to roadways, but in that case the material requires to be laid in sets, to prevent horses slipping. The cost is stated to be considerably less than that of flags or stone sets.

Reminiscences of Paper Making.—It is said that William East, an English paper-maker, once upon a time set his men to work, and went away on business. While the men were at dinner, Mrs. East accidentally let a blue-bag fall into one of the vats of pulp. Alarmed at the occurrence, she determined to say nothing about it. Great was the astonishment of the workmen when they saw the peculiar colour of the paper, and great the anger of Mr. East when he returned and found that a whole vat of pulp had been spoiled. After giving the paper made from it warehouse room for many years, Mr. East sent it up to his agent in London, to be sold "for what it would fetch." "For what it will fetch!" said the agent, misunderstanding the meaning; "well, it certainly is a novelty, but he must not expect too much." So he sold the whole at a considerable advance upon the market price, and wrote to the mills for as much more as he could get. The surprise of Mr. East may be imagined. He hastened to tell his wife, who found courage to confess her share in the fortunate accident, and to claim a reward, which she received in the shape of a new cloak. Mr. East kept his secret, and for a short time supplied the market with the novel tint, until the demand far exceeded the supply, and other makers, discovering the means used, competed with him.

The Deepest Well in the World.—Twenty miles from Berlin is situated the village of Sperenberg, noted for the deepest well that has ever been sunk. Owing to the presence of gypsum in the locality it occurred to the Government authorities in charge of the mines to attempt to obtain a supply of rock salt. With this end in view the sinking of a shaft or well 16ft. in diameter was commenced some five years ago, and at a depth of 280ft. the salt was reached. The boring was continued to a further depth of 960ft., the diameter of this bore being reduced to about 13in. The operations were subsequently prosecuted by the aid of steam until a depth of 4,194ft. was attained. At this point the boring was discontinued, the borer or bit being still in the salt deposit, which thus exhibits the enormous thickness of 3,907ft. The boring would have been continued in order to discover what description of deposit lay under the salt but for the mechanical difficulties connected with the further prosecution of the operations. During the progress of this interesting work repeated and careful observations were made of the temperature at various depths. The results confirm very closely those which have been already arrived at under similar circumstances.

How to Destroy Thistles.—While giving botanical evidence in some thistle prosecutions, Dr. Daniel Bunce, curator of the Geelong Botanical Gardens, stated that an infallible way to destroy thistles was, just before the bud began to form, to cut the roots through with a spade about 2in. below the surface; also, that the practice of cutting them above the surface was an utter waste of both money and labour, as the thistles thus treated invariably sprang up again with a greater number of heads than before.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

LIGHT SCIENCE—α DRACONIS AND PRECESSION.—TESTING A TELESCOPE—CEMENTED OBJECT-GLASSES.—AXES OF THE PLANETS—AND PURCHASE OF A REFLECTOR.

[4404.]—I AM sure that "W. H. S." (query 12120) can only want a candid answer to his question; and will not, therefore, be offended with me if I say that there is not even the ghost of "a shadow of probability" in his "theory." Before replying to the concluding part of the query which he puts, it would be necessary to have his definition of a "vacuum." Perhaps what is called the "Torricellian vacuum" (or space above the mercury in a barometer) is as perfect a one as we can obtain; and I certainly see the light through *that* twice every day myself when I read off the height of the barometer.

Will "J. X. T." (query 12126, p. 340) permit me to point out that he is now putting a very, very, different question to that which he asked on p. 159. If he will refer to his original query there (11716) and re-read it, I think that he will find that, upon the face of it, it is an inquiry whether α Draconis, having been at its nearest to the North Pole (and so our Pole Star) at a certain epoch, returned to the same position 600 years afterwards. My answer to that was (let. 4047, p. 171) that 25,800 years must elapse from the date of its occupation of the position of the Pole Star—when, bear in mind, *it was only some* 10′ *from the North Pole of the Heavens*—until its return to the same place. Now, however, he is asking about a wholly different matter. He has, apparently, been exercising himself severely with some of Professor Piazzi Smyth's pyramid vagaries, and wishes, seemingly, to know how, assuming α Draconis to have been at a distance of 8° 42′ from the Pole, it should, after the lapse of 1200 years, have been found at the same elongation from it? The best answer I can give to this is that the phenomenon of precession is produced by the revolution of the pole of the earth round the pole of the ecliptic (a revolution occupying, as I have said, 25,800 years) at a distance of some 23½° from such ecliptic pole. It must, then, be pretty evident that in the case of a star not actually *in* the pole of the ecliptic, the pole of the equator must approach it, get to its nearest, and then recede from it; and that at equal times before and after it is at its greatest proximity to our supposed star, must be at equal distances. I should strongly recommend "J. X. T." to obtain Proctor's large "Star Atlas"—or, failing that, he might make shift with the smaller one—and study the arrangement of the precessional arrows in Map 1 in connection with the very star about which he is inquiring. He will get a better idea of what he wishes to know from this map than he could derive from almost any amount of verbal description, unaccompanied by Diagrams. He will, of course, find the pole of the ecliptic marked on the Solstitial Colure. Into the physical reasons of precession, and into its complication by nutation, it is as impossible as it is needless here to enter, for are not these things written in the famous "Ipswich Lectures" of the Astronomer Royal?

In reply to Dr. Blacklock (let 4387, p. 357) I would observe that the formula which he quotes for ascertaining the separating power of a telescope of any given aperture, is the one given by Dallmeyer; but that, with a not very limited experience, I have never yet met with an instrument with regard to which its *rigid* applicability could be predicated. Moreover, in testing an object-glass or mirror to the limit of its theoretical separating power, we presuppose a combination of the most favourable circumstances; and, therefore, we should examine the star to be divorced on a calm evening in twilight, with a power not much less than that of 100 to every inch of aperture, and to give the telescope the best possible chance, the components of the pair we are viewing should be almost, or quite, equal, and of a magnitude not exceeding the fourth. I think it extremely likely that Dr. Blacklock did see the companion to δ Cygni on the occasion to which he refers, and for this reason, that the chief difficulty with this very delicate test arises from the fact that the 9th magnitude companion is just *on* a diffraction ring, a ring which would be obliterated by such a haze as your correspondent speaks of. Dr. Blacklock's ideas as to the probable, or possible, cause of the disappearance of very faint stars under increased amplification seem to me to be very suggestive ones, and I think that it might be desirable to institute some experiments for the purpose of determining, or attempting to determine, one or two of the points mooted in his interesting letter.

I may tell "C. B." (let. 4366, p. 353) that object-glasses are *not* balsamed to shorten the focus, but to prevent internal reflections, and to preserve the inner surfaces of the lenses from decomposition. I confess my inability to understand how, if the lenses of "C. B.'s" 48in. object-glass were—as they ought to have been—in contact, he shortened its focus one-third (!) by interposing balsam. This, by the way, induces me to remark that this method of cementing lenses is only applicable when the radii of the two internal surfaces are identical, and that, consequently, it is quite unsuitable in a large proportion of astronomical telescopes.

And, while on the subject of cemented object-glasses, I may inform "Albireo" (query 12224, p. 366) that I believe that the cracking of the balsam to which he refers almost always has its origin in a blow or jar of some sort; at least I know that the tumble of a pocket telescope of my own was incontinently followed by this result. With reference to the second part of his query, I should certainly say that a cemented object-glass was the more durable of the two, and I may answer his concluding question by advising him to have nothing to do with a pancratic eyepiece for delicate celestial purposes. What with the great loss of light, and the annoying visibility of the dirt and dust on its component lenses, it is about as worrying a piece of apparatus as the observer can employ. Nothing equals the Huyghenian eyepiece for astronomical purposes.

"Countryman" (query 12227, p. 367) asks a question with reference to a subject on which our information is by no means perfect, no determination being much more difficult than that of the exact inclination of the axis of a planet to its orbit. With the reservation then, that the data I am about to give are only approximate, I may tell your querist that Bessel put the inclination of Mercury's axis from a perpendicular to its orbit at 26°, that de Vico imagined the inclination of the axis of Venus to be no less than 53° 11′ 26″ (!) that Sir William Herschel conceived the axis of Mars to have an inclination of 28° 42′, and that Jupiter's axis is almost perpendicular to the plane of its orbit, or, at all events, inclined to it less than 2°.

If the object of "Canis Minor" (query 12229, p. 367) be (as it ostensibly is) to examine the physical aspect of the objects about which he reads in books on astronomy; or, should he wish to devote himself—as he would further seem to indicate—to selenography, he could in no other way get so much for his money, as in the purchase of the instrument to which he refers. I should however, strongly recommend him to spend a little more money and have an *equatorial* mounting. An altazimuth movement with a high power is enough to drive anybody mad.

A Fellow of the Royal Astronomical Society.

CONCERNING CERTAIN (OR UNCERTAIN) CRITICS.

[4405.]—Mr. J. M. G. Brookwood (let. 4357, p. 352) is kind enough to attempt to set me right; but, perhaps, it might have been as well if, *in limine*, he had made himself acquainted with what I said, before attempting to criticise it.

I am wholly unaware that I ever penned any such nonsense as an assertion that "the semi-barbarous Hebrews '*wrote*' the account of the Deluge." Admitting, for argument's sake (for we have nothing approaching to proof of it), that Moses did write the account which we possess, I assume that he only gave what lawyers call secondary evidence on the point (as I can scarcely conceive even Mr. Brookwood contending for his bodily presence in the ark); and, such being the case, he must have been indebted to the floating legends of his time for his data. Furthermore, I demur wholly to the dictum of my critic, that "whether the Hebrews themselves can be properly styled semi-barbarous is doubtful, *if we compare them with the other nations of their time*"! Just so. "Inter indoctos etiam corydus sonat;" but the question here is not their relative, but their absolute, knowledge.

The concluding paragraph of the letter under discussion is delicious. How would it read paraphrased thus: "But if 'P. Santalinus' disbelieves, as he seems to ignore, the existence of King Arthur, what reason has he to believe in the existence of George the Third, or of any one else in particular"?

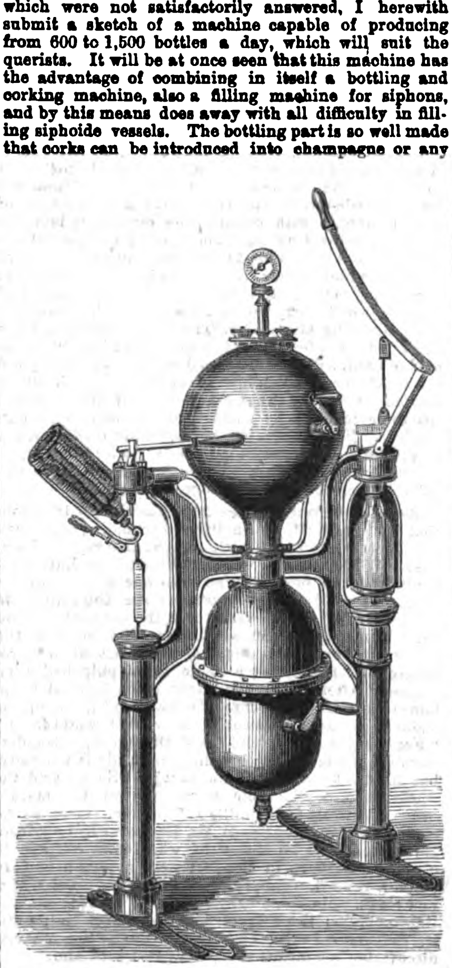
I am exceedingly curious to know on whose authority Mr. Brookwood, in his preceding letter (4456, p. 352), limits the antiquity of the Cave Men to 7,000 years; and I fail utterly to see what he means by the "testimonies adduced by Lyell," inasmuch as that great philosopher assigns 100,000 years as a moderate estimate. It might be worth your correspondent's while to re-examine the evidence on this point, and to make a theory to fit the facts, instead of trying to force the facts to fit his theory.

I should not have condescended to notice the reply to query 11991, on p. 362, coming as it does from a person who, apparently knowing nothing, seems so burningly anxious to impart it to his brother readers, but for the fact that in his floundering attempts to correct me he has himself blundered hopelessly. He never penned a truer sentence in his life than that in which he disclaims all knowledge of fourpenny catechisms, or he would never have made this last successful essay to justify his enrolment in the category adverted to in Romans i., 22. I repeat to "Anon." that the plate *is* placed in the focus of a camera lens, since in everything worthy of that name the chemical and visual foci are made absolutely coincident. I yield to "Philo" the full credit of the assertion, or insinuation, that it is a *fixture* there.) Moreover, if we were to employ a single lens, the plate holder would *not* have to be placed "at a considerably *greater* (!) distance" from such lens than its optical image was formed at, but at a *less* one—the actinic rays residing at the violet, and consequently more refrangible, end of the spectrum. What the "congregate focus of diverging rays" means "Philo" knows best. I fancy that this would bother the Astronomer Royal and Professor Stokes (our two first living authorities on light) a little. With the utmost deference to "Philo" I think that the study of a fourpenny catechism would have obviated this solecism, at all events.

A Fellow of the Royal Astronomical Society.

IMPROVED MACHINE FOR MAKING AERATED DRINKS.

[4406.]—Having seen from time to time inquiries in "ours" as to the best machine for this purpose, which were not satisfactorily answered, I herewith submit a sketch of a machine capable of producing from 600 to 1,500 bottles a day, which will suit the querists. It will be at once seen that this machine has the advantage of combining in itself a bottling and corking machine, also a filling machine for siphons, and by this means does away with all difficulty in filling siphoide vessels. The bottling part is so well made that corks can be introduced into champagne or any



other bottles without the least danger of breakage. It can be used for any aerated drinks, soda water, lemonade, ginger beer, champagne, &c.; it takes up but little space, about a yard and a half square being amply enough. It is remarkably well constructed—with great strength and solidity, can be worked with ease, and not at all liable to get out of order. The gas is produced by means of sulphuric acid and common whiting; the gas compresses itself, becoming perfectly washed and pure before saturating the water. The saturation is made in 25 minutes' time by turning an agitator. It has a manometer to indicate the pressure of gas. I would recommend this to the notice of "D. W. L." or "L. W. D.," who, I believe, asked the question. Anything further I shall be most happy to explain, and I can give the price. H. B. E.

A SEARCHER AFTER TRUTH.

[4407.]—What a strange thing it is that people so generally lose all sense of common justice, civility, and good feeling, to their opponents in any matter which has a theological or ecclesiastical tinge—either will do, though they are very different matters. That being so with people who are usually fair and reasonable, and the weather having taken so warm a turn, with considerable electrical disturbance, I am not disposed to be too hard upon "E. L. G.," who appears to be a subject rather for sympathy under the attack of rabies, which has set him snapping and biting (letter 4360, p. 352).

Permit me to say that "E. L. G." states "the thing which is not," and bears false witness against his neighbour. As to his good taste in making a direct personal attack upon me because I think differently from him, I say nothing, because I care nothing; but I will not allow him to set forth what is absolutely false, and further to deduce from that false premise equally false consequences.

I am not going to discuss either the Bible or my own theological opinions, which concern no one; I would do so faithfully and fearlessly, as I have often done in other pages. This is no place for such topics. It was impossible to discuss the Deluge without some such reference as I slightly made on two occasions, but I ask any one of common sense if there is a shadow of truth in the remark, "What single paragraph thereon has 'Sigma' written without naming or referring to the Bible?" I further ask whether even that limited honesty which disputants of "E. L. G.'s" calibre usually feel binding on them is exercised when, without a shadow of information as to me or my opinions, he ingeniously but indirectly contrives to class me with Voltaire and Bradlaugh.

I have not read any of the works of either of those writers, except Voltaire's poem, "The Henriade," which I thought wretchedly dull stuff. Of Bradlaugh's opinions I know nothing but the probably false statements sometimes given in the papers; if they are true, I entirely dissent from them. In fact, I have formed this sort of picture of him:—A tolerably wide reader, with an intensely bigoted and narrow-minded way of looking at things; an absolute incapacity for seeing anything which does not suit his ideas; a considerable amount of ability, with a vastly excessive estimate of it; a firm conviction that any one who thinks differently from him is certainly a fool, and probably a rogue or a hypocrite; immeasurable presumption, and therefore a belief that, coming from him, assertion is evidence, and abuse argument. That is the sort of conception I have of Mr. Bradlaugh; it may be entirely wrong, as it is based on the reports mainly of his opponents, but if correct, what fun it would be to hear a discussion between him and "E. L. G." That would be a case of when Greek meets Greek,* &c.

It was certainly my impression that my remarks were aimed at the purely physical question of whether there had ever been a universal Deluge, and even that only in the second place, the first being given to "E. L. G.'s" absurd comet as the cause of the supposed Deluge; at all events, I distinctly deny "E. L. G.'s" assertion that my chief object was the Bible, or that I endeavoured to single out two popular errors about it and thrust them forth as facts. To use "E. L. G.'s" words (he furnishes one with a complete armoury), "I flatly deny that any 'sincere searcher after truth' of any kind" would so gratuitously falsify the object, nay, the actual words of his opponent. Why, I did exactly the same thing as "E. L. G." does in the letter I am discussing; he says they are errors, that they are misconceptions of the real meaning of the writers, only it pleases him to except the Deluge from the list. That is what I said and say: they *are* errors, misconceptions, and popular delusions; and I further said and say that it is a mischievous error to insist on our accepting them, or to link them up in any way with religious ideas. It is a gross calumny, and I can scarcely believe an unintentional one, to say that I used them "exactly as Voltaire and Bradlaugh;" on the contrary, I say they are dangerous points incapable of defence, and ought to be recognised as such, instead of being bitterly defended as Sacred truths. (Please give the big S which "E. L. G." so values.) "E. L. G.'s" talk about the account of the sun and moon standing still is pure twaddle, as any one may see who will read the account itself; in fact, he utterly falsifies it, for the battle was actually fought in defence of the Gibeonites, who had surrendered themselves as serfs: the Israelites had *not* bound themselves not to destroy the Gibeonite *religion* in any way, and the writer does *not* tell us that the "superstitious legends are from no Sacred book." There is a sort of parenthesis or marginal note by some later copyist, remarking that there is a similar account in the book of Jasher, which may be a novel, as "E. L. G." says, for all I know about it, but which, I believe, the Jewish Targum calls "The Books of the Lord," and which a greater G. than "E. L. G."—viz., Grotius, considers was a sort of metrical tradition handed down from the period of the events, and such as are repeated to this day among the Arab tribes.

Sigma.

[After "E. L. G.'s" attack on "Sigma" we feel bound to insert the above letter. We are, however, so heartily sick of the subject, and the manner in which it has been discussed, that we will not insert another line on it, come from what quarter it may.—Ed.]

THE ANCIENT CONSTELLATIONS.

[4408.]—The steam-comet is dropped by consent, and your readers breathe again. Without wishing to approach that subject, I must touch on an astronomical matter raised by "E. L. G." He gives an interpretation (letter 4354, pp. 351, 352) of the origin of Aquarius, Capricornus, Argo, and Sagittarius. Now, I think there is very strong evidence to show that every one of these constellations got its name from its aspect. But setting that on one side, I would ask on what evidence "E. L. G." asserts that "only we westerns have enlarged the Bow of Promise into Sagittarius." In the zodiac of Dendera, Sagittarius is a bow-armed Centaur, as in modern maps. That is the most ancient known representation of the constellation.

Richard A. Proctor.

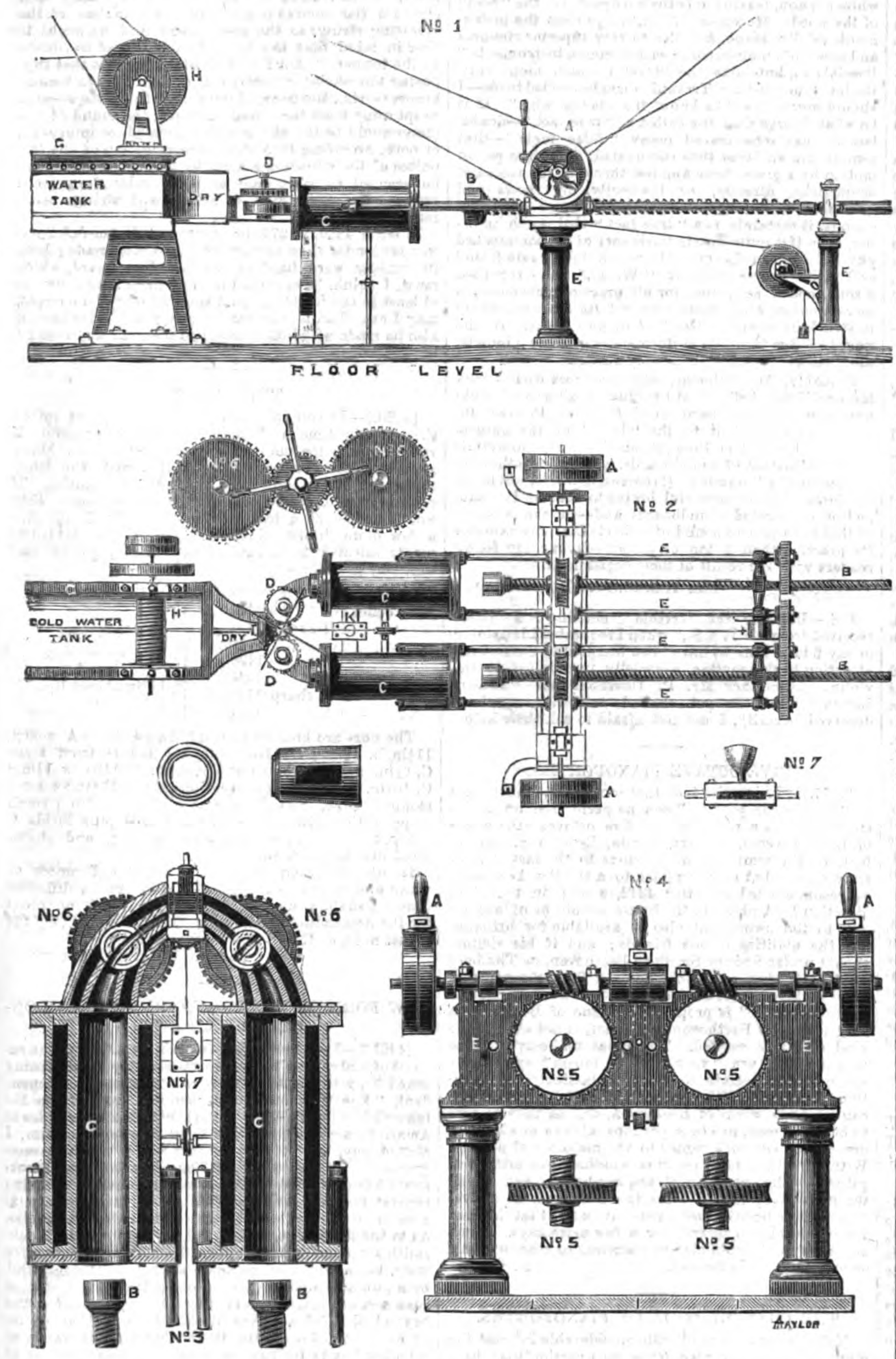
* The original is when Greek *joins* Greek, &c.—F

SYCOSIS.

[4409.]—VARIOUS sufferers have asked at different times advice on this subject. After ten years' suffering from this disease, I adopted, with the most complete success, the practice recommended by Dr. Erasmus Wilson, of plucking out the hairs, which can be easily done with a pair of tweezers, when the pimples are about one or two days past their height. I have well satisfied myself that the removal of the disease is effected by removing the roots of the hairs. M. N.

WIRE-COVERING MACHINES.

[4410.]—I INCLOSE diagrams of machines for covering copper wire with guttapercha or insulating materials, the machines being identical in motive



power with those which furnished the great Atlantic and Red Sea cables. I do not think a description of these machines has ever appeared, and therefore, probably, it may interest many of your readers. I shall not enter into lengthy details, as the diagrams will explain themselves:—A, the driving power; B, the plunger; C, the double steam cylinders; D, the stop-cocks for turning off or on the guttapercha; E, the slide bearings; F, the die; G, the water-tank; H, the creel of covered wire; I, creel of copper wire; K, naphtha pad. No. 1, side section; No. 2, top section; No. 3, enlarged section of cylinders; No. 4, enlarged section of die; No. 5, cog-wheels for screw plunger; No. 6, enlarged section of stop-cocks; No. 7, naphtha pad. It will be easily perceived that the cog-wheels screw on the plunger. Only half or mid section of bearings is shown, the cog-wheels being inclosed.

JOSEPH WILLIAM FENNELL.

SPINNING TOPS AND GYROSCOPES.

[4411.]—"E. H.'s" surprise (let. 4363, p. 353) at my language is due partly to his misunderstanding me, and partly to his misapprehending his subject. He writes, "I say the weight of the top is always sufficient to change, and is in reality always changing the direction of the particles' motion." But the question is, *at what rate?* Moreover, we want rather to have reasoning than to hear what "E. H." or any one else may *say* without showing cause why. He confounds A.'s incorrect reasoning on one subject with my totally distinct line of reasoning on another. It is, of course, perfectly true that gravity draws down the most swiftly travelling bullet—fired horizontally—so that it reaches the ground as quickly as a ball dropped from rest at same height. But it is not true that gravity changes the direction of a bullet fired horizontally as quickly as it would change the direction of a ball thrown horizontally by hand. The velocity of a moving body set travelling horizontally has no effect whatever in preventing the body from being brought to the ground; but it *has* effect in giving the body greater or less power to resist change in the direction of its motion. In the case of a rapidly rotating body, whether the axis be vertical or inclined, the question of the effect of velocity is all important. But "E. H." has utterly misunderstood me if he supposes I intended (as he says) to give a popular explanation of the subject of spinning bodies. I only took one case and one feature of that case. The subject is one for the mathematician. I have never seen a popular explanation that was worth reading.

I would remark that nutation is *not* an action, but the modification of an action. Lunar precession is the action; and this action proceeds more or less rapidly according as the moon's path is more or less inclined to the earth's equator. Solar precession is subject to a similar variation, having a year for its period. The resulting variation in the rate of the lunisolar precession is called *nutation*. ("E. H." speaks as though the matter were a *vexata questio*, asking what is *at present* the explanation accepted; but the whole matter has long since been disposed of. "It is hardly necessary to state," says Sir J. Herschel, "that a rigorous analysis of this great problem, by an exact estimation of all the acting forces and summation of their dynamical effects, leads to the precise value of the coefficient of precession and nutation which observation assigns to them.") The explanation given in Airy's "Popular Astronomy" is the best popular account I know of. It is reproduced (somewhat maltreated) in Mr. Lockyer's "Elementary Lessons," where Mr. Airy's woodcuts reappear, though (through some unfortunate accident) reference to Mr. Airy has been omitted. RICHARD A. PROCTOR.

THUNDERSTORM OF JUNE 18, 1872.

[4412.]—ON the 18th June, 1872, between the hours of 4 and 7 p.m., an interesting phenomenon presented itself. The early part of this period was bright and clear, the sun shining strongly. Suddenly the sun became obscured by a dense mass of cumulus, which filled the north-west portion of the sky. The cumulus, the edges of which was exceedingly well defined, gradually and slowly advanced eastward, but scarcely passed the zenith of this place (Walthamstow) the sky to the east remaining clear. About 5 p.m. distant thunder was heard, increasing in intensity and rapidity, accompanied with every appearance of a severe thunderstorm coming up from the north-west. This, however, did not take place. Towards 6 p.m., or, perhaps, earlier, the thunder ceased, and the dense clouds, instead of passing on eastward, gradually retreated westward so that the sky became clear about 7 p.m., except that shortly after masses of cirro-cumulus formed, which at 7.15 p.m. were finely polarised nearly in the direction of the magnetic meridian. Was this an instance of condensation and evaporation of a stationary cloud? No lightning was seen, nor did rain fall. The above remarks may assist in determining the area of the storm. From the numerous instances of severe thunderstorms on the 18th and 19th, reported in the daily papers from the provinces, it would appear that the atmosphere, being strongly charged with electricity, the *towns* were so many points which determined the disruptive discharge. W. R. BIRT.

LUNAR OBJECTS FOR OBSERVATION, JULY, 1872.

[4413.]—JULY 8, Oriani, Apollonius, Firmicus; July 9, Cepheus, Franklin, Oersted; July 10, Piccolomini, Riccius, Stiborius; July 11, Littrow, Vitruvius, Jansen; July 12, Theophilus, Cyrillus, Catharina; July 13, Rhœticus, Stöffler, Alfraganus; July 14, The Apennines, Aristillus, Autolycus; July 15, Hell, Maginus, Moretus; July 16, Helicon, Leverrier, Euler; July 17, Gassendi, Mersenius, and the *Percy Mountains* between them; July 18, Sirsalis, Crüger, Fontana.

A correspondent of a cotemporary calls attention to the colour of the shadows which covered up the level plain of the Sinus Iridum, on March 19, 11h. 17m., Greenwich mean time. He described it as unlike the ordinary lunar shadow, being of a light gray, through which he saw dimly the surface below, indicating the existence of some ethereal matter overshadowing it.

W. R. BIRT.

ARTIFICIAL MANURES.

[4414.]—PROBABLY at some future time I may have something to say on the subject of artificial manures generally. In the mean time I beg to lay a trifle of information before your readers, and put one or two queries, which some of your correspondents may be able to answer at once, or after experiment. In the first place, I want to know what it is that is understood by the term "stone" coal? In a specification of a patented manure recently published, the inventor states that his discovery consists in the employment of from one to five parts of "stone" coal and one part of sulphate of iron. This mixture is reduced to very fine powder, and may be applied in either the dry or liquid state. When I read this I imagined that "stone" coal might be a printer's mistake for "bone" coal—animal charcoal—but I have found the same term in a communication to the *Revue Horticole*. In this the writer gives some information which may be useful to many of your readers, and I have, therefore, sent it for what it may be worth. He says that he purchased a very fine rosebush, full of buds, and, after anxiously awaiting their maturing, was greatly disappointed, when this took place, to find the flowers small, insignificant in appearance, and of a dull, faded colour. Incited by the suggestion of a friend, he then tried the experiment of filling in the top of the pot, around the bush, to a depth of half an inch with finely pulverised stone coal. In the course of a few days, he was astonished to see the roses assume a beautiful red hue, as brilliant and lively as he could desire. He tried the same experiment upon a pot of petunias, and soon after all the pale and indefinite coloured ones became of a bright red or lilac, and the white petunias were variegated with beautiful red stripes. Some of the lilac petunias became a fine dark blue. Other flowers experienced similar alterations; those of a yellow colour alone remained insensible to the influence of the coal. Now, will any one tell me what is "stone coal"?

Sulphate of ammonia is strongly recommended as an artificial manure, to be applied in a liquid form to plants, especially in pots; and I can quite understand that it may be of very great service in the conservatory, the stove, or the greenhouse, where necessarily the plants do not obtain any ammonia from rain. But I am very doubtful if it is at all necessary for flowers and vegetables in the "open." It is very certain that by some means or other plants do obtain the requisite amount of nitrogen, and it appears to me that sulphate of ammonia can do no more than encourage the "growth" of the plant: it cannot, I take it, increase the quantity or improve the quality of the produce. I think, on the contrary, that the great necessity of plant life—that which it cannot obtain for itself—is phosphoric acid, and I am under the impression that if this is supplied we need not go any further in the direction of artificial manures—except, of course, for crops which require special substances, such as the potato, which cannot be grown without potash. If I am right, the one manure in greatest demand would be "superphosphate," mingled with the chemical ingredient which the constituents of the proposed crop indicate, and of which the soil is found deficient. Farmers are threatened with a great scarcity of guano—one of the most profitable manures used, containing as it does phosphoric acid and ammonia; but the price has risen rapidly of late years, and is now £16 per ton for the best quality. If the price continues to rise it will be impossible to employ guano as a manure with an economical and profitable result; and consequently some other material must be employed to supply the necessary ingredients to the soil. A little discussion may help to throw light on the subject, and I have, therefore, started it with the proposition that sulphate of ammonia and guano at £24 and £16 a ton are not so profitable as nitrate of soda at £17, and "superphosphate" at £6.

SAUL RYMEA.

THE LAW OF VIBRATION AND ATTRACTION THROUGHOUT THE UNIVERSE.

[4415.]—I HAVE no doubt that you, Mr. Editor, will kindly allow me to say a few words on this subject, especially after "The Harmonious Blacksmith" has been kind enough to mention it in his letter 4375, p. 355; and also because I have referred to it several times, and promised to answer several questions, provided I was allowed to explain it first. What I mean by the law of vibration is, that everything in nature, when set in vibration, arranges itself in the same relative proportions between its two ends and its centre of gravity or inertia; that some parts are comparatively quiet to others, and that there are only some parts on a body on which we can set the whole in vibration effectually.

My experiments include almost everything I could lay my hands on; and I found that a strip of wood vibrates in exactly the same relative proportions as a log of a tree, a piece of wire as a block of metal, the air in a pipe as the air in a concert-room, and lastly, I believe it is reasonable to conclude that the earth follows the same, as a stone or a piece of slate does. I could not believe, at first, that this discovery was new, because it is so simple. Then I began reading almost all those books treating on vibration, &c., but found that all those experiments and discoveries were only details, while the law for all is still undiscovered. I am certain these few words sufficiently explain at least what I mean I have discovered.

In my letter to "Fiddler" (4308, p. 307) there is one word left out, and two misprinted, which was, no doubt, my own fault. The sentence commencing, "Whether the law of vibration," and ending at "except the strings," requires the word *is* to be inserted between "instrument" and "constructed;" and the words "prevent the sound parts from 'paulking'" should read "prevent the side parts from 'baulking.'" When the strings are put on a violin it expands sideways, and consequently rarefies the breast in that direction.

J. H. SCHUCHT.

ON THE EFFECTS OF INCREASING THE SUPERFICIES OF SOUNDBOARDS WITHOUT EXTENDING THEIR EXTERNAL DIMENSIONS, AS CARRIED OUT IN VIOLINS, PIANOS, &c.

[4416.]—IT has been proposed to do what the title of this paper expresses for the purpose of increasing the loudness and improving the quality of the sounds obtained from stringed musical instruments, and it is obvious if the corrugation of a soundboard's surface can affect this, doing it will have this advantage over increasing its external dimensions—unless the strings be radiated, and the bridge made longer—because the extent of surface near the string will be greater than it would be if the soundboard's external dimensions be increased, and supposing corrugation does affect what is claimed for it, I think it would in many instances, especially in the harp and violin, be preferable to the employment of two or more soundboards under each other.

Two methods of carrying out corrugation have been published. In one M. Pape places each string or set of strings for one note on what he terms an "harmonic bar," whatever those words may mean. This bar, as represented in the illustrations of his patent, seems to me to be nothing else than a wooden bracing bar of small section. He places the strings very close—*i.e.*, within about ½in. of it, so that the tendency of their tensile force to arch it is well resisted. Each of these so-called harmonic bars is glued on the soundboard proper, and as the strings must, through their bridges, communicate their vibrations to the bar, and the latter (being glued on it) to the soundboard we cannot doubt audible sounds will be generated, although we may doubt if their loudness will exceed those generated in pianofortes strung in the ordinary manner, because each bar being glued *on* the soundboard must become in relation to it a "belly bar," imparting its stiffness or rigidity *to* the soundboard. Now, excessive stiffness in a soundboard is not found to conduce to the production of loud sounds—"quite the contrary," and we may reasonably doubt if the additional extent of surface in vibration—to wit, that of the harmonic bar—can compensate for the rigidity it must induce in the soundboard. I fear the vibrations of the latter will be deficient of amplitude and its sounds of power.

Mr. Robertson, in his patent of November, 1858, No. 2587, price 4d., proposes to augment the surfaces of soundboards by making them of thicker wood, and removing, or as he expresses it, "grooving out" the soft white portion, leaving only the hard part, *i.e.*, the "beat" of the wood. He states "from this process the instruments (violin, piano, &c.) derive very superior richness and power of tone compared with common instruments." Possibly so, but—like the 20,000 Cornish men when the late lamented Mr. Trevanion condescended to die—I should much like "to know the reason why." If it be what George Canning called a "true fact"—doubtless he has experienced many "false facts"—that soundboard surfaces thus corrugated do (when put in motion by a given force applied through the media of drumsticks, directly, or indirectly, by bows and hammers actuating strings) yield more powerful sounds, it certainly is a "true fact" well worth knowing, even if it quite upsets the theory of the soundboard put forth in the ENGLISH MECHANIC by my late friend and fellow correspondent "W. T.," who regarded a soundboard as being, for all practical purposes, a mere wooden drum head (without its tension), which is struck by strings instead of (drum) sticks. By the way, to judge from the performances of some pianists, the "sticks" are not invariably absent.

Probably, Mr. Schucht, who produces what I may term artificial belly wood by glueing alternate thicknesses of soft and hard wood together, thereby insuring an equivalent to the "beet" of the natural belly wood, and has thought much on the materials and construction of soundboards, also some others of our eminently "practical" (?) correspondents, will bring the force of their powerful brains to bear on the subject of corrugated soundboards and—in the absence of that experience a pound of which is far more valuable for practice than a ton of theory—favour my fellow readers with the result of their cogitations.

THE HARMONIOUS BLACKSMITH.

P.S.—But for the terrible "chaffing" I lately received from "F.R.A.S.," when I requested his opinion on my fiddle, I might have been tempted to request his attention to this matter, especially in relation to the violin. As neither Mr. P. Davidson nor "Beacon Lough" have as yet chaffed me with, perhaps deserved, severity, I am not afraid to ask their help.

FIVE-OCTAVE PIANOFORTES.

[4417.]—IT is quite true that most of the music that is "best worth playing" can be performed on an instrument with a range of only five octaves—the works of Bach, Handel, Mozart, Haydn, Beethoven, and, in fact, all the compositions previous to the last fifty or sixty years; but is going back to a smaller keyboard, as recommended in letter 4342, a step in the right direction? A piano in the house should be of use not only to the owner, but also be available for bringing out the abilities of his friends; and if his visitors should prefer Sydney Smith to Beethoven, or Thalberg to Mozart, what could they do on a five-octave instrument? When a few friends meet of an evening, and a "little music" is proposed, a fugue of Bach's, or a long sonata by Beethoven or Mozart, is not exactly the kind of music wanted. The great majority of those who say they are "very fond of music" are utterly unable to appreciate so-called "classical" compositions; and, in addition, it may be said that those who can play the works of Beethoven, &c., as they require to be performed, are (and perhaps always will be) in a great minority with regard to the majority of players. With myself, it is a question whether true music has gained by the extension of the key-board; but, taking things as they are, I think the purchaser of a five-octave instrument would speedily wish that he had given a few more pounds for a few more keys. Such an instrument would also be valueless in case of a sale or exchange being desired.

F. E. C.

THE CONSTRUCTION OF PIANOFORTES.

[4418.]—HAVING read with considerable interest the many articles upon pianoforte construction that have appeared in your valuable periodical for some time past, and having seen nothing referring to Rüst and Co.'s Patent Tubular Upright Pianos, "cottage grands" as they are called, I should like to ask "The Harmonious Blacksmith" if he has ever seen any of them, and if so, whether he would kindly give your readers the benefit of his thoughts about them. Rüst's soundboards are strengthened by means of hollow bars of wood (called "tubes") in place of the solid pieces in general use, and the soundboard is bored through in several places to admit the air into these tubes. The effects of this arrangement are (so the makers say): 1, to more effectually strengthen the soundboard itself; 2, and principally, to produce a greater volume of tone than any pianos made on the old plan. The tone is also of a more mellow and brilliant quality, and much better sustained. I have examined a few of them myself, and consider the method a decided improvement in pianoforte construction, the tone resulting from them being clearer, deeper, and more expansive than anything I have ever heard. The amplitude of vibration is greater than anything I have ever met with, but I would like to have the superior judgment of our friend as above stated. I believe this method of making soundboards involves a scientific or acoustic principle, and there is nothing like working on principle.

H. J.

THE PIANOFORTE.

[4419.]—ALLOW me to put one or two questions to "The Harmonious Blacksmith" with reference to some observations in his letters on the piano. In letter 4351, p. 335, last number, he says, "It would seem that every augmentation of the mass of the bridge must, like increasing the thickness of the belly-bars, obstruct the communication of the impulses of the vibrating strings to the soundboard, and we ought to bear in mind that the latter is only caused to vibrate by the former." Am I to understand by this that supposing the whole, or nearly the whole, of these incumbrances—viz., the heavy bridge and thick bars—were swept away from the sounding-board, the sound of the piano would be thereby greatly increased, or improved, or both, providing that the communication of the impulses of the vibrating strings to the soundboard can be secured as intimately as it is under the present system, the same kind of action and strings being retained?

In letter 4230, p. 275, he observes, "It (the dulcimer) was far louder than any grand piano then made; both its bridges were fixed on its sounding board, which must, I think, have caused it to produce louder sounds at least in the bass." Should such a theory be current, may I ask what is the reason why pianofortes cannot also be made with both bridges on the sounding-board?

SCIOLIST.

THE ORGAN.

[4420.]—IF you have money, buy your pipes rather than waste time and materials in making them; if you have patience and perseverance, make them. Many seem to make themselves acquainted with the fancy names of stops, and build up ludicrous fancies. If readers would search the last seven volumes, they would not be at a loss how to proceed. I will give a few more hints. Subjoined are a few measurements selected from several sets made, voiced, and tuned by myself:—

SQUARE PIPES (WOOD) OPEN.

Tenor (C)	20in.	× $2\frac{1}{4}$	From one set, measuring from the chamfered lip.
(C) sharp	19in.	× $2\frac{1}{8}$	
(D) ,,	$17\frac{3}{8}$in.	× $2\frac{3}{8}$	
(G)	14in.	× $1\frac{3}{4}$	
(A)	$12\frac{1}{2}$in.	× $1\frac{7}{8}$	
(A) sharp	$11\frac{1}{4}$in.	× $1\frac{5}{8}$	
(B)	$10\frac{7}{8}$in.	× $1\frac{1}{2}$	

The next are broader in front than sides:—A sharp, $11\frac{3}{4}$in. × $1\frac{5}{8}$in.; B, 11in. × $1\frac{3}{8}$in; 2nd G from tenor C, $6\frac{3}{4}$in. × $1\frac{1}{4}$in. From another set: B, 11in. × $1\frac{1}{8}$in.; C, $10\frac{1}{4}$in. × $1\frac{1}{8}$in. From another set: B, $11\frac{1}{8}$in. × 1in.; stopped pipe, 2nd D in treble, 5in. × 1in.; small stopped CC, $5\frac{1}{4}$in × $\frac{5}{8}$in.; chamfered pipe inside C sharp, $9\frac{3}{4}$ × $1\frac{3}{8}$in.; semicircular opening, and chamfered inside, 2nd G sharp, $6\frac{1}{4}$in. × 1in.

It will be seen there are slight differences of width and length; each pipe has a somewhat different tone. I shall, at an early opportunity, touch on reeds for the descending scale, from tenor C to CCCC, the lowest note, as the result of my experience.

JOSEPH WILLIAM BRUNELL.

NEW FORM OF VIOLIN—VIOLIN AND VIOLONCELLO COMBINED.

[4421.]—I HAVE much pleasure in attending to the request of, and cannot but feel flattered at my opinion being asked by, your facetious and good-humoured correspondent, "The Harmonious Blacksmith," relative to his funny fiddle (letter 4201, p. 254). Whether the shades of Amati, Guarnerius, and Strad., will rise against him, I cannot say, but on his devoted head be the consequences. Joking apart, "The Harmonious Blacksmith has combined two ideas which I would examine separately—(1) a wholly new form of instrument; (2) a union of the fiddle tribe, from violin to violoncello. As to the first point, taking "The Harmonious Blacksmith's" figure not to represent a section of a box or body, but a series of six open soundboards connected by a jointed sound-post, I conceive that the result of such a construction would afford little force of sound beyond that of a string stretched as is that of an archery bow, for I must think that the resonance of a hollow box or body is necessary to produce power of tone. Witness the effect of a musical box when placed upon a table, particularly if the same table has a hollow drawer. Compare a tambourine with a drum. Also the fact that old Lindley usually mounted himself upon a hollow box (not that I mean to insinuate that he was a sounding-post), to increase his power.

I must agree with "The Harmonious Blacksmith" that soundboards vibrate synchronously (and simultaneously also) with the string which starts them playing second fiddle thereto. If every bit of wood of which a fiddle is built, and which glued together form the body, sounded its own note, what a "jolly row" there would be. It is often laid down in theoretical instructions for fiddle making that the back should vibrate so many times to another number of vibrations for the belly; but this only indicates a certain thickness or test of such thickness of wood as will tend to give a good tone, and neither back nor belly dream of sounding their own independent note, nor does the glued-up body, which possesses a note of its own, act otherwise. It may be laid down as a rule that if two or more pieces of wood are glued together, their pitch will be the same (allowing for non-vibration of glue) as if they were originally one piece of same dimensions. Another remark I would make. If the soundboards are (as it would seem by "The Harmonious Blacksmith's" figure) fastened to the thick outer frame, the thickness of such frame would be likely to deaden the vibration.

Now, as to the second point—the union of the violin tribe in one instrument. I am unable to see how the strings can be fingered. The mastery of double notes on the violin alone is sufficiently difficult, and nothing short of a Briareus (a mythic gentleman, with one hundred hands and fifty eyes) would apparently be sufficient to play a concerto on the proposed instrument. Neither do I think that soundboards fit for a violin string would do for the string of a violoncello.

Suppose our worthy friend "The Harmonious Blacksmith" were first to construct the violin part of his instrument and try its action. This he might chin and save his wooden leg. I see no apparent reason why the vibratory action of a string should not be "returned with interest," whatever may be its position (distance excepted) to the resonant body.

SUFFOLK AMATEUR.

THE BELL PIANETTE.—To MR. BOTTONE.

[4422.]—I AM greatly obliged to Mr. Bottone for recalling my attention to Dr. Cleggatt's patent, and thereby convincing me yet more strongly the wisdom of our law courts' practice of refusing secondary when primary evidence is obtainable. Although I possessed Dr. Cleggatt's patent, I was unable to refer to it at the time I wrote the article on the bell pianette and the lyrichord (printed in No. 378), so I was tempted to trust to the "Abridgment of Specifications Relating to Music and Musical Instruments from A.D. 1694 to A.D. 1866"—one of the cheapest books, containing over 500 pages, in existence, sold for what Jeremy Diddler, Esq., termed the "ridiculously small sum of 1s. 10d.," by her Majesty's Commissioners of Patents at "ye office of ye said Commissioners, over against ye Birkbeck Institution in Southampton Buildings, nere unto Holborne." The aforesaid work is generally pretty accurate, although some of the said abridgments might have been better drafted; but in this they fail in common with certain and sundry Acts of Parliament, not to mention our last treaty with Uncle Sam concerning his Alabama claims. Being, however, but an abridgment, it occasionally is guilty of sins of omission, amongst which are Dr. Cleggatt's proposals to employ "hammers or jacks as in the pianoforte or harpsichord" for vibrating his tuning-forks when arranged to form a musical instrument. I again thank Mr. Bottone for enabling me to correct the error I inadvertently committed, from which some experience ought to have saved me—to wit, excessive faith in official accuracy.

THE HARMONIOUS BLACKSMITH.

AURORA.

[4423.]—Mr. W. HATFIELD, of Bell's Hill, Stoke, near Slough, a reader of the ENGLISH MECHANIC, observed the Aurora of June 3, 1872, and noticed streamers from the magnetic to the true north of a a white silvery colour, sometimes slightly tinged with red, features that I missed.

W. R. BIRT.

COLOURED SUNS—BALSAMED OBJECT-GLASS.

[4424.]—THANKS to "Linea" (let. 4394, p. 358). The erratum he points out very finely illustrates the whole subject of such errors. Not only had I, as he mentions, given the magnitudes of the components of ε Bootis rightly in my "Half Hours with the Telescope;" not only have I a distinct mental conception of their aspect; but positively at the very time the sheet containing the erratum was going through the press, I was publishing in the *Mechanics' Magazine* a picture of the pair, rightly drawn and properly described. How on earth such mistakes creep in, and escape getting turned out, passes me. My reviewer too. How did he fail to notice the error? His remarks show that he is a practised observer.

It may interest "C. B." (let. 4366, p. 353) to know that Dr. Huggins's 15in. object-glass, now being used for spectroscopic work, is balsamed. Dr. Huggins considers that the saving of light is about equal to the effect of an increase of aperture-area by the area of a 5-in. object-glass. Balsaming *ought* not to have shortened focus, if the two glasses were properly shaped. They cannot have fitted, and the balsam became as it were a third lens.

RICHARD A. PROCTOR.

COLOURED SUNS.

[4425.]—IN connection with the excellent essay by Mr. Proctor, inserted on p. 296, perhaps your readers might be interested in a list of the terms employed by several of our best observers, who have endeavoured to convey their impressions of tints in the words which follow. The majority are from Smyth's "Cycle," but eleven other observers have contributed to the list (which I have had in private use for some time), whose names are indicated by the attached numerals. [1] Sir J. Herschel, [2] Struve, [3] Webb, [4] Dawes, [5] C. P. Smyth, Hind, [7] Dembowski, [8] Knott, [9] Talmage, [10] Slack, [11] Miller. The principal authority for these is that invaluable work for all telescopists, "Celestial Objects."

WHITE.

Lucid w.	Grayish w.
Bright w.	Pearly w.
Brilliant w.	Silvery w.
Very w.	Creamy w.
Fine w.	Flushed.
Clear w.	Flushed w.
Intense w.	Brilliant flushed w.
Subdued w.	[3] Reddish w.
Pale w.	Pale reddish w.
Very pale.	Yellowish w.
Whitish.	Greenish w.
Dusky w.	Bluish w.
Dull w.	Purplish w.
[3] Ashy w.	

RED.

Reddish.	Light rose.
Pale r.	Rose tint.
Light r.	Rose r.
Ruddy.	Pale garnet.
[2] Very r.	Garnet.
[1] Very high r.	Ruby.
Vivid r.	[1] Pure ruby.
[7] Deep r.	[1] Rich ruby.
Fiery r.	[1] Intense ruby.
[5] Indian r.	[1] Scarlet.
[1] Brick r.	[1] Full scarlet.
[3] Golden ruddy.	Intense blood colour.
Dusky r.	[6] Intense crimson.
Dull r.	Cherry r.
Pale rose.	Grape r.

ORANGE.

Bright o.	Deep dull o.
Pale o.	[11] Dusky o.
Light o.	[8] O. with scarlet glare.
Deep o.	

YELLOW.

Lucid y.	Golden y.
Bright y.	[2] High gold colour.
Clear y.	Rich y.
Pale clear y.	Crocus y.
Fine y.	Orpiment y.
Pale y.	Flushed y.
Light y.	Ruddy y.
Faint y.	Reddish y.
[7] Whitish y.	Orange y.
Yellowish.	Greenish y.
Full y.	Bluish y.
Deep y.	[3] Pale y. with cast of blue.
Dull y.	[3] Brown y.
Pearly y.	Topaz y.
Creamy y.	Light topaz.
Straw y.	Pale topaz.
Light straw-colour.	Topaz (tinted).
Pale straw-colour.	
[7] Ashy y.	

GREEN.

Greenish.	Pale emerald.
Pale g.	Sea green.
Bluish g.	Pale sea g.
Olive g.	[10] Aquamarine.
Emerald g.	Light apple g.
Light emerald.	

BLUE.

Fine b.	Pale sky b.
Lucid b.	Sapphire b.
Clear b.	Pale sapphire.
Light b.	Opal b.
Pale b.	Flushed b.
Faint b.	[2] Reddish b.
Bluish.	Greenish b.
Cobalt b.	Lilac b.
Smalt b.	[7] Pale olive b.
Indigo b.	Intense b.
Cerulean b.	Deep b.
Sky b.	Dusky b.

VIOLET.

[4] Vivid v.	Reddish v.
Pale v.	

PURPLE.

Lucid p.	Purplish.
Amethyst.	[9] Flushed p.
Light p.	[3] Ruddy p.
Pale p.	Reddish p.

LILAC.

Brilliant l.	Red l.
Light l.	Blue l.
Pale l.	Bluish l.
Faint l.	

GRAY.

Grayish.	Dull g.
Lucid g.	Dusky g.
Light g.	Flushed g.
Pale g.	[3] Bluish g.

ASH COLOURED

Cinerous.	[7] Ashy olive.
Ashy pale.	[7] Olive.

[3] FAWN.

Pale fawn.	[4] Brownish.

CREAMY.

Pale cream coloured.	Pale plum coloured.
Dusky.	Livid.
[3] Tawny.	Lurid.
Plum coloured.	

In the foregoing list only a rough classification has been attempted, and that more one of terms than exact chromatic significance. Descriptions are frequently of equivalent meaning, though differing in words; and of others it can only be said that a general idea is conveyed, the terms being too indefinite. Notwithstanding the difficulty where colour is concerned, the majority of them indicate pretty clearly the impression made on the observer.

T. H. BUFFHAM.

COLOURS OF THE CLOUDS.

[4426.]—WILL some of our meteorological friends kindly favour me with their opinion as to what condition of the atmosphere or of its vapours do the various colours of the clouds arise from? I have not met with any meteorological work that furnishes such information. Why are the clouds at various times of the following colours—dark gray, ruddy brown, bluish brown, brown gray, intense white, yellow white, blue gray, and other colours? The subject is important meteorologically, and one to which I have devoted careful attention during many years, and, by the experience thus acquired, I can readily, and I say without hesitation, successfully, describe for months beforehand the colours which the clouds will display at certain times. I know that the idea or possibility of doing this will be met by profound scepticism by thousands; it is not, however, my object to excite controversy, which would prove nothing, but to put the matter to the test at once by submitting it to direct observation. Before attempting this I should like to learn something of what other persons know of the subject, as it would evidently be useless for me to attempt to explain or describe a law of nature which, after all, might be quite as well known to others.

T. W.

DR. CARPENTER AND PERSPECTIVE.

[4427.]—(LET. 4320, p. 328.)—I wish merely to add that the pane of glass will not exhibit the horizontal and vertical lines which are required in a perspective drawing. I have tried it, and fact seems to agree with theory. It may be necessary for artistic purposes to ignore this convergency, but why, then, should all books upon perspective teach that the drawing should be similar to what would be seen by tracing on a sheet of glass?

M. PARIS.

PERSPECTIVE.

[4428.]—WE cannot, I think, lay down the laws of pictorial perspective by mathematical demonstration, and Mr. Proctor's remark that the perspective of a picture (by which I understand the linear perspective) ought to be mathematically exact must be received with so much modification that I am rather inclined to agree with M. Paris that pictures are, as to perspective, a compromise. By pictorial perspective I mean that representation on a flat surface which truthfully represents to the mind the object sought to be delineated. Form and colour, including shade, are the means by which the picture is produced. The question is, must one or both of these be identical with the form and colour of the object? It is agreed that the colour need not be the same. Mr. Proctor admits that as to colour, shade, and so on, there must always be some degree of compromise. This being the case, there would seem no necessity, *à priori*, for the forms of the object and picture to be identical. The object of the painter is to give a representation of a coloured object existing in space of three dimensions by means of pigments and a flat surface. If he does not seek to copy the colour with pigments of the identical hue, in order to obtain the effect he desires, much less is he bound to make an exact copy on his flat surface of the projection of the solid object. The different points or lines which the eye is accustomed to view stereoscopically are seen under different conditions, and produce different impressions, to that of their projection on the picture; and it may be, therefore, that these latter have to be modified in the same way that the colour was designedly varied by the painter. It is for this reason, I believe, that positions of what I may call "violent perspective" have to be avoided by an artist, or, if necessary to the picture, the sudden convergences of lines have to be tempered or modified in order to obviate an unreal effect. Distant mountains, also, which (if drawn in perspective) would look diminutive and insignificant, have in a picture to be drawn two or three times that height in order to give a natural idea of their elevation. For the mountains, though their height subtends at the retina a smaller angle than does their more elevated outline in the picture, are, through the stereoscopic functions of the organ of sight, which suggest to the mind their distance and consequent magnitude, magnified in comparison to the picture of these objects on a flat surface, which, not being viewed stereoscopically, is not subject to this effect. However this may be, there exists an apparent disproportion between distant and near objects (as may be seen in photographs and in the coloured pictures on the focussing screen of a camera), which renders it necessary in some cases to modify the perspective, or, in the words of M. Paris, calls for a compromise in the picture.

There is no doubt that the nearer objects are the darker they are, and hence arises the blackness observable in the foreground of photographs; but if a painter were to make his foreground always dark, the effect would be unreal, for the broad lights and the detail of near objects give them apparently a greater brilliancy than the greater amount of light, which actually comes from the direction of distant objects produces. Here, also, [illegible] a compromise between fact and ficti[illegible]

A GIANT PLANET.

[4429.]—In the article (p. 244) bearing the above title, which you have republished from the *Cornhill Magazine*, there appears so much loose reasoning that I think it will not be amiss to call the attention of your readers to it. Near the end of the article, the writer says: "As Jupiter and Saturn hold an intermediate position between the sun and the minor planets in respect of size, so those giant orbs hold a corresponding position in respect of inherent heat. Roughly speaking, the earth is 8,000 miles, the sun 840,000 miles, in diameter, and Jupiter, with his diameter of 82,000 miles, comes midway between these orbs." Coming, as it does, from an astronomer, this is a remarkable statement, for most people suppose astronomers to be very exact in the use of numbers, and nothing could well be more reckless than the assertion that 82,000 miles is midway between 8,000 and 840,000 miles. If we multiply Jupiter's diameter by 5, it will then be very nearly midway between that of the sun's and the earth's. But it is not the diameter, it is the "size" that the writer asserts to be "midway," and when we remember the sun's bulk is more than a thousand times greater than Jupiter's, we shall easily see how little he is entitled to hold the place the writer assigns to him. In continuation, he says, "Now the sun is at a white heat, and the earth gives out only what is called obscure heat; and if Jupiter's globe is at a red heat, he again comes midway between the sun and the earth." White heat is a very elastic term, embracing every degree of temperature, from that of a candle flame upwards; admitting, however, that radiant heat decreases in the proportion of the square of the increased distance from the radiating body, then the white heat of the sun must be some thousands of times hotter than red heat. Let us admit, for the sake of argument, Jupiter to be red hot, then the difference between his heat and the sun's will be still greater than the enormous disparity in their bulk. When the writer of the article thinks fit, with insufficient regard to facts, to place Jupiter midway between the sun and earth, in respect of bulk and temperature, it looks very much like struggling to find the materials with which to build a theory at any price.

If Jupiter has masses of clouds so great as to require his surface to be at a red heat to produce them, how could the light and heat of a red-hot body penetrate through these dense and voluminous clouds. According to Dr. Tyndall, a small amount of aqueous vapour will very materially retard the passage of radiant heat, and in this country we get evidence, almost every day, that a moderate thickness of cloud will shut out the sun from our view, and intercept a large part of his light and heat. Now, if Jupiter is at a red heat, his clouds must be as dense and impervious as a Newfoundland fog bank; in fact, they must partake more of the nature of semi-condensed steam than of terrestrial clouds, for if clouds are generated by this red-hot surface rain must fall on it, and directly rain fell it would be sent hissing back in the form of steam. If we even suppose the whole of Jupiter's surface to be red hot, and the clouds to have no effect whatever in retarding the transmission of heat and light, thus giving to the writer's arguments a tenfold greater force than they naturally possess in this direction, then the planet would be totally incapable of materially adding, from his own inherent heat, to the light and heat of his satellites, or to the light of his own surface beyond that which he receives from the sun. The amount by which Jupiter, under these supposititious circumstances, could augment the temperature of his satellites admits of strict calculation. Putting his temperature as high as that of iron red hot in daylight, it will be 1200° F., and his furthest moon must receive less than 2° from such a source; so, as far as heat is concerned, Jupiter would cut a very sorry figure when playing the part of secondary sun to his moons. In the matter of radiant light, calculation shews him to be a still more inefficient performer; for if not illumined by the sun, and shining only as a red-hot planet, he would be invisible to any dwellers in his most distant satellite, if they did not possess any optical power greater than our unassisted vision.

According to Dr. Zöllner, whom the writer refers to, Jupiter shines three or four times as brightly as a globe of his size should, if reflecting the sun's light only. If such is really the case it certainly is not owing to the planet being red-hot. The light of the sun at Jupiter is about $^1/_{27}$th of what it is on the earth, and sunshine here is hundreds of times brighter than the light emitted from a body heated to redness. Now, if Jupiter absorbs two-thirds of the sun's light, and reflects only one-third, he will then shine as brilliantly as if he reflected the whole of a light equal to the $^1/_{81}$st part of sunshine; therefore, if his brilliancy is increased threefold by his globe being red hot, then light emitted from a substance at red-heat must be equal to the $^1/_{27}$th part of bright sunshine.

I have not in these calculations taken into account the effect of absorption due to the dense aqueous vapour surrounding Jupiter; but if we do, how hopelessly weak does the theory of his being a secondary sun appear! Hyrab Scen.

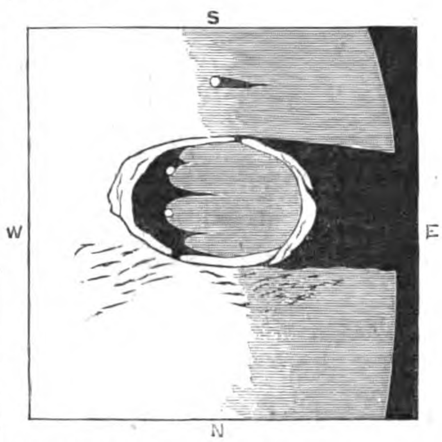
SELENOGRAPHY.

[4430.]—Letter 4381, p. 356, No. 378, by "E.B.F.," calls for a remark or two from me. "E. B. F." is quite right in considering that selenographical sketches, *neatly shaded*, are of general interest provided they are perfectly accurate, and convey to the mind an *exact representation* of the object sketched. They must also be accompanied with the following data:—The day elapsed with the hour and *minute* Greenwich mean time of the Julian period; the selenographic latitude and longitude of the points on the moon's surface which have the earth's and the sun's centres in the zenith and the position of the terminator at 60 north latitude, the equator, and 60 south latitude. These quantities are given monthly in the *Astronomical Register* for Greenwich midnight. The value of the supplement of the angle ☾ − ☉, or the difference of longitudes of the moon and sun at midnight are also necessary as giving the angle of reflection of the sun's light from the moon. In nine cases out of ten shaded sketches are far from being accurate in those details which are really of importance, especially when the objects are near the terminator, as then the shadows change rapidly. We have had from some of our correspondents very valuable shaded delineations of parts of the moon's surface, and such, as they appear now and again in our columns, give a pleasing and useful idea of the objects represented. If "E. B. F." be the possessor of a small telescope he does not require carefully and elaborately drawn selenographs to acquaint him with the appearance of lunar objects as seen in the larger instruments. The fine crater "Copernicus" is a magnificent object in a three-inch telescope. Of course it appears a still finer object when viewed through a larger aperture; but the real value of increased aperture in the object-glass or increased magnification by means of eyepieces consists in the increased perception of minute detail. Without exception, the English Mechanic is, so far as I am aware, the only serial which notices to any extent selenographical matters, and it contains the two kinds of selenographs, the shaded sketch, giving "appearance," and the diagrammatic sketch, giving relative, and in some cases absolute, "positions." If "E. B. F." uses a small telescope frequently, he will often find diagrammatic sketches useful in identifying objects more readily than shaded sketches, as he is confined in using such to the epochs at which they were drawn.

In reference to query 12229, "Canis Minor" will find for general lunar scenery 3in. or 4in. aperture ample. For clefts, minute spots, and streaks not less than 6in. should be used. W. R. Birt.

PLATO.

[4431.]—I beg to inclose a sketch of the lunar crater, Plato, taken June 14, 1872, 10h. p.m., Greenwich mean time, with an excellent two-inch achromatic, power 90.



Can Mr. Birt inform me whether there is a heap of débris near the centre of the floor of the crater, because I failed to perceive any trace of any whatever? T. H. F.

ANCIENT MUSICAL INSTRUMENTS AT SOUTH KENSINGTON MUSEUM.

[4432.]—In his interesting paper on the above subject, printed in No. 377 of "our" journal, Mr. Charles Reade, who, however clever a special correspondent he may be, is, I fear, not quite "read up" on the subject of ancient musical instruments (by the way, he says he is specially "well up" in fiddles), mentions what he terms a keyed dulcimer (query, what can it be) which he classes with the virginal, clavichord, spinet, harpischord, and pianoforte, under the general title of children and grandchildren of that rather "ancyente instrumente of mvsick," the dulcimer.

In his (query, illegitimate) family he confounds two essentially different classes of musical instruments—viz., those struck by hammers, and those whose strings are pulled. He could hardly have done this had he previously "read up" more diligently. The harp, lute, mandolin, guitar, the modern zither, virginal, spinet, and harpsichord are all treated just as Mr. Reade would be were he to "came up" for his "exam." before instructed judges. They belong to the latter class—in other words, their strings are "plucked," and no amount of "pluck" Mr. Reade possesses could save him from the same fate with that conspicuous absence of knowledge he exhibits. On the contrary, the drum, gong, harmonicon, and bells, the dulcimer, and its legitimate child the pianoforte, belong to the former class—*i.e.*, they are more or less forcibly "struck," as in truth the writer was also by Mr. Reade confounding them with the harp class, which are not "instruments of percussion." What Mr. Reade means by a "keyed dulcimer," unless it be the pianoforte, I have yet to learn.

Mr. Reade laments that the complex Welsh harp, with its very practically inconvenient three rows of strings, has survived all the executants. I see but little in this to regret, because I am not aware of anything worth doing which can be done on this I think deservedly obsolete instrument which can't be done at least as well—if not better, certainly with far more ease—on Sebastian Erard's double action instrument, the somewhat complex mechanism of which greatly facilitates performance.

Mr. Reade also mentions certain harpsichords, especially the Rucker, said to have belonged to Handel, the statements concerning which much be taken *cum grano salis*, for its history is rather "fishy," also one bearing the honoured names of "Abraham et Josephus Kirkman, fecit," and the very unusually modern date 1798. The tones of the latter he says are "full of sweetness and tenderness," which may be quite true on the same principle that it was logically proved that a very unkindly man must be full of sweet and tender feelings because he never suffered any outward manifestation thereof to escape him. My fellow readers must long since have perceived the writer has an old fashioned "tenderness" for his favourite harpsichords, but he avers that his—perhaps not very musical—ears have never yet been regaled by "sweet" sounds obtained from any harpsichord furnished either with hard leather or quill plectra, whatever the timbre of those which he obtained by the employment of plectra coated with soft leather on their upper surfaces. The tones of a quilled harpsichord may, to Mr. Reade, be "full of sweetness and tenderness." *De gustibus*, &c. Probably—as it is my intention to visit the collection as soon as I am able to procure the forthcoming enlarged edition of the catalogue—when I hear this instrument both "sweetness and light" may be vouchsafed unto me, for which I hope to be duly thankful, but until I do hear it I may be permitted to christen its sounds—and most of those of its brethren—after my old dog "Snap."

The Harmonious Blacksmith.

THE USE OF COMPRESSED AIR FOR STORING AND TRANSMITTING FORCE.

[4433.]—Being desirous of collecting information on the above subject I should be greatly obliged by new information thereon, also instructions where to obtain what has been printed concerning the perhaps unavoidable waste of force which results from the conversion into heat of a portion of that employed to compress air, especially when its compression is carried as far as from 50 to 100 atmospheres.

I should also be glad to learn if there has been any economical application of compressed air for propelling small boats or private land carriages in which steam boilers and coal are decided nuisances. For this purpose a fellow correspondent once suggested coiled springs—query, a legion thereof—which you may (if you can) wind up "just as you do your watch," and run up Highgate-hill at the rate of ten miles per hour. Now, as steel springs whose reaction would be sufficient for such "up-hill" work as this would be rather costly to make, "let alone" the winding them up "like your watch"—a thing, perhaps, possible by a Brobdignagian horologist for a Liliputian bicyclist—it might be rather more economical to employ compressed air, even if it did cost something more than the fuel of a steam boiler in a boat or railway locomotive. I suspect compressed air would cost considerably less than horse keep, for the fuel—I mean food—those animals consume is rather more costly than coal; indeed, horses are animals of such extravagant habits that I have known instances of their continuing to eat their provender even when they did no work. Perhaps, however, considering the sad (query, jolly) examples we humans set them in the matter of eating and drinking, too (without working), it will be wiser for us not to complain within their hearing, for possibly they might retort "small blame to us equines for that same," or even say to their drivers "You're another." Now, *tu quoque* (especially when true) is not exactly gratifying to our feelings.

The Harmonious Blacksmith.

P.S.—The above—or rather another letter on the same subject—was written about a fortnight ago, and I believe sent about June 9. I presume it and the article on the choice and best methods of working steel for cutting tools and screw-drivers are lost.

THE BEARING REIN.

[4434.]—Perhaps if you print these remarks it will be thought (by some of our readers) that the subject is out of place in a publication professedly devoted to the advancement of science. I know, however, that you for one are on my side. Your words on one occasion were: "We shudder as we write the word" (vivisection). I do the same, and dismiss the last-named practice to call attention to something less horrible—viz., to a most unnecessary cruelty daily and hourly practised on thousands of noble and, notwithstanding their sufferings, affectionate animals. This special act appears to be without the pale of the law; and when I remonstrate with a man (?), I am generally told to mind my own business. If I venture to address my rude ungracious self to a lady, she thinks it may be wrong, but likes to see it.

How many would shudder at such an announcement as this placarded on walls of our towns—"Gratis! Under distinguished patronage. An invention for the punishment of animals has now been perfected, and may be seen in operation daily. Sundays 11 to 1," &c.

Those who shuddered may, perhaps, smile when I state my belief that what is known as the bearing rein used on horses is one of the most diabolical engines ever invented by demons in human form. If careful attention is given to the fact I contend that it is indisputably what I have stated; and who is to blame? I cannot think that those delicate ladies who lounge in the open barouche caressing their pet dogs, have the least idea of what the magnificent animals in front of them are at that moment enduring. Look at the position of the ears, the abortive effort to throw out the chin, the lather on the mouth and breast, the patch of sweat on the satin neck, the quivering under lip, and other expressions of suffering known only to the initiated. What powerful wielder of the pen will undertake to write down the insane use of this horrible instrument of torture? I can supply some materials if "The Harmonious Blacksmith" or any other talented friend to dumb animals (by-the-by some animals make a sad use of the faculty of speech) will put them into shape. OLD PLOUGHMAN.

OUR COAL STORES AND THE ATMOSPHERE.

[4435.]—I SHOULD like to make a few observations on letter 4349 with the above title. Take the atmospheric pressure as 15lb. on the inch we have a pressure of 144 × 15 = 2,160lb., nearly a ton on the square foot, or about 27,000,000 tons on the square mile; since a square mile contains 5,280² square feet, assuming England and Scotland to contain, say, 80,000 square miles, we get 2,160,000,000,000 tons as the weight of the atmosphere. Now, if 2 per cent. of this were converted into carbonic acid, it would be unfit for respiration; 2 per cent. of the last amount is 43,200,000,000 tons.

I think there is a misprint or error in the letter. In the 15th line it is said that "England alone is raising to the surface one hundred and twelve million tons of coal annually, and further on that we have "one hundred and forty million tons of obtainable coal." If this were so our coal supply would not last much over a year.

Now, 3 tons of carbon produce 11 tons of carbonic acid, therefore it would require nearly 12,600,000,000 tons of coals, if we had them, to render our atmosphere poisonous with carbonic acid, even supposing it not to diffuse itself over the world; of course a much smaller quantity of carbonic acid in the atmosphere would make it very unhealthy; but I am of opinion that our atmosphere will last longer than our coal, besides, if 2 per cent. by volume is meant, the weight of the carbonic acid would be half as much again, its specific gravity being 1·5236, or so. PHILANTHROPIST.

BOOT AND SHOEMAKING.

[4436.]—NEVER did one man express the experience of another more pithily than does "Irish Mechanic" express mine in letter 4350, p. 335, on this subject. We differ only in this, he has not mastered the difficulty. I have, and shall rejoice if he benefits, as I have done, from the following experiment. I drew plans of my feet on a sheet of paper, purchased lasts, a good size too large, and a rasp from an ironware shop, and in half an hour succeeded in reducing the lasts to the size and form required, with nothing but the rasp. No technical knowledge of the last-making or shoemaking trades is required for such a very simple operation. I gave them to a bootmaker, whom I engaged to work my boots according to these lasts in every way. The result is entirely satisfactory.

M. N.

[4437.]—THE recent sufferings and experience of "Irish Mechanic" are nearly identical with my own of ten years since. My recollections of them are as vivid as if they were of yesterday. Like him, I too have a long toe that was always in difficulty. The smell of new leather made me feel faint. The sight of an awl induced pricking sensations in my feet. I longed to administer my shoemaker's wax to his own back. The soles beneath me and the soul within me were worn out. My artist suggested that his "uppers" were soft and pliable. I uttered, half unconsciously, "limp." He tendered (my poor feet) advice, and had even felt for me. It was enough I remarked, "Halt!" My two monosyllables had fully explained the case. He handed me a card of introduction to the last new professor, remarking "Clever man, sir. Studied the foot —fond of anatomy," which latter I found true, as after taking a ground plan and elevation of my foot, he wanted a "section." I left the professor with the fond delusion that there was "Balm in Gilead, for me, even me." The ultimate results did not, however, conduce either to ease or elegance. These two men, sir, if I can call them so, had conspired to place my great toe at the inner corner of what they deemed a boot. But I defeated them, sir, and that through their own base machinations, by doing to the lasts what the professor wanted to do to my foot, making a diagonal section—that is, sawing off the great toe and ball of the foot, and fixing on a piece somewhat wider, which, rasped down to about ⅛in. thick, has left me as the story book says, "happy ever after," and this is a true story, sir.

T. S. USBORNE.

ON THE RIFLING OF GREAT GUNS.

[4438.]—THERE is great difference of opinion on this subject; we may, indeed, call it "the battle of the twists." I, myself, don't like the system of studded shot with increasing twist, but prefer ribbed shot with uniform twist. There is this to be said in favour of the guns with increasing twist: their vents have not been worn so large as those with uniform twist after firing. The increasing twist guns have to all appearances been very unfortunate of late; in fact, it would be a disaster to us of no small magnitude if such "accidents" were to happen to our heavy guns in time of need. I was told by a gentleman connected with the Whitworth Ordnance Company the cost of "tooling" their 12lb. shot; it was very small indeed, I think about three farthings each. I don't think the Woolwich guns with increasing twist could be altered to uniform twist without having new inner tubes, or else being bored out to a larger calibre. I shall be glad to furnish any information in my power for the benefit of such an esteemed correspondent as "The Harmonious Blacksmith" and our readers generally. ARTILLERY CAPTAIN.

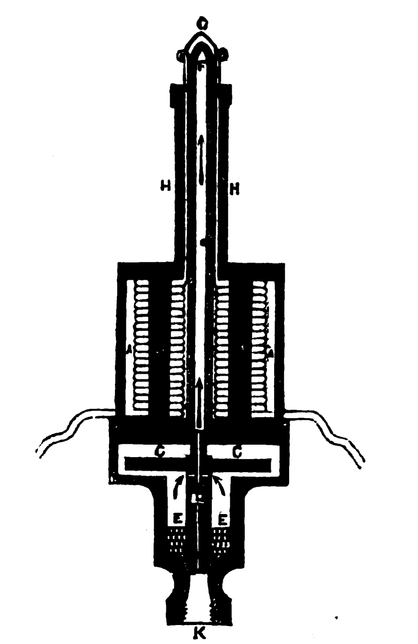
BAROMETERS AT SEA.

[4439.]—SIR J. ALDERSON seems to have fallen into the old error of supposing heavy bodies begin to fall more slowly than light, according to a paper on "Sea Sickness," quoted at p. 323, and Dr. Pollard has followed him with another old and equally false theory. The reason why the mercury does not fall nor rise exactly with the tube is simply because, being a liquid, it is to a certain extent independent of the ship. It is like a passenger in a railway carriage, when the carriage goes on or stops suddenly, the passenger, not being fixed to his seat, suffers in consequence.

M. PARIS.

ELECTRO-MAGNETIC GASLIGHTING APPARATUS.

[4440.]—IN your issue of the 14th inst. I observe a sketch of an electric gaslighting apparatus by Prof. Klinkerfues, University of Göttingen. If you refer to the *Builder*, October 8, 1864, page 743, you will find a description of a similar invention for which I took



"provisional protection" in July of that year—viz.: The invention may be applied to any description of gas-lamp without requiring alteration; the apparatus is about three times the size of a lady's thimble, and very much like an ordinary gas-burner. The principles upon which it is based are stated as follows:—An ordinary telegraph wire communicating with a galvanic battery is connected with the "Electro-magnetic burners" in succession, according to the number of lights required, and the extremity of the wire is conducted back to the battery, when the circuit is complete. Therefore, to light and extinguish the lights it is only requisite to connect or disconnect one of the poles of the battery. Immediately the electric current enters the "electro-magnetic burner" it passes through an insulated wire, which is lapped round two pieces of soft iron, which immediately becomes a powerful magnet, and attracts a soft iron plate, which lifts or opens a kind of valve, and permits the gas to escape through the burner. At the same time that the gas valve is opened, the current passes through a piece of platinum wire close to the burner, which turns red hot, and lights the gas. This effect is produced at every burner at the same instant. This invention was exhibited in Durham eight years ago with success, to the extent of a quarter of a mile of wire and half a dozen lights.

The following is an extract from a letter written upon the subject by Prof. Faraday, dated Aug. 10, 1864:—"No battery having a wire three miles long and at its extreme end a piece of platinum wire affixed would ignite the gas."

I had the experiment tried with a powerful 12-cell battery, using the North-Eastern Railway Company's telegraph wires between Leamside and Durham, and although there was sufficient power to open the gas-valve, it proved Prof. Faraday's statement to be correct.

The cost of the "electro-magnetic gas-burner" (exclusive of battery and wire) was 7s. 6d. each. After the burners are lighted the battery power is reduced to one cell, which keeps the gas valve open during the time required. A, insulated wire; B, soft iron (magnet); C, soft iron plate; D, gas valve; E, mercury; F, gas burner; G, platinum wire; H, brass tube, inclosing insulated wire; K, gas-pipe.

Sunderland, June 17. T. C. EBDY, F.R.I.B.A.

PATRIARCHAL WRITING.

[4441.]—THOUGH it may be bad policy to defend my enemy, "P. Santalinus," against my fellow soldier Mr. Brookwood, I must submit, in answer to the latter, that though the Book of Genesis may not expressly state this or that portion to be copied from journals of the Patriarchs, it certainly implies as much. Chap. v. professes to be "the book of the generations of Adam," and the particulars contained, involving about thirty exact numerical statements, each in hundreds, tens, and units, Mr. Brookwood will hardly suppose could be handed down otherwise than in a book of some sort. It need not be *alphabetical*. Considering the case of the Chinese, who, with the oldest writing known, have not even yet learnt an alphabet, it seems more probable that *they* retain (in principle) Noah's method of writing, and *our* teachers, Hebrew, Sanskrit, and Greek, improved upon it, than that our fathers in the Ark wrote alphabetically, and the Chinese lost the alphabetic principle without losing, like savages, writing altogether. Moreover, if Noah had written alphabetically, I think all his descendants would have retained, though not the same alphabet, the same *direction* of writing, and if in horizontal lines, then most probably, all from left to right, which is certainly more natural and convenient than the Shemite way, at least for right-handed people, and seems suggested by the daily course of the sun, in our hemisphere. Indeed, the undoubtedly greater antiquity of the Shemite way than ours, and the fact of the columns and pages of Chinese going from right to left, would suggest, if it were really Noah's way, a probability that not only might his original country have been south of the equator, but the Antediluvians left-handed, and he or Japhet exceptionally right-handed, as the majority of every tribe descended from them. At any rate, there is good evidence that the Egyptians wrote *alphabetically* (and perhaps on papyri still to be handled and read?) long before Mr. Brookwood's "1500 B.C.," and if he holds the Bible to be anything but forgery, it implies *Books*, we see—they need not be alphabetical—in the lifetime of Adam.

As for Genesis, the Shemite records of Adamite and diluvial times, whence it was compiled, must have come *in writing* either from one who had been in the Ark, or one who *pretended* to have been there. Which does Mr. Brookwood prefer? I think with Halley (p.350, let. 4353, par. 3), "to all that consider the seventh chapter of Genesis impartially, it will pass for the *remains* of a much fuller account," derived in writing from Noah's son, not grandson. And Sir Isaac Newton, in his "Observations upon Prophecies of Holy Writ," the unfinished posthumous fragment that his editors say he had recopied oftener than any other manuscript, and for the latter half of his life had given more time to, than to all his discoveries. Sir Isaac, in the first chapter thereof, shows as well as he ever proved anything, that the man who first translated from these patriarchal writings, the *remains* that we call the Pentateuch, and edited them in the *Canaanite* language (now called or miscalled "Hebrew") could only be the prophet Samuel; and they are probably the document mentioned at 1 Sam. x. 25. They are also rightly called the "Books of Moses"—*i.e.*, Books *about* Moses, and mainly derived from him, but he must have legislated in Egyptian; and Samuel must have compiled from *private* or *family* extracts of the great legislator's works, because the *national* copy had been lost during Samuel's youth, iv. 11; never to be recovered (1 Kings viii. 9), not merely these 5, but the first 7 Hebrew books form plainly one connected work, published by the authority of Samuel, or the college he founded at Ramah, the inferiority of the last two doubtless implying the hands of his pupils, but no ancient work more plainly dates its own appearance. The passage, Gen. xxxvi. 31, fixed the publication of *that* book to be *no earlier* than Saul's coronation, and Judges i. 21, fixes *that* to be *before* the Jebusites lost Jerusalem, which was the eighth year of David (2 Sam. v. 5—10). The whole of this earliest extant Hebrew history limits therefore its publication within those 48 years, and Samuel is the first of now extant Hebrew chroniclers, which *may* be what "P. Santalinus" meant (p. 277) by the funny expression "first of his race." Older Hebrew than his, however, may be extant in Job and some Psalms; for two of the latter (numbered in English 14 and 53) seem plainly two Hebraists' rival translations from one original poem. E. L. G.

ERRATUM.—In p. 352, end of first letter, last line but ten: the parenthetical word beginning this line should be "lunar."—E. L. G.

"J. C." AND DARWIN.

[4442.]—IF "J. C." (let. 4383, p. 356) would look at the letter he is criticising, he would see that no facts of Darwin's are brought forward to assign a particular *date* for the Deluge, but simply as things which the eminent observer, by his own showing, while too honest to deny or obliterate, has been glaringly unable to explain, and does not pretend to have explained; while a fresh-water Deluge, whether at the time all national traditions and old records place it, or at any other time, explains them perfectly. Where is the "implied misrepresentation "? If Darwin has produced a shadow of "explanation" for his great general facts that fresh-water species are *more* distributed than salt-water or land ones, and that sea and land species are *less* freely spread than fresh-water ones, why does not "J. C." produce or quote the explanation, instead of *misrepresenting* Darwin's hypothesis as *explanation*, and "E. L. G.'s" explanation as *hypothesis?*

But his last two sentences are utterly beyond me. I ask why, on Darwin's hypothesis, mammals have not been developed on islands that Darwin insists are "ancient enough," and in his own words have had "time sufficient" for any creation; and "J. C." replies that "a much greater length of time than 'E. L. G.'s' 5,000 years" is needed! What on earth can *my* 5,000 years have to do with it? The question is why Darwin's time has not sufficed, not why *mine* has not!

E. L. G.

CHLORIDE OF LIME.

[4443.]—For the information of "L. T. F." (let. 4281), I beg to state that chlorine in bleaching powder is not fixed. Though commonly called chloride of lime, it is in reality a mixture of hydrate of lime, chloride of lime, and hypochlorite of lime. Mr. Bottone must have adopted an indifferent system of analysis in estimating the available chlorine in this product, or his samples must have been rather long made if he has not found over 20 per cent. in the commercial article. I regularly find up to 30 per cent., but then the sample is quite fresh. After standing aside some days I have found as little as 15 per cent.

Un Irlandais.

GOLAIL OR INDIAN PELLET-BOW.

[4444.]—Letter 4209, p. 255.—If a tube or barrel (breech-loading if you please) were attached to the middle of an ordinary single string archery bow, such tube passing through a ring attached to the bow itself, and having a projection on its end, upto which the bow should be drawn previously to the "loose," it would save the "rap o' the knuckles," and probably increase the accuracy of the projectile, which might be elongated to a bolt.

Suffolk Amateur.

GAMBOGE.

[4445.]—"E. L. G." (let 12050, p. 339) mentions the singular fact that gamboge, slightly transparent when dry, turns opaque when wetted. The fact is singular as being at variance with the general rule that semi-transparent substances become rather more transparent when wetted. May not this opacity result from the motion of the particles of the moistened gamboge breaking up small the reflecting surface? Can "E. L. G." offer any opinion on this subject, and can he or any other contributor say whether this life-like motion of the particles, well known to most microscopists, has been satisfactorily accounted for?

Bobo.

To Mask the Taste of Castor Oil.—According to a correspondent of the Boston *Medical and Surgical Journal*, the following formula affords a method of completely disguising castor oil:—Of glycerine and ol. ricini, two fluid ounces each; ol. cinnam, four minimms. The essential oil should be rubbed up with the glycerine, the castor oil added, and the mixture well shaken before using. This is said to be the very best method of hiding the taste of the castor oil.

Regulating the Hatching of Silkworm Eggs:—M. Duclaux, after a careful observation of the external conditions which favour and influence the hatching of the eggs of silkworms, has prepared the following rules, by attention to which it is said that the development of the eggs can be regulated at will. First, to prevent an egg from being hatched at the usual time, it must be kept, from the period of being laid, at a temperature between 59° and 66° Fahr., and then exposed fourteen days to cold, three months before the time at which the hatching is desired, being subsequently treated in the usual manner. To cause an egg to hatch before the usual time, it must be exposed to cold twenty days after being laid, and kept in that condition for two months, and then removed. Six weeks later it will be in the same condition as ordinary eggs, and can be treated in the same manner. In this way it is possible to have silkworms ready for hatching at any season of the year.

Ozone.—From the address of M. Blanchard, at the re-union of Delegates from the Learned Societies, recently held at the Sorbonne, we learn that M. Houzeau, of Rouen, has considerably extended our knowledge of ozone. By a simple apparatus, he has obtained in about a quart of common oxygen from sixty to 120 milligrammes of the odorous oxygen, or ozone. In this concentrated state it is dangerous for respiration, it burns organic tissues rapidly, attacks gold and silver, and has bleaching properties superior to chlorine itself. In the *Journal* of the Scottish Meteorological Society for January and April 1872, in addition to the usual records of temperature, pressure, rain, &c., is a report on ozone observations, which appears to be of considerable value. The following conclusions are new and interesting:—"When the air had a pleasant sharpness to the feelings, exercising, as it were, a stimulating influence on the spirits, the largest quantities of ozone were obtained. On the other hand, when the air was close, and seemed to exercise a slightly depressing influence, little, if any, ozone was detected."

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[11275.]—**Darkening Walnut (U. Q.).**—Try chromate of potash solution.—Suffolk Amateur.

[11564.]—**Blackberry and Strawberry.**—The raspberry is undoubtedly what is called indigenous in England, as it is in Switzerland, Germany, and like temperate climates. It may be found, according to a farming friend, growing wild in the woods in Kent; but, of course, birds may have carried the seeds from gardens. All "indigenous" plants, however, may have been thus propagated. Some of the finest wild fruit I have found during a number of pedestrian tours occurred in the woods clothing the volcanic cones of the Eifel. On the Grimsel pass in Switzerland they are very fine, and not only as "plenty as blackberries," but much nicer. The blackberry seems to require a cross to sharpen its flavour. In South America I have read a very good variety exists.—M. Paris.

[11589.]—**Dry Steam.**—Steam of a given pressure, say 3lb. per inch, in contact with water, is saturated steam or wet steam of that pressure, and can be neither above nor below the corresponding temperature, as given in Regnault's, Rankine's, or other tables. If it cool one degree, a part will condense, and the rest be still wet steam of a lower pressure, and containing less water in a given bulk. If it be subjected to more than 3lb. pressure, a part will also condense, but the temperature of the whole must rise to that corresponding to the higher elasticity—otherwise, with no rise of temperature, the condensation would go on till the whole became water. If the steam have its temperature raised out of contact with water, it immediately becomes "superheated"—*i.e.*, dry or drying steam—steam in which water will evaporate, or wet bodies can be dried. It may be of no higher pressure than when it was wet steam, and in that case it must occupy more space. If confined to the same space as when wet, it will be of higher pressure. Thus, high and low pressure steam, indeed, of any two pressures, may have the very same quantity of water per cubic foot; or the lower pressure *may* have, as "A." supposes, "more water than in the same volume of high pressure," if their temperatures are equal. But when we compare two wet steams, or two of any fixed degree of dryness, the more elastic will always contain the more water, or be the denser, as well as the hotter. I cannot see any "carping at terms" in denying that a hand can possibly be placed *in* high pressure steam. The steam issuing from a high pressure boiler shows its instant resolution into cloud and low pressure steam, by becoming visible cloud at the very lips of the outlet. Not so the steam from the tea-kettle. That remains for some inches invisible, and in the invisible state will scald severely. But visible cloud will not scald, at least, when decidedly white and opaque, whether coming from a high or low pressure source; for it can in no case contain high pressure steam, nor, probably, any of half or a quarter atmospheric pressure.—E. L. G.

[11589.]—**Dry Steam.**—It appears that "E. L. G." deems this a "very easy query;" but it does not appear that he has given a much more satisfactory solution of it than those who have preceded him in the attempt; he assumes premises inconsistent with observed facts, and hazards various assertions and opinions without any evidence to support them. The remarks of "E. L. G." on high pressure steam, whether in accordance with ascertained facts or not matters little, high pressure steam having no relation whatever to the subject of this query, and whether he adopts overheated or subsaturated as improved synonyms for dry steam is immaterial. Atmospheric steam, he says, is dry except in a rain cloud—which is, perhaps, questionable—at all events, steam is rather a new term to apply to the hygrometric state of the atmosphere, and why he introduces the imaginary composition of his imaginary "Comet of the Deluge" into such "an easy query" as this I don't know, and won't attempt to follow him into such distant regions of time, space, and speculation, which is the less necessary having no bearing whatever on the present query. The incondensible steam referred to in the query, "E. L. G." says was no longer steam at all, but decomposed as all steam is when passed over iron, zinc, or coal, or other combustibles; but not into oxygen or hydrogen; if not, what else can it have been decomposed into? He then says that in passing over the iron, zinc, or coal, the oxygen remains; but in that case the hydrogen must surely be set free, and discharged at the open end of the pipe as an inflammable gas. This, however, is found in practice not to be the case. He mentions that in the case of the steam being passed over coal, the oxygen remains with the carbon, forming carbonic acid, which, no doubt, if in sufficient quantity, would tend to prevent the inflammability of the hydrogen. Unfortunately, however, for "E. L. G.," this assumption does not apply to the present query, for in no instance on which the query is founded was the steam brought into contact with carbon at all, with the exception of the 2 or 3 per cent. contained in the inner surface of the cast-iron pipe when that metal was used. Zinc is far too easily fused to be suitable for superheating steam. The late Mr. T. V. Lee, who was a patentee for the application of superheated or dry steam to various economical purposes, and among others to that of baking bread, biscuits, &c., for which purpose he fitted up ovens at Wapping, Plymouth, and other places, in which he used cast-iron pipes for the superheating coil; but in consequence of the frequent fracturing of these pipes by contraction from the alternate heating and cooling, he on a subsequent occasion substituted copper pipes when fitting up a kiln at Dulwich for an extensive joint-stock company for drying and burning bricks; but the copper he found melted with the heat required to superheat the steam, and was abandoned. Now, in none of those cases was any discharge of inflammable gas observed, nor any mixture of hydrogen and carbon detected. From the above it seems pretty evident that "E. L. G." has not yet hit on a true solution of this "very easy query," and if he considers it worth his further notice will have to adopt some other method of solving it more in accordance with the results of practical observation and experience.—Caloric.

[11589.]—**Dry Steam.**—"E. L. G." while accusing all your correspondents on this subject of making ludicrous errors, falls into the queer mistake himself of giving a supposed explanation, but one wholly insufficient, of the fact that steam of high pressure escaping rapidly into the air does not scald. He is quite correct in saying that as soon as high pressure steam escapes it expands, and its temperature is reduced, but utterly mistaken in supposing that that is the reason why it does not scald, for it expands only as much as the pressure of the air will allow, and its reduction of temperature by expansion alone is only to the boiling point, at which temperature it would scald just as other steam does. I do not, however, as "E. L. G." would do, call such a natural mistake of a half informed man a ludicrous error; it would be not only rude but foolish to do so, for such is the explanation very commonly given, but it is quite erroneous nevertheless, as a very little consideration will show. If a cylinder full of steam at the ordinary pressure of the atmosphere be compressed to one quarter of its bulk, its temperature will rise to about 296°, and if high pressure steam at that temperature filling one quarter of a cylinder be allowed to expand so as to fill the whole of the cylinder its temperature will fall to 212° but no lower, from expansion alone to that extent, and the expanded steam will scald just as much as it did before it was compressed, or as if it issued from a boiling kettle. If, however, steam at 296° be allowed to blow off into the air it does not scald, though its temperature by expansion is reduced no more. The reason of the difference is simple and evident. When steam rises quietly from boiling water, it carries little air with it, and retains its scalding heat, but when high pressure steam issues very rapidly from a narrow opening, it carries much air with it, as in the steam blast of a locomotive, and the mixture of air and steam being cool does not scald. It is very easy to test the correctness of this explanation. If high pressure steam escaping from a small hole be made to blow through a tube of larger diameter, held near but not close to the hole, it will act like a steam blast, carrying air with it through the tube, which will get as warm only as the mixture of steam and air, but if the tube be held close to the boiler, so as to allow steam only to enter the tube, it will soon get unbearably hot, though the steam will expand alike in both cases. A similar explanation renders it clear why breath blown strongly against the hand feels cool, which, when breathed against it slowly feels warm. The breath itself, is of course, at the same temperature, but the breath alone is warmer than the skin, while the mixture of breath and air driven against the hand when we blow strongly feels cool because it is cooler than the skin. Dr. Arnott was so good as to explain this to me when I, like others, was puzzled to understand how the mere expansion of steam under atmospheric pressure could reduce its temperature below that of steam formed under the same pressure, and I never met with the true explanation elsewhere, and it is not, I believe, commonly understood, though so simple.—Philo.

[11656.]—**Boiler for Small Steamboat.**—I beg to thank "P. W. H. J." for the trouble, and you, Mr. Editor, for the expense, incurred in answering my query; although, being pretty well up in engineering matters generally, I thought before making the boiler to take advantage of the brotherly advice so freely given in "ours" upon all matters. Upon carefully reading the answer from "P. W. H. J.," I find the information scarcely so reliable as I could have wished. For instance, the space occupied by boiler and engine is given as $2\frac{1}{4}$ cubic feet, which I find, taking his figures, to be nearly 8 cubic feet for the boiler alone; then I find that the united areas of tubes amount to as much only as one tube $2\frac{1}{4}$in. bore, which, with the fire-box, must be sadly too small for a 2 horse-power boiler. The fear of others being misled must be my excuse for the unpardonable offence of looking a gift horse in the mouth.—L. M. F.

[11742.]—**Painting Iron Bedstead (U.Q.).**—Here is a question how to gild without gold leaf! and a recipe for a white paint that will not in the slightest degree turn yellow! The first might be explained, but the second would puzzle Œdipus. All I can say is procure the "genuine" white lead, not the threepenny and twopenny stuff, made without a particle of white lead in it, and mix with varnish, this will give your bedstead the best effect, but I will not warrant its not turning yellow. Try some of the gold paint for the gilding portion. If the querist means the knobs, centres, &c., they must be lacquered, not gilt.—H. B. E.

[11748.]—**Humea Elegans.**—The correspondent who inquired about the culture of this plant will find the following reliable. I cut it from the *Journal of Horticulture*:—Sow the seed at the end of May or early in June in a pot or pan of two parts turfy loam, and one of leafy soil, with one part of sand. Just cover the seed with fine soil. Place the pots in a frame with a gentle heat, and keep them near the glass, and just moist. When the plants are up admit air freely, and as soon as they are large enough to handle prick them out in pans at about an inch apart, and return them to the frame. When they are fit to pot off singly in 3in. pots do so, using the compost before named; place them in a cold frame, and water them overhead daily, but avoid making the soil very wet. When the roots show at the sides of the pots, and before they are very closely matted, shift the plants into 4½in. pots, and so on until autumn, when they will require 7in. pots. They cannot have too much air after they are established in small pots, nor, indeed, at any time, especially in winter, so long as they are secure from frost. The main thing is to keep them slowly growing, and to shift them into larger pots as those they are in fill with roots. They should have good drainage, and a compost of two parts turfy loam, one of leaf soil, one of old manure, and a sixth of sharp sand. They may be put into 9in. pots in February, and have 11in. or 12in. pots at the close of March. Liberal supplies of water are required, but do not give any until the soil is dry.—SAUL RYMEA.

[11754.]—**Polishing Diamond (U.Q.).**—Diamonds were formerly polished by rubbing them against each other, as was the case with the Koh-i-noor. It was not till the middle of the fifteenth century that Van Bergem, a Dutchman, adopted the method of grinding and shaping them with diamond powder, and two centuries elapsed before the best true brilliant shape was discovered.—H. B. E.

[11772.]—**Black Lacquer.**—Simply Brunswick black. Consult back numbers.—H. B. E.

[11773.]—**Cleaning Plain Blue Silk (U.Q.).**—My wife finds benzine collas a very useful fluid for the removal of grease, dirt, and wine and other stains from her silk dresses. "A Mechanic's Wife" had better try it, and report progress. If it does not answer, I will prescribe another remedy, as I am eager, alike with other members of "our" brotherhood, to oblige the "fair sex."—H. B. E.

[11776.]—**Commercial Geography (U.Q.).**—Dr. Cornwall's "Advanced Geography" well discusses the imports and exports.—H. B. E.

[11821.]—**Holly.**—Holly, if left exposed to wet or lying on damp ground after felling, will become black and stained.—SUFFOLK AMATEUR.

[11865.]—**Fish.**—Cholmondeley Pennell says that in his experience, flavourings, whether of sugar, honey, or essential oils, are useless or mischievous additions to paste baits, and I never heard of a "good" fisherman who employed them.—A. T., Staines.

[11867.]—**Separating Tar from Wool.**—Tar will mix with grease or oil, and soap remove the mixture.—SUFFOLK AMATEUR.

[11873.]—**Magic Lanterns.**—"A. B." will find information on japanning in Vol. XIV., No. 350, and an illustration of "Jack of All Trades'" japanner's stove in Vol. XIII., No. 324. The proper japan can be purchased at most varnish shops.—E. M.

[11874.]—**Bryant and May's Matches.**—I think there must be something wrong about this query. Is "Hipparchus" sure that he tried Bryant and May's matches on linoleum? In fact, is he sure that they were not ordinary matches, or that he did not rub them on the prepared phosphorus paper?—SAUL RYMEA.

[11874.]—**Bryant and May's Matches.**—I have tried to ignite Bryant and May's matches upon linoleum, and failed.—L. M. F.

[11875.]—**Spectrum Colours.**—If "H. P. H." (whom I had no intention to criticise) will look again, he will not find anything in my reply about "white light." I was speaking of making a coloured spinner appear a white one. You may easily make it reflect white light, but not the quantity necessary to entitle it to be called "white" as an object. The light from a gray object, light or dark, may be equally white, *i.e.*, equally neutral light, and the dark gray object in sunshine may be brighter than snow in the shade, but that does not entitle it to be called a white object. Of course, with thanks for "H. P. H.'s" invitation, there can be as many kinds of white undistinguishable by the eye, but distinguishable by the prism, as there are hues of colours distinguishable or many more.—E. L. G.

[11898.]—**Tempering Cast Steel Chisels.**—"U. V. U." wants to know how to harden and temper chisels made out of old files. Being an experienced "old file" myself, I can sympathise with my fellow old files, and must protest against their being put to uses for which their material was not designed, and is usually quite unsuitable; so instead of instructions for doing what I believe to be an impossibility to do effectually, I repeat *Punch's* advice to (silly) persons about to marry, "Don't attempt it"—I mean tempering, not that trial of temper, marriage. No doubt many chisels and screw-drivers are made out of my brethren—I mean old files—but our nature is, alas! generally very coarse; and unless of much finer quality than usual, our employment for such tools is but "a delusion and a snare," most of us being composed of very inferior material (especially such of us as are natives of Sheffield) to that which ought to be (and by good makers is) employed for cold chisels and turning tools. Occasionally a tolerable tool may be made out of one of us, especially if a native of Harrington, and rejoicing in the honoured, if not very aristocratic, name of "Stubbs;" but the old file who writes this can aver, from long and costly experience, that it don't pay to make cutting tools of any other material than first-class cast steel. When they were made of ordinary Sheffield files (some of which are very queer files indeed) he almost invariably found their edges crumbled away in use, their material being weak and brittle when hard enough. This defect renders files especially unsuitable for screw-drivers. Although not required to retain a cutting edge like a razor or chisel, a screw-driver is subjected to considerable force when in use, and to resist that force properly it requires to be what the Frenchman termed "a very great toe"—in other words, very tough. I am decidedly of opinion that double shear steel best fulfils this condition; it is, therefore, preferable for ordinary use for screw-drivers, spanners, and other tools which are subjected to sudden and violent strains. I have, however, found the same cast (tool) steel which is ordinarily employed for chisels, &c., makes excellent screw-drivers if carefully forged at a low heat, hardened at the lowest temperature it will harden, and tempered rather low, say to a deep or even a pale blue. No screw-driver should be left so hard that a good second cut file will not operate on it if pressed forcibly and moved slowly. In fact, you cannot finish a screw-driver properly on the grindstone; it should be filed transversely, so as to form shallow grooves on the surfaces which act against the groove in the head of the screw, and thereby greatly diminish the risk of its rising in that groove and slipping out. Now you can't do this if the screw-driver be tempered too hard to be filed.—THE HARMONIOUS BLACKSMITH.

[11916.]—**Octave Coupler.**—See p. 369, Vol. IX., where you will find "Adept's" instructions, with illustration.—K. T. L.

[11917.]—**Organ Construction.**—If you mean books containing detailed instructions how to make an organ, there are not; but you will find what you want in the ENGLISH MECHANIC.—K. T. L.

[11948.]—**A Bad Sleeper.**—"N. K. R." should leave off drinking spirits or smoking before bedtime. Let his last meal be at seven, presuming he retires to bed between ten and eleven; do not take arrowroot or corn-flour, as it leaves a nasty taste. Keep a glass of cold water by the bed to sip.—H. B. E.

[11996.]—**Deafness Arising from Cold.**—This often arises from swollen tonsils. It may be ascertained by looking into the back of the mouth, keeping down the tongue with the handle of a spoon, when, if swollen, the tonsils will be seen looking like two red balls on each side of the throat, sometimes almost closing the passage. The homœopathic remedy is mercurius iod. The allopathic treatment consists of tonics and astringent gargles.—H. C. M.

[11996.]—**Deafness Arising from Cold.**—Let "R. C. Y." drop two or three drops of warm sweet oil into each ear morning and night. (Proved).—B. S.

[11997.]—**Warming Greenhouses with Gas.**—I have deferred replying to the inquiry of "H.B.E." (May 31, p. 288) in the hope that I might have been able to give him the information he asks me for, but regret that at present I can only partially do so. I have it from the brother of the gentleman who owns the greenhouse referred to in my letter of September 29, 1871, that it has fully answered his expectations, and stood the test of last winter, but am not at present in a position to furnish drawings or a fuller description of the plan I alluded to. The cost of gas consumed during the winter he believed was about £5, the size of the greenhouse (as I stated at the time) being about 15ft. by 16ft. I will endeavour, if possible, to obtain for "H. B. E." more complete information on the subject, but the state of my health has for some time back prevented my following up investigations as to the application of mixed gas and air for heating purposes. I find, however, it is now becoming very general.—HOUBLON.

[12000.]—**Insects in Tables and Chairs** of English woods, beech and sycamore, are most liable to worm, oak or walnut only in the sap; but the sap of walnut is easily stained like the heart wood, hence much walnut furniture soon returns to dust. Constant use is the best check, stillness, especially if a little damp and dark, favours the wood-worm. I have seen furniture eaten up through not being used. Similar conditions mightily favour moth. Fair use is the best for furniture. Modern upholstery and modern ways encourage these destroyers. Furnish a room to look at, seldom use it, never brush it (especially parts not seen), put on the covers, keep down the blinds, shut the doors, and you will soon have moth first and then worm, no matter what the stuffing is, if the cover is of woollen material. Fourpence extra upon an ordinary chair would put American birch instead of English beech, and prevent worm, but not moth. Moth is the effect of negligence, or of buying what you do not want. But cheapness is king, and if your chair is eaten up you have the comfort of feeling that you have saved 4d. But of all English woods walnut is most deceptive, for a tree will sometimes be half sap, hence the temptation to use it, being so easily stained like heart wood, and as to worm, it can hardly be sold before they appear. But after all cheapness is king — you produce a present effect, and then both you and your chairs return to dust.—AFTER NOON.

[12013.]—**The First Watch and Clock Made.**—In ancient books there is scarcely any authority to be depended upon by which the date of the invention of clocks may be traced; of course, clocks were invented before watches. Beckman, in an ingenious analysis of various statements made with reference to the inventors and period of the first clocks made to go by weights and wheels, ascribes the earliest of them to the eleventh century, but does not attempt to say by whom they were invented. Many statements have from time to time been made as to the inventor of clocks. Archimedes and Posidonius, before the Christian era; Boethius, in the fifth century, or about the commencement of the sixth; Pacificus, about the middle of the ninth; Gerbert, at the end of the tenth; Wallingford, near the beginning of the fourteenth, have each, in their turn, been asserted to be the inventor of the clock. We have earlier data as to clocks in England than that of Wallingford, for in 1288 we find that a stone clock-tower was erected opposite Westminster Hall with a clock, the cost of which erection was defrayed out of a fine of eight hundred marks upon the then Chief Justice of the Queen's Bench. Many remarkable clocks from this date have been erected in England and in other countries, which serve as landmarks to show us the advance we have made to the present time in the art and science of clock-making. From the above remarks it will be seen that the early history of time-measurers, or horologia, is involved in much obscurity. Richard Harris, an intelligent English workman, is said to have invented the first pendulum clock, in 1642. Peter Hele, of Nuremberg, is said to have invented the first watch. Johannes Cocclaeus, in his commentary on the Cosmographia of Pomphonius Mela, published in Nuremberg, in 1511, makes the following announcement:—"Ingenious things are just now being invented, for Peter Hele, as yet but a young man, hath made works which even the most learned mathematicians admire, for he fabricates small horologes of iron filled with many wheels, which whithersoever they are turned, and without any weights, both show and strike forty hours, whether they be carried in the bosom or the pocket." In the year 1658, Dr. R. Rooke invented the balance spring. In 1695, Tompion invented the cylinder escapement with horizontal wheel. In the year 1700, Nicolas Facio discovered the use of jewels in watches. In the year 1766, Thomas Mudge invented what is now universally known as the "patent detached lever." In the year 1780, the chronometer escapement was invented. The compensation balance was invented by Thomas Earnshaw, of London.—FREDERICK R. ROHU.

[12014.]—**Organ.**—Consult "An Adept's" and "J. D.'s" letters on the subject before sending queries like this.—H. B. E.

[12051.]—**Fire Engines.**—"A., Liverpool," in answering this query (p. 318), has got out of his depth. "Fire engines generally are used with flexible hose pipes" only on the delivery side, the suction pipe being prevented from collapsing by a spiral wire of copper or galvanised iron. Has "A., Liverpool," overlooked the quotation from Montaigne?—L. M. F.

[12060.]—**Glass Blowing.**—I am sorry I am not able to give "Emily Jane" directions how to blow a glass bulb on her tube. I think she will find it much more profitable to buy her bulb tubes ready-made. To bend glass tubing introduce the tube gradually into the flame of the lamp. Move it up and down, so that the neighbouring parts may be somewhat heated, then apply the heat strongly to the part where the bend is to be made, turning the tube round in the flame, and when sufficiently soft apply gentle pressure with the hands until it attains the proper form.—UN IRLANDAIS.

[12061.]—**Chemical.**—Dissolve in water. Add argentic nitrate as long as precipitate falls. If no precipitate be produced chlorine is absent. If chlorine be present filter off the argentic chloride and add to the filtrate sodic carbonate, evaporate to dryness, ignite, treat the residue with water, and add to the solution argentic nitrate; a precipitate proves the presence of a chlorate.—UN IRLANDAIS.

[12072.]—**Magnetic Moment.**—I presume that in his reply to this query "Sigma" refers to the unit of force adopted in the B. A. standard of electrical resistance, which Ferguson defines to be a force "capable of generating in a mass weighing one gramme a velocity of one metre per second," and which is equal to $\frac{1000}{9811}$ of a gramme = 1·573 grains. Will he say how the force of a magnet in these units may be ascertained? I am acquainted with the method of determining the strength of magnets by the oscillations of a magnetic needle; but this gives only relative results. I am rather at a loss to know what unit of length "Sigma" refers to, unless it be the metre, which seems rather too long for small magnets; and, again, as the poles of a magnet are not at its ends, how may their position be determined so as to have the correct length? And now there is another point concerning which I want some information. Ferguson states (p. 192): "Each pole of the induction coil is the seat of two opposite electricities, alternating with each other alike in quantity but differing in [illegible] can understand how, when the points [illegible] these together, both induced currents [illegible] to the hazy spark which is shortly before described: and that when they are further separated the direct induced current having the greatest tension would alone be able to spark across, in which case the sparks would be clearer and more like those of an electric machine; but a few lines lower down I read that a Leyden jar may be charged by an induction coil, and I cannot see how that is to be done, for it seems that each current would exactly neutralise the effect of the preceding one, being alike in quantity. And in turning to Tyndall's "Notes on Electricity," I there find (No. 306), that owing to some action of the extra current, which I confess I do not understand, "in a Rhumkorf's coil we obtain discharges in a single direction only, instead of discharges alternating in direction." Will "Sigma" kindly say which is right, and he will further oblige—BEACON LOUGH.

[12073.]—**Scarlet Runners.**—The roots may be taken up and preserved through the winter, just like tulip roots, but there is no advantage gained, as just as good plants are grown from new seed, and in the same time.—J. T. B.

[12077.]—**Pyrethrum Parthenium.**—Thanks to "William" for the information kindly given. The flowers which I noticed somewhat early were on old plants that survived through the mild winter. They had an unusual number of bracts, many more than the ordinary flowers, and each *white floret of the ray* had a green calyx inclosing white petals; the yellow florets were unaltered. Since the ordinary flowers have unfolded, these abnormal flowers have disappeared, ordinary flowers appearing on the same plants.—W. R. BIRT.

[12081.]—**Chemistry.**—There is no really simple method of detecting arsenic in the presence of several metals. If "Molecule" had given a list of the metals likely to be present in the acid solution, one might perhaps be suggested. The following, from Galloway's "Analysis," may answer. Pass H_2S through the acid solution, previously reduced by sodic sulphite. Filter and well wash the precipitate, then treat with a solution of NH_4HCO_3 (1 in 12) for a few seconds only, quickly filter and add to filtrate HCl in excess. If a yellow colour or precipitate be produced, arsenic is present. To find whether it exists as As_2O_3 or as H_3AsO_4 add to portion of the original solution KHO in excess, and a few drops dilute solution of cupric sulphate, and boil; if a red precipitate falls As_2O_3 or an arsenite is present. To another portion of the solution add ammonio-nitrate of silver, a reddish brown precipitate will be formed in presence of H_3AsO_4.—UN IRLANDAIS.

[12090.]—**Strawberries.**—My experience (p. 314) proves the value of this "wrinkle," which I learn from a neighbour whose strawberries were as remarkable as his mania for taking his constitutional among them seemed to me. I do not believe in liquid manure of a strong nature. A dressing of horse dung from the roads thrown, not on, but amongst the plants just as they are coming into flower is far better. The advantages of treading down are the cleanliness from vermin, from splashing of grit, dryness, and, consequently, less chance of mould, keeping in the moisture of the ground underneath the upper crust, and the speedy ripening of the fruit. I earnestly advise "Derf Errac" to make a bed of wild strawberries—he will find it pay the trouble.—M. PARIS.

[12090.]—**Strawberries.**—"Derf Errac" cannot trample his strawberry beds too much.—H. B. E.

[12097.]—**Venetian Blinds.**—This query has been given and answered over and over again in "ours." Will not querists search indices before occupying space to repeat questions?—H. B. E.

[12097.] — **Venetian Blinds.** — The principal peculiarities in painting these are, to put the paint on thin, and to let one coat thoroughly dry before putting on the next.—B. S.

[12097.] — **Venetian Blinds.** — The laths are generally painted on a trough in the shape of a letter V, with wires across to rest the laths. There is a small stick cut somewhat the shape of the holes, to pick them up when painted, and hanging them on old stair rods driven into a wall until dry. Plain paint, turpentine the principal vehicle, being used; afterwards varnished, or finished off with colour ground in varnish to fancy.—JOSEPH WILLIAM FENNELL.

[12097.]—**Venetian Blinds.** — The laths must first be sized. When dry they are ready for the first coat of paint. The best paint to use is called enamel green, made for the job, to be had at any paint and varnish warehouse, price about 1s. 8d. per lb. If too thick thin with turps; it is better to have the first coat rather thin, and be careful that the edges are not left with a mass of paint on them. You must first make a trough, by nailing two ½in. pieces of wood together, so as to form a right angle about the length of the laths. Then nail two square pieces on the ends so as to form a trough exactly like a rabbit trough. Mind that it is large enough to receive the laths. Put twenty or thirty laths together and paint all the edges. This done (no need to wait until dry), place them flat in the trough so that the edges only touch the sides of trough, then paint away. When done both sides, hang on wires through cord hole to dry.—B. R. B.

[12098.]—**Dandelion Roots.**—Collect the plants that have not flowered, roots and leaves. Bruise the roots and cut up small, and put into a wide mouthed bottle equal weight of bruised plant and pure spirits of wine (not methylated spirits), digest for a month, shaking daily. If once or twice during the time you could pour off the spirit and put the plant under pressure to fully extract the virtues it would make the tincture stronger. When complete strain through muslin, and you have tincture *Leontodon taraxacum*. Dose, ten to twenty drops, in water, fasting twice a day. Sluggish liver is rubbish. Read "Ourselves, Our Food, and Our Physic," by Benjamin Ridge, price 1s. 6d., Chapman and Hall, on this point.—WATTS.

[12099.]—**To Advanced Chemists.**—In cases of calculus of the bladder *Cannabis sativa* (hemp plant) or *Arbutus uva ursi* (bear's berry) have been found curative. In calculus of kidneys, *Lycopodium clavatum* (club moss) or sarsaparilla have proved curative. "Cireb" might consult Drs. Carlier or Gandry, Brussels. In chronic cases very small doses should be taken, and the treatment extend over a period. "Cireb" seems an Anglo-Indian; perhaps he has not investigated the Hindu remedies for calculus. They use *Parigdta, Baiʼainti, Nimba, Chitraka, Tamarinds, Durba, Catechu*, and many others. See Wise's "Hindu System of Medicine." 1845. Smith, Elder, and Co., or Thacker and Co.—WATTS, Chotahukeene.

[12101.]—**The Watch.**—"S. H. L.," virtually asks to be taught the trade through the medium of the ENGLISH MECHANIC. This will be asking too much, I think, besides I have little faith in amateur watchmaking. It is a business of which it may be said that you have but begun to learn after having served an apprenticeship of seven years, and in which the proportion of workmen who are thoroughly competent, both theoretically and practically, is astonishingly small; how then can an amateur expect to succeed in it?—WEST CORNWALL.

[12106.]—**Organ Building.**—The same question has been asked, and the answer given to this effect: it has been tried, but proved far from satisfactory.—JOSEPH WILLIAM FENNELL.

[12106.]—**Organ Building.**—1. Nicholson, the organ-builder of Worcester, has given instances of making an open pedal pipe serve for several tones; but as I have only heard, but not seen them, I cannot explain their mechanism. 2. In the Great Exhibition of 1851 there was a noteworthy invention by Brothers A. and M. Ducci, of Florence. They exhibited two chamber organs of good tone, and many other merits, but especially remarkable for the amount of sound from extremely limited space. Rossini had been surprised on finding in one of their organs 9 stops, or, deducting the halvings of the principale (our diapason) and the trompette into treble and bass, 7 complete registers (exclusive, it is presumed, of the pedal contrabass) comprised in a space of "1 mètre, 50 cent. cubes." The platform upon which the music-stool stood measured, he says, 130 cent. in length by 30 in breadth, and that that was the pipe which gave contrabass C of 16ft., and successive chromatic sounds. If my memory serves, in one instrument the music-stool itself was such a pipe. Accompanying them was a detached instrument, called a barystate, of the same construction as the aforesaid pedal contrabass, designed to supply in a portable form those undertones for an orchestra. The chromatic scale of two octaves was given by four pipes. The dimensions, of the lowest, giving the tones from FFFF 24ft., was nearly 5ft. 6in. × 2ft. 2in. × 10in. The next pipe was 3ft. 9in. × —(?) × 7in. The valves or pallets for each note were ranged along the front of the pipe, opened inwards, each in their depression from outside acting on arms and an iron spindle inside, which passing into the air chamber at the block of the pipe simultaneously opened a valve there to give ingress to the current of air. The chief features of their pedal pipes were, first, the production of 32ft. tone from an 8ft. pipe, and so on in proportion. Secondly, the utilising of each pipe for six semitones. Thirdly, the eliciting from pipes of that construction two qualities of tone, the bourdon "timbre," or the rasping quality of the contrabass or violin. These instruments came furnished with the testimonials of Rossini, De Mayer, &c. "Certes," says Rossini, "MM. Ducci ont mérité de grandes louanges par cette inventions qui, en honorant leur génie, recule les limites de l'art; par cette découverte en genre de contrabasse dans un seul tuyau, on peut s'attendre à une suite d'inventions mécaniques qui fourniront au monde de nouveaux effets de phénomènes acoustiques." They stood the test of examination, and in conjunction with an ingenious machine for cutting wood obtained either a silver medal or "honourable mention" from the jurors, and yet, in England at least, they have remained unnoticed—like Barker's pneumatic lever—for twenty years! 3. The pyramidon, invented by Sir F. A. G. Ouseley, an inverted pyramidal pipe, giving the purest bourdon quality of tone, is very economical in height, and the pipes can be conveyanced off to odd places or packed dovetail-wise. The dimensions of C C C 16ft. tone are—the base 2ft. 7in. square and 3ft. perpendicular from base to apex, mouth 8in. × 2½in. But the pipes are difficult to make. 4. Another kind of economy, which I have myself carried out, is by attaching to the usual pedal keyboard of 2 or 2½ octaves any lesser number of pipes from a septave of 12 upwards. The duplicate action is obtained simply by extra arms and trackers from the rollers. In churches and chapels where an organ is wanted almost entirely for choral accompaniment and where, to say the least, the fugues, solos, and concerted pieces of the concert-room are not necessaries, there is economy and acoustical gain in having two pedal stops of the sub-vocal or sub-manual tones only, instead of the usual one stop of 30 pipes or 2½ octaves, the upper portion of which is practically useless for church choral purposes. Some will call this heresy!—H. E. H.

[12108.]—**Confusion in the Head.**—No tobacco; little drink, and that little not too near meal times; no tea; no heavy meals; no food at all near bed or getting up time. This system of negatives proved to be good.—HENRY NEWMAN.

[12108.]—**Confusion in the Head.**—See my reply to query 10720 ("Singing in the Head"). The recommendation proved beneficial. I have no doubt it will do so in "Agent's" case.—WATTS.

[12109.]—**Old Locomotive Tubes.**—Plug one end and fill the tube with melted resin. When cold, bend as required. The resin must be melted out when the tube is bent.—T. G.

[12109.]—**Old Locomotive Tubes.**—The best plan would be to fill the tubes up with soft solder or fusible metal, bending the tube and then melting it out. Fusible metal is composed (one recipe) of 1 tin to 1½ lead. As for soft solder, it can be purchased from the tinman's cheap enough.—P. W. H. J.

[12109.]—**Old Locomotive Tubes.**—I have seen iron pipes bent by making them red hot in a forge, and gradually bent to the required curve by several heatings. I have no doubt such could be done with care in locomotive tubes.—JOSEPH WILLIAM FENNELL.

[12109.]—**Old Locomotive Tubes.** — Anneal your tubes well in coke fire, fill them with lead. You will then be able to bend them, by means of pressure or levers, don't hammer them to bend them; then melt out lead.—A. R.

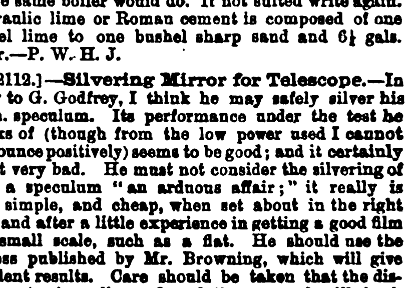
[12110.]—**Silver Plating.**—I thank "Electric" for reply; I have tried the porous cell process, it is too slow, the gold also works through the porous cell. I am sorry after your kind offer that I do not live nearer you. I am in London: Perhaps you can assist through our MECHANIC.—ELECTRO.

[12111.]—**Hothouse Boiler.**—No form of boiler can make much difference in the height that it is to be placed; if the present form cannot be raised, I would advise "W. F." to call in a practical greenhouse engineer to see whether there could not be some alteration in the arrangement of the pipes so as to admit of them being placed higher up, as without a drawing of the arrangements of the pipes, I could not judge upon that point. If no other way would do, a sure plan would be to line the ash pit with bricks backed with 2in. thick of clay, and set in hydraulic lime. I think that upon the whole this would be the best plan, as the same boiler would do. If not suited write again. Hydraulic lime or Roman cement is composed of one bushel lime to one bushel sharp sand and 6½ gals. water.—P. W. H. J.

[12112.]—**Silvering Mirror for Telescope.**—In reply to G. Godfrey, I think he may safely silver his 10½in. speculum. Its performance under the test he speaks of (though from the low power used I cannot pronounce positively) seems to be good; and it certainly is not very bad. He must not consider the silvering of such a speculum "an arduous affair;" it really is easy, simple, and cheap, when set about in the right way, and after a little experience in getting a good film on a small scale, such as a flat. He should use the process published by Mr. Browning, which will give excellent results. Care should be taken that the distilled water is really good, and the sugar of milk fresh and good also.—H. C. KEY.

[12113.]—**Gold Quartz.**—The specific gravity of the substance is 3·25, and that of gold is 19·34. Therefore there is $\frac{3\cdot25}{19\cdot34}$ gold in the substance, and, as it weighs 306 grains, ∵ there is $306 \times \frac{3\cdot25}{19\cdot34}$ grains of gold = 51·42024 grains.—P. W. H. J.

[12118.]—**Organ Construction.** — "Hautboy" asks if reeds can be fixed to make an organ bass. I should expect to find an organ channel too confined to give a round mellow tone; even if the mechanism to sound them could be adjusted. I have fixed reeds of deep tone (C C, and two or three notes above) in pipes no bigger than principal C, modifying the tone by means of a movable perforated tompion, such as is used for stopped diapason, only with a hole drilled through it; and the tone was fair. But we must



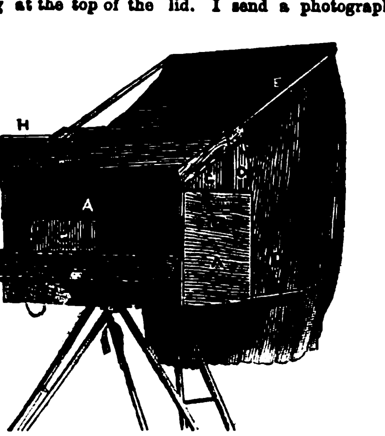
remember reeds speak in a harmonium on a wider area. I should, therefore, recommend the following plan:—Make a wind-chest long enough to contain the six notes on the bass side of tenor C, and another for the six transferred to the treble side, the depth to be three or four inches, according to the room you have on the organ soundboard; the height may exceed the width of an ordinary harmonium. There should be a block running along the bottom of this wind chest, and holes pierced to correspond with the holes on the organ soundboard. These are to take the pipe feet. Cut a slot through the face of the wind-chest down to the pipe-hole. Just above the upper edge of the block fix the note by counter-sinking, and cut another slot below its reed. Then fix a hollowed cap over the note and the slot in the block. Holes must be drilled in the top of the wind-chest to communicate with the outer air. If possible, procure the American notes. I subjoin a diagram: the second note is covered with the cap, and has the foot inserted.—T. S. G.

[12124.]—**Voice Weakness.**—Thanks to Henry Newman for his answer. I have no ailment with my lungs, but have always had (naturally) a weak voice ever since I can remember. I can rise rather high in singing, but have not the power to carry the sound far. Could "H. N." offer any other suggestion than the one already offered. If so, I shall feel deeply indebted.—JACQUES ERICK.

[12127.]—**Herbs.**—Robinson's "Family Herbal." W. Nicholson and Sons, Halifax.—S. COOK.

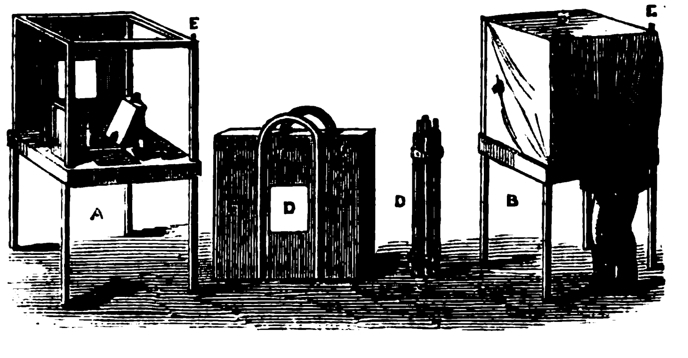
[12127.]—**Herbs.**—Culpepper's "Herbal," Newton's "Herbal," and Paxton's "Botanical Dictionary," either of which may be had cheap at a second-hand bookshop.—ZETA.

[12128.]—**Portable Dark Tent.**—In reply to this query I am able to give the result of a dozen years of photographic work, and not a few experiences in these contrivances. There are three varieties of dark tent:—1. Those in which all the materials for work are arranged *in situ* ready for operation, and thus transported from place to place. The great objection here is the inconvenient bulk and additional weight. 2. Those in which nothing is carried but the belongings to the tent itself (of which kind Rouch's stands as a good example). 3. Those capable of containing all the impediments for a journey, which are removed prior to commencing operations. The last is the kind to be preferred, as it obviates the necessity for a separate receptacle for the camera, chemicals, &c., and thus lessens the weight of the outfit. The tent I use was constructed for me by a country carpenter in the south of Ireland, during a visit in 1868, under my directions. It is simply an ordinary trunk, or box, having a hole for a screw and nut at the bottom, by which it is attached to the head of a strong tripod. The lid being lifted there are two angular pieces hinged inside, that fold down against and close the end apertures, and rest upon ledges an inch below the edge of the box proper. The front (a lock part) of the box is hinged and opens down in a line with the bottom. The upper surface has ledges nailed round, forming a dish or trough to catch the washings, and a small piece of metal tubing through at one corner, to which an indiarubber pipe is attached. This trough and the real bottom of the box form the operating table. In each upper corner of the raised lid a square groove is cut, and covered with a piece of sheet iron. These take a couple of iron bars (just long enough to pack diagonally inside the lid), having eyes at the end to take a transverse rod carrying the calico. There should be three thicknesses of this—two black and one orange. It is nailed round the ledges that form the trough, and to two upright movable bars at the side, which in taking down fold into the trough. Light is obtained from a yellow window in front, and a small triangular one in one of the folding angle pieces at the side; a lid closes in the glass from breakage in travelling. A water-can is hung at one side, having a flexible tube passing into the interior, the end of which, when not in use, is kept above the water level through a ring at the top of the lid. I send a photograph



which may illustrate the foregoing description, and may say in conclusion that, taken "all in all," I have never used or seen anything superior to this arrangement. I may add that the cloth hangs loosely and very full round the operator, and is easily tucked under the waistcoat when light has to be excluded. A, tent box; B, lid; C, angle piece hinged on the under side of B; D, small iron cramp, this shape [———] to hold up the lid, and fitting in brass tubing let into the wood; E, iron rod to support the calico; F, lid to protect the glass G; H, water-can.—CORNUBIENSIS.

[12128.]—**Portable Dark Tent.**—"Occasional Photo" may find the accompanying rough sketch answer his purpose. A is a box made out of ½in. deal, 2ft. square (or thereabouts) by 4½in. deep; the lid is cross-headed, and has fillets round the three unhinged sides for tacking the light proof covering to; a space is cut out in centre 6in. or 8in. square, and filled in with yellow calico. D, the bottom of box has a small sink about 8in. by 10in., by 1in. deep, with a hole for escape of water; the hole is fitted with a cork, which should not be withdrawn until the plate is fixed, and the operator is standing clear of the spray. A frame for top hinged to lid folding down on underside when not in use; two uprights working on pins at front, and fastened when in use to top frame by two iron pins which also answer the purpose of keeping the cloth in its place (see E E); four blocks are strongly fastened at corners for either plain or screwed pins on top of portable legs being let in to them. Four portable legs about



3ft. long, B shows the frame with black waterproof covering, tacked on three fillets on lid, and three insides of box. The cloth is made with a hem and cord passed through it for tying round waist of operator; the cord must be long enough to allow expansion of cloth to full extent, and not disappear at either end. Before packing be careful to dry the inside thoroughly. C shows the box with straps and handles; inside is the black cloth packed along with bottles, dipping bath, water jug, developing dish, &c. D shows the portable legs. F F are holes for ventilation. —A. C.

[12129.]—**Firebars.**—Cast-iron firebars last longer in fire-box with great heat. Cast bars will sooner melt than wrought iron ones, but wrought iron will bend before cast iron will melt. Cast iron is also cheaper. —PLOUGH.

[12130.]—**Electricity.**—This difference is usually illustrated by stating that the electricity developed by the electric machine has greater intensity, but is smaller in quantity, than that obtained by the galvanic battery. Considering facts, it gives a stronger shock than a battery of a few cells would do, but it has much less effect as measured by electro-chemical decomposition, such as decomposing water into its components, oxygen and hydrogen, for example.—PHILANTHROPIST.

[12131.]—**Electricity Applied to Engraving.** —There is a patent process for copying writing, &c., from a plate prepared in precisely the same way as "Philanthropist" proposes, but chemicals are used, which instead of giving a copper deposit adhering to the plate, give blue copies on a prepared paper laid on the plate. A kind of copying press is used. If (as I infer) "Philanthropist's" idea is to bring the engraved parts into relief for printing in the ordinary way, I believe the field is quite open to him, and to insure success only two things are necessary. 1. That the engraving be sufficiently raised above the level of the plate. 2. That there be no irregularity in the surface of the raised parts. I hope it will not be asking too much of a "Philanthropist" to let me know if he succeeds.—COUNTRY PRINTER.

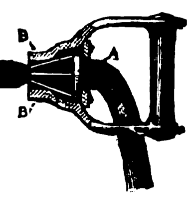
[12131.]—**Electricity Applied to Engraving.** —I think the principle of the pantelegraph, with which no doubt "Philanthropist" is perfectly acquainted, could be still further improved and applied as this contributor suggests, to the engraving of metallic plates by electricity. The apparatus, which has of late years not received as much attention as its ingenuity deserves, should come into general use, and many valuable improvements in its application would soon appear. "Philanthropist" says, "suppose a metallic plate, thinly coated with wax, to be subjected to the action of a galvanic battery, &c., is the plate to be entirely immersed in a boiling solution of wax or rubber, so as to be coated all round? Assuming in such a case that the coating remains intact, except where the steel point has penetrated, while under the action of the battery, which is very doubtful, the deposit of copper would be very slight, and scarcely of sufficient depth to be printed from. I think, however, that "Philanthropist" could easily suggest a process whereby impressions might be taken from metallic plates, something similar to the preparation of lithographic stones.—RAT-TAT.

[12131.]—**Electricity Applied to Engraving.** —For the benefit of "Philanthropist," I send the following extract from the "Year Book of Facts for 1840," which shows the process was gone into many years since. Mr. Thomas Spencer, of Liverpool, stated in the *Athenæum* that he had not only succeeded in doing all that M. Jacobi had done (producing copies of copper-plate engravings—in other words, electrotyping), but had successfully overcome those difficulties which arrested the progress of the latter. The objects which Mr. Spencer says he proposed to effect were the following: "To engrave in relief upon a plate of copper; to deposit a voltaic copper-plate, having the lines in relief; to obtain a *fac-simile* of a medal, reverse or obverse, or a bronze cast; to obtain a voltaic impression from plaster or clay, and to multiply the number of already engraved copper-plates." The results which he has obtained are very beautiful, and some copies of medals are remarkably sharp and distinct, particularly the letters, which have all the appearance of having been struck by a die. For the details of Mr. Spencer's process, see the *Athenæum*, No. 625, p. 811. My opinion is that the deposit would not be fine or even enough to give a clean impression when printed from; it might do for rough common outline work, but for fine shaded engraving I do not think it would answer. If "Philanthropist" tries the process, I for one should like to know the result.—ZOO ANDRA.

[12133.]—**Hard Water.**—Mr. Pearce would do well to construct a cistern of sufficient size, wherein the water might gain a quiescent state after some time, and deposit some of the hard silicious particles. A layer of carbon at the bottom will hasten the precipitation. An excellent ale-filtering tap, suggested by an electrician in a back number of the ENGLISH MECHANIC, might also be tried with success in the manner recommended.—RAT-TAT.

[12134.]—**Restoring Brass Wire.**—All "Keighley" can do with the brass wire, which has become corroded by exposure, is to sell it to a brass-founder, or remove the rust to the sound core, and either tin or paint it.—RAT-TAT.

[12135.]—**Chest Expander.**—I enclose a sketch of a handle of a chest expander, arranged so as to be adjusted to any part of the indiarubber. It will be seen that A is a ring having four short arms each working on a hinge at one end. This ring, with the arms, is to slide a short distance in the circular part of the handle, which requires to be of the same shape as engraving. It will be seen that when the handle is pulled, the parts B press against the arms, and cause them to grip hold of the rubber—more you pull tighter it holds. The part A is kept in its place by a ring or washer screwed on the inside.—ZOO ANDRA.



[12137.]—**Liquid and Solid.**—Maunder defines solid as "not fluid, firm, true, compact"—and liquid as "not solid, fluid, dissolved." Mercury should be defined as a solid which is fluid at ordinary temperatures. Tomlinson says: "Mercury becomes solid at – 40°, in which state it is malleable, flattens readily under the hammer, and can even be struck into medals. At a lower temperature it becomes brittle," &c.—QUERCUS.

[12137.]—**Liquid and Solid.**—No well-marked boundary exists in Nature. If the writer of the book lived at the North Pole, mercury, he might consider, as much a solid as we do butter, which, I suppose, under the line would be a liquid. Ganot, I presume, wrote for temperate latitudes. Ice is a solid, yet, under certain conditions, flows like a viscous fluid. "E. L. G." is, however, the man to tackle this question.—M. PARIS.

[12142.]—**Leaky Tubes.**—Wind round the ends inside with soft wire as close to the end plate as possible; the wire to be of the thinnest kind.—RAT-TAT.

[12143.]—**Cayenne.**—Try covering the face with fine gauze or muslin.—DERFLA.

[12143.]—**Cayenne.**—Plug nostrils with cotton wool, or use wool respirator.—PLOUGH.

[12144.]—**Timber Houses.**—Build the walls without the cavity. Plaster inside and out. That the plaster may hold to the outside, first drive the nails used up to the heads. Then apply the laths and drive the nails into the boards, but be careful to keep all the laths about one-eighth of an inch from the walls. They should not sit closer than this, and be nailed about two inches apart, and may or may not be covered with the cement. The inside may be treated in the same way, or the laths to be nailed on the upright beams forming the framework, so that the plastering stands out a few inches from the walls. By this means a layer of dead air can be inclosed all round the building, and an air-tight and damp-proof building will be [illegible] RAT-TAT.

[12144.]—**Timber** [illegible] shown is not to be [illegible] timber out. If "Bee" is wealthy he should consult an architect, but if he cannot afford to do so, if he will publish an address I will forward him some hints that might, if sent to the Editor, take up too much of "our" space, but on which I believe he might rely, as I have assisted in the construction of many of the better class of the homes of England.—OLD PLOUGHMAN.

[12146.]—**How to Procure a Patent.**—Buy "Law of Patents," Weale's series, 2s.; call at Patent Office, Southampton-buildings, and ask any questions. —DERFLA.

[12150.]—**Photography.**—"Tripod" had better adhere to the old and reliable collodion process than adopt the new collodio-bromide method. With the latter there is a good deal of nicety of manipulation required, and a greater purity of chemicals necessary; and my experience of it is that it is not so reliable as the former. I would advise an amateur especially to be satisfied with the old process.—E. B. F.

[12152.]—**Dyeing Raw Cotton.**—Try a solution of logwood and proto-sulphate of iron (copperas).—C. J. B.

[12154.]—**Varnish for Printing Inks.**—The varnish used in the manufacture of printing inks is made from linseed oil, boiled in a peculiar manner. The process I don't know, but I fancy it can be bought cheaper than you can make it yourself. Ask for printers' ink varnish of any of the ink manufacturers, and you will be supplied with what you want.—ZOO ANDRA.

[12155.]—**The Suspended Shilling.—Another Reason Wanted.**—The oscillations of the shilling are, I think, produced by the action of the pulse, but the latter part, I believe, is entirely a matter of belief—that is, if the experimentalist believes that the shilling will strike the glass the required number of times he will find that it does so. I myself have never succeeded in this part of the experiment but once, when, having seen some one else do it, I was confident of success. It is the same with mesmerists; if the person operated upon believes that he is going to be mesmerised, it succeeds, but if he is so strong minded as to disbelieve the powers of the mesmerist, he cannot be mesmerised. So it may be in this experiment, that it is not purely mechanical, but partly the will of the experimentalist.—EXCELSIOR.

[12155.]—**The Suspended Shilling.—Another Reason Wanted.**—The suspended shilling striking the hour is simply caused by involuntary muscular action, the holder knowing or guessing rightly, or nearly so. Let "H. G. W." wake in the night and try it, he will find his shilling sadly at fault.—PLOUGH.

[12156.]—**Mice Eating Peas.**—To protect peas or beans from mice, take common furze, cut it into inch lengths, and put it over the seeds before covering with earth.—PLOUGH.

[12156.]—**Mice Eating Peas.**—I have found soaking the peas in a very strong infusion of tobacco a preventative. Perhaps the sparrows did the mischief; if so, netting, wire or string, or perhaps soot sifted over them, will protect them.—M. PARIS.

[12156.]—**Mice Eating Peas.**—More likely the sparrow, and I have kept them off this year's peas by pieces of red cloth tied on a piece of string a foot apart, suspended from two stakes in the ground. To protect any kind of fruit or vegetable from the "pests of the garden," I recommend all growers to read part 8 of Beeton's "Book of Garden Management," to be had through any bookseller.—ZETA.

[12156.]—**Mice Eating Peas.**—For some years I have been troubled with mice eating small crops, and even sparrows get so familiar with a "scarecrow" that what was not destroyed at night had a poor chance next day. This year "poor pussy" belonging to an adjoining farm took up her quarters under my garden seat, and, not being disturbed in her occupation, she has proved herself a very useful tenant. I have not had any scarecrow contrivance nor lost any crops by mice or birds.—THOS. A. BRADLEY.

[12157.]—**Smell of Paint.**—"Seagoe" should try a good handful of damp hay in each room, or a pan of water, both of which I have found successful.—THOS. A. BRADLEY.

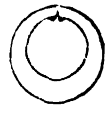
[12157.]—**Smell of Paint.**—1. Place a vessel full of lighted charcoal in the middle of the room or place painted, and throw on it two or three handfuls of juniper berries; shut the windows, the door, and the chimney close. Twenty-four hours afterwards the room may be opened, when it will be found that the sickly, unwholesome smell will be entirely gone. Another and a simpler method is to plunge a handful of hay into a pailful of water, and let it stand in the newly-painted room.—H. T. C.

[12157.]—**Smell of Paint.**—I have heard that standing open vessels of water in the room, &c., will draw the smell. The water will be covered with a film.—DERFLA.

[12157.]—**Smell of Paint.**—To remove the smell of new paint close the rooms at night, cut a large Spanish or some English onions into slices, put them into a plate, and place it on the floor; well ventilate next day.—ELECTRO.

[12157.]—**Smell of Paint.**—Place a vessel full of lighted charcoal in the middle of the room newly painted, and throw on it two or three handfuls of juniper berries, shut windows, chimney, and door. Four and twenty hours afterwards the room may be opened, when the smell will have been extinguished. The smoke of the juniper berry will not spoil anything. Another plan is to plunge a handful of hay into a pail of water, and let it stand in the room newly painted.—H. B. E.

[12158.]—**Packing Rings of Piston.**—I have constructed pistons up to 6in. diameter, which answered well, in the following manner. Let the two rings be cast shape of sketch. If cylinder is made of brass, rings to be of cast iron, or *vice versa*. First, chuck up and turn inside to fit on a mandril very slightly taper. Having placed on mandril, turn both sides with slide-rest, take off, and true up by testing up on a surface plate, and scraping the prominences; eschew any grinding whatever (I am opposed to any grinding of surfaces intended to move afterwards). Now, having got ready the piston-head and cap, place the rings in position, place a sheet of writing-paper between rings and cap, and screw up tightly; place in lathe, and turn them a trifle larger than bore of cylinder; take out, and saw through with a tenon saw in thinnest part, and the ring will open slightly larger than when turned. Take a piece of thin sheet brass and fasten at one side of the saw-cut nicely, with one rivet or little screw, and file down to thickness of ring, and when putting piston together place thin side of one ring opposite thick side of the other; the object of these valve-like pieces is to allow the rings to expand or contract freely, according to the inequalities of the bore and the wear. Thus, if to the steam forces its way through the one, it shuts the other tightly.—A., Liverpool.



[12161.]—**Mangle.**—American birch stands very well; rollers to be 4½ or 5in. diameter; the length is very common, 2ft. 4in. long. If the Editor is agreeable I will send sketch of a new system for giving pressure.—DEVONSHIRE.—[Send.—ED.]

[12162.]—**Machine Punches.**—Some machine punches are actuated like steam hammers. "Try Again" may make a simple punch by forming a screw on the end of a rod, attached to the crank of a fly-wheel to fit any kind of punch.—RAT-TAT.

[12163.]—**Meerschaum Pipes.**—It is possible for an amateur to re-wax his meerschaum, first by taking off the old wax by rubbing with sand-paper marked OO, plugging the bowl and stem with cork (the latter to hold by) and dipping in liquid white wax. When perfectly dry it is polished and finished off with shave grass or crape. The wax will cost six shillings a pound. He can also remove the colouring matter from his meerschaum by boiling it a few minutes in water—but I would recommend him first to remove the amber carefully; then oil the pipe well all over, except that part of the rim he wishes to remain white, then dip the oiled part only in very hot water. Examine after a few seconds, and dip until all the colour required is visible, let the pipe cool and wipe off and polish with a rag. Many pipes are finely restored in this way, but care and practice is necessary in handling and experimenting on manufactured meerschaum.—ZETA.

[12164.]—**Temperature of the Planets.**—There is, as far as I know, no scientific reason why Mars should not be inhabited by some animals of a different kind from those which inhabit the earth. For if animals, or rather animalcula, live in sulphuric acid, a liquid destructive to almost all life, why should they not inhabit Mars, the heat of which, to ordinary animals, would be destruction?—E. JOHNSON.

[12168.]—**Limelight or Electric Light for Magic Lantern.**—I am pleased to give "Hon. Sec." the best information in my power, and having for many years been a practitioner (though an amateur one) in optical science, and more particularly in lantern work, I trust it may prove of some value to him. First, then, a reliable pair of lanterns with achromatic lenses and three and a half compound condensers, will cost about £6; let him not think of a single lantern unless to part with it for a pair after a little practice. Next comes the question of illumination, and if the limelight is fixed upon he will require two burners, a dissolving tap, and one or two gas-bags, as he may determine to employ the mixed gas-jet, or the blow-through; this will cost £8 with two bags, £5 10s. with one. He will find most opticians advise the blow-through system for a novice, as it is devoid of danger. I should advise him, however, to obtain a lesson or two from a practical hand, and go in for the best system if at all. I come now to the electric light: he will require sustaining lamps, and a powerful battery; the latter for real practical work should not be less than a combination of forty Groves or fifty Bunsens, and costs from £12 to £15; the sustaining lamps are expensive affairs, the Duboscque and Highley Malden being to my mind the best and cheapest. I cannot, having due regard to the very wise rule laid down in "ours," advertise these gentlemen by quoting their prices, but these may be obtained through any optician. Having now told "Hon. Sec." what is required, and given him an idea as to the cost, I will give him my opinion as to the value of the two systems; if the apparatus is required simply for purposes of illustration, with paintings, photographs, or prepared objects, let him not for a single moment think of the electric light, as, in addition to larger primary cost, it is more expensive to work, a filthy job to manipulate. The light in the best hands is liable to get out of focus, and even when burning well a certain amount of flicker on the screen is produced, which more than counterbalances the extra brilliancy obtained. If, on the other hand, it is desired to illustrate the phenomena of solar light, spectrum analysis, &c., the limelight is comparatively useless. I can, however, hardly imagine that any one asking for the information that "Hon. Sec." does, could have it in contemplation to go into illustrations, which, even in the hands of Professor Tyndall, are properly designated experiments. The working cost of limelight as generally employed comes to something like four shillings for an entertainment of two hours. In conclusion, I will give "Hon. Sec." one or two words of advice: Have nothing to do with fan dissolvers, almost sure to be offered wherever he goes; and let him get a practical lesson or two before he begins.—M. G. C.

[12168.]—**Limelight or Electric Light for Magic Lantern.**—Let me give "Hon. Sec." the benefit of my experience, and for this purpose I will reply to his questions *seriatim*. 1. The first cost of a single lantern with 4in. condensers and achromatic object-glass would be about £8. An electric lamp to be used with the lantern would cost about £10; and forty cells of Grove's battery would cost about 14s. per cell. It would be useless to attempt to produce satisfactory results with a battery having a less number of cells than forty. A double lantern is never used with the electric light. The first cost of a single lantern for the lime light, with 4in. condensers and achromatic object-glass, would be about £5. Two gas-bags of the best make would cost about 50s. each, the pressure boards about £1 the pair, and the oxyhydrogen jet would also cost about £1. The price of a pair of lanterns varies very much according to the quality and style, but a pair of the best make could probably be purchased for £20. This should include gas jets, gas bags, and all accessories. 2. The cost of working the limelight for an exhibition that would last two hours would not exceed 5s. For the same time the cost of the electric light would not be less than a guinea. 3 and 4. The limelight is incomparably more simple, clean, and easy to work than is the electric light. The former is speedily prepared, and can readily be worked by a handy person after a little instruction and practical experience. Not so the electric light. It requires some hours to amalgamate the plates, mix the acids, and fill the cells; and long practice, amounting almost to an apprenticeship, is needed to produce good results with the battery. Even at the best, the electric light is uncertain, and never can be relied on to produce a continuous effect, as does the limelight. It would be impossible to carry out a two hours' entertainment relying only on the electric light; whilst with the limelight there would be no difficulty in this. 5. In England Grove's battery is generally used for the production of the electric light, whilst on the Continent Bunsen's battery is preferred. Not less than forty cells of either form of battery could be advantageously employed. The first cost of Grove's battery is greater than that of Bunsen's, but it is cheaper in use. 6. The electric light can be used for the purpose of exhibiting experiments in spectrum analysis, for which the limelight is unsuited. "Hon. Sec." will probably have no difficulty now in arriving at a decision. The electric light is altogether unsuited for the purpose that he appears to have in view.—AN AMATEUR LECTURER.

[12172.]—**Constipation.**—I have been unsuccessful in my attempt to obtain answers to two queries ("Rust in Iron Vats" and "A Cement for Cracks in Stourbridge Clay Fire-grate Backs"), but am most happy to give "H. S. A." such information as I have derived from others, or from my own personal experience. I have found the greatest benefit from a tumbler of cold water (filtered soft water), taken before breakfast. Friction of the body by horse-hair gloves, or, if the skin is too tender, with the Persian gloves (goat's hair) —may be got at Savory and Moore, Regent-street. The tepid or cold shower bath (with feet in warm water), or the sponge bath every morning. Before drying the skin let "H. S. A." try friction with the gloves. The skin is but the external continuation of the inner mucous lining, and there is the greatest sympathy between them. Friction of the spinal column by the hand of another person until much redness is produced is most useful. Constipation is much aggravated if the mind is allowed to dwell upon it. Homœopathy is much vaunted for this affliction, but after repeated trials I found it useless for me. To live upon cathartic medicine is useless—indeed, an aggravation of the complaint; but the secretions are usually deficient or defective, and here occasional small quantities of physic are useful. I prefer the best rhubarb to anything else (not the compound rhubarb pill). There is a balance to be preserved in the body, and if any one secretion is greatly increased it will diminish other secretions, to the injury of the health. Moderation in eating—slow eating, and drinking after eating rather than with the solid food are all useful, for the digestion is usually defective in these cases. Are "H. S. A.'s" grinders in good working condition?—R. T.

[12172.]—**Constipation.**—Having been a great sufferer from constipation, I may, perhaps, be allowed to offer a few remarks. However little is thought of it by the large number who are constitutionally troubled with that disorder, I am confident that sooner or later the effect of neglected constipation is sure to be felt; I believe that a large number of diseases are the result of that neglect, or from wrong treatment in endeavouring to regulate the bowels. The use of aperients or a diet suitable to act as an aperient appear to be the usual remedies; the former is a bad remedy, and the latter a very uncertain one, as, however careful some may be of their food, the bowels will be obstinate. If "H. S. A." will try eating figs, prunes, apples, bread and milk, and other light articles of diet, avoiding all indigestible substances, he will receive benefit; but I doubt (if in his case the constipation is hereditary) whether a regular action of the bowels would then take place. If medical skill could have effected a cure, your humble servant would have benefited by it, as money and years were wasted in the vain attempt. Chronic piles was the result, and six months after a successful operation my old friend re-appeared, only to be pronounced incurable. The usual remedies only laid me in bed; whilst lying there I thought of the method used to relieve the bowels in the hospital by means of the enema. In a short time I lost headache and heartache, and other followers of constipations, and my last dose of medicine dates back to the commencement of plain water used with the enema three years back. I now eat anything, and am in perfect health; it is a good thing for the medical profession that so much false delicacy and prejudice exists. I think, with Dr. Lankester, that it would be a good thing if a little physiology were learnt in the schools. There is one thing certain, the ENGLISH MECHANIC supplies the wants of all classes, no matter on what subject.—J. W.

[12172.]—Constipation.—Use bread made of flour from which only the very coarsest portion of the bran has been extracted. Get it direct from the mill, as the bakers will "cook" it by mixing the bran with flour, which is not so good. This bread is more wholesome than bread made entirely from fine flour. Drink half a glassful of cold water at night and a whole glassful in the morning. Avoid medicines. — COUNTRY PRINTER.

[12172.]—Constipation.—A friend of mine who had suffered for two or three years, and at one time narrowly escaped with his life, found at length a remedy in the following simple prescription: Eat an apple (juicy, if possible) and drink a tumbler of water immediately after rising in the morning. If one apple fails, try two, or even three. He was advised to try this by the last physician (a homœopath, by the bye) out of the many to whom he had applied, and having persevered with it is now seldom troubled. Exercise, change of diet, and plenty of vegetables and good fruit should, however, soon render "H. S. A." independent of medicine and medicine men.—TRY THEM.

[12172.]—Constipation.—After having suffered for more than two years from the same complaint, trying everything I could think of, but only obtaining temporary relief, the following advice was given me about six years ago by a medical gentleman, which, after having adopted and faithfully practised since then, I am happy to say has given me complete relief: "After having cleared the bowels by means of any opening medicine, commence and drink one or two tumblers of cold water every morning, say half an hour or so before breakfast. Then, in the course of the day, take a good sharp half-hour's walk, setting the heel firmly to the ground. Make these two simple rules a matter of conscience," said my adviser, "and you will find relief." Six years' trial has proved successful in my case.—G.

[12172.] — Constipation.—As a fellow-sufferer with "H. S. A.," I advise him to use, as I have done for years with complete success, a pint of oatmeal porridge with cream of milk, either as first or last meal daily. A "user of porridge needs no pills."—M. N.

[12172.]—Constipation.—If "H. S. A." has not already tried it, I think the following remedy will be of use:—Take half a tumbler of Friedrickshall water as hot as possible, immediately on waking in the morning. This, if persevered in, will certainly do good.—S. J. H.

[12172.]—Constipation.—To remedy, I got my baker to make me a brown loaf now and then, but finding grit in it occasionally, I suspected the sweepings of the board were put in it. I then ordered a steel mill, like a large coffee-mill, costing, I think, £6; it grinds very fine, and has been in use six years without repairing. We make the bread half ordinary white flour which we buy, and half meal as it comes from the mill.—BRAVIA.

[12172.]—Constipation.—1. Sip cold water when dressing in the morning; not take a draught, but keep on sipping every two or three minutes. This was a London physician's recipe, and cured a friend of mine when every other remedy had failed. If necessary, also drink a little water just before going to bed. 2. A couple of figs cut open and fried, or well soaked in olive oil, will open the bowels without injuring the mucous membrane (as medicine does), and without purging. 3. Eat brown bread. The first remedy I have long used myself.—K.

[12172.]—Constipation.—If "H. S. A." will habituate himself to breakfasting off pure oatmeal porridge for some time to come, and a plentiful use of spinach at dinner, using brown bread, and abstain from the use of malt and spirituous liquors and the weed, I believe, from personal experience, that he may safely do without any purgatives, which but aggravate the symptoms named.—A NOVICE.

[12172.]—Constipation.—Constipation is easily cured without medicine if the sufferer try a cold-water injection—a common enema can be bought for four or five shillings—regularly everyday at a certain hour. Regular habits, plain food, and out-of-door exercise should be followed, and an occasional dose of castor oil is never injurious; but the great thing to be borne in mind is "regularity."—PLOUGH.

[12173.]—Coloured Ink.—If "E. B. F." adds a little lump sugar to his ink it will make it shine, or a little gum will do as well.—ZOO ANDRA.

[12173.]—Coloured Ink.—Add a small quantity of gum Arabic.—QUERCUS.

[12174.]—Agriculture.—The difference between red clover and cow grass is that one has a hollow and the other a solid stem. In case of cattle's stomach becoming distended with clover or green food, give linseed oil at once.—PLOUGH.

[12175.]—Soundboard.—In confirmation of what "The Harmonious Blacksmith" has said about increasing the loudness of tone by placing a musical box on a soundboard. I have placed a small one on top of a large drum, and was astonished at the loudness of tone thus produced. Two or three instruments appeared to be playing in most pleasing unison while the music lasted. "E. B. F." might try a soundboard on the same plan.—RAT-TAT.

[12176.]—Hydrogen Flame.—The cause of failure may be that the cork is not air-tight. To test this, stop the mouth of the funnel by the hand, and apply suction to the tube—before putting the acid and water in, of course.—JAS. C. HARKER.

[12176.]—Hydrogen Flame.—"Whitaker" is not the only amateur who has failed at this experiment by using too large a pipe—one disproportioned to the quantity of zinc and sulphuric acid used, and the amount of gas generated; but if he will put a nozzle with a small orifice on his pipe, he will find the hydrogen to issue from it in a steady jet, with sufficient pressure to expel the atmospheric air, and prevent it from entering the generator.—E. B. F.

[12177.]—Algebra.—ERRATUM.—The first answer to this query, line five, should read *minus* 1, instead of 1.—CERVUS.

[12177.]—Algebra.—$\frac{x}{y} = -\frac{x}{-y}$. The two minus signs neutralise each other. Similarly $\frac{a}{(a-b)(a-c)(x-a)} = -\frac{a}{(a-b)(c-a)(x-a)}$, for $(c-a)$ is the same as $-(a-c)$, and corresponds to the $-y$ in the first expression.—PHILANTHROPIST.

[12178.] — French Magazine. —The *Magazin Pittoresque* is an excellent illustrated publication, cheap, and widely circulated. Published in Paris.—C. J. R.

[12179.]—Vitality and Electricity. — There seems something doubtful about this set of questions. Are they from the real "Rat-Tat" or some one else? However, assuming them to be *bonâ fide*, I will answer as well as I can. 1. Hair is a bad conductor, and there is not the least probability that it conveys any ethereal fluid to the brain, unless it be some barber's concoction so named. A liquid electrically charged has a tendency to force its way through capillary openings, but there is no electric tension high enough in animals to produce this effect to any extent, or to affect the circulation of the blood, though it is possible that the blood in the veins and arteries may be in different electric conditions, and so be attracted through the infinitesimal vessels which connect the two great sanguineous systems. 2. Not the least likely that any true life action, however temporary, could be developed; possibly in many cases death is really not complete, but that which is deemed so is absolute exhaustion of nervous and vital power, and in such cases, artificial respiration, fresh blood and electricity might revive the powers of those who are otherwise practically dead, but in whom the organic system is not destroyed, but its motive power gone; also in such cases mesmerism might recall to life those thus apparently dead. 3. The death of one of a number through whom a current was passing would, no doubt, involve a great shock to the rest, but nothing else. Nor is there reason to suppose that an infectious disease would be carried on by the current, but the general conditions would be such as to greatly facilitate its communication irrespective of any action of the electricity itself.—SIGMA.

[12189.]—Battery Coil.—Mr. Tonkes being silent (I hope not for much longer) I reply: Smee's always diminish in force; the liquid not being cold should be of little consequence. These matters will be explained in a week or two in "Electro-Metallurgy." 2. With twelve cells the platinum is sure to be quickly burnt off, but I expect there is solder run up it also. 3. Halse's coils have no secondary, but a great length, or rather several lengths, of primary, and the shock from them is the "extra current" of the primary itself.—SIGMA.

[12194.]—Enamelling.—The basis of all kinds of enamel is a perfectly transparent and fusible glass, which is subsequently rendered either semi-transparent or opaque by the admixture of metallic oxides. White enamels are composed by melting oxide of tin with the glass, and adding a small quantity of manganese to increase the brilliancy of the colour. The addition of oxide of lead or antimony produces a yellow enamel. Reds are formed by an admixture of the oxides of gold and iron. Greens, violets, and blues are prepared by the mixture of the oxides of copper, cobalt, and iron, and these when intermixed in different proportions afford a variety of intermediate colours. The proportions in which the ingredients are used, as well as the degree and continuance of the heat necessary to their perfection, constitute the secrets of the art. The best enamel was formerly imported from Venice; but during the restrictions imposed on commerce at the beginning of this century the importation almost wholly ceased. The high price of the article therefore induced British artisans to attempt its manufacture, and they succeeded in producing a hard white enamel, superior to the best Venetian in whiteness, and much more valuable to the dial-plate makers. Several years back, Mr Wynn communicated to the Society of Arts a series of recipes for the preparation of enamel colours, and for which the society awarded him a premium. The following is a list:—No. 1. Red lead, 8 parts; calcined borax, 1½; flint powder, 2; flint glass, 6. No. 2. Nitre, 1; white arsenic, 1; flint glass, 10. No. 3. Red lead, 1; flint glass, 3. No. 4. Red lead, 9½, borax, not calcined, 5½; flint glass, 8. No. 5. Flint glass, 6; flux No. 2, 4; red lead, 8. After the fluxes have been melted they should be poured on a wetted flagstone, or into a large pan of clean water, then dried, and finely powdered in a biscuit-ware mortar, for use. To make yellow enamel: Take red lead, 8 parts; oxide of antimony, 1; and white oxide of tin, 1. Mix the ingredients well in a mortar, and having put them on a piece of Dutch tile in the muffle, make it gradually red hot, and suffer it to cool. Take of this mixture 1 part, and flux No. 4, 1½; and grind them in water for use. By varying the proportions of red lead and antimony, different shades of colour can be obtained. To make orange enamel: take red lead, 12 parts; sulphate of iron, 1; oxide of antimony, 4; and flint powder, 3. After calcining these without melting, fuse 1 part of the compound with 2½ of flux No. 1. To make dark red enamel, take sulphate of iron, calcined dark, 1 part, flux No. 4, 6 parts, and colcother 1 part; of the two latter, mixed, add 3 parts. To make light red enamel, take sulphate of iron 1 part, flux No. 1, 3 parts, and white lead 1½ parts. To make brown enamel, take manganese 2½ parts, red lead 8½ parts, flint powder 4 parts. For enamelling watch dials, the enamel generally comes from the makers in small cakes, from 4 to 6 inches in diameter. These are first broken with a hammer and ground in a mortar with a small quantity of water, after which the copper dials to be enamelled are cleansed in the pickle, rinsed in water, and laid face downwards on a smooth napkin, and a thin layer of hard enamel called "backing" is spread over the side with a quill or bone spatula. The coppers are next slightly pressed with another soft napkin, which leaves the enamel dry enough to be spread more evenly with a steel spatula. Next is spread a layer of glass enamel over the side of the coppers called the "first coat." The surface ought to be dusted with a camel's-hair pencil to remove any dust, otherwise the work would be spoilt. The next process is firing, which consists in melting it, till it becomes one uniform mass on the surface of the copper. The firing is executed between a muffle in a small charcoal or coke furnace. The plates must not be over fired, nor must the heat be suffered to melt the enamel too rapidly, but a kind of rotary motion, called coddling, must be given to the work, by holding the loaded planche lightly with the tongs, and gently drawing the edge of it towards the mouth of the muffle, and then returning it to its former place till the fusion is complete. The work is now ready for polishing, technically termed using off. This is performed by rubbing the surface of the plate on a grit stone with fine sand and water, until all the glazed appearance is completely obliterated, and one uniform and equally rough surface is produced. The intention of this process is to remove the mottled appearance on the surface and give a more equal convexity to the plate. The method of painting in enamel is performed on plates of gold, silver, and copper, enamelled with the white enamel; on which are painted with colours which are melted in the fire by which they acquire a brightness and lustre like that of glass. This painting is the most prized of all for its peculiar brightness and vivacity, which is very permanent, the force of its colours not being effaced or sullied by time as in other painting, and continuing always as fresh as when it left the workman's hand.—WILLIAM H. HEY.

[12197.]—Roses.—The great London Horticultural Rose Show takes place on the 3rd July, the great Birmingham Show, 25th to 29th June. Turner and Bragg, of Slough, and Messrs. Veitch, Surrey, are considered the top growers of the day.—ZETA.

[12207.]—Light.—1. A beam of common light would not be entirely intercepted by one plate of tourmaline. A beam of plane polarised light would be sensibly wholly intercepted by such a plate, when its vibratory plane was at right angles to the plane of vibration of the light. 2. Yes. 3. Tourmaline or Nicol prism. Read Sir John Herschell's Familiar Lectures on Scientific Subjects, "Light."—H. P. H.

[12217.]—Violin Tuning.—"Just as you please, my dear, you pays for your fiddle (or ought to do so) and you takes your choice" how you may please to tune it. The big fiddle yclept contrabass is ordinarily tuned so that the pitch of its middle string is a fourth above that of its third string, and its first string a fourth above the former, thus A, D, and G. The strings of the violoncello, viola, and violin are usually tuned each a fifth above the next string below it, and the fifths are, or should be, tuned perfect. As all fiddlers are supposed to put their fingers in their proper places—*i.e.*, to stop in time (by the way, very few do)—the fact that the fifths are perfect with open strings don't matter, for, of course, it would be quite beneath any fiddler's dignity to acknowledge the existence of so vile a thing as temperament; in a word, his harmony is supposed to be perfect, which, considering he is human, and therefore imperfect, is more than could be expected, seeing we don't ordinarily gather sweet figs from prickly thistles. I have been told Paganini occasionally altered the pitch relations of his strings, probably to facilitate stopping in some of his intricate passages, but I am hardly "fiddler" enough fully to appreciate this; probably my friend "Fiddler" could let the light in on this matter, and enable us to see the "guts" of it. I don't understand the question, "How they tune them in each key;" indeed, I hardly know what the expression "tuning in a key" means. The piano is commonly said to be tuned in C; but this signifies no more than that its white keys, or rather the strings sounded by them, are tuned to that scale. Its temperament being equal, it might be said to be tuned in any key or scale from B to G below C, or from C♯ to F♯ above C, provided transposition to the extent proposed in Mr. Ryley's patent (No. 2562, A.D. 1801, price, with drawings, 6d.) be carried out, for its white keys may then be employed for performance in any scale, major or minor.—THE HARMONIOUS BLACKSMITH.

[12223.]—**Wheelbarrow.**—I have the pleasure of informing "C. T." that he can see many wheelbarrows constructed so that their wheels run in the centre instead of the end in daily use if he will just take the trouble to "step over" to the flowery land, alias China. They are not used by laundresses in that country like the two-wheeled ones are in this, both by them and costermongers, for the very sufficient reason that John Chinaman is very "conservative" and extremely sceptical on the advantages of clean linen, so he—being determined to err on the economical, if not the safe side—prefers wearing his cotton inexpressibles and whatever it may be which does duty for a shirt among "celestials" until they become, like unto human righteousness, unclean, not to say "filthy rags," and to ride on what, were he an "ablutionary animal," would doubtless be his laundress's barrow, which resembles the celebrated one-wheeled velocipede excepting that, being rather more under human control, it don't turn over and eject the rider—a thing which some unreasonable persons of a dissatisfied order of mind might object to. As "it's a lang call to Locheil" (I mean to the flowery land), it has occurred to me that "C. T." possibly might prefer looking at this one-wheel affair nearer home. If I am not mistaken, it was exhibited by a London firm, then existing (Messrs. Deane, Dray, and Co.) in one of the cattle shows at the Agricultural Hall, Islington, some few years ago, but *cui bono*. Is this another cropping up of the old idea that it is easier to roll a weight along when supported on one wheel than when supported by two? Certainly, one wheel is likely to encounter only half those obstructions yclept broken, but yet large, stones which are placed on our roads under the fallacious pretence of mending our ways; but to suppose the friction is any less with only one wheel than it is with two is about equivalent to the hypothesis that a man could "walk" with less friction and fatigue on one leg than on two. I fear this would not facilitate "human progress" much. Of this supposed unipedal man it would seem that it might be said, as it was in the case of "our Mary Hann's" epistolary correspondence, "this cums hopping," &c.—THE HARMONIOUS BLACKSMITH.

[12225.]—**Lead in Sulphuric Acid.**—The dark brown substance in the acid named by "Tony White" is not lead, but some organic substance, probably a piece of cork or straw. It is of small consequence, except in delicate cases of quantitative analysis. If required pure, add to a small portion a fourth, by measure, of water, and filter through paper, then evaporate the water out again in a beaker. If lead is present in sulphuric acid it will settle as a thick white sediment to the bottom of the bottle, and by careful decanting the clear acid may be teemed off.—PRIAM.

[12255.]—**Hair.**—Put one ounce of flowers of sulphur into one quart of cold water, allow it to stand twenty-four hours and decant. Wash the beard every night with the sulphur water, taking plenty of time. This recipe, taken from the American *Journal of Pharmacy*, will be worth the attention of our fair friends as a tolerably certain cure for dandruff and other minor (?) evils.—H. P. H.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Suffolk Amateur" has answered 11275; "H. B. E." 11742, 11754, 11773, 11776.

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QUERIES.

[12256.]—**Preserving Garden Produce.**—I am an Englishman living on the prairie of America, where the winters are long and very severe, frost penetrating the earth over 3ft., and cutting off nearly every one of our cultivated vegetables and flowers which are exposed to it—parsnips alone of mine withstood its severity. It would oblige me if some of your able correspondents will give me suggestions on the best modes of keeping the various garden products for the table, for use during the long winter, and plants of others, and flowers to put out in the spring, which is six weeks later than in England. Frame-houses are out of the question, as fuel, glass, and labour, are very costly articles. The English here would like to gladden our eyes with familiar perennials and hardy annuals and green vegetables, before or later than midsummer.—EMIGRANT.

[12257.]—**Milking Machines.**—Will any of your numerous readers kindly give me an illustration of the best and simplest milking machines for milking hard milch cows?—FARMER.

[12258.]—**Old Violin.**—Can one of "our" readers inform me whether a violin bearing the label, "Chetianus Amates, Camonensis, 1640," is valuable? The instrument appears to be of the age indicated, and has a full and clear tone.—A. J. L.

[12259.]—**Faulty Acetate of Soda Bath.**—Will any correspondent let me in to the secret why my acetate of soda toning bath has taken a fancy to turn my prints a beautiful pink, just the colour of pink blotting paper?—PINKY TONE.

[12260.]—**Cleaning Back of Teeth.**—The toothbrush only cleans the front of the teeth. Would it not be well to provide also for cleaning the back of them, or are they less liable to decay at the back than in front?—BEAUTY.

[12261.]—**Spirometer.**—Will any reader of the MECHANIC be kind enough to give me what information they can as to the best method of making a spirometer? If with illustrations I should be very glad.—WONDERING WILLIE.

[12262.]—**Press for Cutting Paper, Card, &c.**—I want to construct a cheap and effective press for cutting paper, cardboard, &c. The ordinary press and plough is of no use, as it is required for cutting up and not for trimming. It is important it should cut the paper perfectly square, so as to fold nicely. Will some one kindly assist a—COUNTRY PRINTER?

[12263.]—**Circular Saw Driving.**—I should feel obliged by the following information:—I want to drive a circular saw by an intermediate shaft. The main shaft runs 40 revolutions per minute. My saw should run 650 to 700 revolutions. What size pulley should I have on the main, which I should not like to be above 3ft. 6in.? Also, state size of the pulley and drum on the intermediate shaft. The size of pulleys on the saw bench is 9in.—JAMES DAVIES.

[12264.]—**Freemasonry.**—Will some one kindly inform me how I may become a member? What are the fees and periodical payments? I live at a distance from any lodge, and have no opportunity of consulting any one who can supply me with the information I require. Some information about the objects of freemasonry, &c., would oblige—EDGAR.

[12265.]—**Pig Feeding.**—I should be much obliged if some reader who has had experience in stock feeding would inform me whether it is better to feed pigs with barleymeal, or whether the best Indian meal and bran, in about equal quantities, would not be better than barleymeal?—C. R.

[12266.]—**Photographic.**—Having followed the instructions given in the MECHANIC, under the heading of "Photography for the Uninitiated," I find that my negatives are not so bold as some that I have seen. The details are, however, well out. After they have stood for a few hours they fade almost entirely away. I shall be obliged if some correspondent will state the cause.—KING COTTON.

[12267.]—**Cabinet for Birds' Eggs.**—Would any reader kindly inform me of the best form of cabinet for keeping birds' eggs in?—C. T. B.

[12268.]—**Strength of Shafts.**—What number of horse-power (indicated) is a shaft of the following dimensions capable of turning with safety, when running at the rate of 170 revolutions per minute:—150ft. long, 2½in. diameter half the length, 2¼in. and 2in. equally the other half. Would some kind reader please answer this, and insert the calculation in "ours," for future guidance of Self and Co?—IXION.

[12269.]—**Staining Leather.**—Can any of the readers of the ENGLISH MECHANIC inform me of a good permanent dark brown stain, to stain a plaited leather watch guard (glossy, if possible)?—B. S.

[12270.]—**Charcoal Furnace for Model Boiler.**—Could any reader give me the sizes and description of a charcoal fire suitable for a model boiler 8in. diameter and 14in. long? I have got a spirit lamp 8in. by 3in., by 1½in. deep, with three jets ½in. diameter. Ought it to raise steam enough?—S. O. LEES.

[12271.]—**Double Flageolet.**—Will some one give me a scale for this instrument?—T. CRANE.

[12272.]—**Electrotyping.**—Can any reader of the MECHANIC give a description of electrotyping for printers? I understand all the battery arrangement. What I want to know is, the substance used to make the mould. Is it wax or guttapercha? How is the plate separated from the mould? and what is the process of filling up at the back? Any information will oblige—ZOO ANDRA.

[12273.]—**Water Power.**—I have a stream of water from a ½in. tap; it has a fall of at least 80ft. Will any of your numerous readers tell me how I can utilise it so that by a turbine I may turn a coffee-mill?—BŒTIS.

[12274.]—**Telescopic.**—Will "F. R. A. S." be kind enough to consider the following, and express his views upon it:—Is it impossible, as yet, to so accurately figure a Foucault speculum that the image will bear magnification? Suppose one of the finest reflectors by With or other competent maker, had attached to it, in lieu of a common eyepiece, a complete full-sized Powell and Lealand microscope, with a properly formed low angled objective (say of 25th or 50th inch); if this instrument be now turned on the moon or other object, affording sufficient light, would not some additional details of crater formation become obvious? I have tried this, with indifferent results, with a ¼in. microscopic power, but I consider my mirror altogether inferior, and think the door for further advancement in this direction may be found by trying again with a fine and complete instrument. If the mirror casts a perfect image, the microscope will unquestionably magnify correctly that image; if those mirrors do not cast correct forms, I cannot but place some doubt on all investigations conducted with them.—BETSY SUMMERCITY.

[12275.]—**Test for Arsenic.**—What is Bettendorf's test for arsenic?—W. H. HEY.

[12276.]—**Boiling under Pressure.**—I have about two gallons of a liquid which requires to be boiled under pressure for about eight or nine hours. Could any correspondent inform me the best and easiest way of accomplishing this?—W. W.

[12277.]—**Aniline Black.**—Would Mr. George Davis or any other of your chemical correspondents give me a good process for making aniline black; if possible, one without acid? Also tell me if there are any other books upon aniline dyes that are better and more recent than Dr. Reiman's?—W. W.

[12278.]—**Mercury.**—I have lately been experimenting with mercury, and I am afraid I have unavoidably inhaled the poisonous fumes given off when mercury is undergoing dissolution in nitric acid. I have lately had a very peculiar feeling in the throat, and a heaviness on the chest. Can any one say if this is due to my inhaling poisonous fumes, and what is the best thing to be done in the event of poisoning by mercurial vapours?—QUERCUS.

[12279.]—**Diminished Action of Battery.**—When a Grove's battery has been in action some time its power decreases. Is this owing to a change taking place in the sulphuric or the nitric acids? If so, how may the acids be purified?—SEMAJ.

[12280.]—**Winter's Machine.**—How is it that the ring of a Winter's machine increases the length of spark? Is it necessary that the wire passing through the wooden ring should be of iron? Would not brass do?—SEMAJ.

[12281.]—**Length of Electric Spark.**—What arrangement of an ordinary 18in. plate machine would produce the greatest length of spark?—SEMAJ.

[12282.]—**Holes in Valve-board of Harmonium.**—Will any reader inform me why the holes for admitting the wind through the valve-board of a harmonium are made so long? I cannot get them wind tight on that account. I should like to know if I might make them round.—VANDALK.

[12283.]—**Food Analysis.**—Will some one kindly inform me the best book on food analysis, and how to detect the adulterations? I have Normandy's "Commercial Analysis" (Weale's series), but some of the processes—those for testing flour, for example—are not trustworthy.—JAMES C. HARKER.

[12284.]—**Essence of Phosphorus.**—Can any reader inform me how to make essence of phosphorus, and also say the dose of the same for an adult?—S. COOK.

[12285.]—**Logarithms.**—In the table of logarithms I have before me, the logs. are given of numbers (not exceeding four digits) to only five places of decimals. Thus I find log. 6·102 = ·78547. How can I from this work out log. 6102·5 and log. 6102·57? The table shows at this part an increase in the logs. of ·00007.—C. P. E.

[12286.]—**Moresque Style.**—Would any reader kindly inform me where I could procure picturesque designs of the above style? Is there not something published in England or elsewhere that contains, among others, designs of the kind?—A MASTER SUBSCRIBER.

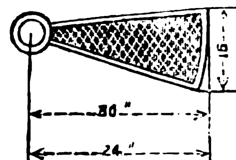
[12287.]—**Telescopic.**—Being desirous of obtaining an astronomical telescope, similar in power to the 3·7in. object-glass of 5½ft. focus, by the younger Gulley, which is often mentioned in "Celestial Objects," "F.R.A.S." or any other subscriber would greatly oblige by stating whether Mr. Browning's 4½in. reflector (the Educational), of 5ft. focus, would be likely to suit my purpose; or whether his smaller instrument of the same aperture and 3ft. focal length would suffice? Is the latter theoretically superior to an achromatic, which has an object-glass of 3in. aperture, and 4ft. focus? My "respondent" would further oblige by mentioning the publishers of the "Mem. R. A. S.," and by saying whether odd volumes of the "Memoirs" can now be obtained.—B.

[12288.]—**Radius of Object-glass.**—I have lately obtained from Chances two discs of optical glass, 4in. diameter flint and crown. The specific gravity of flint is 3·652; crown, 2·5. Will Mr. Oldfield kindly give me (in inches) the radius for grinding the glasses, the focus of the combination to be about 5ft., and convex on both sides? I have some tools by me of the following radius: 34in., 17in., and 84in.—AMATEUR.

[12289.]—**Electric Bell.**—Will some of "our" electrical friends kindly explain and show the mechanism of the above, as worked in connection with Tyer's new block instruments? I am given to understand that there are no magnets, but cannot see as they are inclosed in a box, only the hammer and bell being visible. A drawing would greatly oblige. Will a battery such as are used with the speaking instruments do for the above? I am told that there is no porous partition between the cells. Is there or not? They are charged with bluestone and water each cell. Would not a series of common preserve pots do as well as an oblong wooden box, usually seen at telegraph offices? Would they not be as cheap?—J. W. T.

[12290.]—**Hydrogen Lamp.**—To "ANALYST."—Many thanks to "Analyst," but what "combustion" does he refer to? Is the action of spongy platinum on hydrogen understood? Can "Analyst" tell me why it loses its power after a time? Washing it in nitric acid and heating in spirit flame revivifies it, but only for a few hours. Can "Analyst" tell me how to make it as active as when first bought? The loudness of the explosion is hardly to be accounted for by "Analyst's" explanation. I fancy the hydrogen gets "occluded" to a great extent in the platinum and then goes off.—H. H. G.

[12291.]—**Nature Printed Leaves.**—I have read the article on p. 298, and should like to know the process of carbon printing. Will some kind reader of "ours" give it. Is gum or glue best to use with bichromate of potash in printing?—ROBO.



[12292.] — **Breadth of Stair Steps.**—Is there any rule for making the breadth of spiral stair steps—*e.g.*, if the length be 30in. and breadth 18in., what breadth should one at 24in. long be?—J. G. W.

[12293.] — **Watch Springs.**—Will some reader be kind enough to give instructions to put a mainspring in a lever watch? I have been attempting to put one in, but I have not yet succeeded. —J. L. B.

[12294.]—**Larkin's Iron and Brass Founder.**—Will S. Bottone please give the price of Larkin's "Iron and Brass Founder," as mentioned by him in No. 367, p. 79, query 11857?—A. H.

[12295.]—**Engraving by Graphotype, &c.**—What progress is the graphotype making? I should like some details of the process, and in what respects it is superior to wood engraving—I presume in cheapness. Would Mr. Bottone kindly inform me if he thinks such an idea as the following possible:—To take some hard chemical salt which is not deliquescent but dissolves in water, vinegar, &c., and write on it with a fluid which would make the part written on insoluble in the fluid used, such as water or vinegar, so that the written parts would stand out in relief to be engraved on.—PHILANTHROPIST.

[12296.]—**The Nightingale.**—In answer to "Heders" (let. 4334), we have a saying in the Midland Eastern Counties that "the nightingale is not heard north of Peterborough." Can any of your readers inform us of its being heard by themselves so far north as the East Riding, and in what locality?—PLOUGH.

[12297.]—**The Tremolo in the Violin.**—Will "Fiddler" or any other violinist kindly inform me if there is any way of acquiring the tremolo on the violin? I mean the trembling of the finger on a note, which in slow expressive music is such an ornament. I have tried numbers of times but cannot manage it, and yet a friend of mine says that it came to him naturally, without effort. If any one can give me any information on the subject, I shall be very much obliged.—CORELLI.

[12298.]—**Lighthouses.**—Will any of "ours" kindly answer the above query (p. 107, No. 11591)?—W. H. HEY.

[12299.]—**Tar Pavement.**—Will some kind reader of the MECHANIC inform me how the material is prepared for making the foot walks at the various railway stations near London? It seems to me to be a preparation of coal tar and gravel, but of this I am not certain. It would suit my purpose admirably, as I wish to lay a floor of the same kind to thrash and clean seeds upon. Any reader acquainted with the subject would confer a favour by giving the information as to materials, and the method of doing the work.—HORTI.

[12300.]—**Direction of the Terrestrial Meridian.**—Will any reader of "ours" inform me how to find the direction of the terrestrial meridian—that is, the direction of a line passing through any given place, and joining the two poles of the earth?—YOUNGSTER.

[12301.]—**Unequal Sizes of Cone Pulleys.**—Required, a rule for finding the diameters of one cone, the diameter of the other being given, and the distance of their respective centres given also. In one of the early volumes of the ENGLISH MECHANIC, a formula is given by "J. K. P.," but it is necessary to have a knowledge of trigonometry to work it out, and I am convinced, speaking from experience, that many correspondents and readers know little if any thing of it, hence the necessity of a rule that will not be merely a curiosity, but a boon to many as well as—JONATHAN.

[12302.]—**Stains in Oak Plank.**—I am using some oak plank that has a quantity of brown streaky stains in it. They only occur in some of the planks, others, though cut from the same tree, are the natural colour. Can any reader inform me how I may remove the stains without injury to the planks; or shall I have to stain the light parts to match the dark? This I wish to avoid if possible.—J. C. S.

[12303.]—**Small Castings.**—I do a good deal of electrotype and small castings, and want to know the dodge how the same mould is made to give both right and left. I mean, suppose a medallion with head facing the left, how I can get its fellow with head facing the right.—ROBO.

[12304.]—**Phrenology.**—Will any of "our" readers who are well up in this subject (*i.e.*, what is usually understood by the term) kindly inform me at what period of the individual's life the characteristic bumps are developed? It appears to me if the brain exercises any influence on the shape of the cranium it must be before the latter has assumed its osseous nature; hence if phrenology is anything worth calling a science it is placed on the horns of a dilemma; for either the brain must have received its peculiar developments before Education steps in, or the bones of the head are distorted by the soft mass of the brain? I can't believe the latter, and am very doubtful about the former.—SAUL RYMEA.

[12305.] — **Locomotives.** — The longest barrelled locomotives in this country are, I believe, to be found on the Great Eastern line. What are the advantages gained by a long boiler, and are there not accompanying disadvantages which might outweigh the advantages? —E. M.

[12306.] — **Botanical Names.** — Will any correspondent oblige me with the botanical name of a plant known as the French willow—a sort of bush about 8ft. high, with abundant spikes of pink-coloured bloom; and also of one known as the Rose pea—a name which sufficiently describes its habit, being like a rose bush with a pea-like blossom?—HORTUS SICCUS.

[12307.]—**Kerosene.**—Will "Sigma" explain to me the nature of kerosene and its uses, and what it is produced from?—A. H.

CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

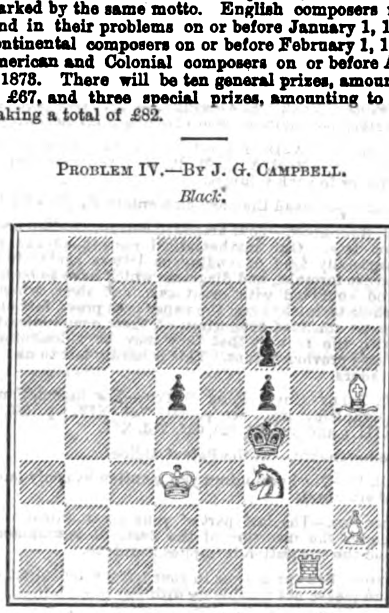
The Managing Committee of the "British Chess Association" announced that play would commence on Monday, June the 24th, at the St. George's, Westminster, and City of London Clubs, and be continued every day, Sundays excepted, until the termination of the matches.

The celebrated Prussian player, Zuckertort, has entered as a competitor in the "Grand Tourney." The foreigner will prove himself no mean antagonist, and he has recently added to his reputation by defeating the formidable Anderssen in two set matches. Our players must look well to their laurels, or most assuredly an important prize will be carried to Berlin.

The Problem Tourney in connection with the British Chess Association is open to the world without entrance fee. Each competitor will contribute five original problems; one in two, two in three, and the remaining two in not less than three nor more than five moves. The problems to be free from conditions, to be written on diagrams, and to be accompanied by their solutions. Each competitor to send in two sealed inclosures; one will contain his problems, and must be marked by a distinguishing motto, the other will contain the name and address of the competitor, and must be marked by the same motto. English composers must send in their problems on or before January 1, 1873; Continental composers on or before February 1, 1873; American and Colonial composers on or before April 1, 1873. There will be ten general prizes, amounting to £67, and three special prizes, amounting to £15, making a total of £82.

PROBLEM IV.—BY J. G. CAMPBELL.

Black.



White.

White to play and mate in three moves.

SOLUTION TO PROBLEM III.

White.	*Black.*
1. Kt to K 7	1. K takes P
2. R to K 2	2. K takes Kt
3. B to Kt 5 dis. ch. and mate	

TO CORRESPONDENTS.

W. H. J. (Lincoln).—A subscription of five shillings constitutes the contributor a member of the Association for the current year, and entitles him to admission to all the proceedings of the Congress.

S. J. H. (Liverpool).—Any friend acquainted with the game would teach you the notation of the board in ten minutes. Hoyle is no authority on chess. Your solution to No. 2 is wrong.

T. W. J. M. (Brighton).—The variation in problem No. 2, which you fail to see through, is clear enough—*e.g.*, (1) $\frac{\text{R to Q B 3}}{\text{K to Kt sq.}}$ (2) $\frac{\text{B to K 6 (ch.)}}{\text{K to R 2}}$ (3) R to R 3 mate.

C. H. YEO (Paignton).—You have evidently overlooked the use of the B P on B 2.

ARGO (Yarmouth).—Your problem shall be reported on next week.

ADDITIONAL solutions to No. 2 have been received from Wiseaf (Dulwich); W. Doery (Glasgow); J. E. and S. H. W. (York).

CORRECT solutions to Problem III. have been received from R. A. P.; W. N. P.; C. R. Howson (Birkenhead); Wiseaf (Dulwich); A. R. Molison (Swansea); C. J. L. (Portsmouth); W. Doery (Glasgow); W. H. Whitfield (Ashford); J. E.; J. Beresford (Vauxhall); Argo (Yarmouth). All others are wrong.

"JACK OF ALL TRADES."

WE have not heard from "Jack of All Trades" since we last went to press. We hope to hear good news before we appear again. We have transmitted him £21, and the following is a list of the contributors:—

	£	s.	d.
J. H. Hayward	£1	0	0
Philo	1	0	0
J. K. P...	1	0	0
Sigma	1	0	0
Khoda Bux	2	0	0
Cireb	2	0	0
J. C.	0	10	0
Solicitor	1	1	0
D. H. G.	1	1	0
Curative	1	1	0
Manus	1	1	0
J. Halden	1	0	0
T. Wheatley and Rev. Gerard Smith		15	0
G. P. Coffin	1	1	0
Editor of the ENGLISH MECHANIC	5	10	0
	21	0	0

USEFUL AND SCIENTIFIC NOTES.

Pre-historic Trees.—An interesting statement was made by Mr. Fallows at the monthly meeting of the Tees Conservancy. The dredging operations in the Tees had been very much impeded during 1870 and 1871, from the bed of the river, between the 9th Buoy and Jack-in-the-Box, twenty-seven oak trees, of sizes varying from 5ft. to 14ft. in circumference, and from 20ft. to 45ft. in length, had been taken out. Those trees were on the south side of mid-channel, on a clay bottom, with about 2ft. of sand around them. The largest tree weighed 11 tons. Mr. Fowler, the engineer, believed the trees had grown in pre-historic times, and had drifted down to some place in the upper reaches of the river.

The Correct Weight of Milk.—Mr. Gail Borden, of White Plains, N. Y., who conducts an establishment for preparing condensed milk, has been making some experiments for the purpose of determining the correct weight of crude milk. He took the milk of several cows, and, mingling it together and then thoroughly cooling it, he had it accurately weighed. The result was that a quart of milk, so measured and weighed on delicate scales, was equal to 2lb. 2¼oz. The tests were made with differrnt samples of milk at different times, but without materially altering the weight. Mr. Borden has adopted the above as a true weight of a quart of milk of fair average quality. Hence, any person who buys milk may determine by weight, with satisfactory accuracy, whether he receives a quart when he is required to pay for that quantity.

Labour and Health.—He that is industrious in his calling shall stand before kings; he shall not stand before mean men," is a maxim conceived in the spirit of true wisdom, if expressed in the language of Oriental poetry; is confirmed by the highest intelligences of ancient Greece, which animated its youth to exertion by exhorting them always to strive after excellence and for the first place; is indorsed by the great and eloquent apostle of the Gentiles, in the well-known words, "Be not slothful in business; fervent in spirit; serving the Lord." Our great workers furnish a living commentary upon these texts. How many complain of their mishaps, misfortunes, and want of success in life, which is in reality all their own fault in the majority of instances! Misfortune is often only another name for mismanagement. They use no arduous exertion, they use no proper endeavour, as if all the good things of nature were to be had without toil or labour, and the world itself were to be no theatre of probation. Kind Providence giveth all things to labour; every reasonable desire is within reach of the industrious. Viewed strictly within the limits of the subject, the importance of a constant occupation of the time in the pursuit of good ends by good means will be acknowledged by all who have ever felt the miseries of inaction and have roused themselves from this torpor. Whether the work is of the brain, or the hand, or both, in whatever proportions existing, the pursuit should be engrossing, and a lively interest taken in the work; not maundering in the clouds, or in the waters under the earth, or the mind occupied with something else whilst seeming to be employed at its real business. It is this half-mindedness which is the bane of labour, and can never advance its performer.

Hints as to the Employment of Blasting Powder.—"Powder is a good servant, but a bad master," and too much care cannot be taken in handling it, says an Australian paper. Strict attention to the following rules would prevent many an accident:—First, only the best powder and safety fuse should be used; the stuff used for tamping to be free from quartz, spar, or flinty matter—clays, slate finely pulverised and dry, will be found to be the best; second, ragged holes to be made smooth by claying, or the safety fuse to be protected by a tube of guttapercha or indiarubber, or by being bound in some hempen substance; third, no powder should be left about the walls of the hole; fourth, the charge should be passed down through a tube having a funnel or bell mouth; fifth, wet or damp holes should be charged with a cartridge, or the powder placed in a bag made of some impervious material—a composition of pitch and coal, or wood tar would answer well. The ramming bar to be copper, or iron tipped or capped with copper. Sixth, a misfired hole, or hole holding fire, should never be bored out, the drill or borer always cutting deeper than the water, reaching the charge first. Holes have been known to hold fire for many hours.

THE "ENGLISH MECHANIC" LIFEBOAT.

No doubt it is a source of grief to many that the English Mechanic Lifeboat should make such slow progress. We, however, have not encouraged it very energetically, for the best of all reasons. Thanks to the National Lifeboat Institution and British philanthropy, there are but few available points on our coasts where a new lifeboat is required. Had we known at the time the fund was suggested that so much had been done, and so comparatively little had been left undone, we should have hesitated before we indorsed Mr. Luff's proposal. Two or three opportunities have since occurred where new boats have been supplied to old stations in the place of old or imperfect boats. But no new station has recently been established. We have preferred, and no doubt the subscribers agree with us, that the boat launched by our aid should be called "The English Mechanic Lifeboat." That, however, could not be easily done if we merely supplied a new boat for an old one, as a new boat generally takes the name of the one it has displaced. We believe in the course of a short time a new lifeboat station will be opened, and we trust it will be supplied with our lifeboat. We therefore venture to call on our friends to complete the fund; at least £400 are required for the boat alone, and we have nearly £336 in hand. We ought not to be long reaching the remaining £64.

Amount already collected .... £335 16s. 7d.

ANSWERS TO CORRESPONDENTS.

*** All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, June 25, and unacknowledged elsewhere:—

W. Hibbs.—W. G. Owens.—W. Young.—W. H. Willcocks.—P. H. Towler.—Wm. Moor, jun.—Philadelphian.—E. W. R.—Margaret E. Bache.—Screw-driver.—D. M. Thomas.—A Builder.—T. C. Ebdy.—Humanitas.—W. Ward.—Retort.—Carl Pfeiffer.—C. Headley.—Simpson and Groombridge.—Richard E. Oakes.—F. R. Leyden.—Wm. McHardy.—Francis and Co.—R. M. Hatch.—P. H. Harrison.—T. Cooke and Sons.—T. W. Abbott.—A. T. T. Paterson.—W. C. Griffin.—C. F. Harrison and Co.—J. K. P.—W. Busby.—Bernard Lodge.—E. W. E.—T. H. Greenwood.—Joe.—Joseph Nash.—J. W. K. L.—J. B.—Owl.—Micros.—G. W. C. H.—Cornwall.—James Henderson.—Alfred H. Allen.—J. E. Devlin.—A. G. H.—J. H. Rodwell.—Fiddler.—Cast Steel.—E. W. G.—A., Liverpool.—P. W. H. J.—H. J. B.—Old Sub.—E. B.—Edward Stanley.—J. Vord.—An Amateur Organ Builder.—X. M. S.—Teachable.—E. A. Weddle.—R. N. S.—R. P. S.—G. L. W.—Dolomite.—E. N.—James Greenhalgh.—J. J. Pollock.—W. G.—L. S. M.—Wilson Unwin.—John Hopkins.—George Thompson.—Sigma.—W. Allan.—Irish Mechanic.—H. B. B.—S. E.—Analyst.—Surveyor.—J. R.—P. Santalinus.—R. J.—M. G. C.—J. W. Durrand.—J. A. Hurd.—J. W. Fennell.—Khoda Bux.—Henry Newman.—The Harmonious Blacksmith.—Alpha.—J. D. M.—A Constant Reader.—Ben J. Williams.—Henry Back.—Messrs. Gower and Son.—Wm. Ferguson.—New Subscriber.—Kinko.—George Lampard.—A. B. Macdowell.—Northumbria.—G. J. Matthews.—Philanthropist.—Ixion.—Wm. Oldfield.—H. O'B.—Often Proved.—Tempus Fugit.—Edward Goodwid.—Industrious Will.—Child.—Scythe.—James Greenwood.—L. G.—John Pearson.—C. N. M.—An Old Subscriber.—Diligence.—Samuel Cook.—Dough.—W. D. L.—Samuel E. Hicks.—C. B. B.—Economy.—Rev. H. C. Key.—W. H. Skelton.—S. J. M.—J. P. B.—W. H.—Charles Bird.—A. B. M.—Soft Solder.—Tyne Engineer.—Swan.—A Mechanic.—Bolton Trotter.—A Countryman.—Tom-Tit.—R. A. Proctor.—J. B.—Sarah Holland Cash.—Chronometer.—J. M.—E. Dakin.—Sea Mouse.—J. W.—Pat.—Rat-Tat.—E. B. Fennessy.—Waynflete.—William Marriott.—J. C. L.—Ante Lucem.—G. T.—Robert Thomas.—C. J. Recordon.—J. D.—E. G. Roberts.—Touchstone.—C. Shepherd.—Wm. Peckover.—Dr. Chadwick.—W. B. Foster.—Pupil Teacher.—A. R. A.—W. Baker.—S. B. Bosanquet.—O.—E. L. M.—Wheelwright.—T. N.—A. G. W.—Melville Pike.—T. C. Eddy.—Practical Bookbinder.—Excelsior.—W. U. Park.—J. E. Reeve.—Practical Man.—Paper Maker.—Bed of Stone.—Dutch Water Works Company.—Signor Frederick.—William Binney.—F. A. Helps.—James Alexander.—Architect.—E. B. H.—W. B. B.—J. B. Tweedale.—E. T. T.—Draughtsman.—J. C. A. Wagner.—E. Holmes.—Alfred Day.—G. H.—M. Robinson.—More Light.—Sigma.—Fiddler.—R. Callon.—H. A. Hewitt.—T. M. Jones.—C. A. Young.—Summer Time.—Glaston.—Avalon.—Fate.—A Swimmer.—E. T. G.—Mason & Co.—Contented.—F. I. R. B. A.

J. E. Reeve, G. W. H., J. M. Martin, and Water Pipe.—See No. 6 "Hints to Correspondents."

T. Parkinson and Co., X. M. S., and a Notts Inquirer, are referred to "Hints to Correspondents," No. 4.

A. P. W., Decimal, Bagshot, and Weatherhead.—Consult last index.

P. Woodhouse, Communicator, and E. A. E.—Really too trifling.

G. W. K. L.—Thanks. Request as to "Saul Rymea" complied with. Your letter on Sewing Machines next week.

Douche-Bath.—The controversy has terminated, and, as Mr. Proctor says, "by consent."

G. L.—What you say about modern "discoveries prove the inspiration of the Bible" is good enough. But if your letter were inserted a dozen correspondents would commence a discussion on the passages you quote, and we should be floated on another Deluge controversy.

Hooslum.—For a method of cleaning felt hats, see reply 12089, p. 840. Carbonate of ammonia is the salt generally employed.

Barmes—Would like to see some instruction on billiard playing in the English Mechanic, written by some one who thoroughly understands the subject.

To Eos.—"H. B. E." says:—"I am sure every subscriber to 'ours' will be glad to see again communications from 'Eos,' when it is convenient for him to write again." Should this reach "Eos" in the depths of his African solitudes, we should like him to know that we thoroughly indorse the desire of "H. B. E."

Mechanical Equivalent.—You make a mistake. We have no desire to come down on you "with a crash" because you persist in believing in perpetual motion, after many weary years of experimentalising. We are only sorry to hear of the expenditure of so much unproductive labour. Only imagine what a number of cabbages you might have cultivated during the time, and so have contributed to the wealth of the world. Try and understand the meaning of the words you write under—"Mechanical Equivalent."

Betsy Summercity.—The discussion on the "Cometary Deluge" is closed, or we should try to find room for your very funny letter. If, however, you would like to start some of the points mentioned by you, such as the world being once red hot, as many rock districts prove, or the age, use, and productions of rainbows, space is at your disposal. But then the comic side of your nature must be kept under due discipline. "E. L. G." is pre-eminently serious, and so, in fact, are most of the other correspondents who have taken part in the discussion. Don't imagine we can't enjoy a good joke because we caution you about being too funny. The reason why we hate bad jokes is because we intensely like good ones.

A Three Years' Subscriber.—Try Gay and Co.'s waterproof solution. See advertisement on front page.

J. Marsden, A. D., A Leeds Subscriber, Bron, J. Pearson, Never Rust, A. Z., W. P., W. K. B., are referred to indices to back volumes.

Inventus.—Read the most elementary English History.

C. J. Recordon.—Your amended communication arrived too late. Our mathematical correspondents seem especially fond of sending us letters containing abstruse formulæ, and diagrams which have to be set up and engraved with great care, and then, when the whole is finished and the paper is at press, forwarding to us amended renderings of their communications, with the request that they may be substituted for those previously sent. This is hardly fair to us or our readers.

T. P. Lilly and A Poor Smith.—For instructions on galvanising iron, see p. 441, Vol. XIV.; p. 546, Vol. XIII.; and pp. 478, 523, 622, Vol. XII.

Phonocamptic.—At the Patent Office.

E. B. F.—The harmonium you mention has only one row of vibrators.

Vent Peg.—The last part of your communication precludes the insertion of the first. It is unmannerly, and the suggestion it implies is untrue.

Horos.—See our answer to your letter a fortnight since and please not trouble us with any more letters.

E. L. G.—Your able letter on the Negro in answer to "Fiddler" next week. It is a most interesting question, and we hope it will be temperately discussed.

The Harmonious Blacksmith.—Yours on the Piano in Canada next week.

J. D., who has sent us so many useful contributions on organ building, says:—"I am happy to say I am recovering nicely from the frightful accident I sustained in March last—viz., a broken thigh, dislocated hip, and injury to the spine—and hope in a week or two to resume my articles on the Organ Built. The Mechanic has been a great source of pleasure to me during my long confinement to bed."

Everard Calthrop.—We know of nothing better suited to your requirements than Leroy's non-conducting composition. See advertisement.

C. E. and Three Bridges.—Your queries are advertisements.

Rev. H. C. Key.—The controversy was stopped not because it was exhausted, but because it occupied more space than we could devote to it, and also because it got unnecessarily warm.

E. L. D.—Fear not for the Truth, but fear rather your own fears for it.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JUNE 18, 1872.

1752 C. F. Hengst, Fulham, and J. B. Muschamp, Kensington, for improvements in the manufacture of gas, and in the apparatus employed therein.

1753 E. Gilbert, Edinburgh, for improvements in signalling on railway trains, and in the mechanism and appliances therefor.

1754 J. Ducomet, Paris, for improvements in steam gauges.

1755 J. Pollock, Walbrook, City, for improvements in the manufacture of envelopes and postal wrappers.

1756 W. Cotter, Gloucester-street, Bloomsbury, for improvements in bow saws.

1757 S. Cropper, Cheapside, for improvements in ink fountains for printing presses. A communication.

1758 J. H. Johnson, Lincoln's Inn-fields, for improvements in locomotive engines and carriages. A communication.

1759 W. Eacott, Featherstone-buildings, Holborn, for a new or improved advertising apparatus. A communication.

1760 W. O. Palmer, Clapham-road, for a new or improved signal lamp.

1761 J. Farmer, Salford, for improvements in machinery for stretching, drying, and "ageing" woven fabrics.

1762 J. Bloomfield, Colchester, for improvements in sewing machines.

1763 S. Pelle, Carlisle, for an improved mowing and reaping machine.

1764 P. King, Liverpool, for improvements in ships and appliances for raising sunken vessels.

1765 T. White, Birmingham, for improvements in nut-crackers and lobster crackers.

1766 W. Firth, Bradford, and P. Smith, jun., Keighley, for improvements in machinery for spinning and doubling worsted, silk, cotton, and other fibre.

1767 R. W. Kenyon, Accrington, Lancaster, for an improved machinery to be employed in the manufacture of healds for looms for weaving.

1768 G. Anderson and J. Buchanan, Linlithgow, for improvements in apparatus for drawing the charge from retorts employed in making gas or oil.

1769 J. Dupont, Liverpool, for the application and treatment of certain plants not hitherto used for the production of filaments and fibres.

1770 J. Birch, Newton-heath, Lancashire, for improvements in the manufacture of iron and steel, and in apparatus to be used in such manufacture.

1771 H. Shanks, Linlithgow, N.B., for improvements in drawing retorts and in the means employed therefor.

1772 J. Picken, Stewarton, Ayrshire, for improvements in the manufacture of Scotch bonnets or caps.

1773 G. Weir, Glasgow, and J. Weir, Liverpool, for improvements in safety and other outlet valves for steam boilers.

1774 D. Ballardie, Glasgow, for an improved appliance for holding railway carriage and other window sashes.

1775 L. Crévisier and L. Lecamp, Rheims, France, for an improved apparatus for cambering leather, leather cloth, and other fabrics.

1776 T. A. Weston, Ridgewood, New Jersey, U.S., for improvements in differential pulleys, portions of which are applicable to other chain wheels.

1777 W. Stuart, Wolverhampton, for improvements in window-sash fasteners.

1778 R. Searle, Manor-gardens, Hackney, for improvements in the use and application of fluids for obtaining motive power and in apparatus for the same.

1779 R. McFarlane, Rickmansworth, Herts, for improvements in treating wood for the production of paper pulp and in apparatus employed therefor, parts of which improvements are applicable to the making of steam-tight joints for various purposes.

1780 W. E. Newton, Chancery-lane, for improvements in self-cancelling stamps, labels, and other analogous articles. A communication.

1781 A. McNeile, John-street, Pentonville-road, for improved machinery for cutting or shaping wood.

1782 J. M. Zamoyski and W. Jackson, Great George-street, Westminster, for a novel mode of constructing (with reference to independent axles and crank shafts) railway locomotives, traction engines, and other engines, railway carriages, vans, and trucks, as well as tramway carriages.

1783 W. R. Lake, Southampton-buildings, for improvements in rotary pumps and engines, and in means for effecting the transmission of power thereby, parts of which improvements are applicable to the construction of rotary blowers and ventilators. A communication.

1784 J. Heald, jun., Lancashire, for improved door fasteners for railway waggons, carriages, or any other kinds of doors.

1785 H. A. Bonneville, Piccadilly, for a new and improved apparatus for securing corks in bottles. A communication.

1786 J. G. Rolls, Clapton, for a new material adapted for use as an electric insulator for telegraphic and other purposes, and also in a hardened state adapted for use as a vulcanite.

1787 G. A. Tate, West Hartlepool, for improvements in millstones or grinders and in the manufacture thereof.

1788 J. Milroy, Edinburgh, for improvements in constructing foundations, piers, quays, and similar structures.

1789 J. Browning, Strand, for improvements in photometers.

1790 J. Stubbs, Manchester, for improvements in machines commonly called "reels for winding yarns or threads into banks."

1791 J. H. Johnson, Lincoln's Inn-fields, for improvement in the separation and utilisation of volatile and condensible gases, and in the machinery or apparatus employed therein. A communication.

1792 J. W. Bretherick, Over Darwen, Lancashire, for improvements in machinery or apparatus for sizing and varnishing healds for weaving.

1793 G. White, Queen-street, City, for an improved material and its application for the manufacture of hats, bonnets, caps, or other similar coverings for the head. A communication.

1794 G. Hulme, Macclesfield, for a treatment of felted cloth in the production of a washable covering for floors, with patterns not on surface only, but also passing partially or entirely through the cloth.

1795 J. Imray, Southampton-buildings, for improvements in the manufacture of iron and steel, and apparatus therefor. A communication.

1796 E. Korting, Hanover, Germany, for improvements in condensers.

1797 H. Marrian, Birmingham, for improvements in machinery or apparatus for manufacturing lozenges, medals, and other similar articles of confectionery.

1798 W. P. Maddison, Dewsbury, Yorkshire, for improvements in the means of and apparatus for raising water from mines and other low levels.

1799 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of iron. A communication.

1800 J. H. Johnson, Lincoln's Inn-fields, for improvements in seasoning wood. A communication.

1801 G. Haseltine, Southampton-buildings, for improvements in the manufacture of iron and steel and in apparatus employed therefor. A communication.

1802 C. W. Smith, Highfield, Gloucestershire, for improvements in the extraction of indigo and other similar substances from plants containing such substances.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JULY 5, 1872.

ARTICLES.

ELECTRO-METALLURGY.—II.

By J. T. Sprague.

EQUIVOLT.—A unit devised by me to connect together tension and quantity. It is the force engaged in effecting 1 equivalent of chemical action in a circuit of 1 Ohm resistance, and under the Volt electro-motive force. It is described in No. 351, Vol. XIV., p. 318. Its mechanical equivalent is 4,673 foot pounds. This unit, when thoroughly comprehended, will greatly aid in understanding electricity, and the doctrine of the correlation of forces.

Galvanometer.—An instrument for measuring "current" by its magnetic effects in deflecting a magnetic needle. They are not comparable among themselves unless graduated for the purpose. The tangent and sine galvanometers are proportional, so that knowing the value of any one deflection that of all others may be calculated. Any galvanometer may be graduated to give exact measures, by inserting a voltameter in the circuit with various batteries and resistances, and noting the time in seconds, during which a given measure of gas is produced. The tangent galvanometer was described in No. 283, Vol. X., p. 530; the sine in No. 285, Vol. XI., p. 579; my universal instrument in No. 287, Vol. XII., p. 1, and one specially adapted for use in electro-metallurgy will be described hereafter.

Insulators.—Bodies possessing high resistance; all, however, allow some current to escape or rather "charge," to be lost as current. They are called "electrics," because friction develops electric excitement in them. Ebonite is the highest "non-conductor," paraffin, sulphur, and glass follow. A full list was given in No. 245, Vol. X., p. 272. Telegraphic insulators are the porcelain cups, &c., to which the wires are secured, and which prevent electric communication being formed between the wires and the earth through the posts.

Ions.—Faraday's term for the two parts into which an electrolyte breaks up; they may be regarded as "radicals," and may be either single atoms of elements, doubled atoms which still act as one chemically, or they may be compound radicals, like cyanogen, ammonium, and the radicals of acids. They are of two classes, named from the electrode at which they appear, but it must be remembered that the same radical may be an anion at one time and a cation at another, according as it is united with a radical more or less high in the order of affinity. See anions and cations.

Intensity.—The old term for the properties now described as electro-motive force and tension: Batteries were said to be arranged for *intensity* when the cells are coupled together in series. The term leads to such confusion that it is best abandoned altogether.

Intensity of Current.—A term adopted from the French *intensite de courant.* It means "quantity," and the best writers now use the simple word "current" to avoid the confusion of these conflicting terms.

Measurement.—See Units.

Molecule.—The ultimate particles of free or complete substances. Modern chemistry draws a strong distinction between atoms, equivalents, and molecules, terms as to which there was formerly much confusion. Conceiving the atom of any element, as the ultimate particle possessed of an attractive force (in a degree more or less great) which is part of its nature, the molecule is formed by the union of two or more atoms by means of these attractions. In gases and most vapours a single measure being regarded as the atom, 2 such united form a molecule or molecular volume; it is found that (with a few exceptions), no matter how many elementary atoms may be required to form the complete body, yet (when formed) it only occupies 2 vols., condensing more and more as each atom is added. Of course the measure of volume is to be taken at the same temperature and pressure. Thus, taking the measure of hydrogen as the unit of *atomic* volume, we get as molecules—

Free hydrogen	H_2 =	2 vols.	2 atoms.
„ oxygen	O_2 =	2 „	2 „
Water	H_2O =	2 „	3 „
Ammonia	NH_3 =	2 „	4 „

$$\text{Ozone } O_2 + \begin{matrix} O_2 \\ O_2 \end{matrix} = \begin{cases} O_3 = 2 \text{ „ } 3 \text{ „} \\ O_3 = 2 \text{ „ } 3 \text{ „} \end{cases}$$

The last instance illustrates the action of substances in the "nascent state" as well as the nature of molecules, for while the normal molecule of oxygen is 2 atoms, if one such molecule can be broken up, its constituent atoms can force themselves into 2 other molecules, and then 3 volumes condense into 2; but owing to the tendency to lapse into true normal molecules, this union of 3 atoms is unstable, and the third atom is held by a feeble bond; hence the chemical energy of ozone and its many curious properties.

Nascent.—It is found that substances have a much greater chemical force at the instant in which they are being set free from combination than when they are free bodies. They are then called "nascent." Most of the processes of electro-metallurgy are considered to be effected by secondary electrolysis, through this action of nascent hydrogen. This special energy is supposed to be owing to the substances (or radicals) being then in the atomic instead of the molecular condition, and therefore having all their chemical energy or attractions engaged in seeking a combination. It is commonly the case, also, that a radical cannot be set free at all, unless in the presence of some other bodies with which it is capable of uniting. (See Molecule.)

Negative.—In the battery, the copper, carbon, or platinum plate.

Negative Pole.—Cathode, platinode.

Negative Ions.—Oxygen and acid or chlorous radicals.

Notation.—The mode of expressing chemical substances and reactions by their symbols. (See Equivalent.) There are many modes of expressing the same things in different formulæ according to the special theory of constitution adopted, or the particular view of the matter intended to be described; and there are two distinct systems in use.

= *the Equivalent.* — This system, used in all the old books, is based really on oxygen (which was called 100), and the weight of hydrogen which combined with oxygen being called 1, the equivalents of other substances were afterwards reckoned from this. Hence water is in this system called $\frac{HO}{1\ 8} = 9$. This system will, for some reasons of practical convenience, be used in these papers.

= *the Atomic.* — This, which is called the "New Notation," is generally adopted in all modern chemical books. It is based on the fact that water contains 2 *measures* of hydrogen to one of oxygen, and this being conceived to show the atomic relations, water becomes H_2O, and H being called 1 as to weight, it becomes necessary to call O = 16, and in consequence most of the metals have their weights similarly doubled as compared with the equivalent notation, while the number of atoms of those which are unchanged (the monovalent elements) have to be doubled. The following example of the action of sulphuric acid upon nitrate of soda exhibits the two systems:—

Equivalent.

Salt.		Acid.		Salt.		Acid.
Na,NO_6	+	H, SO_4	=	Na, SO_4	+	H,NO_6
23 62		1 48		23 48		1 62

Atomic.

$$\overline{2Na,NO_3} + H_2,SO_4 = Na_2,SO_4 + \overline{2H,NO_3}$$

23 62	2 96	46 96	1 62

This means that nitrate of soda on being mixed with sulphuric acid is decomposed into a fresh acid and salt, sulphate of soda, and nitric acid.

Ohm.—The unit of resistance, called the British Association unit. (See Units.)

Ohm's Laws.—These formulæ, devised by Ohm, enable us to calculate from certain data all the information we require. The symbols should represent fixed units (see Units) to obtain definite results. Otherwise they are merely comparative.

E stands for electro-motive force, R for resistance, C for current. Any two of these being known we can calculate the third; thus knowing the force of the batteries to be used and the resistance of a circuit, which mainly depends in electro-metallurgy on the size of the plate, we can tell how much metal will be deposited in a given time, and therefore regulate the rate of deposit by adding to or diminishing the cells of the battery, &c.

Current ....$C = \frac{E}{R}$

Resistance ....$R = \frac{E}{C}$

Electro-motive Force...$E = C \times R.$

In these formulæ the symbols represent the total forces and resistances of the circuit, which are ascertained from their several component parts.

For the details of these laws, see No. 330, Vol. XIII., p. 423.

Ozone.—See Molecule.

Platinode.—Daniell's term for the cathode, or that plate in any cell which does not dissolve.

Polarisation.—The act of arranging the substances which form an electric circuit in a polar order or chain of + and − radicals, presented towards and reacting on each other. It resembles the arrangement which takes place in a number of magnetic needles which arrange themselves in an order of NS, NS.

Polarisation of Plates.—This very confusing and absurd term is applied to an action which occurs whenever the current passes from liquid to solid conductors: there forms on the surface of the latter a film different from the liquid. In the voltameter a coating of oxygen and hydrogen gases condenses on the plates; in the Smee and other single acid cells a coating of hydrogen forms on the negative metal; in a decomposition cell, say of sulphate of copper, the cathode is soon surrounded with an acid liquid, while the anode is apt to be coated with crystals of sulphate, owing to the concentrated state of the surrounding liquid. In all these cases not only is a greater resistance introduced, but an electro-motive force is generated, opposing that of the current, so that if suddenly connected to a galvanometer, and the main circuit broken, a reverse current will be maintained for some time. On this principle are constructed, for some purposes, what are called "Secondary Batteries."

Poles.—The wires, plates, &c., leading from the battery; their name is the opposite of that of the plate they lead from, thus the zinc is the positive metal, plate, or element of the battery, but the wire leading from the zinc is the negative pole.

Positive. In the battery, the zinc plate, in a decomposition cell, the anode.

Positive Pole; + the anode, the zincode, by which the current enters.

Positive Ions; hydrogen, metals, and basic radicals.

Quantity.—A term based on the idea that electricity is an actually existing element having quantitative relations to chemical actions similar to the atomic weights of the material elements. The definition applicable to existing ideas of the nature of electricity will be found under "Current."

Radicals.—Either elementary atoms, or compound bodies which act like atoms, retaining their completeness and individuality through a series of chemical changes. It is considered that the acids are formed of such radicals, whose attractions are satisfied by hydrogen, while salts are the same radicals satisfied by metals or compound basylous radicals. These radicals are the *ions* of the theory of electrolysis. Many radicals, indeed most of the acid radicals, are incapable of existence as separate bodies, and the same is the case (at least, in ordinary conditions) with the most important compound basylous radical—viz., ammonium, NH_4, which possesses the reactions of a metal analogous to potassium, but whenever set free breaks up into ammonia and hydrogen $NH_3 + H$.

Basylous	Chlorous
Electro-positives	Electro-negatives
Cations	Anions
Hydrogen	Oxygen
Metals	Chlorine
	Acid Radicals

Resistance.—The opposi[illegible] the circuit to the development [illegible] an inherent [illegible] in degr[illegible] conduc[illegible] called non-conductors. Whatever the special substance however, its actual resistance may be expressed in any common unit; thus we may describe the resistance of a decomposition cell as equal to so many feet of a given wire. The unit of resistance now generally employed is the ohm.

Resistance requires to be considered in the various sections of the circuit as "internal," that of the battery itself, and "external," that of the work to be done, the conductors leading to it, and any measuring apparatus employed.

Resistance, when it is not work in some form, always converts the energy of the current into heat.

See Ohm's Laws and Units.

TENSION.—The strain put upon the circuit by the electro-motive force; it may be regarded as a single amount, or as + and − equal in opposite directions from the source. At the source it is equal to the electro-motive force; calling this 100, it falls throughout the circuit in exact proportion to the resistance; it is, in fact, used up in passing the current against the resistance; the effect of tension will be explained hereafter.

UNITS.—Any fixed measures may be used, but I shall only refer to those employed in these papers; for discussion and comparison with other units see No. 293, Vol. XII., p. 147, and No. 299, p. 280, Vol. XII.

— *the Absolute* are based upon the units of mass, length, and time, 1 gramme, 1 metre, and 1 second; and the fundamental unit is that force which can generate a velocity of one metre per second; gravity being a force of 9·811 such units (or 32·2ft. per second). For practical use larger units have been devised by the British Association, viz:—

— *Electro-motive Force and Tension.* — The Volt = 10^5 or 100,000 absolute units. The Daniell's cell, that is the chemical affinity of zinc displacing copper from its union with sulphuric radical, is 1.079 Volts; and, therefore, for rough purposes may be taken as a Volt.

— *Resistance*, the Ohm = 10^7 or 10,000,000 absolute units; Ohm measures made of German-silver wire can be obtained of scientific instrument makers, and from them instruments for measuring resistances can be made as described in No. 305, Vol. XII., p. 435.

— *Current.*—The Veber, $\frac{10^5}{10^7} = 10_2$ or ·01 absolute unit per second. 1 Veber decomposes ·00142 grains of water.

— *the Chemic.*—The unit of current is much more conveniently based upon an equivalent of chemical action, or quantitative result, and the unit I shall use in these papers will be a current effecting one equivalent of chemical action (in grains) per ten hours. (See Equivalent.) A current of 1 Veber per second is equal to 5·68 of these units, therefore in any calculations (see Ohm's laws) the unit of electro-motive force (the Volt) would have to be multiplied by 5·68 to give the result in chemical units, and a force calculated from these units would be divided by 5·68 to express it in Volts. This unit I will for convenience call a "Chemic." A *chemic*, therefore, is a rate of current which in a second is equal to ·17606 of a Veber, and would in ten hours deposit or set free 1 equivalent in grains of any element or ion.

— *Current and Energy.*—See Equivolt.

VEBER.—See Units of Current.

VOLT.—The unit of Electro-motive Force and Tension. (See Units.)

VOLTAMETER.—An apparatus for measuring the current by its chemical action; the term is usually limited to a vessel provided with two platinum poles for the decomposition of dilute acid and with tubes for collecting and measuring the gases given off. It is of little practical use, as it gives great resistance and no more information than a properly graduated galvanometer which has little resistance. It is, however, useful theoretically, and also for graduating galvanometers to show really quantitative measures instead of mere angles of deflection. (See Galvanometer.)

The voltameter and its principles are described in No. 290, Vol. XII., p. 76.

WIRE.—For gauges and properties of copper wire; the resistances and weights of various sizes, see No. 317, Vol. XIII., p. 97.

ZINCODE.—Daniell's term for the anode.

LESSONS ON CHEMISTRY.*

BY SELIMO R. BOTTONE.

(Late of the Istituto Bellino, Novara, Italy.)

(Continued from p. 243.)

D. DITHIONOUS ANHYDRIDE. *Synonym: Hyposulphurous anhydride.*[1] *Symbol:* $S_2''O_2''$. *Molecular and combining weight:* 96.

181.—This body is as yet unknown in the separate state. Combined with the elements of water it forms:—

D2. DITHIONOUS ACID. *Synonym: Hyposulphurous acid.*[2] *Symbol:* $H_2{}'S_2''O_3''$. *Molecular and combining weight:* 114.

182.—PROPERTIES.—This body is scarcely known in the free state, owing to its tendency to decomposition. When a sulphite (see 163) is boiled with sulphur, or when sulphurous acid is added in excess to a mixture of sulphur and a soluble base (see 169), sulphur is taken up, and a salt containing this acid is the result. Thus:—

$$\overbrace{2Na_2{}'S''O_3''}^{\text{Sodium Sulphite.}} + \overbrace{S_2''}^{\text{Sulphur.}} = \overbrace{2Na_2{}'S_2''O_3''}^{\text{Sodium Dithionite.}}.$$

If an aqueous solution of any dithionite be acted on by acetic acid (or, indeed, any acid which does not produce much heat on admixture with water) it acquires a full golden yellow colour, owing to the liberation of hyposulphurous or dithionous acid. If the mixture be maintained at a very low temperature the hyposulphurous acid produced remains unchanged for a considerable lapse of time, consequently the yellow liquid remains clear and transparent. If the temperature be allowed to rise above 32° Fahr., the acid is rapidly decomposed, sulphur being deposited and sulphurous acid eliminated, thus:—

$$H_2S_2O_3 = S + H_2SO_3.$$

Owing to its instability dithionous acid is of no practical use, *as such*, but combined with sodium, as sodium dithionite or hyposulphite, it is largely employed by photographers to dissolve away the unaltered silver salts used in the various photographic processes. Large quantities of sodium hyposulphite are prepared at Newcastle-on-Tyne by the following process:—8 parts of crystallised sodium carbonate, Na_2CO_3, are well mixed with 1 part of sublimed sulphur, and the resulting mixture is thrown into a vessel containing 16 parts of rain water. Sulphurous anhydride is now passed through this mixture until it acquires a distinctly acid reaction. The mixture is then boiled for a short time, filtered, and after concentration set aside to crystallise. The reactions which take place may be easily understood on examination of the annexed equation:—

$$Na_2CO_3 + S + H_2SO_3 = H_2CO_3 + Na_2S_2O_3$$

183.—Our knowledge of the hyposulphites is due to Gay-Lussac, who first made them known under the name of *sulphuretted sulphites.*

E. DITHIONIC ANHYDRIDE. *Synonym: Hyposulphuric anhydride.*[3] *Symbol:* $S_2''O_5''$. *Combining weight:* 144.

184.—Unknown in the separate state.

E2. DITHIONIC ACID. *Synonym: Hyposulphuric acid.*[4] *Symbol:* $H_2{}'S_2''O_6''$. *Combining weight:* 162.

185.—PROPERTIES.—Dithionic acid is a colourless inodorous fluid, having a specific gravity of 1·347. It possesses a strong sour taste, and has all the properties of an acid. By exposure to heat it is decomposed, splitting up into sulphurous anhydride and sulphuric acid, thus:—

$$H_2S_2O_6 = H_2SO_4 + SO_2.$$

Neither the acid itself nor its salts have found any application in the arts.

186.—PREPARATION.—When a stream of sulphur dioxide is caused to pass through ice-cold water, in which is suspended manganese dioxide, this latter gives up half its oxygen to the sulphur dioxide, being thereby reduced to the state of monoxide, while the sulphur dioxide is transformed into dithionic acid. The following equation will render this clear:—

$$2SO_2 + MnO_2 + H_2O = MnO + H_2S_2O_6.$$

The resulting dithionic acid immediately combines with the manganese monoxide to form manganese dithionate, MnS_2O_6. From the manganese dithionate the acid may easily be obtained by treating the solution with an equivalent of sulphuric acid, evaporating to separate the manganese sulphate formed, and concentrating the fluid until it acquires a specific gravity of 1·347.

F. TRITHIONIC ANHYDRIDE.[5] *Symbol:* $S_3''O_5''$. *Combining weight:* 176.

187.—Not known except in combination.

F2. TRITHIONIC ACID. *Synonym: Sulphuretted hyposulphuric acid.*[6] *Symbol:* $H_2{}'S_3''O_6''$. *Combining weight:* 194.

188.—This body is very similar to dithionous acid. It differs from it in being much more stable. On boiling the concentrated solution, it is resolved into sulphur, sulphur dioxide, and sulphuric acid. Thus:

$$H_2S_3O_6 = H_2SO_4 + SO_2 + S.$$

This acid is of no practical importance.

G. TETRATHIONIC ANHYDRIDE.[7] *Symbol:* $S_4''O_5''$. *Combining weight:* 208.

189.—This body has never been isolated.

G2. TETRATHIONIC ACID. *Synonym: Bisulphuretted hyposulphuric acid.*[8] *Symbol:* $H_2{}'S_4''O_6''$. *Combining weight:* 226.

190.—Resembles dithionic acid. Its salts may be obtained by acting on a dithionite with iodine, when an iodide of the base is formed simultaneously with a tetrathionate. In the case of sodium dithionite (hyposulphite of soda), the following equation illustrates the changes which take place:—

$$2Na_2{}'S_2''O_3'' + 2I' = 2Na'I' + Na_2{}'S_4''O_6''.$$

From the tetrathionates, the acid may itself be obtained by the action of a dilute acid. It is very instable. Owing to the ease with which it loses sulphur, it was formerly employed in photography for *sulphur-toning.*

H. PENTATHIONIC ANHYDRIDE.[9] *Symbol:* $S_5''O_5''$. *Combining weight:* 240.

191.—Like the other anhydrides of its class, this body has not been isolated.

H2. PENTATHIONIC ACID. *Synonym: Trisulphuretted hyposulphuric acid.*[10] *Symbol:* $H_2{}'S_5''O_6''$. *Combining weight:* 258.

192.—This body is prepared by passing a current of hydrogen sulphide into a solution of sulphurous acid. It is a colourless, inodorous fluid, of an acid, bitter taste. By the action of heat it is resolved into sulphur, sulphuric acid, hydrogen sulphide, and sulphur dioxide, thus:—

$$2H_2S_5O_6 = H_2S + H_2SO_4 + S_4 + 4SO_2.$$

SECTION 7C.—COMPOUNDS OF SULPHUR WITH CHLORINE.

A. CHLORINE MONOSULPHIDE. *Synonym: Protochloride of sulphur. Symbol:* $Cl_2{}'S''$. *Combining weight:* 103.

193.—PROPERTIES.—This body appears as a thin, brownish red liquid, having a specific gravity of 1·620. It boils at about 147° Fahr., but is decomposed on boiling with evolution of chlorine. It has a disagreeable penetrating odour, fumes strongly in the air, and possesses a hot, bitter, and acid taste.

194. — PREPARATION. — Dry chlorine gas is passed for several days through flowers of sulphur. The resulting liquid is cautiously distilled at a temperature not exceeding 150° Fahr.[11] A variable mixture of this substance, along with the next described, is largely used in the preparation of vulcanised indiarubber.

B. CHLORINE DISULPHIDE. *Synonym: Subchloride of Sulphur. Symbol:* $Cl_2{}'S_2''$. *Combining weight:* 135.

195.—PROPERTIES.—A dark yellow oily liquid, having a specific gravity of 1·686, and a boiling point of 280° Fahr. Its taste and smell are similar to those of the monosulphide. It also fumes on exposure to air.

1 Dithionous acid, hyposulphurous acid.

2 Hydrogen dithionite, hydrogen hyposulphite, hydric dithionite.

3 Dithionic or hyposulphuric acid.

4 Hydrogen dithionate or hyposulphate.

5 Trithionic acid.

6 Hydrogen trithionate.

7 Tetrathionic acid.

8 Hydrogen tetrathionate.

9 Pentathionic acid.

10 Hydrogen pentathionate, hydric pentathionate.

11 This is the process usually followed, but the result is certainly contaminated with free chlorine.

196.—PREPARATION.—By long continued boiling the last described compound gives off chlorine, and is resolved into this body, thus :—

$$2Cl_2S = Cl_2 + Cl_2S_2.$$

SECTION 7D.—COMPOUNDS OF SULPHUR WITH BROMINE.

SECTION 7E.—COMPOUNDS OF SULPHUR WITH IODINE.

197.—Compounds similar to those containing sulphur united to chlorine exist; in which the chlorine is replaced by bromine, or by iodine. They are of no practical use. No compound has yet been described containing sulphur and fluorine.

OUR FOOD SUPPLY AND THE SEWAGE QUESTION.

By HENRY MAC CORMAC, M.D.

I AM not an agricultural man, but I take the utmost interest in agricultural progress. The loss of ammoniacal ingredients and phosphates of transition I have long deplored, and very often have I intended to draw up some observations on the subject. I have now done so, and describe the means by which I would purpose to accomplish the important result of effectively rescuing the now lost azote, lime, and phosphorus of transition. Without further preface, therefore, I shall proceed to read my Essay on "The Economic and Effective Arrest of the Lime, Phosphorus, and Azote of Transition, through the medium of a prepared Humus or Soil, and their application along with that of ordinary excreta to purposes of agriculture." The liquid phosphate of lime now sells for some £20, and ammonia at from £80 to £100 per ton. Vast quantities of these important substances are imported from abroad, and very largely fabricated at home. But whatever be the actual amount made use of, the supply of animal and mineral phosphates and preparations of ammonia falls far short of the requirements of the soil. Everything, speaking of alimentary substances, which the earth is made to yield ought to be returned in some shape to the soil. This plain and indubitable canon is nevertheless violated continually. What the land gives is very insufficiently and sparingly returned to the land. Fluid and solid feculence, instead of being deposited in the soil, is suffered to pollute the earth's surface and the interior of human dwellings as well; or gathered in cesspools or trailing sewers, contaminates the atmosphere, violating self-respect and human dignity, and everywhere promoting discomfort and disease. Agriculture, properly conducted, would enrich the earth, whereas it positively impoverishes it, so that foreign ingredients—apatite from Spain or America, and guano from the Chincha or other islands—are needful to prevent the land from wearing out, a spectacle which Maryland and Virginia, as I have witnessed, furnish on a large scale. As it is, the yield is vastly less than are our requirements, and much, very much, less indeed than what with proper management our forty or fifty millions of acres might be made to afford. The better the soil is treated, the more it will return, and the worse and more grudgingly it is treated the less it will return. Bad treatment involves bad and insufficient returns, whereas good treatment involves copious returns, abundant corn and green crops, plenty of milk and butter and eggs, any amount of legs and shoulders of mutton, ribs and rounds of beef, flocks of poultry, flitches of bacon, and well nourished, instead of half-starved, impoverished men and women. The food supply in these islands, though relatively less both in quantity and quality than what it ought to be, is still absolutely very considerable. Taking the returns made in June last year there were then, fractions omitted, some nine millions of horned cattle on hand, thirty-one millions sheep, and four millions swine, irrespective of imported cattle and preserved meats. And yet of the thirty-one and a half millions constituting the population of the United Kingdom, very considerably more than one-half almost never taste butchers' meat at all, and of those who do, the meat supply might often be most advantageously increased. With spade labour, or machine labour the equivalent of spade labour, and house feeding, the corn yield and the meat yield of our acres might be doubled, possibly trebled, at once. Of course, stalled animals would be the better of a little daily outing, with strict attention to stall ventilation and stall cleanliness as well. As at present conducted, the feeding of stock, horn cattle, and horses alike is conducted with the greatest possible waste; the land is not adequately utilised, and the manure supplies or possible manure supplies, are in a great measure dissipated and lost. Now, as manure is of quite as much moment as the soil itself, and as manuring ought to be carried to as great an extent as the soil will profitably take it in, it is of the very greatest urgency that no available particle of compost should be wasted. It is quite as important to save manure as to reap grain or to feed stock. One, in fact, is the needful correlative and complement of the other. And yet the collection of manure is most imperfect, and what is actually stored past is exposed to almost every element of waste and decay at once overhead and under foot. In addition to the proper storage and preservation of manure, in respect of which the practice of the Chinese colonists in Java seems to me deserving of special attention and consideration, I propose that the solid and fluid excreta of man and brutes should be commingled with a prepared humus or soil, consisting of the following ingredients, as well calculated to insure the desired results :—

Prepared Humus.	lb. or parts.
Perfectly dry humus or soil	100
Calcined gypsum powder, from ...	10 to 20
Common alum, from	1 to 5
Copperas (green), from	1 to 5
Sulphuric acid, from	1 to 5

These ingredients and the proportions hold equally good for a thousand or ten thousand tons as for a single hundredweight, duly comminuted and commingled, constitute a very effective disinfectant and deodoriser and vehicle. The cost of a thousand tons of earth or soil I need not specify, but I may mention that common gypsum may be had at some £1 10s. per ton, sulphuric acid and sulphate of iron at 7s. 6d., and alum at 10s. per hundredweight. The humus or soil has its own great especial merits, while the three sulphates, along with the sulphuric acid, combine their several utilities and constitute an admixture well adapted to the objects in view—namely, the effective and inoffensive conservation of the products of animal waste and decay until they can be returned to the soil. This admixture will grasp the ammonia compounds, whether *in esse* or *in posse*, firm and fast, and as for the phosphates, they will likewise be laid hold of and retained. Every farmsteading, according to its dimensions and requirements, ought, at the outset of every year, to be provided with hundreds or thousands of tons of this prepared humus, properly stored, and at hand in order to be effectively utilised. The ordinary summer soil, dried and levigated, answers every purpose as a main ingredient; clays, however, calcined and levigated might be resorted to. The waste refuse of brick and limekilns, road dust, turf, and coal ashes, charred seaweed and charred peat, so far as the supply sufficed, might also be had recourse to. The foregoing effective and economic compound might further be advantageously employed wherever animal waste was liable to be deposited, as in provision stores, slaughter-houses, sheep-pens, fowl-houses, catgut factories, knackers'-yards, pigstyes, stables and stable-yards, pork and fish-curing establishments, and the like. The water now employed in the closet system, leading as it does to extended cesspools beneath the level of the streets, fouling the rivers and foreshores of the sea, ought to be entirely superseded by sanitary humus instead. The importance of common soil as a deodoriser and disinfectant, as we find from Roman and Israelitish records, was not unknown to the ancients. By the moderns its utilities have been strangely neglected. The inhabited surfaces of India are dense with trodden-down ordures. The towns and villages of Europe are in little better case. And yet feculence of whatever description ought to be consigned to the soil, and never for a moment suffered to pollute our dwelling-places, or those of the creatures whom we associate with us. In my treatise entitled "Moral Sanitary Economy," published some twenty years ago, the subject was dwelt upon in the strongest terms. The resultant admixture of sanitary humus and feculence, fluid and solid, might be preserved until needed in suitable receptacles, slate or brick lined, or dried as in the sample now exhibited, by a moderate temperature in kilns or otherwise. The sooner, however, the procedure here described could be resorted to, the better would it prove, at least, if we are to realise the great objects to be accomplished. The recent bones of a horse or ox weigh, let us say, from 80lb. to 100lb., of a man from 11lb. to 15lb., of a sheep or swine from 10lb. to 15lb. per cent. of its living weight. Now, all the phosphorus, or, if we prefer the expression, all the phosphates of the bones, brain, and nerve structures generally, along with all the azotised excreta, or possible ammonia which, guided by the laws of tissue metamorphosis, I calculate at one-half the amount of the phosphates, that is to say, all the bones and all the flesh of any given animal find complete transit from within to without, in about ten weeks or so, mainly through the kidneys and allied structures, and, owing to our present treatment of them, are almost utterly lost and dissipated. The proportions and the time as above stated, though not absolutely, are approximately true, inasmuch as tissue change is much more rapid with some than others, and with young animals and children at least twice as rapid. Otherwise, the calculations are founded on physiological data, and in the main correct. Suppose we take the horse or ox in illustration. During each and every year of its life, then, this animal, and other animals in proportion, sheds or expends, be the same more or less, one thousand pounds avoirdupois of the phosphates, and about five hundred weight of nitrogenous compounds, both of which all-important substances, human wants and the requirements of the soil regarded, are now as effectively lost and dissipated as if that phosphorus and that nitrogen were actually thrown into the great deep, a destination indeed which, for the most part, they positively incur, or as if the annual tens of millions sterling which the lost phosphates and ammonia of transition may be supposed to amount to were squandered similarly. By the judicious application of sanitary humus, the nitrogenous and phosphatic compounds, the amount furnished by the individual multiplied by the grand aggregate of living beings, might, I believe, be effectively saved and utilised, thus supplying a mine of wealth to which all the Potosis and Golcondas in existence were the merest trifles in comparison. In effect, animal waste, both fluid and solid, could be turned to full account, the general health and well-being prodigiously enhanced, and the yield of the soil multiplied to an extent to which I am quite incompetent to fix a limit.

INSTINCT.

THE following is a summary of the Lowell Lectures on this subject delivered by Professor Chadbourne, for which we are indebted to the *Boston Journal of Chemistry* :—

The nature of Instinct is not defined till its manifestations have been carefully investigated in all their diversity of modifications. It is at length defined to be "an impulse to a particular kind of voluntary action which the being needs to perform as an individual or representative of a species; but which he could not possibly learn to perform before he needs to act." It "includes all the original impulses, excepting the appetites;" and also includes "that knowledge and skill with which animals are endowed, which experience may call into exercise, but which it does not give." The appetites are regarded as functional and as proper conditions for the activity of certain instincts. The operations of instinct are simulated in inorganic nature, and on a still higher scale in plant life. The catch-fly pours out a sticky fluid which holds the smaller insects. The Venus's fly-trap puts forth leaves fashioned to act like barbs for holding their prey. The pitcher-plant beguiles insects down into its deep cavern along hairs pointing downward that hinder retreat. The provisions for the fertilisation of plants, for the diffusion of the seeds, and for the securing of them in places favourable to their germination and development, are in many cases exceedingly like instinct. Plants, like some animals, even become protectors to other species of life: as the oak forms a gall or oak-apple which serves as a home and food for the gall-fly. The first connection of Instinct with these instinct-like processes is seen in the provision for the nourishment of the young animal life. The raising of the head and the opening of the bill to receive food by the young robin, to which the act of the parent bird in supplying the food is a corresponding act of instinct, is an example.

Pure instinct needs no experience. It goes before to preserve life until knowledge from experience is possible. It works by a wisdom of which its possessor has no apprehension. The theory of transmitted skill involves an ancestry certainly of marvellous ingenuity. How did they come by it? How did the species survive till these geniuses appeared? The theory of natural selection accounts for the survival of the fittest; but how does it account for that characteristic in the animal by which it preserves itself? Hibernating animals feed voraciously in the autumn, when food is abundant, and accumulate fat to an unwonted degree; instinct then leads them to their winter's retreat, when the whole vital activity is so reduced that life is maintained for months without food. How were the species preserved till the changes in structure and function corresponding to these hibernating habits were effected? Then we find some species of animals dependent for their preservation on other species. The caw-bird lays its eggs in the nests of other birds. The owner of the nest hatches the eggs and nourishes the young as its own. When mature, the foundling forsakes its home and all the birds it has ever known, to seek its own species, hatched in scattered nests, and mates and lives henceforth with them. Darwin tries to account for the hexagonal cell of the bee on the principle of economy. The bee wishes to save as much as possible of honey from going into wax. But the question is, how came the bee to be a builder at all? Nor does the existence of the instinct to build such cells turn on the continuance of bee-life through the winter, as Darwin would have it. For some wasps, that perish every fall, leaving only eggs to perpetuate the species, build mathematical cells like honey bees.

The Pianoforte.—There are in a good pianoforte of seven and a half octaves, when completed, 214 strings, making a total length of 787ft. of steel wire, and 500ft. of white (covered) wire. The total number of strings, when properly stretched to produce the right tone, exert a pull of over ten tons; this represents the force with which one end of the piano is drawn towards the other end, and it explains the reason why good pianos are built so strongly and so heavily. Such a piano will weigh from 900lb. to 1,000lb., and will last, with constant use, not abuse, twenty to twenty-five years.

THE HOLTZ ELECTRICAL MACHINE.

THIS machine, invented by Herr Holtz, of Berlin, in 1865, an illustration and description of one form of which we gave on p. 90, seems to be gradually rising into favour, and obtaining an increased share of the patronage of experimenters and lecturers on electricity. It is one of that class of machines the type of which is seen in the well-known electrophorus, in which the electricity is "generated" or developed by the continuous inductive action of a body already charged, as contradistinguished from that class in which the effects are produced by friction. It consists of two thin glass plates, one a trifle larger than the other, the smaller being made to revolve in close proximity (about an eighth of an inch) to the larger, which is fixed, and has at opposite ends of a diameter two windows or apertures. Along one of the edges of each of these windows, and partly covering the aperture, a strip of paper is glued, having a point, or tongue, projecting into the opening and pointing in the opposite direction to that in which the smaller glass plate is revolving. Opposite the windows, but separated from them by the revolving plate, are brass conductors with points, generally denominated "combs," which, being connected with other rods and insulated, convey the electricity to the discharging knobs. To put the machine in action it is essential that the atmosphere should be dry, and this desideratum being secured it is only necessary to electrify one of the armatures and put the revolving plate in motion to obtain sparks varying in length from 2in. to 8in., according to the size of the machine, and according to the degree of electrification of the armatures, the latter condition being limited solely by the completeness of the insulation. Thus, as the motion of the revolving plate is continued, the armatures become more and more strongly electrified, and the conducting rods being affected in a similar manner, the discharging knobs may be *gradually* withdrawn further and further apart, and the length of the spark increased as far as the capabilities of the machine will allow. But the prime necessity is a dry atmosphere—moisture or dampness in the air being an effectual bar to the successful operation of the machine. The armature is generally charged, and the electricity induced, by striking a piece of ebonite or vulcanite, as it is indifferently termed, with flannel, or preferably catskin, but a glass cylinder, tube, or plate, excited by friction with a silk handkerchief, will be found to give almost equally good results. The electrified ebonite or glass being brought near to one of the armatures, and the machine put into motion for a few seconds, the discharging knobs having been put into contact previously, electricity is speedily developed, which may be known by the strong smell of ozone, the hissing noise, and the increased resistance experienced by the hand in turning the crank, and in the dark by the fringes of light which appear on the points of the conductors and the paper tongues. If the discharging knobs are now gradually withdrawn a continuous stream of sparks will pass so long as the machine is continued in motion; but care must be taken not to separate the knobs by too great a distance, or the action of the machine will cease, and it will be necessary to begin de novo, as will also be the case if the movable plate is allowed to stand still for a few minutes.

The Holtz machine of the original design is *cæteris paribus* more powerful than the ordinary machines; but it is said to be impossible to obtain sparks of greater length than four or five inches, unless accessories, such as the two condensers, H H[1], shown in the illustration at p. 90, are employed. These condensers are, in fact, small Leyden jars, and are coated with tinfoil inside and out for about a fifth of their height. With their assistance sparks of 8in. or more may be obtained.

It is obvious that the handiest method of arranging the plates is that shown in the figure referred to, but within recent years Holtz has introduced a modified form of his machine, in which the plates are arranged horizontally, both being made to revolve, but in opposite directions. In this design the "windows" and armatures are dispensed with, but four "combs" are employed, two above the upper plate at the opposite extremities of a diameter, and two below the lower plate at the ends of a diameter crossing the other at right angles. Each of the two upper combs is connected through the conductors by means of a brass rod with one of the lower combs, and the electricity is induced by holding an electrified sector of ebonite over the upper plate opposite to one of the lower combs. The action of this modification is exactly similar to that of the original machine, and it is, of course, governed by the same difficulties as to the duration of its action. These difficulties, have, however, been overcome to a considerable extent by Poggendorff, who increases the size of the armatures and adds a second pair of combs, connected together somewhat in the fashion of the modification by Herr Holtz, mentioned above. We have no practical acquaintance with Poggendorff's modification, but we have reason to believe that a machine which formerly could be induced to yield a spark of only 3in. or 4in., by this simple means can be made to develop sufficient electricity to give a spark of 8in. or 9in.; while, best of all, the machine remains in action if the knobs are separated to the extreme distance, or the movable plate allowed to remain still not merely for minutes but for hours.* A Mr. Ritchie, a philosophical instrument maker of Boston, Mass., has also improved the Holtz machine, by constructing the fixed plate as shown in the annexed engraving, which gives the ordinary design (Fig. 1) with windows, and the improved form or Ritchie

FIG. 1

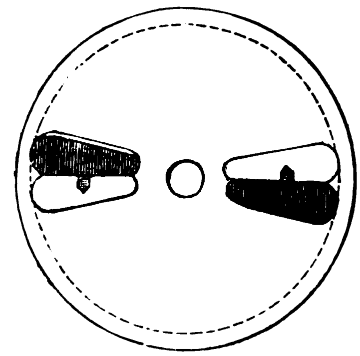


FIG. 2

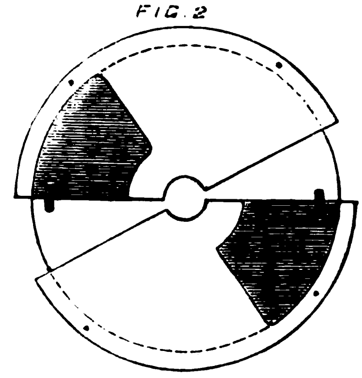
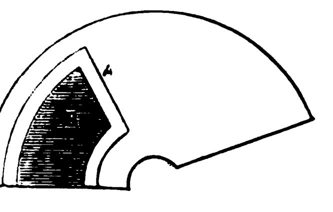


FIG. 3



sector (Fig. 2). We understand that small instruments on this plan exhibit greater effects than machines double the size of the ordinary construction. Professor Henry Morton, however, has communicated to the *Journal of the Franklin Institute* a further modification, which is claimed to be a great improvement on the Ritchie design. This has been invented by Mr. C. Van Brunt, who describes his amended Ritchie Holtz as being "evidently near perfection." An inspection of Fig. 2 will show that instead of a plate with windows Ritchie employs two sectors, and considerably increases the size of the armatures. In the experiments made by Mr. Van Brunt he discovered that a series of paper points instead of the one tongue considerably improved the action of the machine; that short points are as effective as long ones; that the increased size of the armature was not only a decided gain, but that an armature of a good conducting material was better than an ordinary paper one. Under these circumstances he was led to arrange a machine with an armature of tin-foil and paper, the latter, however, being used as an insulator. The modification is shown in Fig. 3, where A is the paper and B the tin-foil. The paper A, which may be the ordinary paper supplied with the machine, should be about the width of the collecting points; the outer edge being opposite to and level with the edge of the revolving plate indicated by the dotted line. According to Mr. Van Brunt, the paper should not hang over the edge of the sector; and in place of the paper tongues he uses a row of common half-inch pins, cutting off the required number from the strip of paper on which they are sold, and pasting them down just as they are. The superfluous paper he turns underneath, and places a wedge of cardboard beneath the heads, so as to cause the points to "cant" over the edge of the sector towards the revolving plate. After gumming all securely a piece of tin-foil is pasted down on the paper, leaving a margin on three sides of half an inch, the other side being brought into connection with the heads of the pins. A strip of paper about an inch wide is then to be pasted round the foil, and covering it for half an inch. The surface of the strip and the outside edge should be well covered with shellac, but none is needed under the foil or anywhere else. By this means the foil is placed in an insulated pocket, as it were, "the paper tapering off the tension as when used around the inside top of a Leyden jar." The machine arranged in this way will, it is said, yield sparks of a length certainly equal to the radius of the revolving plate: it is easily put into action, and produces a "torrent of electric discharge," while, if the edge of the paper is well protected with shellac, the machine will not reverse or lose its tension. A large Leyden jar attached to the negative side in place of the small condenser shown on p. 90, "will increase the length, brightness, and sound of the spark, and the machine will retain its charge twenty-four hours, and perhaps longer, in ordinary winter atmosphere [U.S. weather]. This acts as a large and small ball for passage of sparks on an ordinary electrical machine. There is no danger of breaking the large jar, for the small phial acts as a unity jar, the strain is thrown on the phial; this should be protected by a cork the size of the phial, covered with tin-foil pushed down to the inner coating for the conducting-rod to rest upon: the strain is thus distributed. The upper edge of the coatings of the phial should be covered with strips of paper and shellac, to prevent spontaneous discharge." Mr. Van Brunt also says that his machine runs with little friction or noise and makes much less ozone; but he thinks that an entire modification of the parts will still further improve it. He discovered, too, that the form of the windows is of no consequence whatever, a few holes, a mere slit, or large holes answering the same purpose. In fact, Poggendorff had already constructed a machine in which the paper tongues were passed through small holes, and Töpler, of Riga, had made an arrangement in which the inductive action was exerted on tin-foil mounted on revolving glass plates, but it does not seem to have been successful or to have received much attention.

* We believe that several of these Holtz machines are in use in the colleges of the United States, and it is probable that some of our correspondents there can give us reliable information on the subject.

IMPROVEMENTS IN GLASS-MAKING.

FROM the *American Manufacturer* we gather the following particulars of the experiments made by Dr. Benrath, director of the glass-works at Dorpat, Russia, to produce a glass which has the good qualities of flint glass without its defects:—The good qualities of ordinary flint glass are: that it is as clear as crystal; that it has a high specific gravity; a low fusing point, so that it melts easily; and strong power of refraction and dispersing light. It is, therefore, invaluable for chemical and optical purposes. Its defects, however, are that it is easily acted on by chemical and mechanical influences—that means its surface cannot stand rain and sunshine, much less acids or boiling water, and it is so soft that it is most easily scratched. The chemical difference between ordinary and flint glass is that the former consists of silex, lime, and soda or potash, while oxide of lead is added to make flint glass out of it. Chemically speaking, common glass is a silicate of lime and potash, while flint glass contains also silicate of lead. Döbereiner was the first who, in 1829, substituted baryta for lime, making a glass which, in chemical terms, was a silicate of baryta, of soda, and of potash; but his glass was too soft, as it contained too much of the latter two ingredients—55 per cent. of silica, 21 of baryta, and 22 of the alkalies. During the last few years Benrath took the matter up, and attempted to produce a glass with less alkaline matter and more silica and baryta. He made one of sand 1,000 parts, heavy spar (sulphate of baryta) 785 parts, Glauber salts (sulphate of soda) 435 parts; the glass obtained was found by analysis to contain 58 per cent. silicic acid, 30 per cent. baryta, and 12 soda. But the glass had a slight blueish or brownish shade, probably from the sulphur reduced from the sulphates, and like ordinary glass, had usually a greenish tint from the iron contained in the sand or other ingredients. Splitgerber proved, in 1855, that three-tenths of 1 per cent. sulphur is enough to give to glass a very intense yellowish brown colour, but Benrath succeeded in overcoming this difficulty by using different forms of baryta, as the carbonate, and now declares that by the substitution of the heavy and cheap baryta compounds, in place of the more expensive lead, a very clear, hard, heavy, and cheap glass can be made, which in many instances may supersede the more expensive flint or so-called crystal-glass, and will be preferred for some purposes, as it is uninfluenced by the weather, as is the case with the softer flint.

THE CULTIVATION OF GRAPES UNDER GLASS.

THE following method of growing grapes in an economical manner was contributed to the *Farmer* by Mr. James Dougall, and will doubtless supply many amateur gardeners amongst our readers with useful hints:—

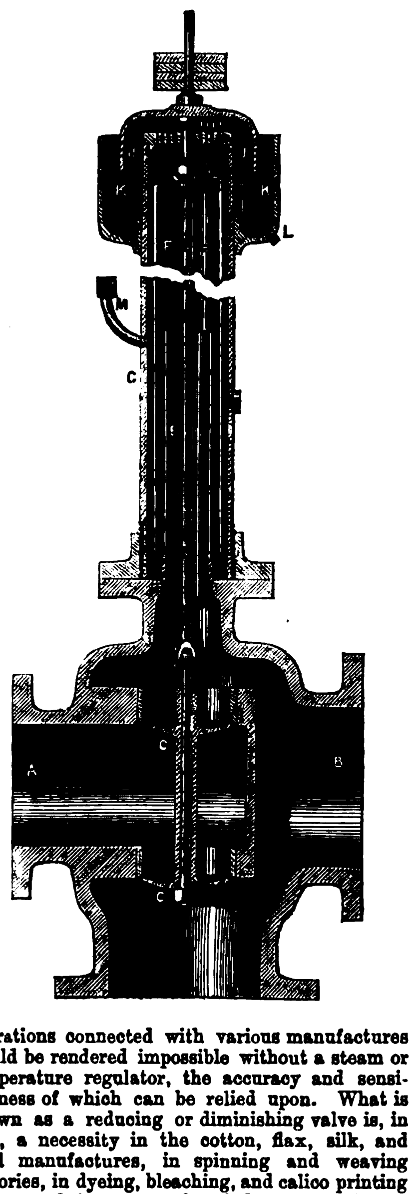
Many persons would be induced to erect a small vinery for the culture of the finer varieties of grapes, were it not for the great trouble attending their culture under glass in the ordinary manner, in watering, syringing, ventilating, &c., requiring the services of a professional gardener, or occupying more time and attention than the generality of persons can spare. By adopting the following plan in erecting the vinery, they will be relieved of the greater part of this trouble, and have a fine supply of delicious grapes, with no more trouble or attention than is required to grow the natural vine out of doors. The sashes are made stationary, but so that they can be unscrewed and taken off for repairs at any time. They extend from the front wall to within 1ft. or 10in. of the back wall at the top, leaving an opening of 10in. wide along the top, to be closed by sheet-iron ventilators in the winter, or when requisite, but which is kept constantly open from the time the vines are uncovered in the spring till they are laid down and covered in the autumn. The principal peculiarity is in the glazing. The glass is laid end to end without lapping or putty, and merely kept in its place by small pieces of tin, and a space of ¼in. is left open between every third or fourth pane, so that all the rain that falls on the house is distributed pretty equally over the entire house, very little running off the roof except in very heavy thunderstorms. There is no ventilation whatever below, as a draught I have found injurious to the vines. Any air that comes in is by these openings in the glazing, and the heated air finds vent at the top. Last year was a very dry one; but the vines never suffered from the drought, though they were never watered or syringed from the time they were uncovered in spring, when it was done copiously, till again uncovered this spring. Nor were they the least affected either last year or this with mildew or red spider; though previous to adopting this plan I was annually troubled with both, in spite of syringing copiously morning and evening.

My present vinery was not erected for that purpose, but for a small conservatory, and the floor was sunk about 2½ft. or 3ft., with a brick wall all round. About twelve years ago I filled it up level with good compost, and planted the vines all inside, there being no opening for their roots to extend to the border outside. It was intended principally for proving the newer seedling vines and varieties, then out, with a few of the best old varieties, and in a space of 24ft. by 14ft. contained for several years thirty-six vines, which were thinned out as they were proved worthless, till it now contains twenty-four; this is still too many, about sixteen being all that could be properly grown in that space. Last year it got a liberal supply of liquid manure in spring; this year it got nothing but clear water at first and rain as it falls, and is doing as well as last year, and vigorous enough for a house containing so many vines. The ends of my present vinery are not glazed, having only a small window and door on each end. Were I to erect a new one, I would have the ends glazed to within 3ft. of the ground, and would have openings in the front wall to allow the roots of the front row of vines to extend into a prepared border outside. For those who may wish to try this plan, I would recommend the following varieties as being the most successful with me, and of the finest quality:—Black Hamburg, Muscat Hamburg, Champion Hamburg, Lady Downes, Golden Hamburg, Bowood Muscat, Buckland Sweet-water, General de la Marmora; the first four are black or purple grapes, and the last four white grapes.

Black Hamburg is by far the most profitable and best of the blacks, and Bowood Muscat and Buckland Sweet-water of the whites. Lady Downes and Bowood Muscat are the better for artificial impregnation, as they do not set the fruit very well. The principal trouble in following this plan, more than is required in out-door culture of the vine, is the necessity of thinning the grapes on the bunches to about one-half when about a quarter grown, to give room to the rest of the berries to swell.

SELF-ACTING REDUCING VALVE.

THE annexed engraving is a sectional illustration of what is believed to be the best form of reducing-valve hitherto designed. It has been patented by Messrs. Crossley and Hanson, of the firm of John Crossley and Sons, Halifax, and is another instance of the truth of the old adage that "Necessity is the Mother of Invention." There are many manufacturing processes which require at some stage or other steam of a low but steadily maintained pressure, or at all events the temperature which corresponds with the specified pressure. In many cases, indeed, the value of the process entirely depends on the success with which this result is obtained, and sundry delicate



operations connected with various manufactures would be rendered impossible without a steam or temperature regulator, the accuracy and sensitiveness of which can be relied upon. What is known as a reducing or diminishing valve is, in fact, a necessity in the cotton, flax, silk, and wool manufactures, in spinning and weaving factories, in dyeing, bleaching, and calico printing works, and in many other industries carried on in the United Kingdom; for it is simply impossible to obtain a constant and unvarying pressure in the steam boiler, which shall be also suited to the requirements of the processes in operation. For this reason, and owing to the defects of other appliances for securing similar results, the reducing-valve which forms the subject of this article was designed by Messrs. Crossley and Hanson, and is made by Messrs. Whitley, partners, of Leeds, who are sole European manufacturers for the patentees. The vertical section annexed will, with the following description, serve to explain its action. Steam from the boiler enters at A, passes the equilibrium valve C C, and acts with equal force at the outlet B, within the tube E, and on the float F, which latter works in mercury between the inner casing E and outer casing G, and is weighted to yield the required pressure. When the pressure of the steam in the tube E and at outlet B is not sufficient to support the weight on the spindle D, the valve C C opens, thus permitting the passage of more steam, and in conjunction with a contrary action when the steam pressure is in excess of what is required, insuring an unvarying pressure or corresponding degree of temperature. If the valve, through any casualty to boiler or pipes, or through scale or sediment resting on its seat (a contingency of rare occurrence) is prevented from closing properly, excess of pressure forces the mercury up through the holes I in the cover, where impinging against the dome J, it is thrown back to the receiver K, whence it is easily drawn off by the plug L and returned to its proper place through the capped elbow M. By this means any loss of mercury is prevented, and the apparatus to which the valve is attached is preserved from the injurious action of the excess of pressure. In the engraving the valve is shown in the act of closing, the steam pressure acting on the mercury in the tubes. It only remains to say that a large number of these valves are in use, yielding results which have not hitherto been attained with other forms of diminishing valves. Dial gauges are supplied to indicate the pressure at the outlet B, and by decreasing or increasing the weight on the spindle, the pressure or temperature can be varied as desired.

PRESERVING PHOTOGRAPHIC PRINTS.

A METHOD of preserving photographic prints so as to retain permanently the beautiful tone they exhibit when in the washing water, is mentioned by Mr. Sutton, the French Correspondent of the *British Journal of Photography*:—

Every photographer, he says, must have observed how beautiful prints sometimes look in the washing water, and how much they lose of their vigour and beauty on drying. This is especially true of fully-toned prints, which, although they show a warm tint of black in the water, dry sometimes of a cold inky tint, besides becoming mealy. It seems important, therefore, that prints which are intended to be framed for an exhibition, or which the artist desires to keep for himself as choice specimens and the best which the negatives will yield, should be so printed as to lose none of the beauty which they exhibit in the water—none of the rich warm tint, the transparency in the shadows, the clearness of the details, the perfection of surface produced by the water acting as the varnish. But the only way to preserve all these excellences is to substitute glass for water, and so to mount the print against the back of a glass plate as that when viewed through the glass it may appear exactly as it does under water—that is to say, exactly as it would if removed from the water and pressed whilst still wet against the glass plate. The problem, then, is to substitute for the water some kind of varnish which, when perfectly dry, will not produce any change in the appearance of the print. Imagine for an instant the problem solved and the thing done, what would be easier than to mount all such prints as we intended to be framed and glazed against the glass of the frame instead of upon a cardboard which is placed more or less loosely behind it? or to mount all such choice prints as an artist might desire to keep for his own use upon plate glasses, to be pressed in a plate-box like negatives or glass transparencies?

The problem is a very old one, and it has been already solved by means of collodion and gelatine. M. Davanne has recently described the process at a meeting of the French Photographic Society. It is as follows:—Coat the glass plate to which the face of the print is to be applied with plain collodion, and immerse it immediately in a bath of cold water in order to wash out the ether and alcohol, as in the common wet process with the nitrate bath. Then pour over the film a solution of white gelatine, strength about eighty grains to the ounce of water. It must be sufficiently hot to flow freely, and care must be taken to avoid dust and air-bubbles. Tilt the plate so as to let the excess of gelatine run off into another vessel, and then place it upon a horizontal support. The film of gelatine will thus be very thin. Before waiting until it is quite dry, lay the face of the print down upon it just as it comes wet from the washing water, and press it into close contact with the glass. When viewed through the glass it will, of course, look just as it does in the water, and this beautiful appearance it will not lose on becoming dry.

With respect to the white background, ... of any other colour, ... may consist of ... paper applied t... the gl... the print. Or ... m... paper for a ... print will b... be trimme... will, of co...

the print has become dry against the glass it may be put into a frame with a thin board behind it. Several prints may be mounted together upon the same glass. The only objection to the plan is that if the glass should be broken the print would be destroyed; but this objection is greatly outweighed by the increased beauty of the result. I strongly recommend the plan to persons intending to send framed prints to an exhibition. By using a rather thick plate glass the risk of breakage would become very small indeed. The perfect optical contact between the surface of a print and that of so splendid and smooth a varnish as a sheet of glass is an advantage not to be underrated or despised. There is no loss of detail, no change of colour, none of the mealiness produced by drying, and none of the vulgarity of albumen. The result is not only technically but artistically finer than when any other method of enamelling and mounting is employed. If, when the print is dry, it be brushed over on the back with plain collodion, the pores of the paper would be so filled with air and water proof material that greater permanency would, no doubt, be secured.

WOODS USED IN SHIPBUILDING: THEIR CHARACTERISTICS AND SPECIAL APPLICATIONS.*

In this article it is intended to consider briefly the kinds of trees used in ships at the present time, and to notice their characteristics and the purposes to which they are applied. All *timber* trees belong to the *exogenous* tribe of plants, which increase in bulk by additions to the external surface. They are divided into two classes—viz., leaf and cone bearing, which may likewise be distinguished as non-resinous and resinous respectively. The latter includes all kinds of firs and pines; the former all other varieties of the above-mentioned tribe. Of the former class, the following trees are those chiefly used in shipbuilding—viz., oak, teak, elm, mahogany, greenheart, sabicu, mora, ash, and lignum-vitæ. Of the latter class, red or Dantzic pine, yellow pine, cedar, cowdie, Oregon pine, spruce fir, and larch. An examination of the longitudinal and cross sections of the trunk of a tree shows two distinct kinds of tubes, or grain, as it is termed, formed by the fibre of the wood. These are a longitudinal or vertical series of tubes, grouped so as to form concentric rings, and a series of tubes radiating from the pith at the heart of the tree. The former are termed *vascular tissue*, and the latter *medullary rays*. Besides these, in the former section a great number of small pores or cells are discovered. These are termed *cellular tissue*. The concentric rings of vascular and cellular tissue are divided into groups by the intersection of the medullary rays, which are in planes about normal to the surfaces of the tissues. We have remarked that the medullary rays radiate from the pith; this last is a soft substance, composed of cellular tissue, and inclosed in the *medullary sheath*. Under the bark the wood is young and soft, and is termed *sap wood*. This is rarely used, as, except in a few cases, it is very liable to decay. Without entering into the interesting subject of the manner in which wood grows—a question which belongs rather to the province of botany than to that of naval architecture—we may simply say that the growth takes place under the bark, and that the oldest wood is, therefore, nearest the centre of the tree. The concentric rings already referred to are generally considered to be the growth of a year in a temperate climate; but in the tropics they denote the number of wet and dry seasons during which the timber has been growing. It is asserted by some that the pith is always nearer the north side than the other sides of the tree as it grows, the reason given being that the sap flows more readily under the direct influence of the sun's rays than when shaded. Generally speaking, trees which have these rings close together yield superior timber to those in which they are wider apart.

Leaf-bearing Trees.

A careful examination of the sections of leaf-bearing trees will at once suggest two principal divisions of this tribe:—

1. Trees with *distinct* medullary rays. 2. Trees with *indistinct* medullary rays. Of the former, the chief instances are oak, beech, &c. Of the latter, elm, teak, greenheart, mahogany, ash, &c. These are again sub-divided into those in which the rings are distinct and those in which they are not:—

First division. Medullary rays distinct.	First sub-division. Rings distinct.	Oak, &c.
	Second sub-division. Rings indistinct.	Beech, &c.
Second division. Medullary rays indistinct.	First sub-division. Rings distinct.	Elm, ash, &c.
	Second sub-division. Rings indistinct.	Mahogany, teak, greenheart, lignum-vitæ, &c.

Oak.—The oak is found in all European countries, but chiefly in Great Britain, Italy, Sicily, Spain, and Prussia. It is also indigenous to North America. The two chief varieties of oak found in the British Isles are superior for general shipbuilding purposes to all the others. These two varieties are principally distinguished by the manner in which the acorn grows upon them, and are termed the stalk-fruited oak (*Quercus robur*) and the cluster-fruited species, or *Quercus sessiliflora*, respectively. The latter is sometimes known as the Durmast oak, and the former as the true English species. The stalk-fruited oak is by far the better of the two for shipbuilding purposes, although the Durmast oak is very commonly used. The Sicilian and Sardinian oaks are valued chiefly for their great curvature, and are, therefore, very suitable for the frames, especially the floor timbers. As, however, the timber cracks, or "shakes," in drying, it is not suited for other purposes. Prussian and Polish oaks (known in the market as Dantzic oak) grow very straight and tall, and the timber is tough, and dries without shaking; it is therefore specially adapted for deck plank, to which purpose it is applied. It arrives in this country chopped or sawn into planks of various thicknesses. When the tree is curved, the curvature is cut in the plank, which is bent straight when laid as deck. A considerable quantity of American oak is now consumed in shipbuilding. The best variety, termed *live* oak, is very hard, and is used for frame timbers, pillars, &c. The American white oak grows to a very large size, and is generally straight. It has sometimes been used for stern-posts on account of its size; but it is neither so strong nor so durable as English oak. Among the defects to which oak is liable, the following are the most common:—*Cup shakes*, caused by the sap freezing under the bark, and separating two of the ring layers, which remain thus separated throughout the future growth of the tree. *Rind galls*, produced by damaging the inner bark, or by improperly lopping the branches; the wounded part decaying, and the future growth covering it up. Extensive rottenness from this cause is sometimes found in the interior of a piece of timber whose surface is perfectly sound. *Foxy stains* occur in timber grown on marshy soils. These are indications of its being in a state of decay. Oaks from damp or sandy soils are very liable to this defect, and are generally much softer and lighter than those grown in more suitable situations. Mountain oak is by far the hardest and most durable of all. The introduction of iron for shipbuilding purposes, besides lessening the amount of oak timber required for the frames and side planking, has also precluded its use in places where wood is still required, from the fact of its containing gallic acid, which dissolves the iron with which it comes in contact. The principal application of oak in wooden ships is as frame timbers, plank both of side and deck, stems, stern-posts, pillars, topside chocks, and sometimes as beams. In iron ships, for the reason stated, it is rarely used, except as deck plank and towing-chocks.

Beech.—Beech is very little, if at all, used in the Royal Navy; in merchant ships it is sometimes employed as bottom plank under water. It is very liable to dry rot.

Elm.—This tree is indigenous to, and attains its highest state of perfection in, this country. It is valuable chiefly on account of its lateral toughness, the fibre being intertwined; it is, however, very subject to shrinkage, warping, and alteration of form: besides which it cannot be used with advantage in situations where it is liable to become alternately wet and dry, as under these circumstances it speedily rots. When constantly under water it is very durable, and even seems to be improved by a lengthened period of immersion in salt water. It is, therefore, specially adapted and generally used for keels, garboards, and planking of bottom under water. Elm is the chief timber used in boatbuilding, although for the diagonal-built large boats of H.M. Navy mahogany has superseded it. A kind of timber termed Canada rock-elm is now in very common use. It is a light-coloured, straight, close-grained, and very flexible wood; it grows to a great length, and of nearly uniform dimensions throughout. It is much used for boats, ladders, gratings, planking, and in some cases even for beams.

Ash.—Ash is a wood but little used in shipbuilding. It is a native of Great Britain, and is often found of very large dimensions. It is light-coloured, and very elastic and tough, and is chiefly worked into capstan-bars, handspikes, and other similar appliances.

Mahogany.—This timber, which but a few years since was used only by the cabinet-maker, now enters largely into the construction of ships. It is of two kinds, distinguished as Spanish, or Cuba, and Honduras mahogany. The former is obtained from the West India Islands, and the latter from the countries of Central America. Spanish mahogany is chiefly used for ornamental purposes on account of its greater hardness and its superior appearance. Honduras mahogany has a coarser grain, grows in larger logs, is tougher, and generally far better adapted to structural purposes than the former. Great care is required in its selection, as some kinds, owing to their growing in swampy soils, are very light, spongy, and liable to decay. In fact, the heavier Honduras mahogany is, the better it is found to be. Cuba mahogany may be easily distinguished from Honduras by its having the pores or cellular tissue filled with a chalky substance, those of Honduras mahogany being empty. Cuba mahogany is used for cabin furniture, steering-wheels, binnacles, and other work which is made ornamental as well as useful. Honduras mahogany is usually employed for inner and outer side-plank, beams, waterways, shelves, the plainer portions of cabin furniture, &c.

Teak.—Teak is now the most useful wood employed in shipbuilding, both from its great strength, toughness, and durability, as well as from its not injuriously affecting iron with which it may be in contact. It is also very free from shakes or shrinkage when drying. The best teak is procured from Malabar, although a great deal of inferior wood is imported from Ceylon, Java, and the Malayan Peninsula. The chief defects in this timber are worm-holes, which are frequently found to traverse the interior of the log in all directions, the surface appearing sound. Great waste therefore occurs in converting it, and much judgment is required in selecting it for purchase. Good teak when freshly cut is usually of a greenish-brown colour, changing to reddish brown after a few minutes. It contains a great quantity of an oily substance, and is, therefore, very inflammable. At the heart of teak a peculiar deposit is often found, which dulls the edge of carpenters' tools when working it. It has a chalky appearance, and at first sight one would be led to suppose that it came there by artificial means; but upon careful inspection it is found that the cellular tissues in the neighbourhood of the heart, or pith, are charged with the substance. Mr. J. Davidson, the teacher of chemistry to the Royal School of Naval Architecture, has analysed some specimens, and found them to consist of phosphate of lime, which had presumably been abstracted from the soil, and secreted at the centre of the tree, similar to camphor and other resins. Teak is chiefly used for backing behind armour-plates, deck-flats, beams, inner and outer side plank, sometimes for frame timbers, also for bulkheads, companions, skylights, coamings, &c. It is also frequently chosen in preference to mahogany for cabin furniture, as when polished it has an appearance very like walnut, from which wood knotty specimens of teak can hardly be distinguished. The shrinkage of teak when drying is inconsiderable; hence it is very useful for the engine and boiler bearers of wooden ships and for other such purposes.

Greenheart.—This wood is obtained from British Guiana, where it attains a great height. It grows very straight, but is very liable to split. Its colour is generally a greenish yellow, but in the most valued varieties it is black. It is highly esteemed for its durability under water, and its freedom from the attacks of marine insects. It is used for waterways, shelves, plank of bottom, &c.

African Oak.—This timber is procured from Western Africa. It grows very straight and long, and is somewhat similar in appearance to teak, but heavier, harder, and usually in smaller logs. It is not suited for work under water, as it is very liable to attack from marine insects. The chief application of African oak is for keelsons, pillars, beams, waterways, and frequently for sheerstrakes and wales. It is very liable to destructive shakes at the heart when drying, and to perforation by insects.

Sabicu.—This is a very hard kind of timber, somewhat similar to coarse-grained, deep-coloured mahogany in appearance, but considerably harder and heavier. Its grain is very short, and the fibres are usually very much twisted and interlaced. From its great hardness and toughness it is very much used for such parts of a ship as need these qualities, and at the same time do not require longer pieces than can be obtained with tolerably straight grain—for instance, bitts, bollards, cleats, &c. It is a very durable wood, but is frequently found shaken at the heart, while the outside is perfectly sound.

Mora.—This wood has but recently been introduced into shipbuilding, and as yet has not been used to a sufficient extent to enable us to judge exactly of its qualities. It seems, however, to be durable and tough, and very difficult to split. Its chief application, as yet, has been for side plank. It is procured from British Guiana, where it is found in great abundance.

Lignum-vitæ.—This is procured from the West India Islands, and is a very useful wood, both to the rigger and the marine engineer. It is remarkably tough, dense, and heavy, and has the property of resisting crushing forces with nearly equal strength along and across the grain. Hence, being excessively hard, it is very useful for dead-eyes, sheaves, and rollers. The sap wood is very much lighter in colour than the heart, the latter being a dark green, while the former is nearly yellow. In cutting a log for sheaves the direction of the grain should be parallel to the axis of the sheave, and in making the latter it is usual to leave a ring of sap wood around the heart wood, in order to prevent it from splitting by too rapid drying. The marine engineer uses it for shaft-bearings when in contact with sea-water.

* By Samuel Thearle, Fellow of the Royal School of Naval Architecture and Marine Engineering. From the *Annual* of the School.

Cone-bearing Trees.

The coniferous trees are divided into two classes—pines and firs. The former have needle-like leaves, growing in clusters from the same stalk; the latter have them straight and separate, but many growing on the same leaf-stalk, like the teeth of a comb. In shipbuilding the pines are far more useful than the firs, for besides attaining a larger size, they are generally more durable and stronger. All the coniferous trees are characterised by a straightness of growth, which, combined with their lightness and flexibility, render them specially suitable for masts and spars. They have, however, many other important applications, as will be seen presently.

Red or Riga and Dantzic Pine.—The most useful of all the pines used in shipbuilding is the *Pinus sylvestris*, commonly known either as Red, Dantzic, or Riga Pine. That obtained from Riga is the best on account of its size, strength, and flexibility, making it suitable for the larger spars of ships, such as the lower masts and topmasts. It is a reddish-coloured wood, the depth of tint varying with the amount of resin contained. It is also very much used for the deck plank of ships, the outer cuts, free of heart, being termed Dantzic Crown Deals; those at the heart are inferior, and sold at a lower price.

Yellow Pine.—This is the largest kind of pine now commonly obtained, and is imported from Canada. It is very much used for large masts and yards, for neither of which purposes, however, is it so well adapted as Riga pine, being considerably lighter, and not so elastic, strong, or durable. Large spars of the latter wood are, however, getting very scarce, and hence yellow pine is superseding it. The decks of passenger ships and yachts are sometimes made of this wood on account of its light colour and freedom from knots. It is very much used for cabin bulkheads and other light fittings. It is now grown in Great Britain, being known as the Weymouth Pine.

Oregon Pine.—A species of red pine obtained from Oregon and the adjacent island of Vancouver's, is now becoming very generally used for lower and topmasts, and as it grows to a large size, at the same time being very straight, tough, flexible, and durable, it is a very good substitute for Riga pine, which, as has been already remarked, is now rarely obtained of large proportions. Spars of this pine 130ft. in length have been brought to this country, and one of gigantic dimensions was presented to the Queen about four years since by the Colonial Government. The mast, when planed, shows a pretty waved grain, which is much esteemed by seamen. The trees brought from the mainland are superior to those from the island, being generally freer from knots. The chief disadvantage its use has at present is its high price, due chiefly to the heavy charges for freightage.

Cowdie Pine.—This is a species of pine recently imported in large quantities from New Zealand. It grows to a very great size, and has been used for some of the largest spars in a ship. It, however, lacks elasticity, and is very liable to warping and shaking. Being very free from knots it is sometimes used for the decks of pleasure vessels, as, when planed or cleaned, it has a most agreeable light yellow colour.

Spruce Fir.—The chief variety of the fir tribe as regards its use in shipbuilding is the spruce, *Pinus abies*, which grows in Norway, Scotland, and other northern countries. It is used for the small spars of ships and for boats' masts. The wood is tough, close-grained, and elastic, and also whiter than the pines. As it is very full of large knots, great care is required in the selection. Spruce deals are used for some of the lighter fittings of ships, but not generally to the same extent as yellow pine.

Larch. — The larch is common to Northern Europe, although it has been grown in this country only during the past century. The Duke of Athole was the first to plant it in Scotland on his estate at Blair Athole, about the year 1738, since which time it has become very common. It is a timber of great strength, and remarkable for its durability when exposed to the weather, but it is much harder to work and more liable to warp than Riga pine. The larch has not yet been extensively used in shipbuilding.

Cedar.—This is a species of fir more frequently used for ornamental than for useful work, as it is very weak. It is, however, almost indestructible from time, and no insect will attack it. It is chiefly used for cabin furniture, and in such parts of the ship's hull where durability and no great strength may be required.

MECHANISM.*

(*Continued from p.* 376.)

M. AMPERE appears to have been the first to direct public attention to the importance of kinematics as a special study. Plato speaks of astronomy as "the doctrine of the motions of solids;" and to come to recent times—very recent indeed—there is a still valuable work by Emerson, which we have here, and which contains some very good illustrations. Here is one of the mechanism of a rat-trap, and very well it is done. The reason why the book is produced is this. It was probably first published about 1750; this copy, which is the second edition, corrected and very much enlarged, with 43 copper plates, was published in 1758. The title-page is well worthy of our consideration in connection with the present course of lectures. It is—"The Principles of Mechanics," explaining and demonstrating the General Laws of Motion, the Laws of Gravity, Motion of Descending Bodies, Projectiles, Mechanic Powers, Pendulums, Centres of Gravity, Strength and Stress of Timber, Hydrostatics, Construction of Machines: A work very necessary to be known by all gentlemen and others that desire to have an insight into the works of nature and art; and extremely useful to all sorts of artificers, particularly to Architects, Engineers, Shipwrights, Millwrights, Watchmakers, &c., or any that work in a mechanical way. The Second Edition, with 43 Copper Plates. 1758.

The order of Emerson's subjects is remarkable. They begin with motion, lead on to equilibrium, and end with structures. In our days the habit seems to be to begin with structures, descending through equilibrium, and very seldom proceeding so far as motion is understood in mechanism. In the preface he lays great stress upon motion, and not, as in modern books, equilibrium. On that he lays no stress. He writes:—"What else is there in the visible world but matter and motion? Mechanism is a science of such importance as without it we could hardly eat our bread, or lie dry in our beds, and by it we come to understand the motions of the parts of an animal body—the motions of the celestial bodies. Without mechanics a general cannot go to war, and the meanest artificer must work mechanically, or not work at all, so that all persons are indebted to this art, from the king down to the cobbler."

Although pure mechanism or kinematics has thus been recognised as an important study in and by itself, yet no work appeared in the English language, as far as I know, until the year 1841, one year after Dr. Whewell's book, which was six years after M. Ampere had drawn attention to this subject. Then Professor Willis, the Jacksonian Professor of Natural and Experimental Philosophy in the University of Cambridge, published a volume on "The Principles of Mechanism, designed for the use of students in the University, and for engineering students generally." To this work all who have alluded to mechanism acknowledge great obligations. In it the subject is treated as a mathematical one, and although in the present course of lectures the purely mathematical aspect of the problem must be ignored, there is no reason whatever why the young mechanicians should not study the subject with the only key that can unlock for them its treasures.

Whilst allowing the "open sesame" character of this mathematical key in the question of mechanism, it is well to avow that purely mathematical minds have claimed for their favourite science far too much of the power of a magician's wand over terrestrial mechanics and mechanism. Mathematicians boast that they hold the key of the gate; it is a reflection upon their good taste that they seldom walk in the pleasant pastures of which they have the key. If mathematicians would but become as familiar with the technicalities and wants of machinists and mechanists as they are with the omnipotence of x and y, they would often receive the right hand of brotherhood, where now men are provoked to say, "Stand back; we do not want you." There will be no solid progress in the refinements and precision of mechanism, either constructive or kinematical, until there is less dissociation between mathematics, physics, kinetics, and practice. The youth of England are led in the dynamical relations of x and y to calculate the path of the earth in its orbit, and they can do it to a second in a year. The same x and y enable them to tell the periods of the revolution and rotation of the earth; to find the velocity of light, and to measure the length of its waves to the millionth of an inch; to calculate the exact curve of the spectroscopic diagrams in the solar corona, and this with an accuracy that even decimals fail to represent to the mind. Such is considered a triumph of mathematical dynamics. But ask a mathematician to determine the quantity of irregularity produced by an unbalanced fly-wheel; to say how a small weight on a large fly-wheel may produce back-lash through a mill, and destroy the teeth of some of the largest wheels in that mill, or to state in what motions or how to utilise the heat that passes away, or to what influences a ship is subject by the rotation of heavy machinery within, or to calculate in any given case what is called negative slip; and how is that slip in a screw propeller to be avoided. Ask the mathematicians to take a given problem, with given numbers, under any of these heads, and they will turn from it and think it beneath their notice—probably it is beyond their skill.

Mechanism, then, is the alphabet; machinery is the written expression, and that machinery is a combination of parts. These elementary parts are furnished by the mechanician. Hence the study of mechanism should precede the study of machinery; but it has failed, and still fails to do so.

Apart entirely from the mathematical and scientific reasons why mechanism does not hold its own as a branch of well-defined and intellectual study, there are one or two obvious social ones. Mechanism is not directly allied to utilitarianism; it bears a relation to utilitarianism of a character similar to that which art bears to it. The necessities of life must first be met, and then may be entertained improved means for meeting them. Houses, boats, bridges, clothing, and food must first be procured, and then, and not until then, need be considered the best way for accomplishing these, or for rendering them more attractive when they are procured. Hence art and mechanism first succeed, and then precede, utility. Again, our very bodies, and the contrivances which nature has so profusely scattered around, have given man what may be called an intuitive knowledge of mechanistic combinations. Men avail themselves of these as they do of books in a library, and rarely give a thought to anything but the branch that they are themselves at the time wanting.

Mechanicians are only a numerous class of those who do this. To the extensive storehouse of nature's contrivances perhaps every branch of art and science resorts more than it is willing to allow. When the Government, about 100 years ago, referred the question of a lighthouse to Smeaton for the Eddystone rock, Smeaton, who was experienced both as a kinetical and constructive mechanician (he was the first to intoduce the use of cast-iron teeth in large wheels), did not contrive a lighthouse, or even consider he was called upon to design one. What he did was to look about through nature's storehouse, and to consider where and how resistances were met similar to the resistances he was called upon to meet. Hence, when he published a report, in folio, of the designing and executing of the present Eddystone lighthouse (three or four previous ones having been either burnt down or washed away), he printed, side by side with a drawing of the structure he proposed, the trunk and the branches of an oak tree, which he took as his model. On the wall is a diagram taken from Smeaton's own account of the Eddystone lighthouse, and showing the peculiar mode in which he dovetailed the stones one into the other. The question of the Eddystone lighthouse is quite foreign to our present purpose, but the diagram there shows the mode in which the oak branch enters into the stem of the tree; and in the text Smeaton points out how beautifully the obtuse angle of the branch is fitted in with more material than the acute angle, and how it strengthens the acute angle; he also shows how the stem of the tree is fixed into the ground, and to this natural contrivance he owed his ideas, for from them he writes:—"I could make a figure not ungraceful; and at the same time carrying the idea of great firmness and solidity" (p. 42). That is sensible constructive mechanism. There may be many in this room who remember the year 1851, when the country was very much perplexed to know what to do with the Exhibition it had summoned, and did not know how to put it under cover. Architects, engineers, and others, were completely baffled. They felt that if they raised a building, either of brick or stone, damp in the walls would spoil the treasures of art to be deposited there. No available suggestion originated with them. In the crisis a gardener came forward, and to him is due the credit of having suggested the design for the building. Sir Joseph Paxton, who owns he was no engineer, writes of the Exhibition of 1851:—"Nature was the engineer in this case," and he requests those who choose to do so to compare the leaf of the water lily (the "Victoria Regia") with the building erected in Hyde Park, for he says, "from this I obtained all my ideas" of what should be comprehended in the first iron and glass building that was ever seen. Let us look—the inquiry shall be as brief as possible—at a few more of similar illustrations. A spider's web across a garden path suggested the Menai Bridge to Telford before 1818. The structure of bones suggested the tubular one which carries the railway across the Menai Straits. The little worm which perforates the wood of ships suggested the Thames Tunnel to Brunel; the telescope, the microscope, and the camera obscura are all clearly set forth in the eye; it was a lobster shell which gave the idea of curving wrought-iron tubes to Watt; wasps make paper, and there are other wasps that make paste-board. Spiders form nets; hail and shot are formed exactly alike. Birds' feathers suggested the slates to our houses, and birds' nests are lessons to this day in basket weaving. England, as an island, is warmed as this room is warmed. In the torrid zone there is a boiler and furnace, and the Gulf Stream is the enlarged pipe of a huge heating apparatus. In the hand we have a vice, and looking at that vice which we all possess from a mechanical point of view, it is evidently one more perfect than the most ingenious vice the accumulated skill of engineers could possibly produce. There are eight or nine different vices in one, that is to say, it is a vice of varying

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

size and form; it needs no clams; there is no chance of damaging the work put in it by the serrated edge, as is the case in an ordinary vice, for, as you know, clams of wood, lead, cloth, and other materials are used to save the work. Look at it from any point of view, it is unapproachable. If you want to hold a circular piece of metal, how much more beautifully do you do it than can be done by any contrivance of engineers. You hold it between two fingers and a thumb. Although this is a question of statics, it is worthy of a few moments' consideration. You observe, many people put things upon four legs; theodolites*, instruments, tables, &c., are generally put upon four legs, but Nature tells us we should put them upon three. When this pencil is held on three sides by two fingers and one thumb, you cannot press it any direction without its meeting with resistance, but once put it between four fingers and there are four places in which it may escape. Another peculiarity of this vice (viz., the hand) is, that you may hold a chisel in it so as to be quite steady, and yet it will slide along, and there is no vice known to me which will do this. This vice, then, is not only a very curious one, but, in respects which would draw us very far aside, it is one possessed by no animal except man. Look, again, at the wrist joint. We have vices with balls and sockets, and universal joints, but none equal to this universal joint at the wrist. There is a fortune for anybody who can make a vice to equal it, so simple and so universal. Then, again, the stomach is a perfect laboratory. The lungs are a bellows; the skull is an arched vault, beautifully put together; and the teeth! what a complication we have of knives, saws, wedges, and mill stones; and in the jaws there is an arrangement which has often been tried, but which has never yet been successfully attained, called a draw-cutting action, the nearest attempt to which is in bread, hay, and paper-cutting machinery. Not only is the eye a telescope and a microscope, but there is in its apparatus (viz., in the "iris") a specimen of what engineers have been attempting for a long time—an expanding pulley. No expanding pulley has yet been successful. To adapt such suggestions as these supply, and to combine them with the structural schemes which ingenuity or necessity furnished, seemed to satisfy all the wants of men until the steam-engine enlarged its usefulness by giving a rotary motion in addition to a reciprocating rectilineal one. Watt did this in 1770, and from that time we began to date our mechanical progress. Then it was that men who saw a high scientific and intellectual study in mechanics were gradually turned from such considerations as the mathematical demonstration of the parallelogram of forces, or the abstract beauties of algebraic analysis, to the more important considerations which these engines producing rotary motion led them to entertain.

When we note how slowly, even in these days, the direction of men's thoughts change, we must not be surprised that comparatively few minds have left the beaten track, and entered on studies of pure mechanism. It is, both in its abstract and practical character, a very fascinating study, and those who promote it render the art of the mechanic less empirical and far more scientific than it is at present. As an architect should study engineering, so a mechanic should study mechanism. A mechanic, as the term is applied, means one who makes machinery. This view is just as narow as that which would restrict the term engineer to one who drives an engine. If there is one occupation more than another which should win respect from the required combination of mental knowledge and handicraft skill, it is that of the mechanic; and of mechanics none need these qualifications more than the smith—

> A mighty man is he,
> With large and sinewy hands,
> And the muscles of his brawny arms
> Are strong as iron bands.

For that man can take an uncouth, shapeless mass of cold iron and so correctly judge of the volume of that uncouth mass, as to select the required quantity, and no more, for a form to which it bears no resemblance, and to which form he shapes it, although he is never able to touch it with his fingers. Before you is one of the recent triumphs of skill in wrought iron, and if there is any one present who has taste for work of that kind, it is well worth study. It has been lent by Messrs. Peard, Son, and Peard, and is a pure piece of wrought iron. It is most artistic and graceful in form, and is put together without brazing in any part. How far it has been screwed together, or how far it has been simply welded, there are, no doubt, those in the room fully competent to judge. No one, however, can leave it without admiration, and recognising the truth of the statement, that of mechanics there are none who more deserve the thanks of the community than the class called smiths.

(*To be continued next week.*)

* The adjusting-screws of theodolites, are, as a rule, four in number—the three-legged stand is the support of a four-legged instrument.

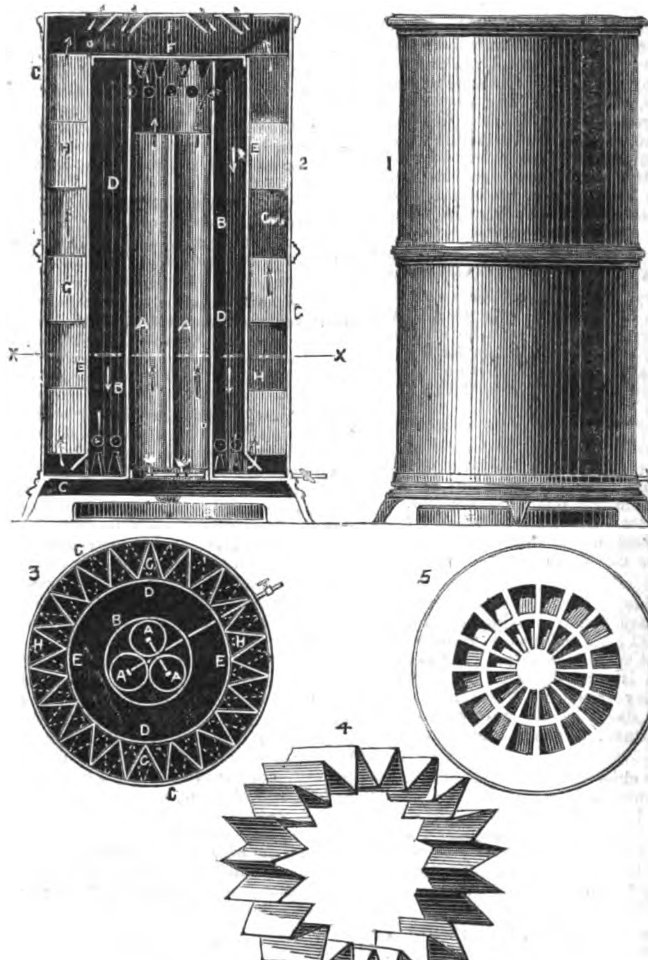
EBDY'S PATENT GAS-STOVE.

THIS invention is for warming, ventilating, and disinfecting buildings, heated by gas, coke, mineral oils, or other fuels: the stove is so constructed that a current of warm air is continually circulating therein. Each light or burner is inclosed, or burns within a long tube or chimney, by which means all or nearly all the offensive products of combustion are burned, and by the use of the radiating heaters or gills the air within the stove is thoroughly warmed before making its exit at the top of the stove. Fig. 1 represents the exterior of the stove, Fig. 2 vertical section, Fig. 3 shows a section on line X X; Fig. 4 shows the circular radiating gills or heaters H; Fig. 5 represents the top of stove I. A A, Fig. 2, chimneys, B B another tube inclosing chimneys, C outer casing of stove, D D chambers which are formed by placing an inverted cylinder E, having an air-tight cover F, over the tube B; G is another chamber; H shows the radiating gills or heaters. It will thus be seen that each light or burner is inclosed or burns within a long tube or chimney, these tubes or chimneys being inclosed within another tube, which is attached to the bottom of the outer case. This tube has air-vents cut at the top to allow the air to pass into the chamber D. This chamber is formed by means of an inverted cylinder E, which has an air-tight cover F, over the tube B, and chimneys, by which means an air space is left between the top of the cylinder and cover of the stove; air-vents are also cut at the bottom of the cylinder to allow the descending current to pass into the chamber G, which is formed by the outer casing of the stove. The spaces thus formed between the outer casing of the stove and the cylinder are filled with radiating heaters or gills of zig-zag form. The stove is raised above the floor upon a stand, so that the atmospheric air may pass up the chimneys and between the air spaces and thence down the downcast chamber, and from thence into the outcast or gill chamber. As the air circulates in the stove in ascending and descending currents it becomes well heated, and is deprived of those noxious qualities which generally accompany the use of gas. The gills warm the air which circulates within the chambers and maintain an even temperature.

When it is intended that coal should be burnt in the stove, the chamber is made larger, a grate is placed at the bottom and a fire-door in the side, and the top of the cylinder is inclosed and carried through the top of stove, and a small tube or chimney connected. The stove may be placed either in another apartment, or may be sunk beneath the floor of the building with down-cast and up-cast shaft.

The stove is well adapted for disinfecting rooms and buildings: when so used, the disinfecting fluid is to be placed underneath the stove in a vessel, as shown at Fig. 2. The fluid evaporates, is taken up by the air which passes into the stove, and is given off together with the heated air at the top of the stove. Any number of lights may be employed, the size of the stove being regulated accordingly.

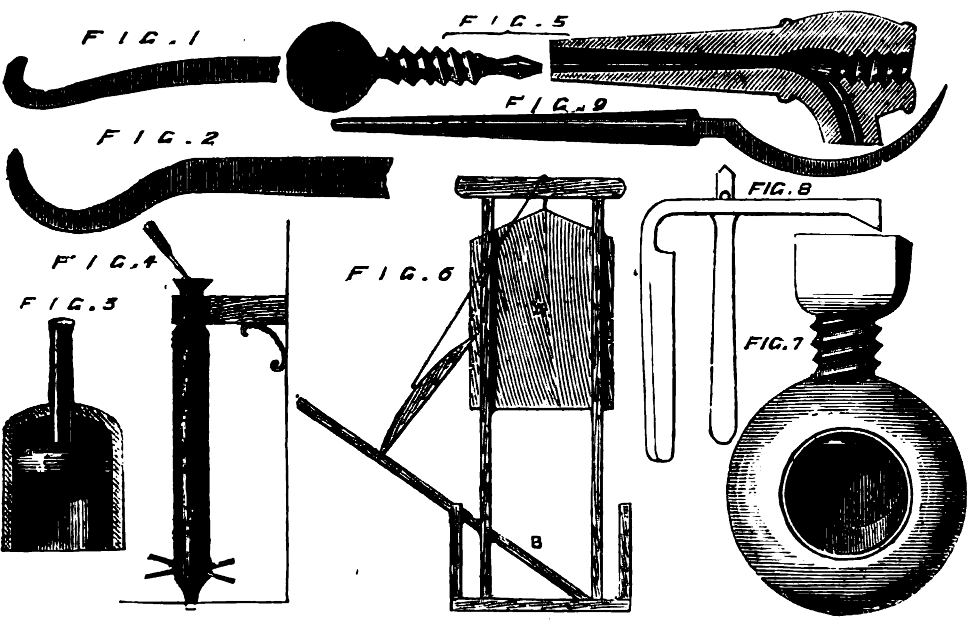
Mr. T. C. Ebdy, architect, of Sunderland, is the inventor and patentee.



THE TURNERS AND TURNERY OF KING'S CLIFFE, NORTHAMPTONSHIRE.

WE extract the following interesting information from the *Quarterly Journal of the Amateur Mechanical Society*, to which it was contributed by Mr. J. H. Holdich. For very many years the small town or rather village of King's Cliffe, about eight miles from Oundle, has been remarkable for the manufacture of various useful articles in soft wood, chiefly by means of the lathe. I cannot, says Mr. Holdich, tell much in the way of history. On making inquiry at Cliffe itself, all I have been able to learn yet is from a man who told me that his grandfather died in 1818, at the age of eighty-eight, that he was brought up a turner, and practised it all his days. This takes us back about 140 years; but probably the trade had been carried on many years previously. There are at this time no fewer than forty men constantly employed in the trade, so that it has not decreased since the days of Morton. The woods most in request by the turners of King's Cliffe are maple, sycamore, alder, birch, lime, chestnut, beech, ash, and whitethorn. Lime, sycamore, and beech are often cut into boards for trenchers, when of sufficient size, but the woods in most request are poles from two to six inches in diameter.

It is usually sold in parcels, each parcel containing a rood, or half rood, the buyer to cut it down and convey it home. So much of the country having been disforested, there is a comparative scarcity of this material, and it has to be sought at greater distances than formerly, while the workmen complain somewhat of the "Leicester folk," who come to them to buy poles for "bobbins" to wind cotton on, for which they commonly give about £1 5s. a ton, delivered at the nearest station. When the poles are brought home they are stacked out of doors for twelve months, then put under cover for another twelve months, before they are fit for use. Sometimes green wood is boiled to extract the sap, and is thus used in a very short time after being cut down, but an experienced turner told me he did not consider this to answer; the wood under such circumstances being very liable to split; e.g. salt-cellars and egg-cups are turned out roughly and left some time before finishing; but if the wood is boiled, as above, a large proportion of them crack and are useless. The tools employed are simple enough; the lathes—at any rate, by the side of a Holtzapffel—are generally clumsy, heavy-looking, with wooden wheels, and wooden chucks ringed with iron. I find the lathe-heads usually come from Birmingham, and cost about £1 5s. to £1 15s. each, the frames being home made. Common chisels and gouges, with hook tools, are used with great dexterity, the result of practice in one particular line. The "hooks" are commonly made by the village blacksmith, under the turner's direction, for different turners seem to me to have different twists, and each prefers his own. I have had a set of six made for me at 1s. 6d. each. They are more substantial than some I have, of Holtzapffel's, and of a different shape.



The Holtzapffel's pattern, Fig. 1, has a shank of 5in. and a handle of 9in.; the King's Cliffe pattern, Fig. 2, has a shank of 8in. and a handle of 12in.

It is really very interesting to see how cleverly these tools are managed. There is here, as in other places, a division of labour, for though most of the turners can do many things, each one has his own speciality at which he is most expert. Thus, at one shop are made spice boxes, salt-cellars, &c., at another pump buckets, at another water and beer taps, at another spoons, and so on.

The articles made are, however, very numerous. I have before me the price list of a man who, with his son, carries on a fair business; it comprises about sixty different articles; and these again divided into different sizes, though, it must be observed, he does not himself make all the articles mentioned, but supplies them. However, he and his son make a great many of them. It would be needless to name them all—let me rather select a few. First on the list we have "butter prints" of four kinds; 1, in cases (Fig. 3); 2, single prints; 3, oval prints; and 4, mould prints. Those in cases are divided into six sizes, viz.—1lb., ½lb., ¼lb., ⅛lb., 2oz., and common size. The simple prints are divided in like manner, and with the others there are different sizes and prices. The turner will readily understand how the ordinary prints and cases are turned, but there is an ingenious device (Fig. 3) in connection with the carving which calls for notice. They are, of course, carved with chisels, gouges, &c., the contrivance in question is for holding them, and very handy it is for the purpose. It consists of an upright post, the bottom formed as a pivot, turning in a hole in the floor usually, the upper part in a wooden collar carried by a bracket projecting from the wall. Near the lower extremity are two bars of iron, running through the post at right angles, on which the workman keeps his feet and so steadies the work or turns it as may suit his purpose. The butter print is fixed by a thumbscrew in a socket in the upper part of the post; napkin rings are first fixed in a holder fitting into the socket. There is no turning about the butter moulds—they consist of two pieces of wood, three or four inches square and about an inch thick, on each of which one half of the device is carved (a wheat-sheaf, swan, &c.), the butter being pressed between them.

The spice box is another article of which many are made. These are divided into small, middle, large, and large with five lifts, each lift being, in fact, a separate box, the bottom of which forms the top of the one immediately beneath it. There is a screw for each division, which is cut with a simple V-tool by hand, without any guide. The lathe head is turned with the left hand and the tool held in the right, and it is curious to see with what facility and accuracy this is done. The insides of the divisions, like the insides of all other boxes, are cut out very quickly with the hook tool (Fig. 2), and the bottoms squared with a similar tool of rectangular shape.

Taps are made of various sizes—large ones for water-butts and smaller ones for beer and other purposes. Fig. 5 represents a tap in section. The screw is cut by hand with the V-tool. To cut the female screw the tap is chucked on a taper iron mandril which holds it sufficiently firm for the purpose. The outside is turned as far as the projection for the spout, which is shaped with the paring knife.

The mouse-trap (Fig. 6) is also made in considerable quantities and is very effectual for its purpose. It will be seen that there are seven pieces besides the string, five of these being turned, and all put together for one shilling—less if sold wholesale. The principle is very simple; the wooden block A falls on the mouse when, to secure the bait, he ventures his foot on the treadle B.

The turned nutcracker (Fig. 7) may be seen on many stalls at fairs where nuts are sold. It is simple enough, consisting of two pieces only, a wooden box and a screw. The figure will sufficiently show what it is and, I should suppose, the manner of its use.

Salt-cellars and egg-cups are made in large quantities; the wood is cut into proper lengths and roughly pared with the knife. A taper screw, or worm chuck, is fixed on the mandril and the piece of wood screwed on with a few turns and cut out most expeditiously with the hook tool and gouge.

The words "puzzle boxes" and "Chartist whistles," which occur in the list, may excite curiosity; they are, however, very simple articles. The puzzle box is in the form of a ball, ornamented with sets of concentric circles, two of which, on opposite sides, serve to conceal the ends of a cylindrical box which is fitted in diametrically and capable of being pushed out with the finger, when the proper place is found. We have no Chartists about here that I am aware of, and why the whistle, which, by the bye, is not a whistle, should be named after them, I cannot tell. It is a small box with a perforated top, standing on a foot, something like a pepper box in shape, with a cylindrical piece projecting from the top, made to represent a whistle, but whoever attempts to sound it receives a puff of flour in the face, through the holes, to the discomfiture of the performer and amusement of the lookers-on.

And now let me turn to the manufacture of spoons, which is peculiar and has peculiar appropriate tools. They are made of poplar, alder, and, it may be other woods—of poplar by preference. The first process is to cut them into lengths and give them the rough shape of the article with the saw and paring knife. The bowl is then cut out with a curious instrument called a "fixel" (Fig. 8), if that be the right word, for I have not yet been able to find it. The blade is in the form of a gouge, about six inches long. The spoon is held by the left hand on a block and the fixel in the right when the bowl is chopped out with ease and considerable precision. It is then finished with the "smeething" (Fig. 9), the bowl being held in the left hand, with a bit of rag to guard the hand, and the tool in the right, the long handle going under the arm to steady it and give power. The spoon is then put into the lathe (commonly the simplest form of pole or spring-lathe) where, in a few turns, the handle is completed with a gouge. The whole is then finished off on the block with a knife of peculiar shape, with a long handle like the smeething, and used in the same fashion. All these tools are made by the village blacksmith.

Some few toys are also made here, as humming tops, small churns, rattles, &c. The humming tops are made of four pieces, painted, varnished, and sold at 6d. and 4d. each, which seems but little money. Some rather ornamental watch-stands, cotton-stands, pin-cushions, and spill-cups, also deserve a passing notice, but probably I have already become sufficiently tedious, so will pass on to a few words about the demand for, and the price of, the various articles of which I have spoken. Bearing in mind that not less than forty men are constantly employed in these works, it will be seen at once that the demand is considerable. Wooden spoons are not yet out of fashion, and notwithstanding the great increase of metal spoons and dishes, and the cheap and cleanly crockeryware, there are places where wooden ware is still preferred, and where it holds its head aloft. Large quantities are sent to Liverpool for exportation, mostly, I am told, to America; and the manufacturing districts of England, Yorkshire, Lancashire, &c., are ready markets. I was in a shop the other day where a man was turning tobacco boxes, in the form of little barrels, He had an order for a gross from Lancashire; these are sold at 4s. the dozen (wholesale). An order was once given for fifty pounds' worth of butter prints alone for America.

Touching the price at which the Cliffe ware is sold it seems marvellously small, and yet an industrious workman will make a very fair living out of it. It is not very easy work, but a man will turn six dozen salt-cellars in a day, which being sold (wholesale) at 1s. 6d. per dozen will produce 9s.; but then something must be allowed for wood, wear of tools, &c., so that probably he will not earn more than 7s. 6d. Egg-cups again are sold at 10d. a dozen, and I was somewhat surprised when a boy about seventeen told me, perhaps a year ago, that he had, by way of trial, turned 16 dozen in a day, no less than 192, but that it was a very hard day's work, lasting from 3 a.m. till dark. He has, however, now outdone himself; I was in his shop a week or two ago, and he told me he had turned 19 dozen in a day, from 7 a.m. to 7 p.m., allowing one hour only for meals, and that he intended the day after my visit to turn 21 dozen, for he had an order for 2 gross, of which he had turned 3 dozen only, and he wanted to complete the order next day. Probably he did it, but it seems to me a marvellous quantity—252 separate articles! The wood, I should observe, was cut into lengths of about two inches, and roughly pared, and each piece had to be screwed on to a taper screw and turned, the inside with a hook tool, the outside with a gouge. Another man told me he had once begun and finished 13 dozen spoons in a day, which, if sold at 10d. a dozen, would produce 10s. 10d., but these are unusual quantities, and could not be produced for any length of time in like proportion. Butter prints are variously priced according to the size. Those in cases for 1lb. are sold at 14s. per dozen, for ½lb. at 10s., and so on. Spice boxes with five lifts are sold at 18s. per dozen, with four lifts at 15s., &c., which, taking the many pieces into account, seems very little. Nutcrackers are sold at 8s. per gross. Puzzle boxes at 1s. each, retail; considerably less, probably 8s. per dozen, wholesale, and so on. Croquet sets are also made here, but not many of them. at from £1 to £3 the set, and very well made too. The balls are of crab tree, which is getting somewhat scarce.

There is a pretty method of ornamenting small boxes and other ware by transferring small pictures from paper to the wood, which are then varnished over. A word about the varnish. It is usually home-made. A very useful one is composed of—6 ounces of gum sandarach; 1 pint of methylated spirit of wine; 4 ounces of black resin. Perhaps a quart is made at a time, mixed in a tin can, and set near the fire to melt. The can should be large, as it is liable to boil over if care be not taken, and care must be taken in this matter. When [illegible] ly mixed it is strained into bottles [illegible] simply laid on with a camel's-hair [illegible] room. Another kind, somewh[illegible] with shellac.

SCIENTIFIC SOCIETIES.

ROYAL SOCIETY.

Origin of Volcanic Energy.

AT the last meeting of this Society for the Session just concluded Mr. R. Mallet, F.R.S., read a paper on "Volcanic Energy;" being an attempt to develop its true origin and cosmical relations. He discovers the true cause of volcanic heat to be derived from a crumbling process going on in the interior of the earth. It is necessary to presume a hotter nucleus than crust, so that the rate of contraction is greater for the former than the latter. Thus, if there was no crushing and dislocation going on, a cavity would be formed between the nucleus and the crust. The author, however, imagines that the solid crust sinks together after the shrinking nucleus, and the work thus expended is transformed into heat, by which, at places where the crushing takes place sufficiently, the material of the rock so crushed and of that adjacent to it are heated, even to fusion. A volcano is formed by the access of water to such places, for without water no volcano. It would thus appear that the volcano is our safety-valve. We get steam up inside by the crushing of our crust and the influx of water, and have bursting prevented by the outlets and channels in communication with the interior. Applying the theorem of Lagrange—

$$T = P\left(\frac{1}{\zeta} + \frac{1}{\zeta}\right)$$

the author shows that the earth's solid crust, however great its thickness, and even if of materials far more cohesive and rigid than those of which we must suppose it to consist, must, if even to a very small extent left unsupported by the shrinking away of the nucleus, crush up in places by its own gravity and by the attraction of the nucleus. In order to test the validity of this view by comparison with known facts, the author gives in detail two series of experiments completed by him, the one on the actual amount of heat capable of being developed by the crushing of sixteen different species of rocks, chosen so as to be representative of the whole series of known rock formations from öolites down to porphyry; the other, on the co-efficients of total contraction between fusion and solidification at existing mean temperature of the atmosphere of basic and acid slags, analogous to melted rocks. The views are further tested by the data of total annual vulcanity of all sorts of our globe, by known facts of vulcanology and seismology, and by reference to other planets and our own satellite. The author submits that if his view will account for all the known facts, leaving none inexplicable, and presenting no irreconcileable conditions or necessary deductions, it should be accepted as a true picture of nature.

A Voltaic Standard of Electro-motive Force.

Mr. Latimer Clark stated that in the year 1861 a committee was appointed by the British Association for the Advancement of Science to report on standards of electrical resistance, and subsequently on other standards of electrical measurements. The reports handed in recommended the adoption of a system of electro-magnetic units based on the metre and the gramme, the relations of the units being such that the unit of electro-motive force acting through the unit resistance should give the unit current, and that the unit current flowing for the unit time should give the unit quantity. They issued standards of resistance and standards of electro-static capacity, but no material standard of electro-motive force had hitherto been issued. This want the author supplies in the discovery of a battery of pure mercury and pure zinc separated by a paste made by boiling mercury sulphate in a thoroughly saturated solution of zinc sulphate. This battery is sensibly constant and uniform in its electro-motive force, and the measurements are readily made by the potentiameter. Mr. Clark says that the standard of electric potential is second only in importance to that of the standard of electric resistance, and the use of such a standard, combined with an auxiliary battery in the manner above described, admits a of variety of applications, which it is believed will be found of great value in electrical research.

CHEMICAL SOCIETY.

Preparation of Chlorine.

AT a recent meeting of this Society, Mr. Henry Deacon read a paper on his process for the production of chlorine. He said that about two years ago, at Liverpool, he gave an account of his process for the preparation of chlorine from a heated current of hydrochloric acid mixed with air, which since then had been the subject of a great amount of research, with the object of ascertaining how this could be effected continuously, readily, and at the smallest cost. This problem may be resolved into the following:—1. As to the most suitable active or catalytic substances. 2. Whether the mass or the surface of the substance was the active agent. 3. As to the effect of temperature. 4. As to the best arrangement of the substance. 5. As to the effects produced by variation in the velocity of the current of gas. 6. As to the effect of various proportions of air or oxygen and HCl. He had observed that the heated mixture of hydrochloric acid and oxygen or air does not yield chlorine unless it is in the presence of some substance capable of being attacked by the hydrochloric acid, amongst which the copper compounds were eminently active. Sulphate of copper was fixed upon for economic reasons, and almost all the experiments mentioned in his lecture had been made either with the pure sulphate or with pumice-stone, or fragments of clay saturated with it. In experimenting, two clay tubes were generally employed of different bores, glazed externally, and coated internally with sulphate of copper, placed side by side, and passing through the cork of a glass tube sealed at the other end. The mixed gases on entering first traversed the glass tube, and then passed out by the clay tubes. In the more recent experiments this apparatus was placed in a thick, massive iron tube, heated externally by a furnace, so as to maintain a uniform temperature. This was measured by the change in electrical resistance of a fine platinum wire, and also by a mechanical pyrometer. The mixed gases were contained in gasholders worked with strong sulphuric acid, both the amount of hydrochloric acid passed and the amount of chlorine produced being ascertained by passing the gases into a solution of caustic soda. The lecturer then explained the numerous diagrams and tabulated results of experiments with which his discourse was illustrated, from which it would appear that there is a certain comparatively small range of temperature between the critical limits of which the percentage of hydrochloric acid decomposed varies greatly, and that this is not the same for the chloride as for the sulphate of copper, being higher for the latter, although it is the same whether solid sulphate of copper be used, or merely pieces of brick saturated with it. This shows that the action is essentially a surface action. It is, however, remarkable that in experiments on a large scale this temperature is invariably lower than in the laboratory experiments—usually 100° or 150°; also, that when the mixed gases are passed through a series of parallel tubes an increased velocity in the flow of the gas yields only about one-third the increase of the amount of chlorine produced, that an irregular surface does under like circumstances.

From the results of all the experiments contained in the tables he inferred:—(1) That with the same mixture of gases at the same temperature, the amount of hydrochloric acid decomposed by the aid of a molecule of the copper salt in a given time depends upon the number of times the molecules of the mixed gases are passed through the sphere of action of the copper salt. (2) That in long tubes of the same diameter the number of opportunities of action in the same time are nearly the same at all velocities. (3) That in long tubes of different diameters the number is the same when the velocities of the currents of gas are in inverse proportion to the square of the diameters. (4) That in porous masses the opportunities of action increase with increased velocities in nearly direct proportion. (5) That other conditions remaining the same, the percentage of hydrochloric acid decomposed varies with the square root of the proportionate volume of oxygen to hydrochloric acid. (6) That the $CuCl_2$ formed bears no definite proportion to the amount of chlorine produced. (7) That as the sphere of action includes molecules not in contact with the copper salt, therefore hydrochloric acid must be decomposed under circumstances where the union of either element with the copper salt is impossible.

The President (Dr. Frankland) said that the process for preparing chlorine at present used was essentially clumsy and unscientific; the hydrochloric acid given off from the salt cake was first dissolved in water, and then treated with manganic peroxide in order to liberate the chlorine, giving rise at the same time to a large amount of waste products which were thrown into our streams and polluted them. As especially interested in our rivers, he sincerely hoped the process would prove a commercial success.

Dr. Williamson said he would like to ask a question or two for his own information. He understood that the mixture of air and hydrochloric acid was heated before being passed into the decomposing chamber; was it cooled again before it went into the chamber containing lime for the preparation of chloride of lime, and was the undecomposed hydrochloric acid previously removed by washing?

Dr. Debus would like to know whether the sulphate of copper was found to be unaltered after having been exposed to the action of the mixed gases for a considerable time, and also whether, when Mr. Deacon used straight tubes with the mixed gas passing through at different velocities, the gases in both instances had attained the same temperature when it came in contact with the sulphate of copper?

Dr. Gladstone observed that many interesting points started up in one's mind in connection with this subject, and he should like to know more fully why the lecturer believed the sphere of action to include molecules not in contact, and that the decomposition was not due to direct chemical action. It appeared to him that it was unnecessary to suppose the cause to be the mechanical striking of the molecules of the gas against the sulphate of copper surface in their passage through the apparatus, and therefore depending on the flow, for it must be remembered that when a gas was mechanically in a state of rest the molecules composing the gas are in a state of motion, and that when we heat that gas this rate of motion of the molecules amongst themselves varies, although the gas is still mechanically at rest.

Mr. Deacon replied that he thought it would save the time of the Fellows present, and avoid getting over old ground, if they would permit him to put aside all technical questions, and reply only to those which had a scientific interest. In the first place, there is a definite range of temperature where chlorine is freely formed, but no chloride of copper, although at a higher temperature the sulphate of copper is partly converted into chloride. This only applies to pure sulphate of copper, which, even after the action had been continued for six months, contained but mere traces of chlorine. In the presence of clay, however, the sulphate of copper is decomposed, and chloride formed, probably owing to its containing some base which combines with the sulphuric acid. In the case where the exterior glass tube contained two clay tubes of different diameter, the gas coming in contact with the copper salt, certainly had the same temperature, although moving with different velocities. With regard to his allusion to chromium he had expected from the well-known oxidising power of chromic acid that it would have been very active, but, on the contrary, he had found that it was reduced to oxide of chromium, which is one of the most inactive substances. With respect to the theory he had laid before them, without vouching for its correctness, he could say that it was the only way he knew of accounting for the results he had obtained.

USEFUL AND SCIENTIFIC NOTES.

Society of Arts' Music Examinations.—The newly-issued results of this year's examinations in musical theory and composition under Messrs. Hullah and G. A. Macfarren, show that of the 87 certificates and three prizes awarded by Mr. Hullah, tonic sol-fa pupils have taken the first prize, and 68 (more than three-fourths) of the certificates. Mr. Macfarren has awarded two prizes and 86 certificates, and sol-faists have taken both the prizes and 81 of the certificates. The Society has now relinquished its musical examinations, in which, during the last six years, 594 certificates have been issued, more than three-quarters (449) having been obtained by tonic sol-fa pupils. In Mr Hullah's examination the ordinary notation and nomenclature of music is strictly used; in Mr. Macfarren's the exercises may be worked in either new or old notation at the candidate's option. The Council of the Tonic-Solfa College, having tried in vain to induce the Science and Art Department and the University of London to carry on these examinations, has determined, as a provisional measure, to undertake the work for three years at least.

Incubator.—A Mr. Hunt has patented an improved incubator or apparatus of simple and inexpensive construction for hatching eggs, and also for rearing the young when hatched. The incubator is composed of two boxes placed one within another, a clear space being left at every part between them (say of about 1in.), which is filled with a non-conductor of heat. The inner box contains a metal vessel, which is filled with heated liquid (say) every twelve hours, and above this is placed a tray to contain the eggs for incubation. The heat is graduated and air is admitted by a perforated lid at the top of the outer box. That part of the invention relating to rearing the young when hatched, which the inventor calls "the mother," is constructed as above described, save that the vessel for the heated liquid is placed at the upper part of the box, so as to leave a sufficient space to admit the young to warmth. The liquid is admitted to and drawn from the apparatus by pipes and cocks suitably arranged for such purposes.

Gas Purification.—The report on gas purification by the gas referees, which some time since was sent by them to the Corporation and Metropolitan Board of Works, has been published. It announces that the gas referees have devised a new method of purification, by which the gas can be almost entirely freed from the sulphur-impurity at every gas-work (as at Bow-common and Beckton) where lime can be used. But, although the report is dated in January, and the referees state that they had informed the engineers of the Chartered Gas Company of their new method of using lime-purifiers, the official testings for the quarter ending with March show no improvement whatever in the purity of the gas supplied to the City, either from Beckton or from Bow-common. The monthly averages of sulphur in the Beckton gas since the year began have been as follows:—January, 45 grains per 100ft.; February, 44; March, 38; while in those months respectively the impurity has been as high as 58, 51, and 53. In the gas supplied from Bow Common, the average of sulphur in January was 23, grains per 100ft.; February, 22; March, 21; while in those months respectively the sulphur has been as high as 35, 30, and 30 grains.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

A GIANT PLANET.

[4446.]—"HYRAB SCEN" (letter 4429, p. 384) is a pleasing critic. It appears there is "so much loose reasoning" in my article (I may as well admit the authorship) that "it is not amiss to call the attention of your readers to it." This, however, "Hyrab Scen" only talks of doing; for he proceeds to attack part of a sentence which does not belong to my reasoning. Let me give the whole sentence. It runs: "And after all, let us remember that the theory that Jupiter is an intensely heated globe—*a theory to which we have been led by the consideration of many observed facts, and which, in its turn, suggests very satisfactory explanations of other observed facts*—would merely show that [as Jupiter and Saturn hold an intermediate position between the sun and the minor planets in respect of size, so these giant orbs hold a corresponding position in respect of inherent heat]." The part in brackets is the only part quoted by "Hyrab Scen." All my reasoning had been already given, and I was merely describing the general character of my inferences, in that half sentence which "Hyrab Scen" chooses to present as part of my reasoning. Then comes his startling discovery that 82,000 is not the arithmetic mean between 8,000 and 840,000. Has "Hyrab Scen" never heard of a geometric mean? and would he denounce a mathematician who said that "2 is a mean between 1 and 4," because 2 is not the arithmetic mean? Is not 82,000 pretty near the true geometric mean between 8,000 and 840,000; and do I attach the slightest importance to the numerical relation? I do not think any one of my readers (including "Hyrab Scen") for a moment doubted the real meaning of my statement. Then he goes on to the question of "size" as distinguished from "diameter;" and he says. "When we remember that the sun's bulk is more than a thousand times greater than Jupiter's, we shall easily see how little he (Jupiter) is entitled to hold the place the writer assigns to him." Does "Hyrab Scen" need to be told that Jupiter's bulk is more than a thousand times greater than the earth's? or that it was the (rough) correspondence between this relation and the relation between the sun and Jupiter that I had in view? He then similarly maltreats my remark about Jupiter's heat, as compared with the sun's and the earth's. And he very fitly concludes this portion of his argument by saying that "when the writer of the article thinks fit, with insufficient regard to facts, to place Jupiter midway between the sun and earth, in respect of bulk and temperature it looks very much like struggling to find the materials with which to build a theory at any price." He must have known perfectly well (or why garble the extract from the above quoted sentence?) that the materials for the theory had been already found—see the italicised words above; and that the theory would not be in the least affected, even though "Hyrab Scen's" reasoning were correct.

As to the next paragraph of his letter, "Hyrab Scen," if he has read my article, knows perfectly well that I do not regard the cloud envelope as covering the whole of Jupiter. It is the very essence of my reasoning that the red-hot surface of the planet would be discernible—perhaps even through the cloud belts which seem to us the densest. Dr. Tyndall's researches about the "*very material retardation*" (doubtless "Hyrab Scen" means *absorption*) of radiant heat by aqueous vapour relate (in the main) to obscure heat rays, and my theory presents the heat of Jupiter as (in the main) not obscure. "Hyrab Scen" holds that "the clouds of Jupiter *must* be as dense as a Newfoundland fog bank," and also that "they *must* partake more of the nature of semi-condensed steam than of terrestrial clouds." When he has selected between these utterly discordant "must be's" it will be time to discuss his inferences, which at present seem based on a convenient mixture of the two. It further appears that granting Jupiter to have such and such a temperature, the amount by which his satellites' temperature will be augmented, "admits of strict calculation." Unfortunately "Hyrab Scen" does not give us any illustrative calculation. He only tells us that if Jupiter's heat be 1,200° F., the outermost satellite must receive less than 2° from such a source. I should very much like to see the calculation by which this result has been achieved. I fancy "Hyrab Scen" counts degrees Fahrenheit much as a schoolboy counts marbles.

Amazing, also, is the assertion that if not illumined by the sun and shining only as a red-hot planet, Jupiter would be invisible to any dwellers in his most distant satellite. This is almost as bad as Mr Lockyer's mistake about Huggins's ingenious experiment for testing the luminosity of certain nebulæ! "Hyrab Scen" may take it for granted that under his supposed conditions Jupiter, as seen from its most distant planet, would appear as a red-hot orb showing a disc 65 times as large as our moon's. This disc would appear just as *bright* as red-hot iron. I conceive that on a dark night a globe of red-hot iron subtending to the eye an angle of $4\frac{1}{2}$ degrees would be discernible without "any optical power greater than our unassisted vision." But "Hyrab Scen" shares the common error that distance *per se* has an effect in diminishing the apparent *brightness* of a luminous object.

In the third paragraph of his letter "Hyrab Scen" makes me say that "Jupiter shines three or four times as brightly as a globe of his size should if reflecting the sun's light only." He omits the somewhat important words, "*if* constituted like Mars or the moon." To remove all misapprehension, I actually added the words, "Jupiter shines, in fact, very nearly as brightly as though he were constituted like one of our terrestrial clouds." This would, however, have ruined "Hyrab Scen's" ingenious argument, and is accordingly not admitted.

Of course, the argument though ingenious (in a bad sense) is sheer nonsense. What does "Hyrab Scen" mean, for instance, by saying that "sunshine here is hundreds of times brighter than the light emitted by a body heated to redness"? He can hardly mean that a body illuminated by sunshine is hundreds of times brighter than red-hot iron. If he does, I would ask, "What sort of body?" Does a piece of black cloth, for example, illuminated by full sunlight, shine hundreds of times brighter than red-hot iron? If he means that the sun's disc as we see it is hundreds of times brighter than red-hot iron, then what does he mean by the sun's light at Jupiter being one twenty-seventh part of what it is on the earth? The sun's disc as seen from Jupiter is just as bright as the solar disc *we* see. It is its apparent size, not its brightness, which is reduced to one twenty-seventh by the increase of distance.

But "Hyrab Scen" knows perfectly well that in my article on Jupiter I only weigh actual evidence, and deduce certain probable inferences as to Jupiter's condition. I do not attach the slightest *weight* to the questions whether his satellites are inhabited, whether he warms them, and so on. I only touch on these matters in the concluding paragraph of the article. I expressly indicate my belief that such considerations afford no valid testimony for the theory embodied in the essay, adding "that theory must stand or fall according to the evidence in its favour or against it." Nor even do I describe the evidence I have gathered together, in the body of the article *and elsewhere*, as in any sense conclusive.

I hoped, when I read the first sentence of "Hyrab Scen's" letter, that I was coming upon honest criticism, from which I might learn something. To such criticism I am always glad to listen, and not unfrequently I have found in it good reasons for modifying or abandoning opinions of my own. Nor do I in the least mind how strongly it may be seasoned. But "Hyrab Scen's" criticism is not of this sort. He garbles extracts too cleverly for me to suppose that he is either so simple or so ignorant as he represents himself.

To a critic of another sort, who asked recently whether there may not after all be living creatures in such a world as I take Jupiter to be, I would submit that life on a red-hot globe, if possible at all, must be of a kind too far removed from our experience to be a fit subject for reasoning or discussion.

RICHARD A. PROCTOR.

[4447.]—"HYRAB SCEN" is sadly wrong in his criticism of the remark (let. 4429, p. 384) that a diameter of 82,000 is "midway" between 8,000 and 840,000. It could hardly be more accurately so. The nearest whole number to the mean is 81,975; and if these are taken for the earth, Jupiter, and the sun, the latter will be in diameter just as many times Jupiter as Jupiter is diameters of the earth; in surface also, as many Jovian surfaces as Jupiter would display terrestrial ones; and in bulk, the sun would divide into as many Jupiters as Jupiter would into earths. What other intermediate dimension would "Hyrab Scen" suggest as "midway"? He remarks rightly, however, that a mere red heat would by no means account for the fact (if it be a fact) of Jupiter and Saturn each emitting a sensibly greater amount of light than can fall on them from the sun. It would require a decidedly white heat, as high as that of melted cast iron, to rival the brightness of a white object reflecting even Jovian sunshine (a twenty-seventh part of ours), or perhaps even Saturnian, which is about a hundredth of the intensity of ours. This admits of easy proof, even in London, this fine weather; for if we let a sunbeam pass through any concave lens, it will so diverge that an object placed in the shadow of the lens, and at 4·2 times its focal length, will be just as much sunned as Jupiter, and one at 9 times the focal length will be in the condition of Saturn. We may thus exactly represent the sunshine of any exterior planet, and with a convex lens that of Venus and Mercury. By putting your hand at three-tenths or at six-tenths of the way from the burning-glass to its focus, you can judge, in the former case of Venereal, and in the latter of Mercurial sunshine; and the appearance of these planets, as well as of Mars, very well agrees with theory, supposing all about as reflective as the moon, or a lightish gray slate. But not so with the two giant planets. Years ago the sight of their occultations by the moon impressed me with the idea that they far too nearly resembled her deeper-tinted portions, and Jupiter even her bright edge, to be emitting only a twenty-seventh and a hundredth of her average light respectively. Their total lights might be very exactly compared, without much difficulty, by their images in convex mirrors, removed to different distances from the eye, till they are equalised, by night; and by day the moon's reflectiveness might similarly be compared with that of white lead, frosted silver, soot, lamp-black, or other standard materials. This is, I suppose, the way Dr. Zöllner arrived at the result of Jupiter shining "three or four times" as much as he could by sunlight, though the "three or four" seems to me very vague for a serious experiment.

But surely such a result would be conclusively tested whenever a satellite and its shadow are both seen on the disc and near its centre at once, which is not a rare event. If the planet's total light be "*three* or *four* times" his possible reflection, his independent light must be at least *two* or *three* times the reflected, supposing him as reflective as snow or white lead, and in a greater ratio if he is only as reflective as the inferior planets. On the probable assumption of the satellites having no native luminosity, then the spot shadowed by one would be *twice* or *thrice* as bright as the sunned satellite itself, so that whenever the two are seen well within the disc, say in the central half of its area, the body must be decidedly the darker of the two spots. Is this so *always*; or rather, has it *ever* been observed? A late correspondent described a transit in which, when the shadow entered the disc, he was surprised how little darker than the satellite it was. But this must have been at the border, where, by hypothesis, Jupiter's non-luminous but reflective envelope is alone visible. His brightness does certainly decline towards every border, like the sun's, and contrary in this respect to that of Venus, and notably of the moon. But on the self-luminous hypothesis there must be a majority of the disc whereon shadows, far from being *any* darker, must be never, *in any case*, so dark as the satellite casting them, if visible at all. On the other hand, the common theory of solar light alone requires them to be *always* darker, and, indeed, absolutely black, unless the satellite casting them have a very great atmosphere, for nothing else can reflect or refract solar light to them in sensible amount. The other satellites are either absent or in their horned phase.

Again, the question of Jupiter's temperature is surely now far more within experimental reach than that of stars. If Mr. Huggins has detected *any* star's heat rays with his refractor, how much more might be expected of the 6ft. Rosse mirror, with some 30 times the grasp, and no passage of the rays through any medium but air! Would, indeed, it were Teneriffe air instead of Irish, and reflection from a silver film on glass instead of bronze, and capable of being turned to receive rays of the interior planets or horned moon by night, instead of only by day; but still, this thermometry would seem the special work for a giant mirror, and considering that its image of Jupiter must cover a good-sized pea, so that a thermo-battery need not have more surface than to be nearly covered by it; surely the temperature of either the giant planet, or of nebulæ, or comets (all, I believe, yet untried) must be more accessible (as well as more desirable to know) than that of stars, which few have ever doubted to be hot—

Doubt that the stars are fire,
Doubt that the sun doth move!

No, Hamlet, we have quite returned to Mediævalism from both these doubts, but we remain in much doubt about nebulæ and comets (the only bodies really interesting us, as possible and not improbable intruders on our home), and even of our neighbour the moon, what heat she really absorbs and re-radiates is a question as yet strangely ill-approached. The important distinction of her merely reflected heat rays from those warming her has not been made, as it might easily have been, by comparisons of radiation from her illumined and dark parts, and specially at her two quadratures, and between those that have just left their fortnight's day and those about to enter it. All these are experiments that it seems wasteful to grope after with instrumental powers so very far below the highest as all those on which the duty has been hitherto thrown.

E. L. G.

[4448.]—REFERRING to the article with the above title, reprinted on p. 244, and to the reply (let. 4429) of "Hyrab Scen," I may be permitted to supplement the latter's objections to the idea of Jupiter being a sort of midway sun, by calling attention to the planet's appearance at quadrature. If he were a light-giving body, there would be no approach to a gibbous form. I am aware that Arago says there is no phase, but with all due deference to the French philosopher, we must not forget that his assertion has been contradicted by our eminently exact observers, De La Rue and Webb. This fact alone seems to me to tend greatly to nullify the theory that Jupiter gives out unreflected light—unless, indeed, the writer of the article in question considers the inherent light to be so faint, from the heat being of a dull red, as to cause a portion of the planet to be invisible at quadrature by contrast with the reflected light. If this be so, the gain to the satellites must, indeed, be slight.

I may also remark that though Mr. Browning did not see the orange belt till 1870, he having, I ...

previously observed with a smaller aperture, it had been constantly observed at Greenwich.

For my own part I see no reason why we should not allow that planets have atmospheres, differing from our own in such a way that the heat and light rays of our sun are so mollified or intensified as to make Mercury and Venus as habitable as Uranus and Neptune for beings adapted to their respective situations.

L.

AXES OF THE PLANETS.

[4449.]—THERE is a slight inaccuracy in the statement made by "F. R. A. S." (letter 4404, p. 380) on this subject, where he says that the equator of Jupiter is inclined less than 2° to the plane of its orbit. The inclination exceeds 3°. The *positions* of this planet and of Mars are pictured in my charts of the planetary orbits. Recent researches by Dr. Oudemann set the inclination of Mars at about 1½° less than Herschel's estimate. I conceive that De Vico's observations of Venus, even if their accuracy be not admitted, are scarcely spoken of quite justly when "F. R. A. S." says De Vico *imagined* the inclination of Venus to be so and so. Webb speaks of De Vico's work with some degree of confidence. Admiral Smyth adopts Bianchini's estimate of the inclination—viz., 75° (between equator, plane, and ecliptic). So does Prof. Grant.

As to Mercury's inclination, can any reader of the ENGLISH MECHANIC give Schröter's estimate? Webb gives it as 70° for inclination of axis to orbit; but I am uncertain whether he means this angle or its complement, for he speaks of the *axis* of Venus as greatly inclined. Grant says that "the axis of Mercury is greatly inclined to the ecliptic, according to Schröter." Hind omits all reference to Bessel, saying that only Schröter has seen any signs of rotation. I have always supposed that Schröter found the inclination between Mercury's *equator* and orbit to be 70°; but this may be wrong. If the complement of this angle is in question, and Bessel's observations are independent, there would seem to be better evidence respecting Mercury's axial pose than is commonly imagined.

I wonder why Mr. Johnson (answer 12164, p. 390) thinks *Mars* so very warm that its heat "to ordinary animals would be destruction!"

RICHD. A. PROCTOR.

GASSENDI.

[4450.]—REFERRING to Mr. Birmingham's letter (4241), I think difference of illumination, though occasioning some difference in the aspect of lunar objects, cannot fully account for the differences found in our respective sketches. The principal cause I believe to be our difference of purpose. Mr. Birmingham has tried to give a general view of the aspect of the north portion of the floor of this crater, while I almost entirely disregarded appearances, my aim being to note down the place and describe the nature of every distinct object seen at the time. Doubtless, it would be far more pleasing to the eye, and in no way diminish the usefulness of sketches, if they were always neatly shaded, as desired by your correspondent "E. B. F." (letter 4381). Only, in that case, details would have often to be sacrificed. Now details are certainly what we need the most. "To understand how celestial objects appear when viewed through large telescopes," is not, certainly, an unreasonable desire; but this is not the ultimate object one ought to have in view when looking at celestial objects. The telescope is not merely an instrument to introduce us into magnificent shows, but it is a means of study. Mr. Birmingham shows ridge 21 (see letter 4076) as extending eastward of crater 18. I never saw it thus. On the other hand, the position of crater 16 given by him is better than in my sketch, as this crater ought to be nearer cleft 20 than cleft 17.

Jumet-Hainaut. C. GAUDIBERT.

P.S.—Though late, allow me to tender my thanks to Mr. Knott for his prompt answer to my query about ζ Cancri, and also to the Rev. H. C. Key, who so willingly gave such interesting and very uncommon details about this double. It would seem that the companion was about this time at its nearest approach to the primary, as I find (p. 381, Vol. X. of the ENGLISH MECHANIC) in a letter of "F.R.A.S." that according to the latest measures in 1869 it was 0·40". In May, 1868, Mr. Key found it just separated with his 18in., or about 0·25", or 0·30", and since then the distance has continually increased. This date, May, 1868, is of importance as the starting point to ascertain the time of the revolution of this star, which time is not yet satisfactorily determined. Mr. Webb, in "Celestial Objects," p. 199, quoting Jacobi gives not much less than 100 years, while Mr. Hind (see ENGLISH MECHANIC, No. 318, p. 128) gives 58·23 years.

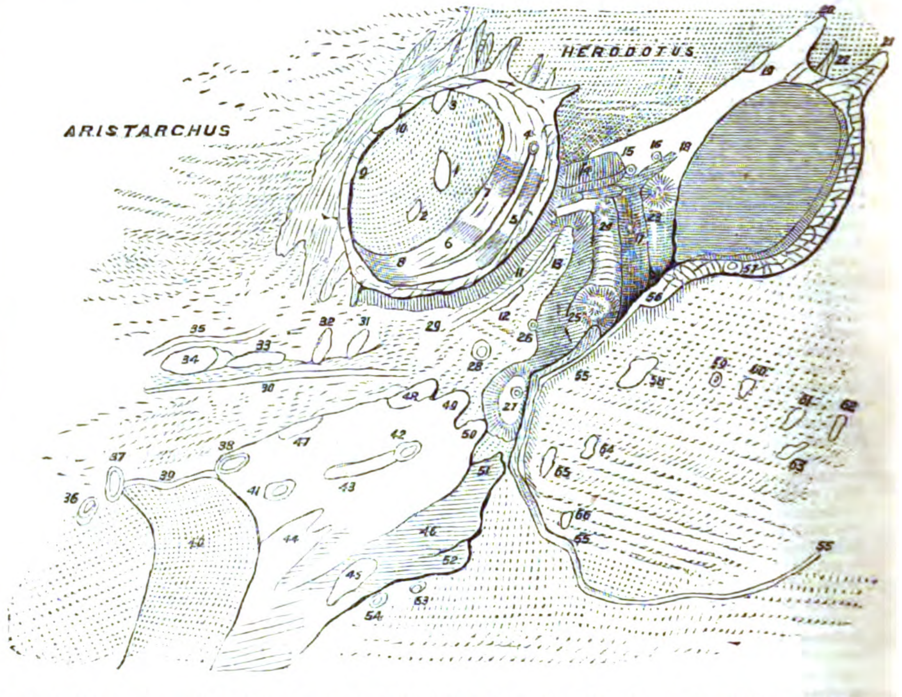
MILK.

[4451.]—THE paragraph, p. 393, quoted from American sources, may mislead many, as it is utterly erroneous. All the world over "a pint of water is a pound and a quarter"—*ergo*, a quart should be 2lb. 8oz. Now, the specific gravity of cow's milk ranges from 1·03 to 1·04, and, therefore, the lowest weight of a quart of milk, if pure, must be 2lb. 9·6oz., instead of 2lb. 2½oz. I fear Mr. Gail Borden, of White Plains, N.Y., must be a 'cute Yankee, who employs measures which would make even a London dairyman turn green with envy, though the latter fully adopts the maxim once calmly enunciated to me by a Chinese to whose charges for milk I objected, "You want milk more cheap, I can,—can put more water." SIGMA.

ARISTARCHUS AND HERODOTUS.

[4452.]—ON May 12, 1872, you kindly published one of my sketches of this lunar group. Unfortunately, I did not then follow the excellent advice given by Mr. Birt, of numbering each object seen, so that when new objects are discovered, their position can easily be determined by referring them to other objects in their immediate neighbourhood. This, and also some other objects not seen by me before, whose positions I could not very well give by referring to that sketch, without a long and doubtless confusing description, is my excuse for soliciting the engraving of another sketch containing the observations of two consecutive evenings, the 17th and 18th of June, 1872.

1 is the central peak on the floor of Aristarchus; it was neatly seen on the 18th, very bright, elongated in a south-west and north-east direction. I think those observers who have large apertures, might successfully look for another small peak on its north-east end. 2 is Browning's peak, which was dull compared to 1. 3 is the peak I saw for the first time on May 30, 1871. It was also dull, but rather easier to see than 2. 4, a shallow craterlet along the eastern interior slope, nearer to the top. 5 is an interior ridge, running from crater 4 parallel with the eastern ridge of Aristarchus, which I saw for the first time on May 1, 1871, but which, I believe, had been seen before by Mr. J. Birmingham. 6, 7, and 8, are dark portions of this slope quite in contrast with the rest. The darkness of 6 is narrower from the floor of the crater to ridge 5, than above. 9 and 10 are two elongated bright peaks on the south-west wall of Aristarchus, but they are not high, I believe, for I scarcely could distinguish their shadows on the 17th. Just north-east of Aristarchus the surface is very much depressed if compared to the portions marked 14, 24,



and 25, but is very much on the same level as the large flat valley running north-west of Aristarchus, where 30 stands. I have tried to show this depression, as it gives a better idea of this whole locality. In this depression 11 is a cleft, and 12 and 13 are two elongated ridges along its north-east border. Here, also, are two other craters which will be described below; 14 is a mass of darkish rocks which with cleft 18 penetrate into the streak of light forming the south-west border of Herodotus, and divides it into two branches. No drawing made with the hand while the eye is at the telescope, will give an adequate idea of this object. 15 and 16 are two very small craterlets on the south border of the eastern portion of cleft 18. These craterlets were seen on the 17th, when the streak of light was on the terminator. The next evening not the slightest trace was visible either to the eye or imagination, though I knew where they are, and I carefully looked for them. 17 is the large valley cutting the plateau which stands between Herodotus and the depression east of Aristarchus. It runs in a somewhat south-west and north-east direction. Its south-west end opens in the middle of cleft 18; its north-east extremity rapidly descends from the towering height where it runs, but it is not cut perpendicular as one would think, when some shadow remains there. It reaches a small cleft, 56, described below. Just south of 17 in the valley there is a small hill seen only on the 17th. 18 is a cleft extending from the east side of Aristarchus into the streak of light. It runs at the foot of rocks 14, but far above the depression on the north, and before it reaches valley 17 it is stopped in two places as if it had been made of an elongated double crater whose walls were still standing. Its eastern extremity clearly stopped in the streak of light and the rim of Herodotus showed no cutting, and yet I have seen at other times this portion of the border of Herodotus quite dark, as if cut. Does cleft 18 cut through this border, or is the darkness caused by the shadow of the towering hill 23? 19 on the south border of Herodotus is a mound on the streak of light seen only on the 17th. 20 and 21 seem to be the remains of an old crater whose south portion has disappeared; 22 a low ridge inside; 23 is a very prominent hill between Herodotus on the east, part of cleft 18 on the south, and valley 17 on the west. On the 17th its shadow was crossing the east rampart of Herodotus, when it came into light. 24 is another hill, but smaller on the opposite side of valley 17. 25 is a very high hill on the north extremity of the west side of valley 17. At the west foot of this mountain, in the depression, there is a craterlet 26, seen for the first time on the 17th; no trace of it next evening. 27 is another mountain not so high as 25, and connected with it by a lower range still along the west border of serpentine valley. On the top of 27 I found a craterlet on the 17th, not seen before by me. 28 is Browning's mountain, but I see it still as a crater with the east and west sides higher than the north and south. 29 is a mound at the opening of the large valley where 30 stands. 30 is a cleft running almost diagonally through this valley. 31 to 34 are mounds forming the south border of the large valley. South of these mounds there are others whose positions I had no time to take. South of mounds 33 and 34 there is a cleft following their contours to some extent. 36 a crater, 37 and 38 are two craters, one situated just on the border of the table-land west of valley 40, and the other on the border of the table-land east of 40, and connected with each other by a cleft 39, bulging north nearly in the middle; 40, a large flat valley; 41, a crater; 42, another crater, west of which is a low ridge 43, running in the direction of crater 41; 44, a low large mound forked on the south-east; 45, a low mound brighter than its immediate neighbourhood; 46, portion of this table-land lower than the rest; 47, an elongated mound along the south border of this table-land; 48, a mound which as well as 49 and 50 project into the depression east of them; 51 and 52 are two other projections of the same kind in the lower portion of this table-land; 53 and 54 at the north foot of the table-land are two craters; 55 is the great serpentine valley. This curious object takes its origin at the north foot of mountain 25; it is enlarged at once more than in any other portion of its course, and encroaches upon the slope of the mountain. It follows the eastern slope of the mountain range 25 and 27, and continues its zig-zag course very much as shown in the sketch; 56 is an opening in the north border of Herodotus, which has been pushed outwards. Within this opening runs a small cleft which connects the great serpentine valley 55 with the interior of Herodotus, and along its course, passes across valley 17, but on a lower level, and seems to cut it much in the same way as cleft 18 cuts the opposite end; 57 on the north border of Herodotus is Schmidt's crater; 58 is a mound; 59 is, I believe, a crater; 60 to 66, mounds. On the south-west of Aristarchus are ridges somewhat as shown, but time failed me to examine them with sufficient attention to describe them.

Jumet-Hainaut. C. GAUDIBERT.

SUN SPOTS.

[4453.]—POSSIBLY Mr. Hart's letter (4398) may serve to explain the nature of sun-spots. May they not be incrustations on the molten substance of the sun? It is singular that Sir John Herschel says that he once saw a sun-spot break across in the middle—or, at least, saw a band of light suddenly appear across one; which would be a phenomenon precisely like that mentioned by Mr. Hart, where he says that the hardened lava at Hawaii suddenly splits up. A.

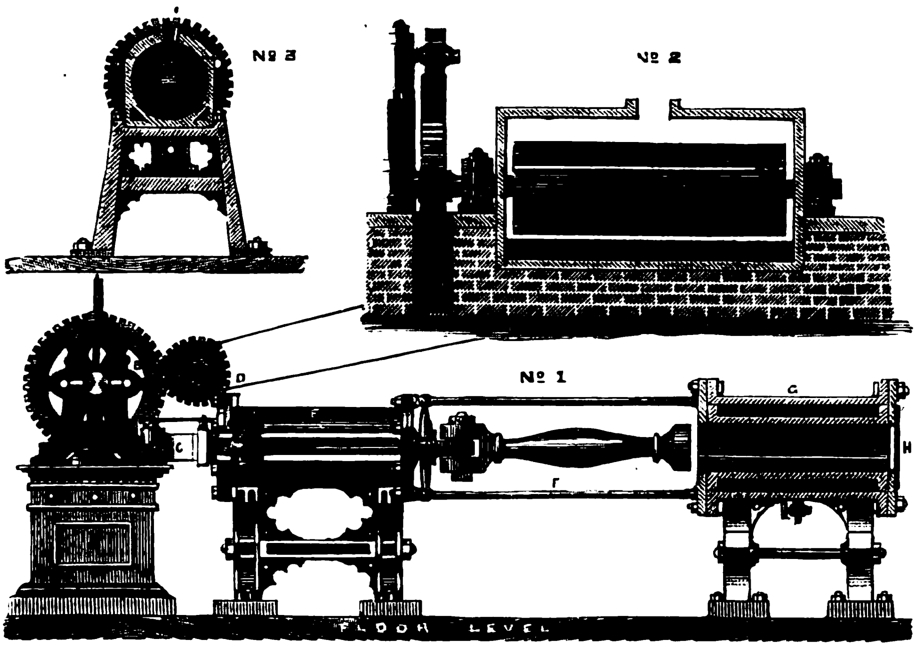
NOVEL METHOD OF SAWING TIMBER.

[4454.]—AN extremely original method of sawing timber has been recently patented in the United States by Dr. G. Robinson. It consists in applying a method hitherto employed in removing tumours from the human subject to the felling of trees and cutting up of wood. Most of your readers are aware that when a current from a galvanic battery is passed through a platinum wire the latter becomes red or even white hot. This red-hot wire is made to burn through a tumour or other excrescence which it is desired to remove, and the idea suggested itself to Dr. Robinson that wood might be divided in a similar manner. On trial it is said that this proved to be the case; for on pressing pieces of wood against a red-hot platinum wire through which a current of electricity was passing, and imparting to them or the wire a movement imitatory in a way of the action of a saw, they were divided in any required direction. By fitting the wire with handles so as to guide it in any and every direction the most intricate fretwork can be done. Some of your readers, who have the requisite appliances, will probably experiment and let us know the result, especially as to the cost of the process. G. J. H.

WIRE-COVERING MACHINES.—II.

[4455.]—IN reference to diagrams last sent (let. 4410, p. 381) of the wire-covering machines, I did not mention that the wire has to pass through the machines twice, and sometimes three times; if more than one wire is required two operations are needed to cover one wire. Sometimes three or four wires are made to pass through the same die, consequently there are as many separate currents of electricity; each wire has a separate covering first before it is made to pass through the same die. In order to prepare the material for covering the wire it is necessary to employ strong and powerful machinery. The tenacity of the material can only be understood by those who have had the working of the same. The writer has not only supplied these drawings, but worked the machines and worked and cut up tons of the material. Gutta-percha must first be cut up with a machine, by some called a "devil," next it is heated in a tank, the water kept boiling by steam; when sufficiently heated it is taken out and transferred to the masticator, whence it is thoroughly wrought into a mass resembling more the appearance of common putty, only of another colour, and more tenacious. It is then taken out from each masticator in masses of about 160lb., and transferred to the hydraulic strainer from which it has to pass through a fine wire gauze, backed by a strong perforated steel plate, after passing through this all impurities are removed. After undergoing several hours' more mastication it is again carried to the machine-room to be cut up in 80lb. pieces for small pickles or masticators, and after that to 40lb. pickles. When a wire machine is to be charged one of the 40lb. pickles is taken out and passed through hot steam rollers; as it passes through it is rolled up in a long roll and then cut in charges the size of the cylinders, and the screw plunger set to work. The second cylinder is charged in the like manner; as soon as the first cylinder is nearly exhausted indication is given by the plunger ringing a bell to summon attendance, the stop cocks are turned in turning off the exhaust; the charged one is turned on, the empty plunger is run out, and the cylinder recharged to be also in readiness at the next sound of the bell. No. 1 is the principle of the hydraulic strainer; A, water-tank, cog-wheels working four eccentric pumps; D, stop cocks for forcing piston and plunger, or withdrawing the same; E, cylinder; F, plunger; G, cylinder with vacuum for steam; C, safety-valves. No. 2, the 160lb. masticator. No. 3, end section of 80lb. and 40lb. pickle.

JOSEPH WILLIAM FENNELL.



THE NEGRO.

[4456.]—"FIDDLER'S" difficulty (let. 4365), which superficial would-be critics in every age continue to make, about deriving negroes and other varieties of man from one ancestor, Noah, overlooks the fact that no history, Biblical or other, has ever implied the existence of more than a quarter of Noachian or Adamite blood in any modern race. Our common father, Noah, is represented as the last Adamite, or member of that peculiar, last-formed, and noblest human race who lived commonly 900 years, had children at the end of five centuries, and in no case under the age (according to the most trustworthy copies) of 162. Such a race must have been, as Professor Owen has lately pointed out, different enough from any now existing, to merit, according to any extant zoological ideas, being classed as another *species*, rather than mere *variety*. Perhaps the rare but well-attested phenomenon, in all historic times, especially the most civilised, of very old persons occasionally cutting new teeth (as old elephants, &c., regularly do) may be a case of *atavism*, or casual reappearance of an Adamite peculiarity, inherited through our single Adamite ancestor, Noah. But did Noah, like his nine paternal ancestors, marry an Adamitess? The suddenly shortened life of his son, barely three-fifths of his own, and still more shortened in all that son's posterity, surely implies that Shem was only a half-blooded Adamite, and his mother one of the "daughters of men" mentioned in Gen. vi. 1, 2—*i.e.*, of the Nephilim or inferior and shorter-lived races, wherewith the higher caste of Adam, who had long been "called by the name of the Lord" (iv. 26, marg.), or had been a sort of Israel, or sacred, teaching and ruling Brahminical caste among antediluvian man, began first in Noah's time to intermarry. There is not a word to imply this new custom of "the Sons of God" had been forbidden, or was generally wrong, or inconsistent with Noah's character as "a just man and perfect in his generations." The latter phrase may mean no more than a monogamist, or may not refer to morals at all, but imply a man of perfect or pure race, he being the last on earth who was so. Now, if his youngest son, Shem—born after the first prediction of the Deluge, indeed above twenty years after (vi. 3, viii. 13, xi. 10)—was, as we see the story implies, a half-caste, there can be no reason for supposing his elder brothers higher born. But they were the sons of two, and probably three, mothers; of two at least, because Gen. ix. 21, corroborated by the Pagan proverb "as old as Japetus," implies Japhet to have been old when his brethren were not so; and decidedly older than Shem, even centuries older, would his *eldest* brother naturally be, if his father married, as all his forefathers had done, in their second century. But then the mother of Japhet cannot be supposed to have not borne her third son till two or three centuries later. The obviously greatest probability is that she died; and not only she but a second Mrs. Noah, the mother of Ham, some time later. This is implied by Shem being called (after Ham's posterity has been described) Shem, "the brother of Japhet the elder"—a brother of old Japhet in some sense wherein the intermediate Ham was *not* so. It may mean brother in character, or in maternal pedigree, their two mothers being of one race or nation, and in either case implies Ham to have had a different mother from both. But if, as is thus plainly implied, our three fathers were each a half Adamite only, and maternally descended of two, if not three, distinct non-Adamite varieties or species, each would be most likely to choose a wife of his own mother's race (if not of his father, Noah's, which may have been providentially prevented, or even forbidden); and hence their children, the first three born after the Flood, would be only quadroon or quarter Noachites; three of the grandparents of each being of one race, we know not how distinct from Noah, but if no further than present Malays, Mongols, and Negroes are from Caucasians, these first-born postdiluvians would be as different as a Sambo (or three-quarter Negro), a three-quarter Malay, and a Mestizo (or three-quarter Carib and one quarter European). And such dilution of the long-lived Adamite element is plainly implied, in Gen. xi., by the longevity in Shem's line falling *not gradually*, but first to about *half* the old standard, and then, after three nearly uniform generations, as suddenly to about *half* again. Doubtless the mass of antediluvians, the "flint-folk," and other kinds of Nephilim, had been shorter lived than ourselves, not having the quarter of Adamite blood that, as a whole, we moderns inherit one with another.

"Fiddler" must surely allow, then, that our common descent from Noah does not prevent our supposing the differences seen between human varieties to be far older in origin than his time, or even his ancestor Adam's. Not only does his story, when examined, make such differences probable, but I maintain it makes for one race being as specially marked off from other four or five as he says the Negroes are. It plainly represents Ham as more different from his brothers than they from each other. Now every son of these three must have married either a cousin or sister, and as we read of no law against the latter, though it would be naturally the rarer case, there would arise in the next generation six varieties, the purely Semitic, Hametic, and Japhetic, and the three sorts of half castes, more in number than the three former. Ham's and his wife's peculiarities in their full intensity could only descend in the family of such of his sons as married a sister. Now, of his four sons (Gen. x. 6) there is but one, Phut or Put, to whom Negroes, or central and south Africans appears traceable (see Nahum iii., 9, spoken of the city of Thebes, or No-Ammon). The other three, Cush, Mizraim, and Canaan, are well identified, as fathers of the dark but not black nations, they having doubtless married cousins, and only Phut a sister.

If Negroes were not Noachides, they would have no traditions or ceremonies alluding to the Flood, the Ark, the Dove, Noah's Sacrifice, &c. But such they have, as well as all other races. The *Jonkanoo* dance was a memorial of the great deliverance, which they still preserve in the West Indies, or did during slavery, though their masters, by making them repeat it for their amusement, at any season indifferently, eradicated its religious and chronological character. In Cynric R. Williams's "Tour in Jamaica," 1826, it is noticed. The chief dancer, though chosen for activity, wears an aged mask and white beard worthy of Noah, and the Ark is always represented by a model of a roofed vessel. The real marvel, in the varieties the traditions have taken among such separated tribes as Mexican, Chinese, Polynesian, is that so many should be recognisable and unmistakeable, when we consider how the priests of civilised ancient Egypt, for instance, had disguised the whole subject, to feed the national vanity with ideas of their fabulous antiquity. None, probably, could guess that in their story, as preserved by Plutarch, the killing of Osiris by his brother Typhon, floating of his divided body to sea in an ark, &c., was the killing of humanity, or the antediluvian civilisation, personified as Osiris, by the Flood, also personified as Typhon, &c., were it not for the chronological note that "all these things were said to be done on the 17th day of that month wherein the sun" (in Plutarch's time) "enters Scorpio."

If the most separated nations had not a common ancestor, it would be quite inexplicable how their theogonies came to agree in the attributes, relationships, and alliances of all their principal and secondary gods and goddesses. When Greeks or Romans learnt the mythology of any newly found distant barbarians, they had no difficulty in recognising their own deities. One nation could always tell which of another's gods was their Saturn, or Vulcan, or Pan, or Silenus, either by the characters or kinship and marriages; for marriages of every nation, however numerous, are all related, and married to brothers, sisters, or cousins. But this would not have been, unless the myths related to the same real persons, the children and grandchildren of Noah. They are seen through a multiplying glass, but rarely are two confounded. One man, by the different sides of his character, became various gods. Noah, being father and ruler of the golden age, but being also inventor of tippling, and these characters being too incongruous to adhere long to one subject, he necessarily becomes, as the great Saturn, one deity, but as Bacchus, quite another, among the secondary Olympians. So, again, he was in one view the father of gods and men, but yet was rather the past father, old Cronos, superseded, and his dominions taken by his three sons, of whom all nations knew, and how the youngest and yet mightiest ruled earth in a special sense, the most continental and dry regions, another the sea and "isles of the Gentiles," and a third the hottest lands and swarthy races. And all knew of the "war of the giants," the first rebellion of Cushites against Shem's authority, soon after succeeding to his father's peaceful rule of 350 years; agreeing not indeed with the corrupted and absurd numbers of the modern Jews' version and English of Gen. xi., but perfectly with it genuine readings, the Samaritan, and copies used by Josephus and all ancients; which make Peleg's birth, when "the earth was divided," 50 years after Noah's death.

Another coincidence between all the oldest nations' traditions, inexplicable if it were not a fact, is the identical change in the length all give to their reig[illegible] or generations about that Peleg's time. It is no va[illegible] memory, observe, that a long while ago our anc[illegible] were longer-lived than we. This is totally mi[illegible] senting the phenomenon, which is an extremely and precise one—namely, that whatsoever people have kept records of dated time professedly reaching above 24 or 25 centuries B.C. have all written the reigns, throughout these 43 centuries at least, of no greater average length than modern reigns, but all agree just as uniformly in making the preceding two, three, or four reigns, whichever number they record before that date, reigns approaching or exceeding a century. The Chinese do this; the Hindoos do it; the Persians do it; the ancient Chaldeans, Phœnicians, Egyptians, each did it, as testified by Berosus, Sanchoniatho, Manetho, &c. Now the length of reigns nowise depends, observe, on length of life, but only on the time elapsing between a father's birth and his son's birth. The last ten lords of any manor would have had no longer average tenure if they had all enjoyed the longevity of Noah. The coincidence of histories on this point, then, is totally distinct from that of patriarchal longevity, in which they equally agree. Thus, apart from length of life, the reigns attributed to the first four Chinese emperors from Fo-Hi (the father of the Ark) average the very same length as the contemporary four generations of Shem's line in Gen. xi., as preserved by the Greek and Samaritan copies (not, of course, as they appear in the Jewish and English, which have for these sixteen centuries been well known to have suffered intentional sacrilege in the shortening these numbers). E. L. G.

[4457.]—I am unable to give "Fiddler" any information as to the origin of the Negro (letter 4365, p. 358), but I write this simply to correct an anatomical error into which he appears to have fallen. The cause of the negro's black skin is not, as he imagines, a distinct "membrane consisting of minute vessels charged with fluids of the deepest hues." In order to make the matter clear, I will briefly explain the structure of the skin, which is essentially composed of two layers, the deeper being chiefly formed of fibrous tissue, the surface of which is raised into a series of minute elevations; in these the blood-vessels and nerves ramify; this is called the cutis; the other layer covers over the last superficially, filling all the depressions and serving to protect it; it is called the epidermis or scarf skin: it is entirely composed of cells, which being spherical next the cutis, become more flattened as they approach the outer surface. These deeper cells are called the rete mucosum; in the Negro they are filled with a black pigment, but excepting in the greater or less development of this colouring matter they are alike, as far as I know, in all races of man. To show that climate alone does not cause the black colour of the skin in Negroes, it is only necessary to mention the Esquimaux, who, living in the Arctic regions, are, nevertheless, very dark; moreover, they differ in colour from the red Indians, their next door neighbours in America. This fact sufficiently demonstrates the necessity of seeking for some cause, other than climate, for the variations in the tints of the human race. P. Santalinus.

[4458.]—When in Bombay a good many years ago, I remember hearing of (and seeing some of) a tribe which lived in some of the neighbouring districts. They were Jews, bearing the national stamp unmistakeable on their countenances, and therefore not mere proselytes. They retained many of the Israelitish customs, and kept themselves distinct from the other inhabitants. All this is nothing uncommon, but what is so, and is the reason I now mention them, is that they are the same colour as the Hindoos among whom they live, though other Jews of the same district are white. If I am not mistaken in my memory, various circumstances tend to show that these are descendants, not from the last scattering of the Jews, but of some very much older colony, possibly from the first captivity.

I mention this with the hope that some one who has had better opportunities of observing these people, and more full and accurate memory of them than myself, may furnish particulars. Such circumstances as this, and also the observation that the Americans born tend towards the type of the Red Indian, give support to the opinion that climate, food, and habits are the causes of all the varieties of the human race, though there is much to be said, also, in favour of their distinct origin, and that more particularly as regards the negro race. Sigma.

STONE COAL.

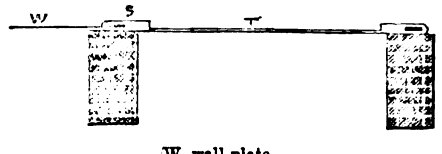
[4459.]—(4414, p. 381.)—Stone coal is so named from its hardness. It can be thrown about like a stone without breaking. It is a general name for the best varieties of smokeless Welsh coal used for malting purposes. Amateur.

METEOR.

[4460.]—On the evening of Saturday, 29th June, at about half-past ten, I observed a large meteor in the western sky. The night was clear, and there were scarcely any clouds. The meteor seemed to come from the neighbourhood of ζ and ι Ursæ Majoris, and described a longe curve westwards, sinking below Leo. Its colour was an orange red, and was of a dull light. It was much brighter than any star above the horizon; but might, perhaps, be compared to Regulus, only it was of much greater brilliancy. A long train of sparks followed, but were instantly extinguished. The duration of its visibility was not more than eight seconds. Antares.

BRANNAN'S SYSTEM OF MONOLITHIC BUILDING.

[4461.]—I accept the invitation of our "Harmonious" friend to give my views on the subject asked. It is my firm belief that doors, window-sashes, chimney-pieces, and even cart and carriage wheels might all be made in moulds from papier-mâché or some other agglutinative material, and be made as strong as, if not stronger than, wood or even iron. I believe many years ago that a very ingenious gentleman, by name Haddan, did take a patent out for the construction of railway wheels in a solid disc of papier-mâché; whether this has been adopted I cannot say. What has been done by Bielefield for full twenty years in the way of house decoration, where the great strength of the material is virtually thrown away, may, I think, be done equally well in articles of every-day use, such as tables, chairs, buckets, water-pans, &c. Considerable tact will, however, be required in the making of the moulds in such a form and in such a number of pieces as to insure perfect casting, and afford facility in detaching the moulds from the castings. I shall certainly try and see what Mr. Brannan has been doing in the way of concrete floors, and see if I can get a wrinkle. I may, however, state that in the house, or rather wing of a house that I have put up, I have availed myself of concrete floors turned on iron girders 10ft. apart, versed sine of arch 13in. I had intended to have placed wooden floors on sleepers let into the concrete, and bought the prepared boarding for the purpose; one room alone, however, has been boarded, that is the drawing-room, where, possibly, the grandchildren may want to have a dance. In the other rooms I have let into the concrete under the skirting a strip of wood 2½in. × 1in., to which the carpets can be nailed level with the floor, and to secure the wood I have nailed every two or three feet pieces of iron hoop about 15in. in length, and carried them under the concrete; nothing can exceed the strength of my floors. The house is, in fact, *one* solid mass. The shell of the arch is at the haunches about 6in., and at the centre about 3½in. I fill up the spandrils of the arches with dry sand, and over all I put about 1in. to 1½in. of *fine cement plaster*. I never leave the centres up longer than a week; on the eighth day I strike them. My stables and farm buildings are also built of concrete; in them both floors and roofs are of concrete without any iron beams. These I build all to one width—namely, 18ft., and carry my arch from wall to wall. I avail myself of the tensile force of iron inside to retain the arch in the place of a buttress outside. I place a piece of bar iron 5in. by ⅜in. or ½in., the whole length in the centre of either wall; at distances of 5ft. apart I have tie rods of ⅞in. or ¾in. iron, these are attached to the wall plate by means of a strap with two eyes, to which I bolt my tie rod.



W, wall-plate.
S, strap.
T, tie-rod.

In these buildings my versed sine is 1½in. to each foot of span, or 30in. for an 18ft. span. The most of these buildings are two storied. My work has cost me about 6½d. per cube foot for walling, and 8½d. for roofing and flooring. I find I can put my roofs on at a cost of about 57s. per square, not of roof, but of ground covered; this includes the blacksmith's bill. I have lately been constructing dairy and larder tables. These I have built on the principle of railway dry arches with flat surface on the top—versed sine of arch about ⅜in. to foot span contained by ½in. tie rods. Nothing can be more beautiful. One of the dairy tables has been made about six weeks, and is fully as hard as slate. The only objection I have to concrete is that it makes me a prisoner; I dare not leave it. I feel sure that some accident would occur. The so-called skilled labour of the English mechanic is so careless and self-conceited that it is not enough to show how a thing is to be done, but one is compelled to sit over the work and actually see it done. I have had two narrow escapes: in one case owing to bad workmanship of the blacksmith, in the other to the conceited ignorance of the carpenter. If concrete be properly done I do not hesitate to say that it can be done at 30 to even 40 per cent. cheaper than brick-work, and four times stronger. The material must be not only of the best and cleanest sort, but must be thoroughly mixed, not too moist, and well rammed. Railroad speed in putting filling over filling must be avoided; at the very utmost the frame should not be filled more than five times in a fortnight, better if only three times. This, of course, involves a considerable outlay in framing. I have, or rather had, about 500 running feet at work at a time. One learns, however, as one goes on, and were I to start again I should go a much cheaper and more expeditious way to work than I have done. The corners have always been the great difficulty, and a great deal of ingenuity has been spent to little purpose in all sorts of patented corner frames, all of which can be avoided by a little arrangement of the frames. In concrete arching it is best not to nail the ligans to the ribs; it is also as well to bear in mind that if they are kept a little apart it is much easier to take them down; the small irregularities in the soffit of the arch form an excellent key for the plasterer. With reference to the flat floor made by Mr. Brannan with the aid of a network of wire, I think the same thing can be done equally well and conveniently with good hoop iron, provided time be allowed for it to dry. The elder Brunel, I believe, made a floor 15ft. square with nothing but three tiers of 1ft. flat tiles laid in cement on a wooden platform, breaking joints in each tier. I believe there is a raised terrace to a public-house, somewhere near Notting Hill, on which our London friends may be seen enjoying their beer and 'baccy pretty thick on the ground, of larger dimensions than the above, but made in the same way. For my part, I believe a monolithic slab of floor might be made of any size self-supporting, provided the materials were good, and time given to let it harden thoroughly. In Bengal, the floors and roofs of houses are all flat, and made of large sâl beams, 3ft. or 4ft. apart, across which are placed 3½in. × 1½in. battens, a foot apart; on these battens are placed two tiers of tiles, 12in. square, 1in. thick, and on the tiles a mixture of broken brick, brick-dust (called soorkiug), and lime, to the thickness of 5in. or 9in., which is beaten down to about 4½in., and plastered with a preparation of jaggery (coarse sugar) and lime. This forms an excellent roof. I mention this in connection with a monolithic floor for the reason that in one of the old abandoned factories of the East India Company in Beerbhoom the natives had cut away all the beams of a room 23ft. by 35ft. or thereabouts, and the floor made of the materials above mentioned remained like a vast flagstone for years. Our "Harmonious" friend alludes to the desirability of building at a cheap rate dwellings for the labouring classes, in which the young, male and female, may have separate dormitories, and the heads of families be somewhat better lodged than they are at present. There is a pretty strong fever on that subject just now, and a number of architects are planning and contriving all sorts of cottages, and publishing their devices in all sorts of magazines, journals, and pamphlets. Many of their designs are no doubt clever, but I have not seen a single plan that accords with my notions of the requirements of the case. Great taste has been shown in the architecture, great consideration for the intended inmates, but at what cost? I have never seen any of these improved dwellings for the labouring classes that are in reality within the reach of the wages of the labouring classes at a proper rental. A dilettanti landowner, newly made, with an enthusiastic wife and daughters given to Dorcas and good deeds, may stud their acres with model cottages, and let them at rentals of two shillings a week, realising a percentage of 3 or 3½, but this is not the sort of building that will do for the masses, who are left as badly off as ever. What is wanted is a class of dwelling, with no external ornamentation, but as much internal accommodation as can be given at a rental of 1s. 6d. to 2s. a week, and to pay a return of not less than 5 or 6 per cent. to the builder. I can see no other way of doing this than by building lower roomed cottages entirely of concrete, including floor and roof, not a bit of wood in the construction save and except in the doors and window frames. At this present moment I am just finishing a cottage for my gardener, in which I give a living room 10ft. × 15ft.; parents' bedroom, 10ft. × 12ft.; girls' room, 10ft. × 8ft. 6in.; boys' room, 10ft. × 8ft. 6in.; and scullery, 10ft. × 8in., making altogether a floor surface of 520 superficial feet. All the bedrooms have fireplaces, not simply for fire, but for ventilation. This cottage, when completed, glazed, painted, fitted with fire apparatus, and a porch at the entrance, and necessary outbuildings, I shall be able to do at a cost not exceeding £85. This would let readily in the neighbourhood for 2s. 6d. a week. I have put no fireplace in the scullery, simply a ten gallon boiler. My reason for this is, that if the back kitchen or scullery is too good, the occupants dwell in it like pigs, keeping the main living room as a show place. A friend of mine has built a pair of model cottages where he has a fireplace in his back kitchen, consequently the main room is never used, but kept shut up and always smells mouldy, and redolent of turpentine and beeswax, laid pretty thick on an eight-day clock, and a highly varnished chest of drawers. My work has been done hitherto with concrete made with Portland cement. Within the last fortnight I have been trying concrete made with General Scott's selenitic lime and selenitic clay. It would be premature to draw conclusions; I may state, however, that the three or four hundred cubic feet of concrete wall which I have made in that way promises well, and if it should answer expectations, I shall be able by the use of the selenitic clay and lime to save not less than twopence per foot cube, notwithstanding that for its proper manipulation it requires 25 per cent. more labour. Before I conclude I may state that I am plastering the inside of my house with this selenitic mortar, and that at less than half the cost of plaster made with ordinary lias lime, I am getting a beautiful face for either paint or plaster, without a vestige of a crack to be seen anywhere. So good is it that a well known architect who came to visit my place was after a long conversation with, and numerous queries put to my plasterer so well satisfied with it as to tell me he should insert its use in the construction of a row of houses about to be built under his plans and inspection. And now for a word for our English Mechanic. I shall be always happy to give to its readers the results of my experiments, although gout in the hand makes writing a task, as the hand cannot keep pace with the idea. An article that would a few years ago have taken forty-five minutes, now takes three or four hours. I have for the weekly twopence picked up so many ideas from the writings of "Sigma

"Jack of All Trades," "The Harmonious Blacksmith," "Philo," and others, that I feel it almost a duty, if not a pleasure, to contribute something on matters in which on experiment I have either failed or succeeded.

KHODA BUX.

MONOLITHIC BUILDING.

[4462.]—THE letter of "our" esteemed fellow-worker, "The Harmonious Blacksmith", on this subject is of great interest as adding one more blow to that assault of truth on the barriers of prejudice, ignorance, and self-interest, to which they must inevitably succumb sooner or later. That this style of building should meet with much adverse criticism and abuse from members of the building trade is only what might fairly be expected, seeing that its employment tends materially to diminish prices; and certain of the arguments employed have, as it is only reasonable to suppose they would have, certain right and truth in them as, for instance, the very favourite one that the work being mixed and constructed in courses it is practically impossible to give each course the same consistency, and hence weak places result. Now, just for argument's sake, grant the objection to be well founded, and let us see what results. We have to compare the strength of joint between a mass of stone and the like in concrete; the stone is smooth-tooled and bedded together with a thin layer of cement or mortar. The concrete is left with a surface more or less rough, according to the size to which the staple material has been broken, and into every crevice of this surface the cement of the next course must run. Now, I venture to suggest that no great effort of mind is required to see that such a joint must be by far the stronger, and granting that the material is not in itself of equal tenacity with stone still the superiority of joint renders a wall of concrete superior in point of tenacity to one of stone; as the weakest link in a chain constitutes the measure of its strength, so must the value of the wall be measured by the strength of its weakest joints. With respect to floors, again, I have no hesitation in saying that the plan of open joist floors as generally used in this country is a palpable absurdity, which, combined with lathe and plaster partitions, renders an English house the nearest akin to a tinder-box possible to imagine, in addition to which all this soundboarding, tends to give to the interior of our dwellings such a drumlike character that peace in any corner when the children are at play is as a rule altogether out of the question. Now, with a truly monolithic structure fire would be next to impossible. The system pursued in France of making all floors and partitions of plaster concrete with iron joists for the floors and oak quartering for the partitions is sufficient to render the buildings almost fire-proof, and as for sound in a well-constructed house a dancing party overhead does not materially interfere with one's comfort. What, then, may we not expect from a truly monolithic structure, ribbed together and braced where requisite with iron? I do not hesitate for one moment in saying that such a structure is as much superior to an ordinary brick and mortar one as that is to a weather-board shanty. Ventilation of the question cannot but tend to good, and I trust that the subject having been taken up we may have from the army of readers of "ours" many valuable suggestions.

W. G. C.

THE HARP.

[4463.]—THE extreme grace and beauty of the harp, the simplicity of its construction, its cheapness, and permanence, lastly its effectiveness as a musical instrument, justly combine, the writer conceives, to commend it to the favourable consideration of every one. Of great antiquity, its image has been found sculptured or otherwise depicted on the Egyptian tombs. It was on the harp that the old Irish performers played, and it was on and for the same instrument as well as for the voice that they composed those glorious airs which render Irish and Scotch music the delight and solace of the world; strains, the love of which Edward Bunting tells us ("Prospectus of a General Collection of the Ancient Music of Ireland," p. 3) neither the experience of the best music of other countries, the perverted public taste, nor the influence of advancing years, has been able to control or diminish. Therefore it is that I wish to see both instrument and music introduced into our dwellings, and brought within the reach of every one. Bunting, indeed, is never tired of enlarging on the merits of his favourite instrument. The Welsh, who appear to have derived it from the Irish, have carefully preserved its use. It is heard in the concerts of London. It is played upon in Italy, France, and Germany. It is the national instrument of Ireland. It may be produced in a cheap and yet efficient form. It possesses merits which the piano, with every improvement, does not share. I would not put down the piano if I could, but let us have the harp also. And let it gladden abodes in which there is no room for the piano, an instrument which the purse does not always suffice to reach, even if there were room.

The piano, however admirable in many respects, is a costly and somewhat perishable instrument, and under existing circumstances is certainly not fitted for every man's dwelling. Begun with one string to each note, it then included two, and finally three strings. Difficult enough to bring into tune, or to keep in it, the piano in many ways is less desirable as a popular instrument than the harp. The harp, if simply constructed, is a very much cheaper instrument. It lasts longer, it is tuned by the player; and, finally, the string of gut or metal is manipulated by the finger of the performer instead of being separated from it by a series of complicated wooden levers which, in some measure, impair the expression, and render the instrument more perishable. The pianoforte is a harp in a box. But if we keep the harp out of the box, we can obtain a vastly cheaper, more enduring, as well as in some respects more expressive instrument. For as many shillings as the piano numbers pounds, we may obtain a cheap, portable, and reasonably efficient instrument that, without impeachment to the real merits of the pianoforte, would suffice to realise most of the satisfactions realisable by music which could be taken into the garden or brought down to the sea-shore, and further prove an excellent accompaniment for violin or voice.

I am desirous, then, of turning the attention of the general public to the importance of musical culture in general, and of the harp in particular. I do not think that musical culture should be confined to musical dilettante, thinly scattered here and there, but extend to the youth of the whole community; in fine, that it should constitute an integral part of general education. Every one should learn to sing, every one to play on two instruments, of which I would have the harp one. I dare say that there might always be some whom accident or disinclination should disqualify, but, in other respects, I would have musical culture as much the rule as the absence of it is now found to be. I shall not enlarge on the excellence of music. Every one who peruses these lines is, I dare say, as much persuaded of it as I am myself. Music, in truth, is one of the stepping-stones to a very great enjoyment, and, if not the only, is at any rate among the most stainless that earth affords.

The harp has been in use in England itself from a very early period. It was under the disguise of a performer on this instrument that King Alfred obtained admission into the Danish camp. In Scotland it was also well known, and we learn from Mr. Gunn, in his history of the instrument, that Queen Mary's harp is still preserved in a noble Scottish mansion. The writer of these remarks has had constructed a facsimile of King Brian's harp, as preserved in Trinity College, Dublin. This beautiful instrument he would wish to send to Kensington, but, beautiful as it is, one of much simpler construction would suffice for all ordinary requirements.

The common Irish harp, of some six-and-thirty strings, or five octaves, is strung with wire, the eight lowest strings of wire No. 18, the next six of No. 20, the next seven of 22, the next seven of 24, and all the rest of 25, or five numbers in all. The wires below the middle G on the harp now beside the writer, and on which many performers have in succession discoursed, are of brass, but the upper register consists of ordinary steel pianoforte wire. But wrapped wire would, doubtless, admirably answer for the lower registers. This, however, is a matter of detail which, should the harp come into vogue, could be settled at any time. The French harp, so named, is strung with gut, and, as recently constructed, is provided with an apparatus for altering the key. The Irish harp was and/is played in but the two major keys of G, one sharp and C natural; but the F and C strings could be raised or lowered at discretion. I have heard the most admirable performers, Italian, French, English, Welsh, on the gut harp, a harp perhaps costing a hundred guineas or more; but, speaking for myself, I found the execution of some poor blind Irish player on the wire harp—that could, I dare say, have been constructed for some 30s. or 40s.—go far more directly to the heart. The wire harp—on which Irish harpers, going on traditions of more than a thousand years, always play the treble with the left hand—I earnestly commend, as a sweet, cheap, and most effective instrument, to the attention of the readers of the ENGLISH MECHANIC and the English community generally. The instrument, if made of a simple bow and sounding-box, would cost the merest trifle. A strong angle-piece of brass or iron would do away with the necessity of an upright pillar; wires, brass and steel, are very cheaply to be obtained. The wires at their upper portion are secured and tuned—*i.e.*, tuned precisely as are the strings of the pianoforte. The lower portion of the string passes through a hole in the sounding-board and is secured to a loose peg or bit of wood behind. Apertures sufficiently large are made in the back of the sounding-box to yield admission to the hand when adjusting and securing the string. The holes through which the strings pass in front are fortified by little triangular bits of metal, or a perforated metal plate, properly fastened, can be substituted. All difficulties in regard of tuning may be got rid of by having recourse to one of Debain's tuned, I believe, metal reed octaves, for I am not quite sure, which he has arranged for the use of pianoforte tuners, and the name of which I now forget. I believe the universal introduction of the harp, gut or wire, and without prejudice to other instruments, would prove the greatest boon to the lovers of the divine art of music that can possibly be imagined, and in this light I most earnestly urge its universal adoption.

IXION.

FIDDLES.

[4464.]—PRACTICE is the only way to decide a theory. Thick strings sound louder, as a contra bass will drown a kit, or, perhaps, a violin—although in the latter case I doubt it. Some may remark, because the tones of each are different, one bass, the other treble. Very good. But I mean both playing the same tone, say upper C, or any of the higher notes; the contra bass would stand a poor chance. You may use the force necessary to produce the tone on the bass, and apply it to the violin, and (cruel treatment it would be!) the result would be a shriek. Now, it is apparent that if we bow too hard, which we must do if the string is too thick, we stop the vibrations as though we put a weight on the string. The bow remains on the string, also the pressure, not so the hammer of a piano; there the string is released. In the contra bass we have large strings, which, when played on in the upper region, become useless as representing violin tones, and Bottesini or any other man could not play solos with effect without the use of harmonics, or by having the instrument strung with thinner strings, which would be a mistake, as far as tone is concerned, but excellent for manipulation. Then the reason why a gut string will not move more than one soundboard is, that it cannot bear the pressure or weight sufficient for that purpose. If thicker gut is used it becomes a bass instrument, for it will not tune up to the desired pitch. I do not mean to say that the pressure of the bow would break the gut, but it would stop the vibration. With respect to a fiddle-string being tuned higher than it is usually, the manipulation would be difficult both as to insuring a clear tone, and fingering. Of course, it could be done if the strings did not break, which they certainly would. That "tubby" tone noticed by "The Harmonious Blacksmith" is the rigidity caused by over straining the string with the weight of tuning, or so many more pounds pressure put on it by means of the peg. Now, Paganini used thin strings tuned high, and produced a tone equal to a piano. I think he was right, but the tuning, fingering, and everything would have to be different; but it is most important to know this, as we take advantage of the present construction without altering it; rather a serious matter to do.

As to the reflectors or soundboards (it matters little—"What's in a name?"), I feel pretty confident they will come in use when known. The late M. Jullien would have made use of them, for in an orchestra an entirely new effect can be made. I presume the reason why a violin sounds louder in an empty room is, because the sounds have a larger plane or flat surface to act upon or react without an interposing medium. May not my reflector act in the same way, considering that it presents a tolerably large surface for the tone to act upon?

FIDDLER.

AMATEUR ORGAN BUILDING.

[4465.]—THANKS to Joseph William Fennell (letter 4372). I, however, propose to place a harmonium pan vertically upon the bellows frame, containing twelve rosewood reeds, from CCC to CC (the 16ft. tone), without pipes, but with tuning wires to supersede the stopped 8ft. pipes.

The specification is as follows:—Open diapason, 8ft., metal (12 lowest, Green's stopped metal pipes, tuned by the ears), 56; dulciana, 8ft., tenor C (grooved to base of open diapason), 44; Lieblich Gedact, 8ft., 56; Wald flute, 4ft., 56; oboe, 8ft., 56; principal, 4ft., 56; Bourdon, 16ft. (the 12 rosewood reeds); one row manuals, CC to G; no swell-box; 2 octaves pedals attached to keys; no coupler; Bourdon stop shuts off wind from harmonium-pan.

Is the organ balanced? If Wald flute is only taken to tenor C, will it give more scope for solo playing, or will it be a worse organ, having less base? If a harmonic flute, which is a 4ft. metal pipe overblown, thereby giving a 2ft. tone, be substituted, shall I benefit by the change? How is the harmonic flute made, and what is the scale with reference to the open diapason; does it require a special pressure of wind? Any information as to the softening of the oboe will oblige. Not feeling myself competent to give information on organ building matters, I have endeavoured to suggest in my queries such data as almost all amateurs must require, in order that the space may be rendered common to at least a large section of readers.

DRAUGHTSMAN.

WOOD PULP FOR PAPER-MAKING.

[4466.]—A STEADY and considerable advance in the price of rags, from which unsavoury and unwholesome materials our cream-laid note and other glossy papers are usually manufactured, has coincided with a fall in the price of paper. The apparent anomaly is easily explained. It arises that from time to time very different materials have been pressed into the service of the paper-maker. Straw is well known as the material from which a tolerably good paper is manufactured. Spanish grass (*Spartium spygarem*) has been utilised to a large extent in some of our paper-mills; in fact, so much so that the streams have been dyed and the fish poisoned wholesale by the foul refuse which is left in the process of manufacture. The bark and even the woody fibre of the paper mulberry tree (*Broussonetia papyrifera*) is used exclusively in Japan, the cunning industry of which almost unknown country produces no less than ninety distinct kinds of paper. This I can vouch for, having seen the Japanese at work during my five years' residence at Yokohama. In 1865, 70,000 tons of vegetable fibrous substance were imported by the paper-makers of the United Kingdom. And now, on the Continent, we find that wood is used in large quantities for the same purpose.

Heinrich Voelter, of Heidenheim-on-the-Brenz, in the kingdom of Wurtemberg, is the inventor of a successful method of manufacturing a tolerably clean white paper pulp from wood at a low price. It does not require bleaching. He has, I believe, obtained patents for his process in almost all European countries and America. It is adopted by all the large paper manufacturers of France, Belgium, Germany, Switzerland, Norway, Austria, and Canada. A single paper-mill in Germany consumes yearly 500 tons of wood pulp, and scarcely a newspaper is printed in Germany which does not contain some proportion of this material.

The cost of the paper pulp produced from wood is stated to be nowhere more than half the cost of rag pulp, and considerably less where there is a good supply of wood and water-power to drive the machinery. If of inferior quality as regards what is called the luxury of paper, the article thus produced from wood is tough, but serviceable and well adapted for printing. By mixing wood with rag pulp in various proportions, papers of different sorts may be produced at moderate prices. For printing papers, either white or coloured, from 30 to 70 per cent. of wood pulp is mixed with that produced from rag fibre; 85 per cent. of pine-wood pulp gives a common tinted drawing-paper; from 30 to 50 per cent. of wood pulp serves for writing-papers of various colours, the latter proportion of pine-wood pulp being used for an ordinary blue letter-paper, which takes the ink easily and is pleasant to the touch of the pen. Coloured papers for book-wrappers, tissue-papers, paper-hangings, cardboards, are all produced by similar instances in various proportions. No single article of manufacture can be taken as a more distinct test of the state of civilisation than paper. Besides all those subsidiary purposes of wrapping and packing, the direct use of paper for the spread of intelligence for the communications necessary to commerce and for the service of literature need only to be hinted at. The reduction of cost of this necessary is thus one of the many boons to mankind. H. B. E.

CONDENSATION OF STEAM IN PIPES.

[4467.]—I AM desirous of conveying steam of 294° initial temperature, 45lb. super pressure per square inch, through 2in. wrought-iron gas tubes, in all 850ft, underground:—*i. e.*, in the first instance 300ft. horizontally, then 200ft. vertically downwards, then again 140ft. horizontally, and finally vertically downwards to engine 210ft. The present temperature within the mine averages 60°. I require to know:—1. What amount of total condensation will take place, the steam flowing through the tubes at a velocity corresponding to the requirements of a steam-engine 8in. diameter of piston, and making 250ft. (piston speed) per minute. The tubes to be supposed as non-clothed, but otherwise kept dry. 2. Difference of initial and terminal pressure of the steam, *i.e.*, between boiler and valve chest. 3. The best way to draw off the water resulting from condensation previous to steam entering the cylinder. 4. The waste steam from engine must be carried away by a 3in. tube going up vertically through a shaft direct to surface, a height of 450ft. This shaft has a strong downward air current, so that in winter it often freezes therein to a depth of 70ft. from surface. There would doubtless, therefore, be also a large amount of condensation in the waste steam-pipe as well, which, however, could probably be accommodated by a proportionately open tap at the bottom. 5. If the temperature within the mine is likely to be raised disagreeably high by steam-heated tubes and resulting hot water. 6. The probable difference in point of fuel consumption as compared with a close proximity of engine to boiler, all else being supposed the same. 7. If in consideration of there being no dead material, in the shape of rods, cranks, &c., to move, this system may be regarded for draining purposes as equally cheap in point of fuel consumption with the more usual methods. I should, perhaps, mention that the tubes would be suspended freely in the shafts and levels of the mine. Any information on the foregoing will be gladly received by

Cologne. A. W. E.

DRAINING MINES OF WATER.

[4468.]—I AM given to understand that of late compressed air is being employed for driving pumping machinery fixed down in mines at convenient points for draining purposes. Would some kind contributor to "our" journal, who may have had experience in this way, give me information thereon? I require an effective power of about six horse-power for this purpose, and its application to the pump, 440ft. horizontally and 410ft. vertically away from the point at surface at which the production of the compressed air could take place. I am, however, uninformed as to the question of cost of power thus obtained. The compression would in the first instance have to be effected by a steam-engine, either direct-acting, or air-pump, or otherwise, and the air would have to be compressed, as stated, to a distance of 850ft. The most suitable pressure, with a view to a possibly small engine within the mine, would be 60lb. per square inch above atmosphere, and it would be desirable to use the air expansively for the sake of economy. In order to compare with other pumping arrangements it would be necessary to know what relative power to that given out would be required to compress the air at surface, and the probable duty obtainable from a bushel of coals thus indirectly consumed in the production of power. The absolute work to be done is that of raising 2,000 gallons of water 410ft. vertical height per hour.

Cologne. A. W. E.

TURRET CLOCK LINE.

[4469.]—WILL some of "our" readers kindly give an opinion of the following idea:—In case of turret clock lines breaking, it has been suggested that a stout wooden bucket (just large enough to freely admit the weight upright) fixed to the floor directly under the weight's position, with three springs screwed to the bucket inside, bending to the centre, and a cushion at the bottom, would break the force of the fall, thereby preventing injury to anything beneath the tower floor. The idea, I think, is remarkably good, providing the weight shall fall exactly perpendicular; but to suppose it would in my estimation is positively absurd, as I naturally suppose that any substance whose length is greater than its breadth, or, that is not of spherical shape, is acted on in falling more or less by the force of gravity and air pressure, causing any such substance to turn over and take an indirect course, the same as an ordinary rifle bullet fired from a smooth bore would by no means take a direct line. And as well as the action of gravity and air, a falling clock weight would, in violently snatching the piece of loose line through its pulley, be pulled on one side, and I think the probability is that in a fall of 80ft., a weight of 200lb. would reach the ground at quite an uncertain point, and possibly 2ft. or more out of a perpendicular line. A firm kind of mattress would then be one of the best means of checking the force of such a fall, and buckets for that purpose, I believe, are useless; but for satisfaction I shall be obliged to any one that will give an opinion on the bucket idea. CURIOUS.

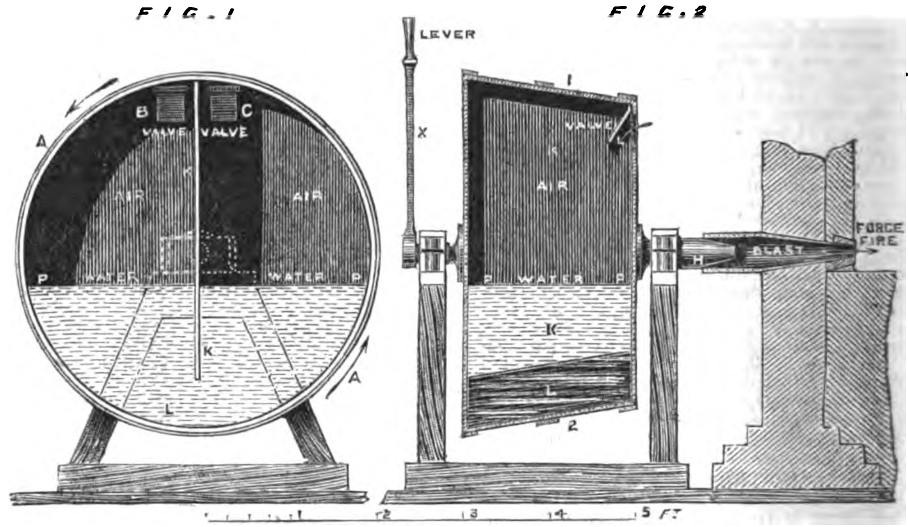
WATER BELLOWS.

[4470.]—HAVING often seen inquiries in your valuable paper about a useful kind of bellows for a smith's forge, I send the accompanying sketch, which I trust will be easily understood. The machine is called a water bellows, and is made of wood—hooped, staved, and headed same as a cask. The taper is to allow hoops to be driven up tight. There is a division in middle K of wood, and a space about 6in. left at bottom L for water to pass through. Two valves B and C of leather are fitted (about 6in. square) one on each side of division K. The lower part of cylinder is filled with water P; a pipe H conveys blast to furnace. When the machine is turned in direction of arrows A, air enters at C, valve B closing. When the machine is reversed in motion, valve C shuts and valve B opens, and *vice versâ*, the air being discharged at pipe H, Fig. 2, which acts same as a trunnion, the water P always keeping its level, but the spaces on each side of division K are lessened and increased as the machine oscillates backwards and forwards by lever X, or any other contrivance to give the required reciprocating motion. The air is constantly being drawn through valves B and C, and discharged through pipe H to fire.

The advantages derived from this machine are cheapness, that there is a very steady blast, and no leather required except for valves B and C, and little power necessary to work it.

The above could be made of metal. I have seen one of these bellows at work for a number of years with good result.

Jamaica, W.I., May 28. HYDRO-VULCAN.



SEWING MACHINES.

[4471.]—IN reference to the Robin Hood sewing-machine described and figured by R. Tansley (letter 4378, page 355), I should like to know whether he has used it, as well as "invented and made" it, as he says, and also what good on earth it can be to have a sewing-machine with ten (or even two) needles set close together in a row. It is self-evident that the work must pass through the machine either at right angles to the row of needles, or in the line of said row. In the former case you will have ten closely-packed lines of sewing—*Cui bono?* and in the second alternative, you will have but one line of sewing, but done ten times over; and a pretty mess it would be. And *cui bono* again? The only way out of the puzzle that I can see, is to suppose the feeder has a monstrous long-stitch motion, and makes the work jump through for the length of ten stitches at each go. What an artful dodge! not very pleasant, though, for the operator; and I cannot suppose that any woman would be induced to use such an alarming apparatus even by the temptation of making 2,000 stitches a minute," or "more stitches in two minutes than she could make by hand in one day." I had all but overlooked the fact that each stitch would also be the length of ten stitches, unless every stitch were separately fastened off before the feed made its next stride. But I am puzzled and give it up. Surely no fellah can understand it. The House calls vehemently upon R. Tansley to "Explain, explain!" He has judiciously omitted to show any trace of the stitching and feeding machinery. Surely the whole thing is a "goak," to which the inventor seeks to add piquancy by the naive inquiry "if there is such a machine at work."

"W. H. T." asks (query No. 12247) after a wheel-brake for the Wheeler and Wilson sewing machine. Mr. Mabson, of Newcastle, some years ago invented a very simple and effective one, which, with his other improvements, is applied to that form of the Wheeler-Wilson called the "Belgravia," but I believe it is patented. It consists of a wedge-like piece of wood suspended on a pivot above and towards the front of the fly-wheel, to which it offers no resistance when travelling in the right direction, but at once wedges it tight if it tries to go wrong. Mr. Mabson's inventions were described in the ENGLISH MECHANIC some two or three years ago, but they have been much improved since. The names applied to them are mostly rather stupid; for instance, this brake is called the "wheel preventer," and sometimes "preventer" simply. The one in plain English means a thing to prevent wheels, and the other, to prevent anything in general. This by way of parenthesis.

Neither the "Belgravia," however, with all its advantages, nor any other form of the Wheeler-Wilson that I have seen, has any means of starting the machine above the table—a most important desideratum, which Singer's, Thomas's, and many other machines possess. Instead of that, the operator has to leave go of the work with the left hand—the very one that is most required in guiding it—in order to give the fly-wheel a shove; or else, very awkwardly, to cross the right hand over the lap and under the table, and all amongst the work. In every other respect the Wheeler-Wilson—and especially in "Belgravia" form—is surely the most effective and uncomplicated of all lock-stitch machines. It has of late had applied to it an improved feed, called the "Archimedian," which works by cams on the spindle, giving positive motions only, and thus dispensing entirely with springs. The only springs in the whole machine, in fact, are those of the tension discs and of the cloth presser. The latter is adjustable to the requirements of different fabrics, by an ingenious contrivance. I hope "A Practical Man" will give a good critical account of this machine and all its parts. If he does not, I should like to send you a drawing and description of the "Archimedian" feed aforesaid.

G. W. K. L.

THE PHENOMENON OF ARGOSTOLI.

[4472.]—IN reply to "Sigma's" questions (let. 4353, p. 352), the phenomenon at Argostoli having been under my observation for about half an hour only, and not at the time being provided with the means of taking the levels asked for, I can only reply from memory and judgment, which, however, will be pretty near the mark. The transverse section of the point of ingress of the sea-water, and also of the channel along which it flows to the point of disappearance, may be represented by the letter U. It will be about 5ft. across and 7ft. in height, with about 3ft. of water along its entire course. (I am speaking of the particular time when I saw it, of course.) The channel is circuitous, and the gradient of its bed will be about 1 in 40. The final level of the surface of the water is precisely what I am desirous of getting at. The water pursues its course through and along an aperture in the rock, which rises abruptly across the channel, and is speedily lost in darkness.

As my guide informed me that the water is always running, and there being a depth of 3ft., while the sea level in the Ionian sea is rarely disturbed to the extent of more than about 2ft., the flow, or rather descent, is, no doubt, continuous.

Boats can approach the sea barrier close to the point of inrush, but the channel is too winding for a boat to traverse. There is no appearance of a reef either close inshore or in the offing; indeed, I can speak positively as to this, for I saw nothing of the kind in reality, nor do I find any indication of one in a plan which I have before me of Port Argostoli. As to a race or strong current, so far as my experience went, there was no evidence of either. I have been riding at anchor in various parts amid the Ionian Islands—once for five months between the Islands of Corfu and Vido—and we always rode "head to wind"—*i.e.*, of course, when there was any.

"E. L. G." mentions five points at which the sea rushes inland; the probability is, therefore, that this description may not apply to the other four; however, the phenomenon is the same. As this matter has had "E. L. G's" attention, perhaps he will give us his theory, for I am sure he has one. "Sigma," too, and several others, might give their opinions on this very interesting question. J. W. RODWELL.

THE ANCIENT CONSTELLATIONS.

[4473.]—I AM quite at a loss to imagine what Mr. Proctor means by any one of the constellations (let. 4408, p. 380) having "got its name from its aspect," but the "very strong evidence" about the four named will perhaps enlighten me. He can hardly mean that the stars scattered over the wide-spreading Argo so connect themselves, apart from others, and into a ship-like or canoe-like form, as to have suggested this form (turned in all manner of positions) to the most separated races of men! As little does it seem conceivable that tribes of both hemispheres, regarding the present winter quarter of the ecliptic, would find its stars divide themselves into three groups, and these suggestive of a centaur archer, a goat-fronted walrus or seal, and either a pourer or pouring vessel of water! Which of the latter (as the same stars make both) does the "aspect" suggest? The grand fact about the zodiacal signs, we must remember, is that not their figures, but only the ideas—only the meanings of their names, are everywhere identical or connected, some or all. The Chinese, most peculiar in this as in most other matters of tradition, seem, indeed, to have but one or two of the twelve identical with ours, and one or two connected in ideas—as dragon for lion, serpent for scorpion, mouse and hare for ram and crab. But, in the second volume of "Asiatic Researches," Sir Wm. Jones has an essay to prove the independence and antiquity of the Indian zodiacal signs, whose names he translates, beginning at our Aries, as "Ram, Bull, Pair, Crab, Lion, Virgin, Balance, Scorpion, *Bow*, Sea Monster, Ewer, Fish." The Bow, he further says, consists of "eleven stars, the γ, ϵ, δ, ζ, ϕ, τ, σ, ν, o, ξ, π of the Sagittary." Maurice, in his "History of Hindostan," maintains that the oldest authorities make it only a bow, with neither arrow nor archer; and it was connected with all the neighbouring asterisms, especially the Ship, the Altar (both, admittedly, of immemorial antiquity, and known to all tribes that had constellations), and the Victim and Sacrificer, which classical authors allow to have rightly and originally accompanied the latter, though the Sacrificer has curiously turned into a second "Centaur," and the beast in his hand, which Ptolemy knew only as a "Beast" undefined, has since become our "Lupus." Besides these seven of the most ancient asterisms, those writers claim to identify with Noah's history at least four or five more; without going to the length of Jacob Bryant, whose three great quartos of "Analysis of Mythology" (unhappily without an index), they admit to have brought "an overwhelming body of evidence," for the Noachic origin and meanings of not only most of the myths, but *all* the 48 ancient constellations. We may at least admit the "Corvus," so inexplicably placed, to be best accounted for as one of Noah's birds; and the zodiacal Fishes, which the sun enters next after the Deluge sign, to represent the peculiar condition succeeding to the memorable 40 days' downpour, the two opposed classes of fish, swimming one over the other, in the sea, and its temporary freshwater covering, before their complete mixture.

As for the zodiac of Dendera, supposing it really the very ancient one Mr. Proctor implies—though I believe its Roman date is now regarded as settled, —it would have had no bearing on my remark about us "westerns," which the context must surely have implied to include all west of Ararat. However, I find that it was incorrect to say "*only* we westerns" had (even to this day) enlarged the Bow into Sagittarius, as Hindoos have learnt (probably from Europe) to make a similar addition to the *figure*, though the *name* remains only the Bow. Sir W. Jones, in the above paper, translates a *modern* Indian account of them thus—"The *Ram*, *Bull*, *Crab*, *Lion*, and *Scorpion* have the figures of those five animals respectively; the *Pair* are a damsal playing on a *Vina*, and a youth wielding a mace; the *Virgin* stands on a boat in water, holding in one hand a lamp, in the other an ear of rice corn; the *Balance* is held by a weigher, with a weight in one hand; the *Bow* by an archer, whose hinder parts are like those of a horse; the *Sea-monster* has the face of an antelope; the *Ewer* is borne on the shoulders of a man who empties it; the *Fish* are two, with their heads turned to each other's tails; and all these are supposed to be in such places as suit their several natures." In support of the rainbow origin of the *Bow*, Maurice cites the classic story of the Centaur's birth (who now holds it) from a *cloud*; and as for *Argo*, he quotes from "Hyginus" "that it is "the ship Minerva numbered in the asterisms, as having been built by her directions," (compare Prov. viii. 22-31), "and the first that ever went on the ocean." E. L. G.

PLATO.—JUPITER.

[4474.]—I INCLOSE a copy of a sketch of Plato as seen on June 14, 1872, at 9.19 p.m. with my 3⅝in. The shadows of the original I adjusted by means of a fine wire stretched across the field of a 120 power eyepiece. I noticed some markings (shown in my sketch) on the floor. I also saw several small craters, or crater-like formations, near or on the border. The shadows appeared sharp and well defined. I have also noticed that the radiating streaks which proceed from Tycho, Copernicus, &c., appear to consist of higher ground, such as rills, &c., when near the terminator, and change into streaks at or near the full. Is this supposed to be

so? Also, may I ask "our" obliging "F.R.A.S." for a few star tests for my telescope? It will clearly divide 52 Orionis, ϵ Boötis, and many more. Will Mr. Proctor please tell me if his theory of Jupiter being red hot will agree with the complete invisibility of the satellites when in his shadow, and the intense blackness of their shadows when in transit? J. W. DURRAD.

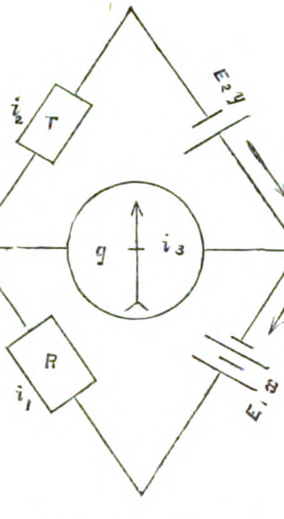
COMPARING ELECTRO-MOTIVE FORCES.

[4475.]—THE following null arrangement for comparing electro-motive forces is, as far as I am aware, original; at least I have never seen it described anywhere:—Join up the two batteries E_1 and E_2 with a galvanometer, as in the diagram, so that their currents go through it in opposite directions. Also insert resistances R and r. Let x and y be the unknown resistances of the batteries, and i_1, i_2, i_3, the intensities in the three branches. Then we have—

$$i_1 - i_2 \pm i_3 = 0,$$
$$(R + x)\, i_1 + g\, i_3 = E_1,$$
$$(r + y)\, i_2 + g\, i_3 = E_2.$$

Now, by altering the resistance R, bring the needle to zero. Then, $i_3 = 0$, and $i_1 = i_2$, therefore—

$$\frac{E_1}{E_2} = \frac{R + x}{r + y}.$$



Here we have the unknown resistances, x and y, in our result; but, by taking another value of R, say R^1, and finding the corresponding value of r, say r^1, we get the simple result—

$$\frac{E_1}{E_2} = \frac{R - R^1}{r - r^1}, \text{ or } \frac{dR}{dr},$$

the ratio of a difference in the value of R to a difference in the value of r. This method, involving no calculation, as only two differences have to be observed, and being perfectly independent of the resistances of the batteries and galvanometer, gives very good results. A further advantage is that, as $i_1 = i_2$, and no current passes through the galvanometer, each battery is being worked to exactly the same degree. Thus they are compared under *similar conditions* which is not the case in Poggendorff's and other methods. I should like the opinions of "S. T. P." and other practical contributors. In the diagram it appears like a Wheatstone's bridge, but it is quite different in principle. O.

OUR COAL STORES AND THE ATMOSPHERE.

[4476.]—MAY I ask Mr. Thompson (let. 4349, p. 334) how it is that the rate of mortality is lower in towns where there is a large number of manufacteries. And in one instance I know of (where the manufacturers threatened to close their works if they were continually prosecuted by the inspector of nuisances for not consuming their smoke) the inhabitants looked to the death rate, and finding they were more healthy with the smoke than other towns were without it, they asked the manufacturers to keep their works going; so that Mr. Thompson's carbonic acid gas must be beneficial in the atmosphere. W. ALLAN.

BALSAMED OBJECT-GLASSES.

[4477.]—"F. R. A. S." in letter 4276, p. 300, was quite right in saying, as a rule, only object-glasses for terrestrial telescopes are balsamed, and then only when the proportion of the flint lens is such as requires the crown lens to be ground to the same curve as the flints on the inside surfaces; then they are balsamed to prevent loss of light, &c., but principally to enable the makers to burnish them fast in the cell to prevent inexperienced owners from getting the object-glass the wrong way in the cell, because in balsamed objects the two outside surfaces only require cleaning, while those that are not require all the surfaces to be cleaned after they have been in use any length of time. Some firms notch the edge of the crown and flint lenses on the two sides which go together, which is a very good plan; and these object-glasses are preferred by the great majority of ships' captains in preference to the balsamed objects, as in using telescopes with balsamed objects they very justly complain of their not being so good when they get out abroad, the balsam slipping with the heat of a tropical climate. The Barlow lens spoken of by "C.B.," I may say, requires the inside surfaces to be ground to the same curve and cemented, which is its principle. But as regards balsamed astronomical object-glasses the least said the better.

WILLIAM OLDFIELD.

[4478.]—I HAVE cemented a large number of achromatic lenses with balsam, and never found it to shorten the focal length. I fancy "C. B." (let. 4366, p. 353) must be mistaken; but if not, then the inner curves of his object-glass do not coincide. Glasses are balsamed together to reduce the number of surfaces, thereby saving light. Large-size object-glasses are not balsamed on account of the risk. RT. THOMAS.

MICROSCOPE CASTINGS.—MOUNTING SMALL OBJECTS IN BALSAM.

[4479.]—IF E. B. Fennessy (let. 4369) will refer to the advertisement columns of the ENGLISH MECHANIC a few numbers back he will find microscope castings advertised for sale. To the possibility of any workman of average ability fitting up a sound, serviceable instrument, I can testify, having just completed one which will bear comparison with any of the instruments sold in the shops at £15. It has English objectives, five powers (½in. to ¼in.), three eyepieces, prism, and analyser, and cost me less than £4, exclusive of my labour.

I have no doubt many microscopists have found the same difficulty as I have in keeping small objects, such as starch grains, diatoms, &c., in the centre of the slide when mounting in balsam—the balsam, if dropped in the centre, or placed at the side, pushing the object before it to the edge of the cell. To prevent this, draw a ring of balsam round the object, and, as it spreads, add as much as will fill the cell, the ring will probably not meet in the centre, but the air-bubble inclosed therein will be driven out by using a clip after the cover has been dropped on. The contraction of the ring of balsam towards the centre drives in the objects, and prevents them being scattered too far to be easily found. MICROS.

MICROSCOPE CASTINGS.

[4480.]—I DESIRE to indorse the wish of the writer in a recent number (let. 4369) "that some one would supply microscope castings at a reasonable price." I have lately had the greatest difficulty in procuring even a stand, and I went to a great number of working opticians, too; they must have had them, but I suppose would not part with them. However, I got an iron one at last, and am now making the models for the stage, &c.; but if I could get these anywhere I would willingly pay a fair price for them in the rough, and I have no doubt that a great many others would also do so.

J. D. H.

ENTOMOLOGICAL.—V.—ON IMAGOS.

[4481.]—WITH regard to killing apparatus, I like an ammonia box used with benzole on wool instead of ammonia for stifling insects; and for large moths I use a solution of oxalic acid, piercing the under side of the thorax of the moth with a pen dipped in it, which dispatches the insect almost immediately. For sugaring, I think the best places are the lee side of wo and the rides and clearings in them, if the wood is not too thick; but almost any locality whatever will, in the season, yield its special variety, and we must remember that where there is one there are generally more, and if a moth is about a certain time after dusk it will be out very probably the same time before daybreak. After catching moths at sugar, I think it a good plan to prick their abdomens, if at all full, to let out the sugar, which may be absorbed by a piece of blotting-paper, or the sugar may appear after the moth is put in the cabinet. The wingless females of moths are hard to distinguish at first from spiders, though practice soon enables us to tell the difference. Virgin females of many sorts will, if put in a gauze-covered box and placed in woods and such places, attract many males. Sallow bloom in the spring and ivy bloom in the autumn are as good, if not better, than any sugar for attracting moths. Street lamps are excellent spots for capturing moths at, and should occasionally be "swarmed." Let it be remembered that few moths come out much before midnight. Yew trees are worth beating at night and day to drive out the moths concealed in them. If insects are not set soon they will become quite rigid, and then they should be put in a zinc box lined with cork and soaked with water, and in a few days they will come out quite soft.

Though these notes are short, and might doubtless have been written by a more able pen than mine, yet I hope that they may be of some use to many of the readers of the English Mechanic, and I conclude by heartily wishing all collectors success in their undertaking.

Ento.

FINDING INTERNAL RESISTANCE OF A BATTERY.

[4482.]—I have tried "S. T. P.'s" plan (let. 4402), and obtained tolerably accurate results. It can be further simplified by making g, the galvanometer resistance, = R; then, to halve the total resistance, we have only to take away R.

If we make the resistance unplugged in the first equal to twice that unplugged in the second part of the test, or say $R = 2r$, then we have $\frac{B}{S} = \frac{r}{r+g}$. Here we cannot neglect g, unless it is very small compared with r, and if so, our deflection will be proportionately small, unless we have a very delicate instrument. Having at our command such a refined instrument as the Thomson reflecting galvanometer, whose index is without weight or friction, of course perfectly accurate results can be obtained by "S. T. P.'s" plan; but if, as will generally be the case, the experimenter has only a common galvanometer at his disposal, neither very delicately pivoted nor graduated, a null method, by which making and breaking a circuit produces no alteration in the deflection is very desirable. This want "S. T. P.'s" method does not supply, because we have two operations to perform—viz., to reduce R to r, and to put on the shunt. In the mean time the needle has moved, therefore this method cannot be accurately called a null method. The nearest approach to perfection, that I am acquainted with, is Mance's method. Even there the needle jerks when the circuit is made and broken, owing, I presume, to the direction of the current being changed in one of the branch circuits.

O.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4483.]—In reply to Mr. Cash (let. 4380, p. 355), if the crown glass is free from veins, and if he will take the density of both the flint and crown lenses themselves, and not the fragments, very correctly, I shall be able to assist him in dismissing the curious phenomena he speaks of. Till now I have thought that his crown lens was made from what is called British plate, and not Messrs. Chance's white crown at all, because I have only seen one or two pieces of the density stated in his letter some time ago; but I think he will find the crown, when he has taken the density of the lens itself, to be 2·55. Their white crown in sheets is oftener that density than any other. Be certain and state the density of both very correctly to the fourth decimal number. Soft iron tools are the best for grinding and smoothing object-glasses, but they must be made in pairs to true each other with. As the object is now, it will never make a good one, because the proportions are not at all good, and to start afresh will be the best way. I advise Mr. Cash not to make the focus of the object-glass less than 72in., he will find it short enough for him to work. For myself I like the following proportions the best:—3¼in. diameter to 50in. focus, 4in. diameter to 60in. focus, 4½in. diameter to 70in. focus, and 5in. diameter to 80in. focus. I consider these good proportions, and have found them work well.

Wm. Oldfield.

RECURRENT VISION.—ELECTRICITY.

[4484.]—The interesting experiment described by Mr. Petrie (p. 282) does not seem to me to contain a satisfactory explanation of "recurrent vision." The latter phenomenon is seen as well with one eye as with two, and is far too rapid to be compared with the other; indeed, on some occasions have seen, *after* the recurrent vision, persistent spectra, much like those which Mr. Petrie describes, floating before the eye, changing colour, appearing and disappearing alternately in the darkened room, for perhaps thirty seconds after the flash—just such images as one may see at any time by looking steadily at the sun when near the horizon, and then closing the eyes and turning towards the shade.

That the phenomenon is not founded on any special peculiarity of my own eye is evident from the fact that I have shown the experiment to at least fifty different persons, and never found any one who failed to see it. At the same time, I wish to say that I do not consider the idea of a reflected nervous impulse which I suggested as at all certain to prove correct. It is difficult to see how it should take so long a time as one-fifth of a second for an impression to travel along the nerve from the brain to the eye and back again.

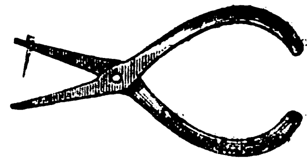
I may add that in my own family I have long been familiar with electrical phenomena similar to those discussed in some recent letters in your paper. In houses heated by a hot-air furnace it is not at all uncommon to obtain sparks of from ½in. to ¾in. in length by simply scuffling briskly over the carpet; and when undressing for the night ladies sometimes receive a rather unpleasant shock by dropping upon their feet the hoop skirt worn between two flannel petticoats during the day. In 1857 I resided in Northern Ohio, and occupied a study heated by one of the abominations called an air-tight stove, the apartment beneath being heated in the same way. In this room the phenomena were more striking than I ever observed elsewhere; and on some favourable occasions, when the temperature of the external air was below zero, I obtained sparks very nearly an inch in length, with which I charged Leyden jars, and performed many other of the ordinary experiments. By a process which I need not explain, but easily enough imagined, I found that the source of the electricity was solely the friction of smooth sole-leather upon the woollen carpet.

C. A. Young, Prof. Nat. Phil. and Astron.

Dartmouth College, Hanover, N.H., U.S.A.

A TOOL FOR PUNCHING THE RIVETS OUT OF BROKEN WATCH-CHAINS.

[4485.]—Most watch jobbers in mending a watch-chain have to split the old link before they can get the old rivet out, so as to get a new joint. The tool that I invented and have used for years (of which I send sketch) is a most decided improvement on the old



system. Any watchmaker can make one out of a pair of strong watch pliers; you may soften the pliers at the ends, drill a hole at one side, tap it, then fit a screw with a fine point, spring temper, and at the other side drill a small hole exactly opposite, so that when the chain is placed under the punch, the rivet pops out without any further trouble.

Ein Uhrmacher.

PERFORMANCE OF TELESCOPE.

[4486.]—In reply to Dr. Blacklock's query (let. 4387, p. 357), I may say that the conditions required for the experiment on dividing power are simply the most favourable; the magnitude of the stars depends on the aperture, the discs increasing in size inversely as the aperture; the power used should be sufficient to show a round disc.

This question, however, is distinct from the test of the telescope's quality. By choosing twilight a close pair may be well divided by an instrument giving much false light, which would fail on the same object on a fine dark night.

The star δ Cygni is an admirable test, owing to the closeness and faintness of the comes, which becomes lost in the light surrounding the large star unless the telescope be good. Reflectors have scarcely any chance with it, as, owing to the intervention of the plane, they exhibit more rings round large stars than do refractors, and these rings, brandishing about as they always will, make it exceedingly difficult to perceive the faint comes.

I have very seldom been able to see it at all, and never well, with my large reflector, as ordinarily used, but with an excentric aperture of 7in. or 8in., which escapes the flat, it is almost always visible and measurable, and as beautiful as in the finest refractor.

H. C. Key.

SPINNING-TOPS AND GYROSCOPES.

[4487.]—As a matter of course Mr. Proctor (letter 4411) has experimented upon and experienced the extraordinary resistance which a swiftly-revolving wheel offers when turned in any direction contrary to the plane of its motion. Now, I would feel much obliged if he will explain for the benefit of all of us, how, as he says, that a body moving at various velocities and admittedly travelling for any period, no matter how short, in a horizontal direction, can fall to the ground in the same time as if dropped from some height and acquiring a constantly-increasing velocity, what becomes of the resistance to change in direction of motion?

I am much obliged to J. M. Taylor (letter 4361, p. 353) for his good temper, as, although unwittingly, I sometimes offend by plain speaking, and must now tell him that having counted so much upon the atmosphere in his former letters, he appears just as anxious now to discard it. But whether in atmosphere or vacuo, I deny *in toto*, until he shows me proof positive, that a cannon ball or any other swiftly-moving body in a horizontal plane is attracted to the earth in the same time as a body left to fall freely from the same height. I am amazed that both "E. H." and himself can hold such an opinion, because if they admit that the ball travels for any portion of its flight in a horizontal direction, then it becomes evident that the ball dropped vertically with constantly-accelerated descent must reach the ground first. *Q. E. D.*

Will "E. H." kindly drop making assertions, and just inform us how he proves that if a cannon ball were fired horizontally in vacuo that it would fall to the ground as soon as if dropped from the same height vertically? Does he deny the force which any moving body exerts against being moved in any direction contrary to a straight line? If so, I would recommend him to proceed to an artillery ground where ball practice is being carried on, and to help gravity by catching one of the passing balls, and endeavouring to drag it to the ground. And, in conclusion not to misrepresent me by attributing to me the statement, "that particles rotating in a plane cannot get out of it." What I did say was that they could not fall to the ground if the velocity were kept up.

A., Liverpool.

SPINNING-TOP.—UPWARD DEFLECTION OF BULLET.

[4488.]—Gravitation acts vertically to the plane of the earth, consequently does not pull the top either to the right hand or to the left, to the north or to the south. Demonstration: Pare carefully just the point of the peg to a level surface. No difficulty will now be experienced in making the top stand, and yet who can say the conditions under which gravity acts have been altered? We have simply extended the base through which the vertical line of gravity acts, and, theoretically, the top would stand without the alteration. Physically it will not do so, because we should require a perfectly-balanced top, even surface, and entire absence of tremor from any and every source, any one of which (and not gravity) would kick the top over; some power (no matter how infinitesimally small) must be applied to turn or remove the centre of gravity.

It is an axiom, and generally received, I believe, that bodies have a tendency to retain any motion imparted to them, in fact, it seems a natural law, and they would retain this motion for ever if none other force interfered. Now, in spinning a top, we impart and convey to it a gyrating or revolving motion, proportioned to the force used in the spinning. Friction, both atmospheric and terrestrial, and possibly, also, electrical, presently extracts the imparted force, and the top ceases to gyrate, and consequently falls, but not through gravitation. As previously stated, in all gyrating bodies, whether vertical or horizontal, the centres of gyration and gravitation must be coincident; if otherwise, "wobbling" ensues, proportioned to the amount of such divergence; when coincident, the top "sleeps." In all heavy, high-speeding machinery this divergence causes immense loss of power and speedy destruction of the machine itself, exampled in an unbalanced fly-wheel or mill-stone.

In the upward deflection of bullet three points require consideration—(1) The difference between the thickness of the barrel at breach and muzzle. (2) The almost utter impossibility of retaining the eye in exact axial position with the two points of sight, to which is added the great annoyance of reflected light from the surface of the barrel. This would, of course, be greatest nearest the eye, serving to depress the breech in order to obtain sight at the further point. (3) The method of igniting charge. To be accurate in results, this should take place exactly in the centre of fore-end of charge, next the bullet. It is, therefore, highly probable an amount of reality does exist in this last question. It can be easily tested by firing the piece at point blank range in inverted positions.

Epsilon.

CO-OPERATIVE STORES.

[4489.]—Mr. R. R. Smith (let. 4389) merely reiterates the perpetual complaint now heard, that we cannot get justice by dealing unjustly; that insane rules and methods bring confusion and absurd results; and he does not gather grapes after sowing thistles? Who makes it necessary for his shopman or he to "realise" this per cent., or that per cent; or in selling one lb. of stuff in one parcel, and another lb. in ten parcels, to be paid for each of these lbs., as for two equal works? Is not selling one parcel doing one thing? Is not selling ten parcels doing ten things? What possible good can he expect for the haphazard injustice of paying the same for one job and for ten?

E. L. G.

THE PIANO-VIOLIN.

[4490.]—I have just seen your issues of the 3rd, 17th, and 31st May (lets. 4074, 4155, and 4282), and am pleased to find that the subject of the piano-violin, or tetrachordion, is being analysed, as in this manner the value of the instrument will be clearly gathered for orchestral and general purposes. I have heard the instrument played, and was much pleased with its sensitiveness and volume of tone, and I should like all persons who have a real taste for music to embrace the opportunity of listening, and, if they choose, playing it also. One of these instruments, of M. Baudet's make, has been publicly performed upon for months past at Theiller's Rooms, Charing-cross Station, to which any person, on presenting his card, can obtain admission. M. Maitre, of Paris, purchased all M.

Baudet's rights and interest in the English, Belgian, and the United States patents some three years back, and he is now about introducing the invention into the English market upon a large scale. I regret that S. Bettone did not better inform himself of this fact before he penned his letter to you, in reply to "The Harmonious Blacksmith," as M. Baudet had no patent to sell to Messrs. Stead and Co., to whom he refers. Baudet did try to dispose of the English patent to Messrs. Stead, but the sale was never completed, and an action is now pending before Vice-Chancellor Wickens' Court to restrain Messrs. Stead from continuing the infringement of Maitre's patent rights, which they have been doing to a large extent.

The instrument I saw and heard was like an ordinary cottage piano, only with two pedals beneath, to which an up-and-down movement was imparted by the feet of the player for rotating a roller, situated above a series of tufts of hair, these being permanently attached to, and standing out from, the strings. The keys, which were acted upon in the same manner as in a piano, had each a rod at the inner end, at the top of which was a strip of rather hard indiarubber; these, being lifted, pushed the tufts into contact with the roller and produced a vibration of the strings, which gave out the musical notes, the tone and volume far exceeding that which can be obtained from a perfect piano. H. GARDNER.

Coloured Suns.—ERRATUM.—In the list of colours on p. 383, from "ash-coloured" to "lurid," ought to have been given in simple order, without the distinctions which are given as headings.—T. H. BUFFHAM.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10478.]—**Pork Diet.**—Does A. H. Cooke know that pork, as an article of diet, has the following defects among others?—(1) It is less digestible than most other articles of food; (2) it is more difficult to detect disease in this than in other meat; (3) it is the principal refuge for the germ of the tapeworm.—HENRY NEWMAN.

[11531.]—**Water Wheel.**—In reply to "D. S." I regret to say that time will not allow me to take advantage of his proposal, which, I will do him the justice to say, seems perfectly fair to both sides. However, I shall be glad to see any other correspondent taking advantage of it. To find the average efficiency would require a number of trials, extending over a long period of time. Consequently, any one taking the offer, if it was proved in his favour, would have well earned it.—P. W. H. J.

[11531.]—**Water Wheel.**—May I ask "D. S." to give us some idea of the form of his rotary engine? We all know the future value of the rotary principle if physical conditions permitted its construction to "wear tight;" but I have never yet seen one (a rotary) in which I could not at sight see unequal speeds and pressures of contact surfaces bound to produce their one fault (not practical because won't wear tight). We all know the even far better expansion utilising capabilities of certain forms of rotary engines over the reciprocatory pistons. But may we ask him also for the "chap. and verse" of his figures, 9, 10, and 30 per cent. Against what makers of modern engines does he lay this charge?—X. M. S.

[11554.]—**Pedestrian Tour.**—Some little experience in this recreation—its joys and discomforts—made me glad to read "Philo's" suggestion of canvas shoes, with stout, broad soles. They are the very thing required—that is, if they will stand hard work. Calf leather shoes or boots are an abomination, and the more you try to make them waterproof the worse they are. I mean that they become offensive from the confined perspiration, and also from the occasional soakings from rain or wet ground, which are inevitable; and, when "set to dry," they become hard and rigid, and make the feet sore. Further, they look horribly shabby from perpetual attrition and dirt. I mean to try the canvas boots this autumn; but I certainly shall not have elastic sides. They are very bad for walking in a hilly country, because they throw a severe strain and pressure on the tendon of the heel and ankle, which ought to be perfectly free. I have before suffered severely from this cause. No more "elastic" for me, I thank you. I would rather go barefooted, or with rags and sandals, like the *pifferari*, now so frequently seen in our streets. Don't be afraid of getting the feet wet, or the whole body, for that matter. There is not the slightest harm in it, if you don't stand about or sit down in wet clothes or boots. If you get ever so wet, walk yourself dry again, if you can; or if arriving wet at your halting place, strip, have a rub down with rough towel, and put on a change of clothes, or go to bed (between blankets preferable) whilst your wet garments and boots are being dried. I have been wet and dry, wet and dry, several times in course of a day, but kept "continually going ahead," and, though of by no means robust constitution, suffered nought; but, on the contrary, felt awfully jolly at being thus able to defy the elements to do their worst. Another thing, don't invest in a knapsack. A commodious satchel, not too large nor too small, is the best thing for stowing what your pockets will not contain. It must have a light strap by which to sling it over your shoulder. You can then wear it either at your back or under one arm, or carry it in either hand, or sling it to your umbrella "crome" (hooked handle), and carry it pedlar's pack fashion. There is an enormous advantage and comfort in being able thus to change and change again the location of your load (be it ever so light a one), which quite contrasts with the irksomeness of even the best possible knapsack.—G. W. K. L.

[11564.]—**Blackberry and Strawberry.**—In answer to "E. L. G.'s" inquiry on p. 307, I beg to say that the raspberry and blackberry are certainly distinct species; the former is known to botanists under the name of *Rubus idæus*, and the latter as *R. fruticosus*. The raspberry is a native of Britain, and is plentiful in many of our hilly and mountainous districts, as well as in moist situations. Withering gives eight or nine places where it is to be found growing wild, and in Carnarvonshire Anne Pratt informs us you have only to wander out about half a mile to gather a basketful. The black and red currant are distinct species, known as *Ribes nigrum* and *Ribes rubrum*, and are both to be found growing wild in many places in Britain.—AVON.

[11589.]—**Dry Steam.** — I maintain that my original statement is correct that superheated steam is merely a higher pressure steam, which necessarily contains more heat and less water in a given bulk, and "E. L. G.'s" letter (p. 386) fully confirms this—vide, "It may be of no higher pressure than when it was wet steam, and in that case it must occupy more space." Now, is not this one way of evading the fact that it is really higher pressure or more heat and less water in any given volume of less capacity than the boiler? I would ask "Caloric" seriously to answer this question. Does he really suppose that he can apply additional heat to steam without converting it into higher pressure steam? and does he, "E.L.G.," or "Philo" imagine that if a vessel be filled with steam at 1lb. per inch, or that at 100lb. per inch, that when condensed there would not be far more water remaining from that at 1lb.? Also, I would suggest to "Philo" that although only one half educated, I know that if the manhole were left off the boiler that the water would evaporate far quicker than if merely escaping through his small vent, which proves that what I assert is correct—viz., that there is less water escaping from high pressure steam at the same moment, although there may be the same ultimately; and that although Dr. Arnott's theory has something to do with it, it must be taken into conjunction with the lesser quantity of water issuing from the orifice. Thus, take any boiler and see how many times it would fill the cylinder before all the water was exhausted (having no supply pipe) with steam at a high pressure, and see how many times less it would take to exhaust it with low pressure steam. —A., Liverpool.

[11589.]—**Dry Steam.**—"Philo" has doubtless given, from Dr. Arnott (p. 386) the correctest way of explaining the sudden cooling of a steam jet, but he was, and still is, wrong in supposing that high pressure steam escaping into air tends only to expand down to a pressure balancing the air—the tendency is to expand till balancing only the steam atmosphere, as if the oxygen and nitrogen atmospheres were absent. Dalton showed that a gas or vapour thus diffusing in a mixture of them, has its ultimate tension limited simply by that of the fluid similar to itself, quite apart from the dissimilar ones, as if they were non-existent. Steam from a boiler, of 30lb. per inch, released into an atmosphere whose steam presses but half a pound per inch (which is about the maximum of atmospheric steam) will expand almost instantly sixty-fold, and not merely two-fold, as "Philo" imagines. It will be sixty-fold whether the half-pound steam be the only resistance present, or whether there be also oxygen of 3·2lb. and nitrogen of 11·2lb. (as usually happens), or airs of double or triple these tensions, even equalling or exceeding that in the boiler. These other fluids merely retard somewhat the time occupied in expansion, but do not affect its amount, for the three atmospheres are independent. The presence of air, therefore, is not necessary to the sudden cooling, as Arnott's instructive experiment seems to lead "Philo" to think, for doubtless a jet escaping into vacuum (whether forming cloud or not) would be as cool. To produce a scalding cloud the escape must be into warm and wet steam. Two steams of different temperatures, whatever those temperatures be, and both near saturation, become on mixture, supersaturated, and therefore form cloud. It is possible, however, for very dry (*i.e.*, very superheated) steam, escaping into air also of great dryness, to diffuse invisibly, and form no cloud even for a moment. This may be what "Caloric" observed with Mr. Lee's superheated steam, but I doubt if it could have occurred in a moist S.W. wind. I have seen a mere momentary cloud re-dissolving at a yard or two from the funnel, with even engine steam (necessarily wet) in the West Indian dry season. Slightly superheated steam would have spread invisibly, but wet steam, as that of engines, cannot do this, I believe, in any natural degree of drought. Even on the Egyptian and Suez railways it must always form cloud for a moment or two. Though "Caloric" did not see the connection, there was a curiously close one between this opportune query and the "Comet of the Deluge." In fact, "Sigma's" mistake that water from a cold steam comet must reach the ground scalding hot, and that of "Philo," that very hot steam should form a scalding cloud, were mutually illustrative, though not identical. Neither the rain in the first case nor cloud in the second need be scalding; but "Sigma's" was the greener mistake, because wholly ignoring our atmosphere's presence. Doubtless, if the earth had no more air than the moon, he would rightly reason that the diluvial water must have fallen boiling hot (which would make small difference physiologically, seeing that, if in drops at all, they would have about 20 times the velocity and impact of rifle bullets). But our globe's 40 or 50 mile great-coat of air formed at once a cushion and fire-screen, as it does in the case of the 11 or 12 times more rapid (and therefore 1,331 to 1,728 times more heating) impact of the November meteors. The upper 30 or 40 miles of air-coat bore, in either case, the brunt of the encounter and its heat, radiating most of the latter into space, before the small residue could descend by the very slow downward aërial conduction. As for high pressure steam in its escape forming snow instead of water cloud, though I never heard of an instance, it is not an absurd idea, having a close parallel in the escape of compressed carbonic acid, which, from far above its boiling point, cools in this manner below its freezing point, so as to deposit itself in a snowy form, not obtainable, indeed, in any other way.—E. L. G.

[11625.]—**Deaf Dog (U.Q.).**—I would use the cayenne pepper tea as recommended for "Deafness from Cold" (No. 11996).—N.B., whenever a dog has to be dosed, wear thick gloves.—H. O'B.

[11801.]—**Question in Trignometry.**—In reply to my inquiry (p. 309 of No. 376 of ENGLISH MECHANIC), "H. H." (or "W. H.," whichever he may be) says "that both the construction and calculation are adapted to the general problem, whatever be the values of the angles about P." But he does not explain how the intersection of the circles described from the centres of the equilateral triangles described upon the sides of the triangle A B C (see his directions and diagram, p. 260, No. 374, the ENGLISH MECHANIC), will fix the position of the station or point D. It does not appear, from his diagram, that these circles can intersect each other in D at all. In his last letter (p. 361 of No. 378 of ENGLISH MECHANIC) he says "only the triangles must be isosceles," &c., but an equilateral triangle and an isosceles triangle are different things; which statement is correct? It happens in "Numa's" triangle that the angles subtended by the sides from P are equal, and that the sides are nearly so, but this will not occur in actual practice one time in ten millions, perhaps. What we require is a rule by which this question may be answered—Whether station P be near the centre of triangle A B C, or far removed from it, so long as it be within the triangle, and whether the angles subtended by the sides from P be equal or very unequal. If nobody else does it, I will one day send such a rule.—THEODOLITE.

[11837.]—**Organ Bellows (U.Q.).**—The size of a bellows for such an organ should be 4ft. by 3ft. 6in., with a pressure of 2½in. of wind.—J. D.

[11872.]—**Carbonic Acid Gas and the Atmosphere.**—When I made my calculation I included Ireland, and, therefore, took the area at one hundred and twenty thousand square miles. Likewise, the expression one hundred and forty million tons should have been one hundred and forty thousand million tons. I may state that the weight of the whole atmosphere is about five thousand billion tons and not thirty-five billion tons as "Philanthropist" makes it out to be in his reply.—WILLIAM THOMPSON.

[11969.]—**Cochineal.**—I believe this insect has been reared in this country on its food plant and under suitable conditions, but of course only as a curiosity.—E. M.

[11973.]—**Magnetic Engine.**—Does "Glatton" want an electric engine or an electro-magnetic machine? It is doubtful from his query.—L. C.

[11996.]—**Deafness Arising from Cold.**—A pinch of genuine cayenne pepper, with boiling water, say as much as will cover a sixpence to a gill of water, when half cold used as an ear wash, by pouring in a teaspoonful at a time, thrice repeated, that is three spoonfuls one after another as one wash, and used two or three times a day as long as the deafness continues.—OFTEN PROVED.

[12011.]—**Magic Lantern Effects.**—The following is extracted from "The Magic Lantern: How to buy and how to use it." The slide to give the effect of falling snow consists of a light framework of mahogany, between the two sides of which are arranged parallel rollers, one of which, being worked by a winch handle, unwinds a piece of black linen, or silk, pierced by numerous pinholes, through which the light passes when the fan is lowered, and on turning the handle in the proper direction the appearance of falling snow is produced. Care must be taken that the perforated curtain be focused while bringing it down, or the snow will fall invisibly." A moonlight effect is sometimes produced by means of a single slipping slide; the scene is first exhibited in colours representing a day view, and on pulling the glass slip a blue tint painted on it is thrown over the picture, giving a very good effect of night. The moon is represented by a circle scraped out of the blue tint.—C. BROWN.

[12012.]—**Water Power.**—"P. W. H. J." considers that my reply to the above question is of practically although correct in theory; he states that I have calculated the natural effect due to a fall of water, but that I have not gone any further. If he will refer to my letter he will perceive that he is in error; I have made a large allowance by putting the velocity $v = 10$, instead of 19¼, to allow for the effects of fluid friction and the well known phenomenon of the contracted vein. I stated that I did not know the length of the pipe, and I hinted that the data precluded great accuracy as in most physical problems; perhaps if the pipe is a very long one, the allowance I made was not enough; a further deduction should have been made for the modulus of the wheel employed, but it would vary accordingly as a turbine or other motor was used. "P. W. H. J." states that in the rainy season there might be 2 horse-power, but he previously estimates the ordinary power at ¼ horse-power; I made my calculation on the supposition that there was as much water as could run through the 3in. pipe. To suppose otherwise would add another element of uncertainty to the calculation. I think it would be useful if some of our correspondents would give us extracts from tables as to the practically observed effects of fluid friction as depending on the length, diameter, and inclination of the pipe. At the same time I must say that "P. W. H. J." has given practical details which I could not have furnished. I said almost all I had to say on the subject, and I could do no more.—PHILANTHROPIST.

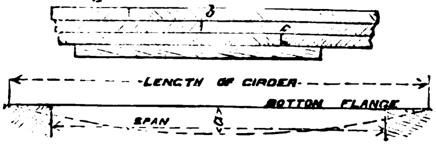
[12013.]—**The Frst Watch and Clock Made.**—In answer to "A Glasgow Highlander," Reid's "Treatise on Clock and Watchmaking" contains a vast amount of useful and interesting information; published by Blackie and Son, Glasgow and Edinburgh; as also E. J. Wood's "Curiosities of Clocks and Watches." There are also a great number of works on watchmaking published in French. Ancient writers differ greatly as to the date at which clocks were first introduced. Claudian states that Archimedes constructed a machine or sphere for the measurement of time 200 years B.C., but the most ancient of which we have any definite record is the one constructed by Henry de Vick or Wick, a German artist, in 1370, of which there is a full description and engraving in Reid's work alluded to above; but there is no doubt that Vick's clock was the invention of no one man in particular, as we may fairly infer that different men at various times made additions and improvements to horological machines, before they attained even that state of perfection.—TEMPUS FUGIT.

[12014.]—**Organ.**—If "E. C." will refer to No. 359 of ours, article "The Organ Built," he will find that I have explained how to do what he asks.—J. D.

[12072.] —**Magnetic Moment.**—I fear that I cannot give "Beacon Lough" the information he seeks without a greater expenditure of time and labour than I can at present spare. It is not contained in any book I know of, unless buried under a mass of mathematical symbols which I only very partially comprehend. I should think the readiest mode of getting at the magnetic moment in absolute units would be by ascertaining in those units the current which produces a given deflection to each magnet in the same galvanometer (tangent being, of course, most convenient), and deducting the force used up in the resistance itself; probably a very careful measurement of the extra resistance produced by the magnet would also furnish it. As to the coil, I do not myself understand the quotation from Tyndall, and have not the book to refer to. There is an alternating discharge of different tensions, and, as "B. L." sees, by careful regulation of distance, one of these discharges can be suspended, in which case the "extra current" will be brought into play: is this what Tyndall refers to. It is by the same means that a jar is charged; it cannot be done if both terminals are connected to the coatings; a discharger must be included and opened to the distance at which the one discharge cannot pass; then sparks pass to the jar and gradually charge it.—SIGMA.

[12106.]—**Organ Building.**—Stopped pipes will not answer well to produce more than one tone, although they can be made to speak two notes by a valve on the top of a "chimney," yet I have always had the idea that a perfect organ of one or two stops is preferable to one with a dozen imperfect stops, and if every alternate semitone is left out what can be done with a number of the little effects which organists often use, but which puzzle the uninitiated so much? An open pipe may be used to produce three notes.—J. D.

[12125.]—**Cover Plates.**—The cover plate of a girder is that piece of metal added to supply the deficiency of the joint of the plates at *a b c*, and the rivet holes in same. If each plate were taken singly, it will be seen that the joint at *a* is only spliced, so to speak, by plate *b*, and the strength is only the strength of *b*, likewise of *b* and *c*. It should be calculated to supply as nearly as possible that deficiency, taking the number of square inches area. Cover plates are necessary on the bottom flange of a girder, because the metal is in tension, say four tons to the square inch. Cover plates are not considered necessary as a matter of calculation at top flange of a girder, because there the metal is in compression, and the edges butt upon one another. But the practice is to place them both at top and bottom of a girder; it makes a good joint, and is something to the good to resist the varied strains that may not have been taken into the general account. Four tons to the square inch in tension and compression is the practice for wrought iron. I generally strike a parabolic curve from end to end of girder, and see that my plates are well beyond the curve (for load distributed). The formulæ will give the depth of metal required at *a*, from which the curve can be calculated. Do not cut the metal too fine.—DRAUGHTSMAN.



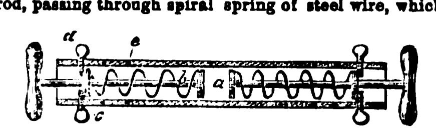
[12125.]—**Cover Plates.**—By cover plates I mean (and I think I have used the correct technical term) the plates which are bolted or riveted on each side of a girder, sometimes one side only, where a joint occurs in the vertical web.—EXCELSIOR.

[12130.]—**Electricity.**—The force which urges the current from a galvanic current or voltaic current, as it may be called, is enormously less than the force with which frictional electricity is urged on. The consequence is that the latter or frictional is able to leap over or pass obstacles that would stop the former; but by linking cells together the voltaic current is caused more and more to approach the nature of the frictional current. It, however, requires 1,000 cell battery to make the current leap over a space of $\frac{1}{1000}$ of an inch in air. But an electric current of moderate power, furnished with a proper conductor, is competent to urge the current across an interval ten thousand times as great; but measured by other standards the frictional electricity is almost incomparably more feeble than the voltaic electricity. For example, it is not without special arrangements for multiplying the effect that frictional electricity can be made to deflect a magnetic needle. The difference may be expressed thus: Voltaic electricity is low in intensity but in great quantity, and frictional electricity the reverse. The deflection of a magnetic needle and other actions of the voltaic current depend upon quantity solely, hence superiority of galvanic battery in producing such deflection.—P. W. H. J.

[12133.]—**Hard Water.**—Try Professor Clarke's plan of adding lime-water. Quantity to be added depends upon degree of hardness. For very hard water you might try proportion of 1 lime-water to 10 water. The way that it has been done at some waterworks is to let the mixture run for some distance at considerable velocity. For water of 10° hardness the process requires sixteen hours to render it good serviceable water. This, I think, will be the cheapest plan. I don't see how Condy's fluid could be profitably employed.—P. W. H. J.

[12133.]—**Hard Water.**—Boil, and allow to get cold, all cooking and drinking water. This will precipitate some, if not all, of the solid matter it contains, and kill any living organisms which may disport themselves therein. To re-aërate it (*i.e.*, to restore its sparkling appearance and destroy insipidity) pour two or three times from one bucket to another from a height of two or three feet.—HENRY NEWMAN.

[12135.]—**Chest Expander.**—"Jack of All Trades" being so unwell I venture to reply for him. In the diagram *a* is a tube, say a foot long; *b* piston and rod, passing through spiral spring of steel wire, which



is fastened at one end to piston, at the other to flat ring *c*, held at different distances within the tube by thumb-screws *d*. Of the three sets of screw-holes, those marked *e* are suited for the greatest strength. All this gear must fit the tube loosely.—HENRY NEWMAN.

[12136.]—**Monkey Nut.**—Botanical name *Arachis hypogea.* Will not live through the winter. Used largely on the Continent for making a first-class oil. Very nice when slightly roasted.—S. BOTTONE.

[12137.]—**Liquid and Solid.**—Mercury is liquid at all temperatures above − 40° Fahr., but solid below that point.—S. BOTTONE.

[12138.]—**Chemicals that Absorb Moisture.**—The principal deliquescent bodies are:—Calcium chloride, zinc chloride, caustic potash, possassium sulphide, potassium carbonate, potassium cyanide, caustic soda, strontium chloride, magnesium chloride, aluminium chloride, iron perchloride, manganese protochloride, chromic acid, copper protochloride, &c.—S. BOTTONE.

[12138.]—**Chemicals that Absorb Moisture.**—Carbonate of potash absorbs so much moisture from the air as to become almost, or quite, liquid in time.—J. C. L.

[12142.]—**Leaky Tubes.**—Wind round the ends inside with soft wire, as close to the end plate as possible, the wire to be of the thinnest kind.—RAT-TAT.

[12142.]—**Leaky Tubes.**—I presume that it is the junction of the tubes with the tube plate that leaks; if so the collars that fit in over the tubes want removing, and fresh ones substituting. A good plan would be to get the waste ends of wrought-iron tubing from the gas-fitter's, and just roughly turn or file the surface. They must be at least 1in. long, and made slightly taper. They must then be gently driven into the place of the old ones, not the whole distance at once, but all be fitted into their places, and then driven home by degrees. If the old collars have been long in their places there will be some difficulty in starting them without damaging the tubes. One plan would be to loosen the collars at smoke-box end, which are always the easiest to loose, and then drive the tubes out. They can be best driven out by getting a tube that will just fit over boiler tubes, and driving that against collar. The greatest caution is requisite, or it will result in the fracture of the tube plate.—P. W. H. J.

[Will "P. W. H. J." please favour us with his address.—ED.]

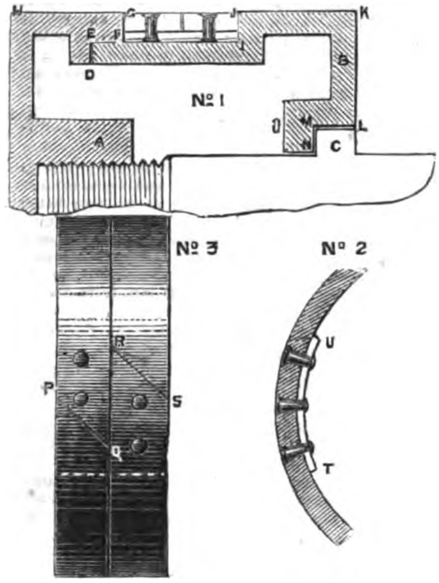
[12145.]—**Small Steam Boiler.**—By the cylinder being 5¼in. depth, I should imagine that it would be 5in. stroke. Probable number of revolutions = 100, and pressure 30lb. (I would here observe that amateurs, in asking questions of this class, seem to make a point of omitting both pressure desired and number of revolutions, making it almost an impossibility to answer them correctly). Then the piston speed is $\frac{200 \times 5}{12} = 83{\cdot}5$ft. per min., and pressure upon piston is 119·28lb. ∴ Units of work performed = 83.5 × 119·28 ∴ H-P = $\frac{83{\cdot}5 \times 119{\cdot}28}{33000}$ = ¼, about, taking friction into account. Then we have to design a ¼ horse boiler. A one-horse boiler requires a square foot fire-grate, and therefore a ¼ horse requires 36 square inches. Thus the boiler is to be 18in. long, 6in. diameter, and grate 6 by 6in. Now this boiler has to stand 30lb. pressure. The thickness that would safely resist this pressure is ·05, or $^1/_{20}$in. thick. This is No. 6 B. W. G. For the boiler, there will be at most 400 square inches. Now, copper of that thickness weighs 9·4lb. per square inch. ∴ Boiler weighs 26lb.; cost of material, at 1s. per pound = 26s.; and of labour = 20s. ∴ Total cost = 46s. Any further information will be given if able. It may be either brazed or riveted, but preferably the former, if a good hand at it.—P. W. H. J.

[12148.]—**Boiler Query.**—From "Molesworth's" I find the following rule:—Let D = diameter of the boiler in inches, P = the pressure in pound per square inch, T = thickness of boiler plate in inches. Then $T = \frac{PD}{6000}$ for ordinary plates, ∴ $\frac{3}{16} = \frac{P \times 22}{6000}$, ∴ P = 51lb. about. The tubes I have not taken into consideration, but by acting as stays they will probably make the boiler able to stand 60lb. safely. The calculation supposes that the rivets are properly distanced and proportioned. In example given, the rivets are too small, for $^3/_{16}$ in. plate requires not less than ⅜in. rivets. On account of the smallness of the rivets, it renders the thickness of the plates useless, as those ¼in. rivets would yield before the plates. A boiler ought always to be so proportioned so that every part would be equally likely to give way at the bursting pressure. The rivets should be 2¼in. distance or pitch. The horse-power I cannot determine without more data. I want to know size of firegrate, whether boiler is vertical or horizontal, height of internal fire-box, and kind of fuel used.—P. W. H. J.

[12155.]—**The Suspended Shilling.—Another Reason Wanted.**—I might almost ask "H. G. W." why mackerel always roost in apple-trees, had it not been gravely asserted in a semi-demi-scientific work some years ago that the shilling would so act, even if the holder were not "up to the time of day." The assertion that an inanimate body will conform to the conventional divisions of time which men use, and spontaneously strike the nearest hour, bears a lie on its face, and another on its back. (Query: Would it be so suave as to strike up to 24 in Italy?) The only solution of the question is that the holder, consciously or unconsciously, brings about the effect he desires, and that a strong wish that it should not overstrike steadies his hand, and stops the vibration of the shilling.—HENRY NEWMAN.

[12158.]—**Packing Rings of Piston.** — The pistons for model engines, and engines of small power, are made in two parts, one fitting on the top of the other, and the ring or other packing goes between. By this plan the ring can be easily turned true. The way it is done is this. Suppose the ring is a brass casting, then fasten a piece of plank to the face-plate and turn in it a recess so that the ring will tightly fit in it. In this turn out the interior to fit recess turned for it in the two halves of the piston, and face truly square both sides. Next place it in position on piston and screw the two halves together, clasping it tightly. Before doing this the piston-rod must be fixed in position on piston. Then the whole must be put between centres in the lathe with carrier on end of piston-rod. The ring must now be turned the merest trifle larger than piston. It is now to be taken off and a saw-cut made at an angle of 45°, with a circular saw. The ring ought now to be ¼in. thick, and ⅛in. to ¼in. broad. If the piston has been turned all in one piece it will be a difficult thing to get a ring on it. One way of doing it would be this: turn a brass ring as before directed, heat it, pass it into recess, and then quench it with cold water. I am afraid that you will hardly make a good job of it. In this case steel would be the best material for the ring, as it would yield more with permanent distortion.—P. W. H. J.

[12158.]—**Packing Rings of Piston.**—Inclosed I send you a rough hand sketch of a piston and packing rings, and herewith append some descriptions:—Surfaces D, E, F, G, H of bottom half A of piston, all turned true to a common centre. As also must be surfaces D, E, I, J, K, L, M, N, O of upper half B. Piston surfaces H, G, and J, K, turned at first a shade larger than cylinder's diameter. The two rings turned at first three-sixteenths of an inch larger than cylinder's diameter, and of a width (together) such as to just jam fast, when surfaces D, E, M, N (by the thread or piston rod) come to contact by the collar C, on the rod being screwed hard. The surfaces O, N, M, L, E, F being moving contact without any shake. The rings are then taken out, and ⅛in. slit out by a saw, as shown (Fig. 3) at P, Q, R, S; while a piece of thin thirty-second part of an inch spring steel is riveted to each ring, as shown (Fig. 2 and 3) permitting their sliding contact on each other through holding them both as one ring. They are now put in their groove in piston, closed the ⅛in. that has been taken out of them, and jammed fast by the thread on the rod. All are now placed in the lathe again (in the previous



centres), and a cut taken from H through G and J to K till just fitting the cylinder "exact." Then release the rings by introducing a sheet of writing-paper between D E and M N, when all is screwed hard again and ready for the cylinder. The amount of paper introduced should not be more than will permit motion to the rings without chatter. The paper must not be omitted, as it not only prevents unscrewing when at work but will be found in years after, by a few hours' soaking in hot water (boiling) to give way curiously when the piston is required again to pieces. Piston rings and cylinder of "cast iron," when if the cross-head guides and stuffing-box on rod be true in a straight line, and a good priming trap be used, this, piston rings and cylinder, will soon become one brilliant burnished surface, friction and wear becoming thereby nearly *nil*. Mr. M. L. Dodsworth, if he takes care to produce this burnishing result, will be astonished at the years his piston will go quite tight.—X. M. S.

[12160.]—**Size of Iron Tool, &c.**—I thought "Optical Bricklayer" (p. 341) would have inferred from my last letter that there could only be one correct size for the polishing tool, the diameter of which should be just so much larger than the diameter of speculum as the sloping margin of the pitch requires. It is obvious that anything larger is superfluous, while anything smaller will not give enough support to the edge facets. The performance of his mirror is certainly very creditable, but if he aims at still greater perfection, he will find that scrupulous attention to the size of tool is not of so much consequence as perfect regularity of pressure between every part of tool and mirror. There is no difficulty in getting this when the two surfaces have rubbed together for an hour or two, but it is in the retouches when parabolising that the difficulty occurs, and each time the mirror is removed from the polisher for the purpose of testing it will be found, on recommencing work, that they do not work so smoothly as before, owing undoubtedly to the fact that the pitch tool has lost its fine figure. To keep this fine figure on the polisher is, then, the point upon which all the operator's skill and patience should be brought to bear. I regret, for the sake of your querist, that what suggestions I can offer I have not yet had the opportunity of trying, as pressing engagements have obliged me to discontinue optical work for some time past, but it appears to me necessary that a duplicate mirror, or else a concave tool that has been ground and polished upon the same tools as the mirror, should be kept for the express purpose of re-figuring the pitch, which should be done with precisely the same stroke and motion as that used for the speculum; and as soon as the concave tool rotates regularly and smoothly upon the pitch, the retouching of the speculum may then, and not till then, be commenced. I may add that it seems equally necessary to figure the pitch tool accurately at the commencement of the spherical polishing, as for those finishing touches that only occupy a few minutes, and on no account should the speculum be made to do the rough work of rubbing up an incorrect polisher until it assumes its own figure. It is advisable, too, to finish the parabolising with rouge of the softest kind. I should be pleased to know the opinion of the Rev. H. C. Key upon this mode of procedure, as a few words from him would be worth more than all I could say to your querist, although I have no doubt that if "Optical Bricklayer" will patiently follow it out, he will in the end find his pains handsomely rewarded.—W. PURKISS.

[12165.]—**Cream Cheese.**—There is a kind of cheese made by the Germans which I hope no Englishmen will imitate. I think that the people who could eat that with relish deserve a prize medal for endurance. I will therefore describe the process of making English cheese as ordinarily carried on. Cream cheese is prepared by mixing an additional quantity of cream with milk previously to coagulating the whole with rennet. Rennet is the membrane of the calf's stomach, prepared in a peculiar manner, which possesses during life the property of coagulating milk, and retains this property to a remarkable extent after death. All the different methods of preparing rennet have the common object in view, to protect it from undergoing putrefaction. This is done either by smoking, salting, or by both at once, or, lastly, one of the three methods combined with the use of spices. When rennet is salted in the dry state it soon produces a salt brine, which also exhibits the power of coagulating milk, and is employed for that purpose. While in many districts it is the practice to remove the milk that has curdled in the stomach, custom has proscribed in others the use of the stomach, together with its contents, as rennet. In the latter case the cheese is less easily preserved, the butter in the coagulated contents of the stomach having a strong tendency to become rancid. It is remarkable how powerful an action is exerted by a very small quantity of rennet. Thus, one square inch of rennet, smoked and salted, is sufficient to coagulate 80 quarts of milk. In Scotland, for instance, where they do not employ the rennet itself, but an infusion of whey or salt and water with rennet, a tablespoonful is enough to coagulate 120 quarts of milk. The infusion employed in the manufacture of the Limburg cheese appears to exert a still more powerful influence. It is obtained by allowing salt and water to trickle through the smoked rennet. According to the statements of the farmers, from four to six drops are sufficient to coagulate 24 quarts of milk. Whether the acid property of rennet is the sole cause of this power has not yet been ascertained, at least I have not seen it mentioned; and it is to be remarked that very often acid parts of vegetables (say, for example, lemons or bramble leaves) are used to assist the rennet, and that that substance, according to all experience, becomes more active by keeping. Berzelius found that 1 part of rennet only lost ·06 parts by weight of its substance in coagulating 1,800 quarts of milk. In Cheshire, a portion of this dried stomach is put into half a pint of lukewarm water, with as much salt as will lie upon a shilling; is allowed to stand over night, and in the morning the infusion is poured over the milk. Dr. Holland said that for a cheese of 60lb. weight a piece about the size of half a crown will often be sufficient, though of some skins as much as 10 sq. in. is often required to produce the same effect. The coagulation of the milk is often assisted by means of large caldrons built over a fire. The best temperature is about 104° Fahr. Soft or hard cheese, with proper attention to these circumstances, can be prepared at will. Season and locality appear to exert great influence in the amount of cheese yielded by milk; 8lb. to 10lb. of good milk and cream should give 1lb. of cream cheese.—P. W. H. J.

[12180.]—**Seasoning Pear Wood.**—A. H. Cooke should cut the trunk of his pear tree into planks, when it would become seasoned much more quickly, and would not be injured by splitting. It will turn well, and is a nice kind of wood for carving into ornaments.—E. B. F.

[12185.]—**Madnip and Wood Laurel.**—Madnip is an old name of the cow parsnip, *Heracleum sphondylium* L., and a figure is given in Gerard's "Herbal," by Johnson, p. 1009. Among the virtues of the plant these are enumerated:—"If a phrenticke or melancholicke man's head be anointed with oil, wherein the leaves and roots have been sodden, it helpeth him very much, and such as be troubled with the headaches, and the lethargie, or sickness, called the forgetful evills." No special medicinal virtue is attributed by modern writers to the cow parsnip. I have somewhere read that in northern Asia the skinned root is a favourite morsel with the natives. Wood laurel is, I conclude, *Daphne laureola* L., spurge laurel, a dwarf shrub, not uncommon in woods, hedges, and thickets. In most catalogues of native plants it is named spurge laurel; but in the excellent "Flora Vectensis," Dr. Bromfield gives it the name of copse or wood laurel, as well as spurge laurel. I remember when in Sussex, the sudden clearance of a wood of every plant of this species by strangers; on inquiry, the cottagers told me that it was taken to market at Chichester and Portsmouth, and sold as a horse medicine, but I could not learn in what class of diseases it was used. The bark is hot and pungent enough. The plant, especially the bark of the roots, has been usefully applied in some skin diseases of bipeds. See *Pharmaceutical Journal*, 1, 397, and Dr. Cullen. I had some reason for believing that the bark of *D. laureola* was sold as a substitute for that of *D. mezereon* in making compound decoction of sarsaparilla. Its qualities, indeed, are similar; as are those of other species, *D. Gnidium*, *Pontica*, &c. See Dr. Lindley on the subject in "Vegetable Kingdom," p. 531, second edition.—GERARD SMITH.

[12186.]—**Cheap Farming.**—Try the Scotch rotation crop system, or stall feed all your cattle. Large portions of land are ruined by turning it into pasture or grazing ground for sheep and cattle. The grass is trodden upon, killed or stunted in growth, and the surface becomes hard and barren for the want of cultivation. A great many things could be said against the grazing system, but as it is an easy, indolent, and aristocratic way of farming, it is generally adopted to the impoverishment of the labouring classes.—RAT-TAT.

[12196.]—**Rendering New Rope Flexible.**—Unlay it and make it up softer, or take the turns out—*i.e.*, twist it partially open, or trust to weather and wear. White manilla is naturally stiff and unmanageable.—HENRY NEWMAN.

[12197.]—**Roses.**—Gloire de Dijon, Maréchal Neil, Souvenir de Malmaison, Louis the XIV., and Sénateur Vaisse. These embrace as many colours, and the three sections, Tea-scented, Hybrid Perpetual, and Bourbon.—IRISH MECHANIC.

[12199.]—**Speeding Pulleys for Gut.**—Has Mr. Williams tried a pair of conical pulleys?—RAT-TAT.

[12199.] — **Speeding Pulleys for Gut.**—If E. Williams will make exactly the same difference in the diameter of his large cone as small one he will find his gut will drive on any speed. Thus, suppose his large wheel is 2ft. 6in., and the smaller speed on his cone 4in., the next on large wheel is 2in. less in diameter; the next on the cone will require to be 2in. in diameter larger, and so on; and *vice versâ*, 2ft. 6in. = 4in. speed; 2ft. 4in. = 6in. speed; 2ft. 2in. = 8in. speed.—E. S. S.

[12199.] — **Speeding Pulleys for Gut.**—The principle is that the sum of the radii of each speed shall be equal. For instance, suppose a driving-wheel of 4 speeds to be 3ft. diameter, or 36in. at smallest groove, then let diameter of largest speed of pulley be (say) 14in. Then 36 + 14 = 50, which is a constant to be abided by. Let diameter of pulley be required to diminish in steps of 2in. Then successive diameter = 14, 12, 10, 8, ∴ diameter of grooves of driving-wheel = (50 − 14), (50 − 12), (50 − 10), (50 − 8), that is 36, 38, 40, 42in. respectively.—P. W. H. J.

[12200.]—**Levelling.**—In reply to "Bricklayer's" question, the figures 50·76 mean 50ft. and 76·100ths of another foot, above a fixed datum level. This may be called 50ft. 9in. without any greater error than the one-hundredth part of a foot, or a little less than an eighth of an inch, the exact height in feet of 50ft. 9in. being 50·75ft. And in all cases of decimals of feet, if they be multiplied twelve times the result will be inches, or inches and parts of an inch. Thus ·76 × 12 = 9·12—that is, 9in. and 12·100ths of another inch. And in the same manner if the decimal ·12 be multiplied eight times the result will be eighths of an inch. Thus, ·12 × 8 = ·96, or very nearly one-eighth of an inch.—C. S.

[12200.]—**Levelling.**—"Bricklayer" is perfectly correct in his assumption; the levelling staff is divided into feet and decimals—thus, 50·76 would stand for 50ft. and 76·100ths of a foot.—SURVEYOR.

[12200.]—**Levelling.**—"Bricklayer's" idea is no doubt correct, though he has not managed to express himself precisely; the 50·76 represents 50ft. and 76·100ths of a foot.—EXCELSIOR.

[12202.]—**Boat Building.**—The best book, in my estimation, on the above subject is "The Book of Boats," by W. H. G. Kingston, price 3s. 6d., to be obtained of any good bookseller in the country. It has very clear and concise directions for making and rigging models of all descriptions; it also contains descriptions of all ships and boats to be found floating in any part of the world.—A. G. H.

[12204.]—**Pansies.**—In answer to "One Anxious to Learn" (No. 378), if not already answered, I find the following an easy method of striking slips of pansies:—Get some good loamy soil (*i.e.*, turfs cut from an old pasture is the best, and turn the grass side down for about a year, until they are thoroughly rotten and incorporated into one mass), ½ part of this to ¼ of dung rotted to mould, and ¼ part sand. Well mix and run through a wire sieve, having prepared a place on a warm border, by taking out the common soil, and replacing with this composition. Get some cuttings of choice sorts, about 1in. or 1½in. long, cut just below a joint, cut the leaves close off half-way up, water the composition, and with a sharp-pointed stick dibble them in up to the lower leaves—that is, put the cutting half way in, sprinkle a little sand round about them, and cover with a hand-glass; shade from the sun for a few days, and in six or eight weeks they will be ready for transplanting; they may be saved during the winter by sticking a few twigs round them or lightly covering with a little straw. I have never succeeded well with the frame, nor yet tried seed; the following are good ones:—D'Israeli, White Sergeant, Ophir, Aurora, Gem, Queen of England, Duke of Norfolk.—PHŒNIX.

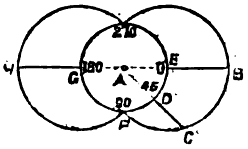
[12205.]—**Double Rockets.**—Best from seed. Sow in the autumn to bloom next year. Perennials, quite hardy.—S. BOTTONE.

[12206.]—**Geraniums and Fuschias.**—The two following are good fuschias:—Bo-peep, and Warrior. The finest scarlet single geranium, Bonfire; double scarlet, Madame Lemoine, and Triompe, generally sold by London florists about 3s. 6d. per dozen.—PHŒNIX.

[12206.]—**Geraniums and Fuschias.**—Geraniums: Excellent and Victor Emmanuel, zonale; Mrs. Pollock and Lady Cullum, tricolor; Crystal Palace Gem and Bijou, bicolor. Fuschias: White Perfection and Marvellous.—S. BOTTONE.

[12206.]—**Geraniums and Fuschias.**—Clipper, Monster, and Richard Headley, among the former; Wave of Life and Cloth of Gold, among the latter.—IRISH MECHANIC.

[12207.]—**Light.**—(1) A beam of polarised light can be readily and completely intercepted by the rotation of the analyser, whether it be a tourmaline, Nichol's prism, or plate of glass, or mica, placed at exactly the right angle. (2) The proportion of polarised to unpolarised light increases very rapidly as the position of complete polarisation is approached. In the accompanying diagram the amount of light which will pass through the analyser in various positions is indicated by the distance which the radius of the smaller circle must be produced before it cuts the circumference of one of the larger circles. Thus, if the analyser be arranged so that it may coincide in position with the polariser, and the amount of transmitted light be represented by the length of the line E B, on revolving the analyser through 45° the light will be reduced to D C, and at 90° complete darkness will occur. On passing this point the light very rapidly increases, attaining its maximum again at 180°



and returning to zero at 270°. On this account in reflecting polariscopes when the angles of the glass plates are not perfectly accurate, a very sensible amount of light is observed when complete darkness is expected. Nichol's prisms, tourmalines, and Herepathite readily give complete darkness.—ALFRED H. ALLEN.

[12207.]—**Light.**—If two similar plates of tourmaline be placed together, so that light polarised in one plane can be transmitted, objects may be seen distinctly through them, but on turning one at right angles to the other, absolute darkness occurs, because the second plate absorbs the light transmitted through the first. A ray of plane polarised light may be very conveniently obtained by allowing common light to be incident on a double refracting crystal, as calcite, when it will be divided into two beams polarised at right angles to each other; by sticking a wafer or a piece of black paper over the point of emergence of one polarised ray, it is possible to obtain the other in a state of isolation. If one of the beams of light obtained by double refraction, either by the above method or by some other, be received upon the lower plate of Birt's polariscope, the light will be completely absorbed, provided that its planes of polarisation be in the same position and angle. When light is reflected from glass at an angle of 56°, 45° consists almost entirely of light polarised in one plane, equal to nearly one half of the incident light, it refuses to be reflected from a second glass plate on which it is incident at the same angle, when the plane of reflection is at right angles to the plane of polarisation of the ray. Hence, as one portion of the incident light only is reflected from the first plate, and that being absorbed when the second plane of incidence is at right angles to the first, it follows that no light ought to be reflected from the second plate if the polarisation of the light is complete. The effects thus observed of extinguishing light, by altering the position of the reflectors, are analogous to those observed by crossing two tourmaline plates. In that part of your question numbered 2, I am not exactly certain, but I have a table of the effects observed by turning the top plate of Birt's polariscope, allowing a candle to shine upon the bottom plate. I should think that from that you could get an approximate.

Inclination of planes of reflection.		Varying brightness of candle.
0°	..	Greatest intensity of light.
0° — 90°	..	Light decreases until it nearly vanishes.
90°	..	Light scarcely visible (with tourmaline probably vanishes).
180° — 270°	..	Same as 0° to 90°.
270°	..	As at 90°, scarcely visible.
270° — 360°	..	Gradually increases as from 90° to 180°.

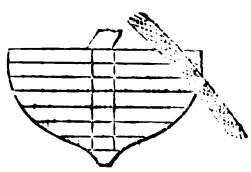
—P. W. H. J.

[12209.]—**First Railway.**—The first railway opened for passenger traffic was the Stockton and Darlington. The Act was passed in 1821 and the opening took place in 1825. The passengers were at first conveyed in a carriage, built by the late George Stephenson, and named by him the "Experiment," it had seats on each side with a table running up the centre, and was drawn by one horse. First, second, and third class passengers were all jammed into this carriage, and in dark winter nights it was lighted with a penny candle. It performed a journey daily each way between Stockton and Darlington. Although locomotive engines were used on this line from the date of the opening in 1825, for the conveyance of minerals and merchandise, yet it was only after the opening of the Liverpool and Manchester Railway, in September, 1830 (the second line opened in England), that they were brought into use for passenger traffic. Mr. Clephan, the editor of one of the local newspapers, describes some very amusing scenes that occurred on the line after it opened.—NORTHUMBRIA.

[12211.]—**Sea Mouse.**—The type of the family *Aphroditidæ.* Its scientific name is *Halithæa* or *Aphrodite* (Goddess of Love and Beauty) *aculeata.* It is well known on our coasts, and probably derives its name of "Sea Mouse" from its abundant covering of silky hairs, which are of a very brilliant metallic lustre, and may bear comparison with the plumage of the humming bird. The back is furnished with two rows of membranous scales which inclose the gills, but these are concealed by the hairy covering of the animal; the lateral setæ or bristles display on their surfaces a beautiful iridescent colouring, which on the movement of the hairs is seen to great advantage. The structure of the bristles or hairs is admirably adapted for weapons of defence; they have rows of barbs on each side, not unlike, when examined through the microscope, the spears used by certain savage nations. All the barbed setæ can be withdrawn into the body of the animal, but to obviate any injury which might arise from that act each bristle is inclosed in a smooth horny double sheath, which closes when retracted into the body and again opens when protruded. Although this animal is endowed with such gorgeous colours, displaying under a full supply of light the changing tints of orange, scarlet, and azure, yet its dwelling-place is in the mud. Even when kept in an aquarium they appear to avoid the light, and hide themselves among the weeds and stones. They are not unfrequently thrown up on our coasts after a gale of wind.—NORTHUMBRIA.

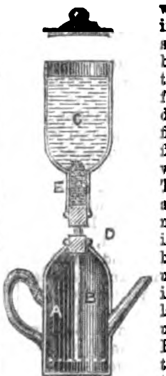
[12211.]—**Sea Mouse.**—The sea mouse belongs to the sub-kingdom *Articulata,* class *Annelida,* it is a sea worm allied to an animal with which "Scrutator," if he is addicted to fishing, is most probably acquainted, the rag-worm. The scientific name of the sea mouse is *Aphrodite aculeata*; it lives in the muddy or sandy bottom of the sea; it is of a long oval shape; its feet or pseudopodia are provided with bundles of long setæ or bristles, which form interesting objects for the microscope; its chief peculiarities are, however, first, the presence of expansions or flaps, one of which is attached to the upper edge of each foot in such a manner that they cover over the back and overlap each other like tiles on the roof of a house. They are capable of being raised and depressed so as to admit and expel the sea water into and from the chamber formed between them and the back, thereby aërating the fluids of the body which are admitted into their interior through an opening; the other peculiarity is that the stomach sends off numerous prolongations with blind ends which pierce the muscular walls of the body and are turned back close under the skin; this structure recals to mind the similar arrangement in some *Arachnidians,* the spiders for instance.—P. SANTALINUS.

[12212.]—**Yacht Building.**—Perhaps the way I adopted in building a similar yacht may be of use to you to know. Make a frame of inch stuff the shape you wish the widest part of the boat to be, and



fasten up in the place where you intend her to be widest; then take several of what are technically termed ribands, thin pieces of wood, say, 1½in. × ½in., and stretch from stem to stern, round frame on one side; then take an instrument, which you can make by riveting pieces of hoop iron, say about 2in. long, capable of taking any bend. This gives the general outline of the timber, and you can easily round off the angular lines produced, by the straight edges of hoop iron.—A., Liverpool.

[12213.]—**Coffee.**—Perhaps the following French machine will suit "Aggrieved Householder." The constituents of coffee and their reactions clearly indicated that to boil it upon the old plan cannot be judicious, but must always cause the loss of the greater part of the aroma. The better mode of preparing it is that of infusion, and it mainly depends upon good manipulation whether, with the same proportions of



water and coffee, an equally strong infusion with the same quantity of soluble matter is obtained as by boiling. The following is the contrivance that has found most satisfaction and is represented in the drawing:—The glass tube B B is fitted tightly into the neck of the flask C, by means of a cork, upon which a pierced drainer is placed. The tube can at any time be made air-tight in the boiling vessel, by means of the cork D D. The water is poured into A, the ground coffee being placed in C, which then lies upon the drainer. When the water is boiled by means of the spirit lamp, the inclosed steam pressing upon it, forces it to rise through B B into C, passing on its way through the ground coffee. When the lower end of B B is thus left open, the air and steam which is evolved from the remainder of the water find their way out through C, and soon bring the contents of this vessel to 212° Fahr., the steam condensing in the first instance, but afterwards passing through unchanged. This actual boiling is allowed to continue for a few minutes, and then removed from the lamp. The steam then condenses in A and produces a vacuum; the atmospheric air consequently forces the water with considerable pressure through the coffee, which, in the mean time, has settled down on the sieve E through B B to A, where it collects as a strong infusion. The coffee forms a narrow and tall column in the neck of C above E, which is consequently extracted rapidly with boiling water under a high pressure. The air rushing through after the infusion has passed forces out what remains in the pores. Attention must be paid with respect to the size of the powder of the coffee; when the strongest possible infusion is desired from a given quantity of the bean, one-fourth more extract is gained from coffee ground to consistency of flour than from the ordinary coarse powder. The filter must, of course, be adapted to this powder in order to keep the liquid clear. This machine will not act so well with heavily adulterated coffee, though it seems to pass chicory best of all the adulterations.—P. W. H. J.

[12216.]—**Transferring Marble Paper on Book Edges.**—Wring your book with the edge perfectly flat in the press, as tightly as possible. Then cut your strips of marble paper about 1in. longer than the edge. Pour on a plate some spirits of salts, and lay the strip on it, marble side upwards. When soaked lay it on the edge, which has previously been damped with a little water, then lay over the strip a piece of old blotting paper, and a pad of old waste paper, ½in. thick. Then take your hammer and rap it smartly and evenly all over, or it will wrinkle the leaves. Remove the pad and see if you have rapped it all over, if not, repeat the operation. Remove all tools out of the way and have your window open. Be careful not to let the spirits touch the glazed side of the paper, which spoils the effect.—PRACTICAL BOOKBINDER.

[12217.]—**Violin Tuning.**—Violins are tuned in fifths from the A string, downwards and upwards, and are thus tuned once for all, alterations in keys being made by different fingering, the open strings speaking natural notes, being, in extreme sharp or flat keys, avoided altogether. Some players, on the violin particularly, do not use the open strings whatever may be the key, the *timbre* thereof being different from that of a stopped note.—HENRY NEWMAN.

[12217.]—**Violin Tuning.**—Tune the 4th to G, the 3rd to D, the 2nd to A, the 1st to C, by a piano or good concert flute. Put your fingers in the right place at the proper time and there is no fear of you.—JOE.

[12217.]—**Violin Tuning.**—Tune your second string to A, and the others from it by fifths. Do not tune for each key; the defects in each key will be best got over by using the fourth finger instead of the open strings—*i.e.,* use the fourth finger on the fourth string; for D, open on the third string, and the fourth finger on the third string; for A, open on the second string, and the fourth finger on the second string; for E, open on the first string.—J. R., Leicester.

[12217.]—**Violin Tuning.**—With thirty years' experience, I never tuned my instrument in any other way but to fifths, and never alter to play in any key whatever.—A., Liverpool.

[12218.]—**Momentum.**—Mr. Jagger may have noticed that horses are inclined to stop when led slowly up a hill with a heavy load. The momentum gained by increasing the pace is very slight, as much is lost by the upward and backward tendency of the load, and can hardly amount to one-quarter of the additional force exerted. Drivers of locomotives, however, say that they get over inclines more easily by "taking a race at it," and the ease of ascent is greatly facilitated by beginning at a good speed.—RAT-TAT.

[12218.]—**Momentum.**—Yes.—XYLOGRAPHER.

[12219.]—**Turning Ivory.**—Ivory turns beautifully and requires no preparation. Use hard wood tools and polish with whiting and water, using flannel.—D.

[12221.]—**Brass Screws.**—"Falstaff" will find some very useful information in No. 335, p. 555, where the number of threads per inch for a bolt or screw 2in. diameter is given as four and a half.—J. C. L.

[12225.]—**Lead in Sulphuric Acid.**—The brown colour is not caused by lead alone, but is some other impurity. Water added to the acid will precipitate the lead as the sulphate, but you will not be able to use it for testing, or any purpose requiring pure acid.—XYLOGRAPHER.

[12225.]—**Lead in Sulphuric Acid.**—The discoloration of the sulphuric acid cannot be owing to lead, but is most probably caused by the contact of some organic matter which has been charred by the action of the acid, and has communicated to it the dark brown colour. If "Tony White" will concentrate the acid to specific gravity 1·845 (the strength of rectified oil of vitriol), with the addition of a little nitrate of soda, he will doubtless obtain a colourless acid.—ANALYST.

[12228.]—**Wood Engraving Tools.**—It would be simply impossible to use the present handles; but you must get some the same shape as shown at p. 298, Vol. X. They can be bought at any shop where they sell engraving tools. Perhaps the tools you have are wood carvers' tools.—XYLOGRAPHER.

[12228.]—**Wood Engraving Tools.**—In reply to "Zoo Andra," the tool handles figured in p. 298, Vol. X (not p. 288, Vol. IX.), are quite correct. The tools with handle should be 4½in. to 5½in.—A. T.

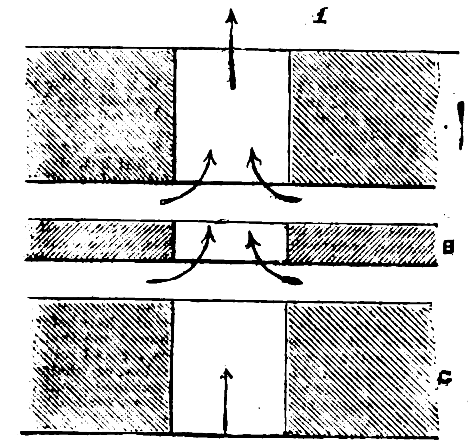
[12232.]—**Secret Spring or Lock.**—The piece of brass or other metal covering the key-hole could be easily furnished with a secret ward inside, which could be removed if discovered.—RAT-TAT.

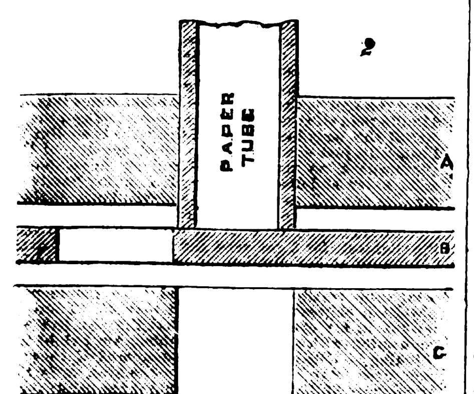
[12233.]—**Red Varnish for Patterns.**—If "England" experiences as much annoyance with red varnish on patterns as I have had, his cry will be, "save me from such stuff again." About twelve months ago I got from London a pattern covered with some sort of red stuff, which I took for red lead mixed with patent drier, probably a little oil. It did not leave a clean mould, the sand stuck to it and made a mess, and it took some three coats of varnish before the pattern was workable. The best varnish I know of to resist damp and an ordinary amount of heat is spirit varnish made of shellac, to be had at any druggists. If it needs be red, add dragon's blood to the desired tint. Give two coats.—W. D. T.

[12238.]—**Red Varnish for Patterns.**—"England" will find the following a very good varnish, resisting damp, and more than an ordinary degree of temperature. The recipe is gum shellac 1lb., methylated finish 1 quart. When the gum is thoroughly dissolved by the aid of gentle heat and frequent shaking, dilute with the finish to the required consistency for use.—C. N. M.

[12237.]—**The Organ.**—The fault appears to be in the chest rather than the bellows. Please answer the following queries:—1. Are the surfaces of the bars to which the pallets bed perfectly true? 2. Are there any chippings, &c., on surface of pallets? 3. Are they sprung or warped? 4. Do guiding-pins grip pallets and prevent their closing? 5. Are their upper surfaces properly leathered? 6. Do they sufficiently overlap the bars and front cheek to exclude wind from grooves, supposing spring, &c., to exercise the requisite force to press and keep them home? 7. Are tail pieces at joint end of pallets omitted, or not fixed sufficiently firm to press pallets home without straining hinge? 8. Are the grooves from tail end of pallets to back of chest properly covered in? 9. Is the joint between wind-bar (back of pallet chest), and under side of bars and pallet grooves, made air-tight? 10. Is the movement attaching pallets to keys put in, and if so, does it draw the pallets down, without the pressure of the finger on the keys? Take off front board of chest, and examine them. The escape of wind "all over the soundboard" is a serious matter, but the first step will be to prevent its unbidden escape from the pallet chest.—J. W., Plymouth.

[12237.]—**The Organ.**—I think I may venture to suggest that as the wind from the bellows reaches the stockboards it must pass the pallets, if I read "Aleph" correctly, and consequently there is fault there. I think that the contact of a well-fitting valve is sufficient, and the mere addition of a stronger spring if the valve is defective will not make it windtight. I subjoin the following as a matter of theory:—Let the diagram 1 represent—A, a portion of the upper board;





B, the slide; C, the table; and let a column of air pass up the hole, not fitting tighter than shown. The hole forms a kind of case or chimney for the air, which I conceive will draw air in from between the slides, and not force it out as generally supposed if the hole is bored true and set vertically as it ought to be. If the holes do not coincide, a great deal of wind must be lost, and, no doubt, this is the cause of the loss of wind in "Aleph's" organ. If I find in my own organ that I lose wind, or that a certain note speaks instead of its neighbour, I shall try the following:—Bore the hole much larger right through, shut in the slide. Make a paper tube to fit the hole and insert it as far as the slide. Cut the tube off level, and insert the foot of pipe. I also suggest another plan where the stockboards are not true. Cut diamonds or washers of leather and glue on to stockboard, one for each pipe. Provide a good straight-edge, and having surfaced the washers at each end, surface all the others to the straight-edge; this will provide a flat board mathematically true, and save the trouble of cutting grooves to prevent runnings. —DRAUGHTSMAN.

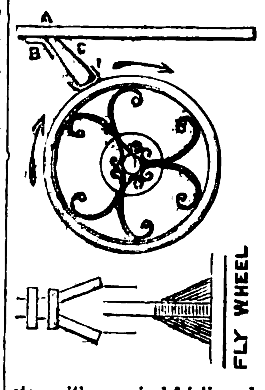
[12237.]—**The Organ.**—"Aleph" has got into a very common difficulty—viz., too hard leather on his pallets and not enough of whiting; no leather will do except the best unstrained and it must be well filled with whiting; the better plan will be to take the windchest to pieces, put another thickness of leather on into which plenty of whiting has been well worked, and try again; success will not be far off.—J. D.

[12239.]—**Hens' Eggs.**—Give plenty of room, change of food, and put a large wheelbarrow full of old lime rubbish or plaster within their reach. They are short of lime and grit.—JOE.

[12239.]—**Hens' Eggs.**—For laying soft eggs give Mrs. Chanticleer chalk, old mortar, pounded oyster shells, &c., strewed about her abiding place; but not egg-shells, as this latter induces her to eat her eggs, for which complaint try cutting her throat.—HENRY NEWMAN.

[12241.]—**Organ Pipes.**—The block wants bevelling off at the top and it will speak correctly.—J. D.

[12247.]—**Sewing Machine.**—"W. H. T." can apply a brake to the Wheeler-Wilson sewing machine in the following manner:—A, table of machine; B, small brass hinge; C, brake, with a piece of leather over the end to keep the wheel from slipping. When the wheel is running it knocks the brake up, soon as the wheel stops the brake falls, and prevents the wheel turning the wrong way. A 2¼in. stroke would drive the machine well with a good supply of steam. The best place would be underneath the machine, and start and stop with a conical friction clutch.—E. S. S.



[12247.]—**Sewing Machine.**—If "W.H.T." has an opportunity of inspecting one of Wilcox and Gibbs' sewing-machines, he will find that that machine has an extremely serviceable and simple brake attached to it, which prevents the machine working backwards. The brake is attached to the large driving wheel. There is an iron guard placed round the near part of this wheel and toward the lower part of the guard is a cup formed in the casting, in which is placed a round rubber ball. Of course the guard should be fixed not so far off as to allow any possibility of the ball falling out, and yet not so close that the ball won't have free play in the forward motion of the machine. "W.H.T." will find that if he can apply one of this kind to his Wheeler and Wilson, it will effectually prevent any backward motion of the machine, as when it is inclined to go that way, the rubber ball having fallen to the bottom of the cup acts as a brake on the wheel and stops the motion entirely, but when the machine moves forward in its proper direction the ball is no impediment whatever. I don't know if this part of the machine has been patented or not.—TOM-TIT.

[12247.]—**Sewing Machine.**—Wheeler and Wilson's machines are now made with a brake by means of a ball which checks the fly-wheel. It can be removed, and I think, except for learners, with advantage.—IRISH MECHANIC.

[12249.]—**High-Pressure Fire-box Boiler.**—By the above title I presume that "495" means a Cornish boiler. There is a little vagueness in his remark that 80lb. steam will be sufficient for warming and dyehouse; the pressure in this case has nothing to do with the quantity of steam required. Besides, for warming, steam is working the most economically when there is only one or two pounds pressure. For a mill of 40 by 80 by 20 yards one horse-power would be more than sufficient. I shall suppose that five horse would do all the warming, dyehouse and all. To move the engine I shall allow thirty horse. Then I shall suppose that thirty-five horse will be large enough. I will now furnish a rough specification:—The boiler is to be of the class known as Fairbairn's boiler; it is to be 30ft. long and 7ft. diameter, double riveted throughout; there are two tubes that contain the fire, and act as flues, each 2ft. 3in. diameter; the tops or crowns of the tubes to be 3in. below centre line of boiler. They are to be ⅜in. thick, best Lowmoor iron, with strengthening ring of 3in. angle iron riveted on to the tube at 10ft. from each end. There are to be three iron rods 1in. diameter for stays, one passing through the centre line and the others 2ft. from it, forming an equilateral triangle. The length of firegrate is to be 7ft. 9in. long, width same as tube; thickness of firebars, ⅞in., distance between them, ½in. For each tube the bars are to be made in three sets, supported by crossbars ⅞in. by 2in. cast iron bolted to the tubes. Each set is to be made 2ft. 7in. long, and 3¼in. deep at middle, diminishing to 2in. at ends. Bridge to be of firebrick, about 20in. high. The fire-doors are to be 16in. by 13in., set in an iron casing bolted to boiler, to be ½in. thick; the door to have ⅝in. burn plate fastened to it, at about 1½in. distant from the door *in principe*, which is to have a 1in. hole in the middle, with a brass slide over it to admit air. The burn plate is to be 17¹⁵⁄₁₆in. by 12¹⁵⁄₁₆in., and to have 20 ⅛in. holes drilled in it at about equal distances. The casing is to stand out 6in. from front plate of boiler, and to be the same for both tubes. The dead plate is to be 10in. long, and the whole width of the tube. The manhole is to be oval, with cast-iron ring riveted to top of hole to be ⅞in. thick and 2in. wide; the hole is to be 18in. by 15in. The door, or lid, is to be 21in. by 17½in.; two ⅞in. bolts are to be riveted into the door, and they must have good screws and nuts. There are to be also two cast-iron D pieces with holes for the bolts to pass through. The weakest section of the D pieces must not be less than ⅞in. by 1in. The nuts are ·9in. square. Next for the mountings. The safety-valve is to be an iron casing bolted over a hole of 5in. diameter. There is to be a gun metal seat in the casing; it is nowhere to be less than ⅜in. thick; the valve opening is to be 6⅜in. diameter. The bearing surface of valve upon seat is to be ⅛in. broad. The valve is to be ½in. thick gun metal, there are to be three guiding ribs cast on it ¼in. thick; total depth of valve and ribs = 6in. The valve spindle is to be 1½in. in diameter. Length of lever to be 3ft., depth = 4in., diminishing to 2in. at weight end, with a small projection ½in. high at that end to prevent weight being thrown off. Weight required to produce 80lb. = 874lb., and diameter of ball or weight = 13in., flattened a little on both sides with screw a side ½in. diameter so as to clamp it in any position. Area of damper = 4ft. by 16in. to be ⅛in. thick sheet iron. Damper counterbalance weight to be 8in. by 10in. by 5in., to be connected with damper over pulleys by chain about ⅜in. thick. The blow-off is to be 3½in. diameter at mouth, and other parts in proportion. There are to be two large glass water gauges, having a range of 10in. The boiler is to be inclined about ¼in. in 10ft. in setting towards blow-off cock, which is to be fixed at the front of boiler, near the side at the bottom. The back pressure valve is to be fixed at front at the bottom between the tubes. These are the principal details, and if "495" is in a further difficulty, if able, I will answer it.—P. W. H. J.

[12250.]—**Chemical.**—Potassium and sodium unite readily. One part of sodium forms with from one-third to ten parts potassium, a compound which remains fluid at 0° Centigrade. When too much sodium is added the alloy becomes brittle and crystalline. In all these alloys the potassium becomes oxidised first. The above is an extract from Gmelin's "Handbook," Vol. III., p. 119. When this alloy is brought into contact with water hydrogen gas is evolved, and the water contains in solution a mixture of sodium and potassium hydrates.—ANALYST.

[12253.]—**Organ Construction.**—The stops I would recommend "Amateur" to use are—Great organ, open diapason, stopped diapason, bass, claribel treble, principal, fifteenth; swell Lieblich Gedact (metal) gemshorn, hautboy; pedal, Bourdon. In "ours" of September 8 last "Amateur" will get full directions respecting couplers.—J. D.

[12255.]—**Hair.**—Shave for a couple of months, and avoid hair lotions as you would avoid poison.—D.

[12277.]—**Aniline Black.**—Leaving Mr. Geo. Davis to give a recipe for the preparation of this colour, without acid, I beg to recommend "Couleurs a l'Aniline," one of the manuals in Roret's "Enciclopedie" as being a most exhaustive work on the subject. —S. BOTTONE.

[12279.]—**Diminished Action of Battery.**—Due to exhaustion of acids, which can only be remedied by replacing with fresh. Great care ought to be given, and very seldom is, to the balancing of the strength of the nitric acid and the sizes of the inner and the outer cells so as to secure efficient working and economy.—SIGMA.

[12292.]—**Breadth of Stair Steps.**—The breadth of step is not proportioned to the length but to the rise, and in such a narrow example as that given, should be calculated at the middle of the step. It is found thus: Breadth $= x - 2h$, in which $x =$ the length of a step in ordinary walking on level ground, generally taken as 24in. Thus, if the rise be 6in., breadth $= 24 - 2 \times 6 = 12$. But account must also be taken of the position of the top step in relation to the bottom one. If it be vertically over, the higher it is the greater will be the rise and the tread less of each step.—C. E.

[12294.]—**Larkin's Iron and Brass Founder.** —I bought my copy at Batsford's, High Holborn, for 6s. 6d.—S. BOTTONE.

[12295.]—**Engraving by Graphotype.**—Though the mode of etching on a salt, as proposed by "Philanthropist," is theoretically possible, I am afraid that in practice it would be found extremely difficult of execution. Few salts which would admit of being produced as smooth blocks would possess sufficient hardness to give a number of impressions, besides, there would be the difficulty of limiting the sphere of action of the hardening fluid so as to obtain sharp lines. Again, the action of the hardening fluid, if it were possible so to limit it, would be so superficial as to render the resulting block of very little service.—S. BOTTONE.

[12297.]—**The Tremolo.**—The art of playing on the violin is so difficult to acquire that the learner has to attack each obstacle with great perseverance, remembering that when he is about to give it up as a bad job, then it is the proper time to begin over again. Young ladies and gentlemen require a great deal of pressing before they will sing a song; but the violin is very much in want of pressure before it will even squeak out "God Save the Queen." Our great Dr. Johnson, who hated music, said, "Give a man a pig of leather and he might cobble a shoe, or some of and he might make clothes, or try him in anything and he would manage to make a somehow, but put a fiddle in his hands and he can do nothing." If the Doctor had only learnt to play on the fiddle, we should have had the gruffest sentimental compositions in the world, and John Bull would have been first again. With respect to playing tremulously, or in a trembling manner, it is wrong for a beginner; rather learn to play tremendously, that is, with determination; hold your fiddle tight round the neck with your thumb, press your fingers down on the strings as hard as you like; then, after an hour's practice, begin the trill, or shake very slow at first, never too quick, and I think by the time you can shake one note after, or into another, without changing the position of the hand, you will have learnt a great many curious things (as the spider said to the fly) you never saw before.—FIDDLER.

[12304.]—**Phrenology.**—Without going fully into this I may say that the brain forms its case, and the brain is derived primarily from the parents and under causes acting during gestation. That brain, education can only very partially modify, and no greater mistake was ever made than to suppose, as some of our great writers do, that a child's mind is a blank sheet of paper on which we can write what we please. Even this partial effect of education is limited to the period of life when the brain and the bones are in process of development, and thus "Saul Rymea's" difficulty vanishes. I have known one person at least who watched this matter upon himself and declared to me that he found a very distinct alteration in form of his head after some months of earnest study.—SIGMA.

[12306.]—**Botanical Names.**—The plant described as "French Willow" is in all probability one of the willow-herbs; Latin, *Epilobium*. Of the *Epilobiums* there are nine British species — viz., *E. augustifolium*, *E. hirsutum*, *E. parviflorum*, *E. montanum*, *E. roseum*, *E. tetragonum*, *E. palustre*, *E. alsinifolium*, and *E. Alpinum*. The individual possessed by by "Hortus Siccus" is probably *E. hirsutum*, well known in the country as "Codlings and Cream." The plant which my inquirer calls "Rose Pea," I do not know under that name. It is certainly one of the *Leguminosæ*, and most likely *Ononis arvensis*; Anglice, "Rest Harrow."—S. BOTTONE.

[12307.]—**Kerosene.**—This is the American name for the illuminating oil (so-called) derived from petroleum. It is, of course, a very variable article as to its constituents and quality, and its only extensive use is for lamps, though it is occasionally stated to have various medical properties.—SIGMA.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "H. O'B." has answered 11625; "J. D." 11837.

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QUERIES.

[12308.]—**Iron Vats Leaking with One Liquid and not with Another.**—Will Mr. Davis or Mr. Bottone, or any other chemist, kindly inform me why the above do not leak with a boiling solution of Bengal nitrate of potash, but do leak with a boiling solution of muriate of potash and nitrate of soda (the artificial mode of making nitrate of potash)? My notion is that there is often an excess of nitrate of soda in the solution (caused by the analysts abroad giving an erroneous analysis of the muriate of potash—*i. e.*, it is not so pure as estimated). I presume that nitrate of soda with common salt is a more penetrating solution than nitrate of potash, but, perhaps the chemists can suggest cause and cure. The vats are cast in five pieces with angles or flanges, which are screwed together with nuts, a thin piece of wood being placed between some, but in others they are caulked with iron cement. I have formerly refined nitrate of soda by itself, and the solution did not leak from the vats.—R. J.

[12309.]—**Boiled Oil.**—Will some reader tell me how the boiled oil used by artists is prepared? Also, how to make a good medium or vehicle for oil painting?—G. W. C. H.

[12310.]—**Professors.**—Will some one of the ever able and ever obliging correspondents of our cosmopolitan publication be kind enough to tell me what constitutes a professor: I mean who has the right to call himself a professor? Professor Huxley or Professor Beesley I can understand, but what about Professor Pepper; or Professor Anderson, the sleight-of-hand man; or Professor Beckwith, who teaches swimming?—P. D.

[12311.]—**Hydraulic.**—I have a well on my property situate in the West of England, the water of which has hitherto been salt and brackish, and totally unfit for anything but culinary purposes. In addition to the foregoing defects, the supply usually ran short in the summer season. In order to augment the supply, and render the water more pure, I was advised to carry the rainfall water from the roofs of the premises into the well. The well in question is 25ft. in depth, and the natural supply of water generally about 10ft. A few copious showers usually fill the well to overflowing, at which time the water is suitable for making tea, grog, &c., and remains so, until from 10ft. to 15ft. has been pumped out. The pump pipe is fixed to within 12in. of the bottom of the well. Having stated the facts of the case, I should be extremely thankful if any of your subscribers would solve what to me has been a difficult problem for some months since—viz., why is it that the rainwater, which I suppose to be of the least specific gravity, is first drawn off, the pump pipe being, as before stated, so near the bottom of the well? I might also state that a neighbour, who has a well 70ft. deep, and a force pump reaching to about midway, finds the same results.—GLASTON.

[12312.]—**Brick Vaulted Arches.**—We have a reservoir in course of construction which we purpose to cover with 9in. brick segment arches of 8ft. span. We wish to know which of the two following methods are considered to possess the greatest amount of strength—viz., two separate rings of bricks, or the arch turned and bonded with headers and stretchers. We are inclined to think the last mentioned the strongest, as it would require but one key. We wish to know if the above has ever been tested.—AVALON.

[12313.]—**Portable Gas Cooking Apparatus.**—Will some correspondent who is practically acquainted with those handy little boiling and broiling stoves which boil over and broil under—such, for instance, as Leoni's atmospheric gas rings—inform me whether they are efficient, and, with gas at 6s. a thousand, economical? Is Leoni's, which appears to be the most expensive, very much better than those of other makers, and is his smallest size, which is only 8in. in diameter, sufficiently large to be useful in the kitchen of a small family, saving, for instance, the time and trouble of lighting the kitchen fire for breakfast, or cooking a plain dinner, on an emergency, for two or three persons? If not, what diameter should be chosen?—Q.

[12314.]—**Bleaching Tanned Goods.**—I should be much obliged if Mr. Bottone or any other of your chemical correspondents would tell me if it is possible to bleach or discharge the brown colour of tanned goods, tanned with oak bark.—TANNIN.

[12315.]—**Dubroni's Photographic Apparatus.**—Will some kind correspondent who has seen or used this apparatus inform me if as good negatives can be produced by it as by the use of an ordinary camera and dark room? Also is it liable to get out of order?—A. P. S.

[12316.]—**Scale.**—Will some kind friend explain the marks on a boxwood scale in a case of mathematical instruments? Under the inch scale is one marked from 10 to 50, each of which is $1/_{10}$in. Then one of ten horizontal lines, divided perpendicularly into nine above, reading from right to left, and into eighteen below, from left to right; with a scale of oblique lines at each end. The reverse side is divided apparently into 15ths, 20ths, 25ths, 30ths, 35ths, and 40ths of an inch. But at the end of this last there is a scale marked C, the divisions of which diminish from 10 to 90. What are the values of these scales?—MATHETES.

[12317.]—**Red Prussiate of Potash.**—Will some chemical friend give the mode of making red from yellow prussiate of potash?—BOB.

[12318.]—**Artificial Oils.**—Chemists say that oils of terebinth, bergamot, lavender, and cloves are isomers, and can be changed one into the other. I have often heard the above statement, as also the artificial production of oil of cinnamon and winter green; but nowhere have I seen the product, or read how it is done. Can some one give the process, or is it all a flam?—BOB.

[12319.]—**Dyeing Pulp for Sugar Paper.**—Will any of your correspondents kindly assist me as above? I am very often dyeing pulp for purple paper, and can't manage to get a slate colour. When using logwood chips I apply a little soda, when boiling after pulp is well washed I apply liquor and alum. Sometimes I use logwood extracts, but still I can't manage to get the black or dark blue shade. I generally apply 8lb. of alum to 100lb. of pulp. Is it too much?—A PAPER MAKER.

[12320.]—**Copper Coins.**—A small copper coin found on the track of the old Roman road through the parish of Carluke measures ⅝in. diameter, with the letters R D on one side quite visible. Would any correspondent tell what it is, or if it is worth anything? Also, a copper coin about the size of a halfpenny, with a St. Andrew's cross on the reverse side, date 1780, with flower on each side of cross; obverse side, a heart in centre with Scotch thistle. Would any correspondent say what it is?—J. WILSON.

[12321.]—**Chess Player.**—Can any reader explain how the automaton chess player is worked? It is at present exhibited at the Crystal Palace.—WILLIE SCORER.

[12322.]—**Bees.**—How can I keep the wasps away from my new swarms? Last year I had two hives completely destroyed by the wasps, and all the honey eaten out of them.—WILLIE SCORER.

[12323.]—**Scarecrow.**—Which is the most effectual way to frighten blackbirds and thrushes from the strawberry beds? Every year I lose many quarts by them, and have tried every kind of scarecrow I can think of, but without success.—WILLIE SCORER.

[12324.]—**Spoiled Hams.**—Having had a number of hams spoiled lately, I shall be very glad if some one can tell me how to cure them as the mild Cumberland hams are cured, and whether in a pickle or not?—J. E. P.

[12325.]—**Brazing Fine Saws.**—Will some practical brazier accustomed to band-saws inform me how, and with what chemicals, I can braze very fine saws, as I find that with borax, spelter, sal ammoniac, &c., I burn the saws before I can get the brass to run, but I believe there is a liquid chemical that makes it run quick?—E. S. S.

[12326.]—**Collodio-Bromide.**—Is it practicable to convert some bromo-iodised negative collodion (Mawson's) which I have, into collodio-bromide to be used in a wet state, chiefly and partly for dry plates, my principal object being to get the most sensitive surface I can?—TRIPOD.

[12327.]—**Horn.**—Will our friend "Jack of All Trades," or some other subscriber, kindly inform me if horn can be softened and moulded by any other means than heat, and, if so, how?—INQUIRO.

[12328.]—**Terra Metallic Tiles.**—Can any one suggest a process to remove the mouldy appearance of a terra metallic tile floor bedded in Portland cement? When the floor was laid and completed the tiles looked bright, but now they look so dull and mouldy. Frequent washing has had no effect.—PUZZLED.

[12329.]—**Practical Mechanics.**—Would you kindly permit me to inquire from some of your scientific contributors the name of any good book on practical mechanics? I have Twisden. If papers on this subject were commenced by one of the many able men connected with the ENGLISH MECHANIC, they would be received with much pleasure and profit by a large circle of readers.—AN IRISH SUBSCRIBER.

[12330.]—**Re Slide Rests.**—I should feel obliged by your allowing me to ask "J. K. P." if he would be kind enough to send the drawings promised on p. 392 of Vol. XII., No. 302, Jan. 6, 1871, in reply to "J. A. L." respecting the above. I think these are the drawings asked for but a very short time since by another correspondent.—H. E.

[12331.]—**Geometrical.**—Required, to find a point in a given straight line, equally distant from two given points not in the line.—R. G. G.

[12332.]—**Chemical.**—If an electric current be passed through a solution of hydrochloric acid, will the water or the acid or both be decomposed?—R. G. G.

[12333.]—**Purifying Mercury.**—Can any readers give me any information as to the best method of purifying mercury? I have some that I cannot clean by the usual method by filtering through a paper funnel, and when put into the barometer tube it falls and cannot rise again, with a thick black scum sticking to the sides of the tube.—BAROMETER.

[12334.]—**Eye Query.**—Would "M. R. C. S." or some other talented and obliging correspondent who knows something about the human eye, kindly tell me what is wrong with my eyes? For a long time any slight fatigue, such as reading a few pages of the ENGLISH MECHANIC, has been sufficient to make them feel hot, dry, and sleepy. Sometimes they ache painfully and are offended at the light. The aching always confines itself to the parts of the eyes that are immediately under the upper eyelids; but the hotness and smarting extends all over the eyes, even to the edges of the lids, which sometimes smart about the roots of the eyelashes. About a month ago, as I was looking with my left eye at a whitewashed wall, I observed a shadowy appearance on the wall—a little to the left and below the point of sight. I at first took this to be the shadow of a hair before my left eye, but a closer inspection showed me that there was something wrong with the eye, for as I rolled the eye about from side to side, the shadow, or whatever it is, moved along with it. At the distance of about 13in., the appearance is about 1¼in. long, like a vertical curved streak, A. A few days after the appearance of this streak, I saw with my right eye a little shadowy spot, a little to the right of and below the point of sight. The more I go to a light body—like a whitewashed wall—the better I can see these appearances, and the farther I go from it the more indefinite they become. The appearances are only seen when the eyes are moving about—from side to side shows them the best. Sometimes the spot in the right eye—at other times it is more definite than streaky in the left eye—projects on the surface of the body looked at. If the light is so dim that I can only just see to read, I cannot see any of these appearances, no matter how I roll my eyes about in order to try and discern them. If I put my hands over my ears and roll round my eyes about, I can distinctly hear them make a slight sound, as if they needed lubricating! The power of my eyes is not decreased in the slightest, for I can read the print of the ENGLISH MECHANIC at the distance of more than 2ft., without optical aid. A few months ago I had a very severe attack of smallpox, but, treated by a homœopathic physician of great skill, I am not marked. There was no pox in my eyes, but I fear that the pox has some connection with my present trouble. Am I right in so thinking? Will my sight be endangered if these appearances enlarge and spread over the eyes, or is there any danger of their doing so? What is the cause of this, and what is its cure? Yawning fills my eyes with water, which sometimes greatly relieves them, and for a few minutes renders the shadows less apparent. Is reading or tea drinking injurious to me? Would wearing smoked or other coloured glasses be of any service? A disease called rickets has made me unable to walk for nearly six years. Might this be the cause of these appearances? Replies are anxiously looked for, and will be thankfully received by—SPECTROSCOPE.

[12335.]—**Botanical Phenomenon.**—Can any botanical reader kindly favour me with an explanation of the following:—During the severity of the winter before last, 1870-71, a geranium which I have was nearly killed with the frost, the terminal branch, however, still retained its vitality, but in a very low degree, the lower parts of the stem being to all appearance quite dead. From that time to the present, a period of about eighteen months, a succession of new but small leaves have been produced, and within the last fortnight a blossom bud has appeared. The plant has been regularly watered once a week, not oftener; there has been but little addition to the upper living stem, which is very weak. I have also a specimen of *Cardamine pratensis* placed about ten months since in a globe, formerly used as an aquarium; the earth above the plant is very dry, the leaves retain their green colour; about the hundred...

of an inch of water is supplied every few days; atmosphere of globe moist.—W. R. BIRT.

[12336.]—**Vine Root.**—Would any gardener, and there must be some of that profession in the innumerable legion which reads the ENGLISH MECHANIC, kindly give me a little information on the following subjects:—I dug up a piece of vine root on a piece of ground whereon stood an old vinery, and divided it into two pieces and potted them. One died and the other has grown to a strong plant, 1ft. high, making several suckers from the root beside the main stem. Could I separate those suckers, or propagate another plant from cuttings, without injury to the vine above mentioned, and, if possible to do so, what time of the year is most suitable? The vine, I believe, is black Hamburg. —PHŒNIX.

[12337.]—**Heliotrope Seed.**—I purchased a packet of heliotrope seed of a seedsman, and he told me it would take a great heat to raise them. I tried them in a hot bed, both in a pot and likewise on the soil, covering the dung on the top of the hot bed; likewise in a pot in the house; also in the open border, and all failed. As I have some seed left, is there any other method of raising it, or is it, as I suspect, bad seed? —PHŒNIX.

[12338.]—**Hyacinth Roots.**—I turned out some hyacinth roots with the soil after the leaves decayed, and I want to know when to repot them. They have several offsets; should they be potted now, or not until the latter part of the year, when the old bulbs are planted. The soil has fallen from the bulbs, and they are now lying in a shady part of the flower border. Will they take any harm there, or should they be put away in boxes in an airy place? Some recommend September, others November, for the time of planting. I have no doubt that an answer to the above will interest many more beside myself, as I see there are many amateur florists in the MECHANIC.—PHŒNIX.

["Phœnix" will oblige by observing "Hints to Correspondents," Nos. 1 and 2.

[12339.]—**Veneers.**—Will Samuel Smither (let. 4331, p. 332) kindly help me out of a hole in getting some small specimens of choice veneers? I am making a table with small pieces, and find a great difficulty in getting any but very common sorts.—SHANINGTON.

[12340.]—**Flour Paste.**—Can any of your readers tell me how to preserve bookbinders' paste from mould and maggots? I make it up of flour, with a little resin and alum, boiled; and I always have it mouldy and maggotty before I can get it used, especially in the summer.—BOOKBINDER.

[12341.]—**Moths.**—My (carpeted) parlour is perfectly infested with moths, and spite of all efforts (lately having the carpet taken up and pepper strewn all over the floor for days), placing camphor all about, and much physical endeavour in the way of killing the creatures, no success is attained; but on beating the sofa, for instance, hundreds drop out at any moment, some fully fledged and others again as grubs. Not only is everything being destroyed by them, but it is in every other sense a perfect nuisance, rendering the room quite unoccupyable. Perhaps some kind friend who has successfully dealt with these pests will give me the information I am in need of.—A SUFFERER, Cologne.

[12342.]—**Pouncing Pattern on Printing Blocks.** —Will some kind reader tell me how the pattern is pounced on printing blocks? either floorcloth or paper-staining blocks.—NEW SUBSCRIBER.

[12343.]—**Dresser Top.**—I bought a new dresser about six months ago with a sycamore top, and it has warped very much. It stands an inch higher at one corner than the other, which makes it look very ugly. Could any of "our" readers tell me if I could remedy it? Would damp cloths put on it do any good?—J. GREENHALGH.

[12344.]—**Disappearance of Art.**—How is the disappearance of mechanical arts in countries of the East, such as Egypt, Assyria, &c., best accounted for?—A. B. M.

[12345.]—**Ontario.**—Would "our" Canadian friend "Gillem," who wrote letter 4880 in this paper of June 21st, 1872, kindly give further information in reference to Ontario as a field for emigration? In what part of the country are the extremes of heat and cold felt the least? What degrees do they register? What is the difference in temperature between the Simcoe Lake district and Toronto? What are the features of the lake district—dense forests or park like; any unoccupied land (Government) on the margin of the lake or partially cleared farm for sale, and price? What particular nationality predominates? What chances for a man to go into business or farming with a capital of £800, with a fair knowledge of either, and a mechanical turn of mind? How about society, fish, game, &c.? and any other information will be much appreciated by—DOLOMITE.

[12346.]—**Gearing Waggon Wheels.**—Not having seen anything on gearing iron axle waggons since I have been a subscriber, I take the liberty of asking if there is any one who would kindly inform me the proper way to set the arms to make the waggon run well?—U. V.

[12347.]—**Stroke.**—Would any brother reader inform me through the columns of the MECHANIC how the stroke of an engine is ascertained? Also, what means is there of finding out the size and weight of fly-wheel requisite for an engine, from a cylinder of given dimensions?—J. H.

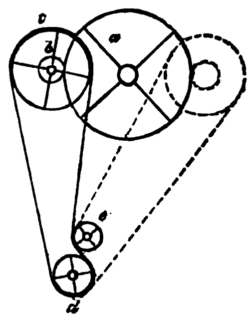
[12348.]—**Spanish Pronunciation.**—I have been for some time studying Spanish, and been taught both by my teacher and by the grammar (McHenry's), to pronounce *c* before *e* and *i*, and *z* wherever found, like the English *th* sharp. I now hear, however, that this pronunciation would, in Spain, be considered stilted and affected, and that the ordinary pronunciation of these letters resembles the English *ss*. I wish to know if this is the case; if so, to what extent the two styles vary, to what classes of people they are confined, and the style most useful for a foreigner to study?—CAST STEEL.

[12349.]—**Emigration.**—Will any fellow reader be kind enough to answer the following questions:—What part of South America is best suited for breeding cattle? Is there any place near Buenos Ayres where land is cheap or can be had by Government grant? What sort of an outfit would it be best to take? I want a good climate for an Englishman.—ALPHA.

[12350.]—**Sulphuric Acid.**—Can any of your able correspondents kindly inform me by what rule or how Dr. Ure compiled his scale of liquid, also dry, sulphuric acid in 100 parts? Also, if I have 40ft. cube of sulphuric acid, specific gravity 1720, what weight of acid, specific gravity 1750, would it be equal to? An example would oblige—CHILD.

[12351.]—**Underground Telegraph Wires in Cities.**—An American travelling in Europe and writing home from London, observes:—"A noticeable feature is the absence of air lines in cities—nearly all are under ground, and to this complexion we must come." Now, will some English telegraph engineer or electrician kindly give in "ours" the best method for running wires through cities, the location in streets longitudinally, and how they cross intersecting streets; with what substance the wires are covered to insulate them, and to protect them from mechanical violence, and the action of water? What provision is made for reaching them for repairs? Their liability to get out of order? What amount of embarassment are the lines subject to from induction, and has there been found any effectual remedy therefore? Finally, throw in such practical hints as will suggest themselves for the benefit of a new American subscriber. I have searched Culley in vain for such information, and almost the only information I have ever come across was Sabine's report of telegraph apparatus, &c., at the Paris Exposition, published in *Illustrated London News*. —DYNAM, Chicago.

[12352.]—**Centrifugal Pump.**—I should be very thankful for some instructions from some of "our" mechanical correspondents. I am driving the above pump with a 16 horse-power condensing engine. The gear as per sketch:—*a*, spur-wheel on fly-wheel shaft, 28 revolutions per minute, by pinion 4½ to 1; *c*, pulley on pinion shaft 6ft. diameter, 126 revolutions; *d*, pulley on disc shaft 2¼ft., making 375 revolutions. The pulleys are connected with a patent chain 14ft. apart, which is constantly breaking. Will it answer to put the pinion and large pulley on the right hand side of spur-wheel as per dotted lines? It would be 81° from perpendicular line. Would a double leather belt drive the pump in that position 10in. broad. The water has to be raised from 5ft. to 12ft. high. How many revolutions should a 2ft. disc make per minute?—TEACHABLE.



[12353.]—**Grinding Scythes, &c.**—Can any one inform me whether machinery for making or grinding scythes and reaping hooks has ever been invented, and if the same has been erected anywhere? The machinery having to be erected in a country where skilled labour is scarce should be of the simplest kind.—SCYTHE.

[12354.]—**Lathe Construction.**—Will "J. K. P." or some other reader be so kind as to give me the dimensions of the fast headstock of a small lathe 2½in. centres, with conical mandril and collar, length and size of mandril, and the best angle for same? Ought cast-steel collars to remain hardened or be tempered? A drawing would greatly assist.—C. N. M.

[12355.]—**Fermenting Bread with Starch.**—I am in a fix. I want to make some dough as light as I possibly can. I have tried the usual method of fermenting it with barm, but find it not to be light enough. I have been thinking if I could get some unadulterated starch—starch being the thing after being fermented that produces the carbonic acid gas—and knead it into the dough it would perhaps be a means of helping it to rise. Would it?—DOUGH.

[12356.]—**Small Malleable Castings.**—Could any correspondent tell me how to make small cast-iron castings malleable? Can any sort of cast iron be made so? A full description will oblige.—W. D. T.

[12357.]—**Stretching Vulcanised Rubber.**—Will any of your many correspondents kindly inform me if it is possible to convert a piece of vulcanised india-rubber 16in. long, 7in. wide, and 1in. thick, into a sheet 7ft. long, 3ft. wide, and less than one-sixteenth of an inch thick?—ECONOMY.

[12358.]—**To "The Harmonious Blacksmith."** —Perhaps I ought to have added to the description of my drawing on p. 665, No. 364, that the principal reason why a portion of the wooden brace was cut away at the back was to assist its being slightly bent when driving on the ends of the flat iron bar at the back. The straight part of the bar in that case would probably be made about ½in. shorter than the brace, so that when the strain on the strings was in operation it would, instead of arching the middle of the brace backwards, tend to make it perfectly straight, and the forward tension of the strings would be resisted by the iron bar behind. Perhaps the same end might be gained by leaving the brace whole, and driving a wedge between the brace and the bar; but that would take up more room. After having studied Mott's system of bracing, described by you a short time ago, I am inclined to agree with you that it will be found quite effectual, at very little expense, if properly carried out. Can "The Harmonious Blacksmith" tell me whether any attempt has ever been made to combine any kind of organ pipes with the upper treble notes of a piano in one instrument? I suppose a good organ-builder and voicer would have but little difficulty in making a "stop" to imitate the piano. Would the "stop" called "dulciana" do? and what would be the probable effect of combining the two, so as to be worked with one keyboard and set of keys? I apprehend the greatest difficulty would be to keep the two systems in unison for any moderate length of time. Would one set of pipes speak properly with varying pressures of wind, so as to give a little variety of tone and expression?—J. C. L.

CHESS.

ALL communications intended for this department to to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

THE CRYSTAL PALACE MEETING.

On Thursday, July 18, a blindfold match: one player against ten.—A simultaneous match: one player against twenty-five.—A consultation match, by first-class players only: two players against two. Play to commence at 2 p.m. in the Concert Hall.

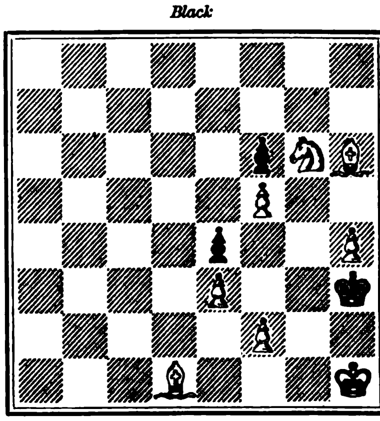
On Friday, July 19, at 3 p.m., a lecture on the "History and Antiquities of Chess," by Captain H. A. Kennedy, in the Opera House.

On Saturday, July 20th, blindfold, simultaneous, and consultation matches. Play to commence at 2 p.m. Grand matches by telegraph at 3 p.m. in the Concert Hall. The players at the Crystal Palace against Clifton, Nottingham, and Birmingham. Telegraph wires will be laid on to the room.

Players desirous of entering the lists for any of these contests should apply to the Manager, J. Lowenthal, 28, Camden-road, N.W.

PROBLEM V.—BY R. A. PROCTOR.

Black.



White.

White to play and mate in three moves.

SOLUTION TO PROBLEM IV.

White.	*Black.*
1. R to K Kt 6	1. P moves
2. B to K Kt 4	2. P takes B
3. R takes B P mate	

TO CORRESPONDENTS.

HENRY TURTON.—We acknowledge with pleasure the receipt of your interesting problem. Your reappearance, after so long an absence from the "Chess World," will be welcomed by many of our readers.

ROTA.—We advise you to study some elementary treatise on the game for three months; at the end of that period we shall be glad to hear from you again.

J. PIERCE.—Accept our best thanks for the excellent problems you have kindly placed at our disposal.

W. AIREY and A. W. COOPER.—You will observe that we publish two lists of solvers; this will meet the difficulty complained of in your letter.

T. J. MILLER.—Try again. We shall at any time be glad to render you any assistance.

G. SLATER and A. W. COOPER.—Problems received with thanks. You may expect a report in our next.

ARGO (Yarmouth).—Your problem is neatly constructed, but it is too easy for publicity. We hope this will not deter you from sending further specimens of your composition.

BRADBURY.—See answer to C. H. Yeo in our last number

ADDITIONAL solutions to Problem III. have been received from W. Airey (Worsley); S. H. W. (York); and A. L. (Dulwich).

CORRECT solutions to Problem IV. have been received from R. A. P.; A. W. Cooper; W. N. P.; W. Airey (Worsley); A. R. Molison (Swansea). All others are wrong.

Obituary.—It is with regret that we have to record the death, on the 27th ult., of Mr. Charles Hill, at his residence, Cotham-grove, Bristol. The deceased gentleman was in his seventy-eighth year, and for a long time had taken much interest in astronomical matters. Mr. Hill was in the possession of an excellent observatory, and his scientific instruments were of the first order. He generally used an 8½in. equatorially mounted reflecting telescope, by Browning, in making his observations, and was, although much advanced in years, a very assiduous observer. He was particularly interested in that department of astronomy relating to comets, and usually managed to find, soon after their discovery, all the small ones that came within the reach of his instrument. He once stated to the writer that when on board a vessel, he made an independent discovery of the magnificent comet of 1811, and wrote a paper, which was read at a scientific society, on the subject. Mr. Charles Hill was esteemed and respected by all those who were fortunately acquainted with him and his death is much regretted.

THE ENGLISH MECHANIC LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£335	16	7
S. J. (3rd donation)	0	8	6
R. E. W. Goodridge	0	5	0
	£336	5	1

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, July 2, and unacknowledged elsewhere:—

F. R. Leyden.—W. L. Nash.—Geo. Awford.—W. G. Roberts.—W. Howard.—Thos. Fletcher.—D. H. Goodman.—Rev. R. Kerwin.—E. Greenbough.—Frederick Pipers.—E. B. Donkin.—W. E. Nash.—A. Ledger.—Jack of All Trades.—J. W. D.—E. P. W.—W. M. Collis, jun.—A. W. D.—James Stanner.—E. Milnes.—Constructor.—Charles Stolnitz.—M. Robinson.—E. J. B.—A Constant and Benefited Reader.—R. Phipson.—Vinery.—Wm. Wood.—Pathfinder.—Right Rev. Dr. Gregory.—Alfred Ledward and Co.—J. W. Buck.—P. Stoneman.—S. Bottone.—Un Francais.—Spero.—Ajanea.—Philo.—J. Gillaird.—W. R. Birt.—Atlas.—Wholesale.—J. H. Whistle.—A. C. G.—W. W. M.—One in Trouble.—Hoop Iron.—Chip.—N. Y. W.—W. C.—W. Crisp.—A Working B.—Northumbria.—Poloski.—A Young Fiddler.—W. T. L.—J. Watson.—Henry T. Vivian.—E. W.—Sarah.—Excelsior.—Artillery Volunteer.—Edinon.—E. N. D.—A Poor Man.—Highlander.—T. B.—Ancoats.—North Deven.—Schoolboy.—A Coal Miner.—Nottingham.—J. G.'s.—C. N. Abbott.—S. T.—Thetamu.—Wm. Oldfield.—Pneumatic Lever.—Veritas.—A Stoker.—J. R.—Rat-Tat.—E. B. D.—Ultramarine.—Henry Mac Cormac, M. D.—R. T. S.—John J. Lake.—B. F.—Isle of Thanet.—Marsh and Pattison.—S. A. Read.—T. C. Ebdy.—O. H. Maggs.—J. M. Withers.—R. Edwards.—G. O. Gooday.—Wm. Lea.—W. H. Neal.—H. Rensley.—John Briggs.—R. M. Smith.—A. P. Compton.—Wright and Mann.—G. Wootton.—J. M. Dale.—J. W. Durrad.—R. A. Proctor.—The Harmonious Blacksmith.—Crowquill.—C. S. Myddleton.—F. R. A. S.—George Browning.—E. W. S.—J. P. W.—E. W. R.—A Brewer.—A Constant Reader.—W. S.—J. W. Fennell.—Bobo.—Parker.—Cornubia.—W. L. B. W. Clenchen.—H. Elfes.—Sirius.—R. M. Hatch.—R. E. W.—A Lancashire Lad.—Priam.—E. H.—Bedfordiensis.—Rev. J. W. Taylor.—Analyst.—B. D. T.—Joseph Roskell.—E. Johnson.—R. Symington.—Saul Rymea.—Capt. Hans Busk.—J. Y.—L. J. W.—L. H. Scott.—Jones and Sons.—C. J. Caswell.—J. Parnell.—J. G. L. Nicholl.—Webb and Son.—E. Betham.—Dr. Carnley.—C. Hagan.—Charles Hughes.—E. L. G.

JACK OF ALL TRADES has written us, but he does not speak in such good spirits as we should have liked to see. He is now spending a few days with "Khoda Bux," in obedience to an invitation.

E. S.—We shall have some more information from "Seconds Practical Watchmaker" soon.

ESSE.—Your suggestion about articles on coach-building is good, and we will try and comply with your request.

W. R. BIRT.—Next week.

E. B. E.—Yes. We have more room to spare this time of the year, and are glad for scraps of information, and particularly from old correspondents.

VERITAS.—Yours next week.

Communications which can only appear as advertisements to hand from J. P., Diligence, A Countryman, A Mechanic.

J. H. T. M., W. L., A Working Turner, Kinko, H. J. M., Jas. Brown, J. A. Hurd, George Thompson and S. E., are referred to back volumes.

J. FORD.—There is no remedy but constant shaving.

MELVILLE PIKE.—Such a telescope as you require should be enquired for through a respectable optician. The book you ask about was recently reviewed by us and is published by Lockwood and Co. Your other queries have been many times answered in back numbers, to which we refer you.

YOUNG GLASGOW.—It is your booksellers fault. You can have any number by return of post by forwarding the necessary amount direct.

G. L. GRANHAM.—It is a respectable firm, and the instruments have been well spoken of by correspondents.

J. SLEABBEN, F. C. D., and Whitesmith.—See "Hints to Correspondents."

J. H. SUTHERLAND.—We have had more than enough discussion from time to time on Squaring the Circle. We should be glad to hear from you on some other and more useful subject.

G. J. MATTHEWS.—Your query is incomplete. It will all depend on the weight of the cylinder.

A. S. LEWES.—In the last number. See also Indices to back volumes.

MANGE.—Consult published Indices.

SENEX.—Once more we ask why assume so many aliases. The chief object of your writing at all appears to be to advertise a third-rate book of which you are author.

VERTUMNUS.—Two or three others have desired to have the last word on the Deluge controversy, but your and their letters would reopen it.

W. WATKINS.—The first query is an advertisement. The second will appear next week.

E. R. J.—What appears to be a source of trouble to you is a source of satisfaction to us. You think the ENGLISH MECHANIC deals with too many things, and treats ignorant readers with too much respect. Certainly those who are ignorant, or comparatively so, cannot agree with you. The "outside subjects" you speak of are only as fringe after all. The *bulk* of the journal is interesting to inquirers and thinkers all the world over.

CARACTACUS.—You are right. Mr. Bradlaugh's name ought not to have been dragged into the Deluge discussion at all, and we do not hold ourselves blameless for permitting it, and we trust "E. L. G." will be more careful in future.

E. B.—Please send description and drawing.

PLANCHETTE.—There must have been some "hocus pocus" influence at work. The insertion of your query would lead to another discussion on spiritualism, and we cannot afford space for it just yet.

KIRKPATRICK, E. W. B., and BALSAM.—Your queries are advertisements.

LENS.—Read Emerson's "Conduct of Life" and Locke on the "Conduct of the Understanding." When you have read them, and particularly the former, which can be had for 1s. 6d., you will most likely say "Thanks, Mr. Editor, for the advice."

THE HARMONIOUS BLACKSMITH.—Your letter on the "Piano in Canada" was crowded out.

F. N.—Reply on Angle of Reflection, &c., next week.

THE "BUILDING NEWS," No. 912, June 28, CONTAINS:—Professional Tenderness; Visit to Leicester Waterworks; Exhibition of Works of Art in Black and White; Metropolitan Board of Works' Report, 1871; Critical Notes of Great Italian Architects.—XIV; Our Present Knowledge of Building Materials, and How to Improve it; Modern Architecture in France; House Planning Competition; St. John's Church, Hull; The School Boards; Architectural Association of Ireland; Comments on the Conference; The Late Mr. Frederick Marrable; Architectural Association; The Institute *Conversazione*; The Progress of the Lock-Out; Building Intelligence; Stained Glass; Water Supply and Sanitary Matters; Correspondence:—"Modern Scottish Ecclesiastical Architecture;" Re Dublin Exhibition; Westminster Abbey; School Planning Competition; Liberal Premiums to Competitors; The *Quarterly Review* on Architects and Operative Masons; Mr. Norman Shaw and Mr. MacLaren; Intercommunication; Parliamentary Notes; Chips; Our Office Table; Trade News—Wages Movement; Tenders: Illustrations—St. John's Parish Church, Hull; Design for Detached Suburban Villa.—Price 3d., post free, 3½d. Published at 31, Tavistock-street, Covent-garden, W.C.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JUNE 25, 1872.

1829 H. Fereday, Shaftesbury-street, Hoxton, for an improved method of and apparatus in tin and other metals for "sifting" or separation of seeds, coal cinders, and other articles and divers small substances.

1830 R. Boyd, Strand, for improvements in projectiles and in the manufacture thereof. A communication.

1831 R. F. Lewis, Herbert-street, Middlesex, for improvements in pen, pencil, and crochet-needle holders, bouquet holders or flower tubes, needle cases, and other like articles.

1832 W. S. Taylor, Edinburgh, for improvements in the propulsion and construction of tramway engines and carriages, and in the apparatus or mechanism connected therewith, which improvements are also applicable to motive-power road engines and carriages.

1833 S. Lewin, Poole, for improvements in ploughs.

1834 A. M. Clark, Chancery-lane, for improvements in railway carriage brakes. A communication.

1835 R. A. Gooding, Manchester, for improvements in apparatus for measuring liquids.

1836 T. Lambert, Short-street, Lambeth, and E. J. White, Overton, Gloucester, for improvements in self-closing valves or cocks for drawing off water.

1837 T. Hampton, Rotherham, Yorkshire, for improvements in the manufacture of Bessemer steel ingots.

1838 G. L. Turney, Addle-street, City, for improvements in boxes to hold pins, books and eyes, pens, and other small articles.

1839 E. Unwin and G. Owens, Chilworth, Surrey, for improvements in apparatus for the delivery of sheets from printing machines, paper-making machines, and other machines which deliver paper or other material in the form of sheets.

1840 R. Kuhn, New Bridge-street, City, for an improved means and apparatus for facilitating the repairing and paving of roads and other places, the apparatus being also applicable for preparing and dressing stone slabs and blocks.

1841 J. Cross, Manchester, for improvements connected with rubbers used for washing or cleansing clothes and other articles.

1842 A. C. Henderson, Charing-cross, for improvements in the construction of stereoscopes. A communication.

1843 G. C. Ogle, Ripley, Derbyshire, for improvements in mowing and reaping machines, and in the machinery or apparatus employed therein.

1844 G. Le Meunier and J. Cochet, Paris, for an improved system of publicity.

1845 W. Bull, Chancery-lane, for improvements in making salt from brine.

1846 W. B. Burrow and J. S. Burrow, Great Malvern, Worcestershire, for an improved "bin" or receptacle for wine or other bottles.

1847 W. R. Lake, Southampton-buildings, for improvements in the manufacture of copper-covered and copper-cored wire. A communication.

1848 T. Morris, T. Fletcher, M. Kelly, and C. Fletcher, Manchester, for improvements in spring mattresses and other articles for sitting and reclining upon.

1849 J. Imray, Southampton-buildings, for improvements in apparatus for working brakes in railway trains and tramway cars. A communication.

1850 J. Millward, Birmingham, for improvements in musical instruments. A communication.

1851 V. van Baerle, Finsbury-square, for improvements in the manufacture of soap or compositions for washing purposes.

1852 W. Spence, Quality-court, Chancery-lane, for improvements in apparatus for carrying leather. A communication.

1853 B. Abate, Regent-square, Middlesex, for improvements in preserving food or organic substances, and also in the machinery or apparatus employed therein, parts of which machinery or apparatus are applicable for making ice and for refrigerating purposes.

1854 A. M. Clark, Chancery-lane, for an improved camp kettle or culinary apparatus. A communication.

1855 H. E. Phillipson, Dublin, for a new or improved palliass.

1856 G. Lowry, Salford, Lancashire, for improvements in the construction of radial and other drilling machines and tools.

1857 W. Dawes, Leeds, for improvements in locomotive steam engines, parts of which improvements are also applicable to other engines.

1858 W. D. Brown, Turin, N.B., for improvements in reaping machines.

1859 W. M. Brown, Southampton-buildings, for improvements in machines for pricking and trimming the edges of heels of boots and shoes. A communication.

1860 W. Scantlebury, Seven Sisters'-road, Holloway, for improvements in the means or apparatus employed for raising and lowering window and other blinds and shutters.

1861 T. Lynch, Enishowen, Ireland, for a new or improved system for preventing collisions on railways and in machinery or apparatus therefor.

1862 W. B. Chapin, Southampton-buildings, for an improved contrivance for securing door knobs and other knobs or handles upon their spindles.

1863 E. Housman, Bromsgrove, Worcestershire, for improvements heating and ventilating churches, hot-houses, and other buildings and structures, and in apparatus to be employed for those purposes.

PATENTS SEALED.

3467 W. Cotton, for improvements in machinery or apparatus employed in the manufacture of looped or knitted fabrics.

3473 E. T. Hughes, for improvements in machinery for drawing or rolling rods or bars into straight or conical forms for shafting, axles, spindles, and analogous purposes.

3474 E. T. Hughes, for improvements in apparatus and processes for producing and applying artificial cold to the manufacture of ice, parts of which are applicable to other purposes.

3481 W. Tatham, for improvements in carding engines and drawing frames.

3489 W. Z. W. Chapman, for improvements in fastenings for carriage curtains and other like purposes.

3509 J. Wilde, for improvements in heating apparatus for stoving or "proofing" felt hats and for other purposes.

3520 A. C. Henderson, for improvements in cigar cases for effecting the simultaneous and automatic cutting and lighting of the cigars.

3851 G. L. Leclanché, for a new electrical contact for clock-work or other applications.

5 A. Silvester, for an improvement in carriage wheels.

6 J. K. Tullis, for improvements in punching holes in leather and other similar materials, and in the machinery or apparatus employed therefor.

9 S. Geoghegan, for improvements in apparatus for names marking or consecutive number branding casks, cases, boxes, and other like receptacles.

52 W. Bash, S. Bash, and G. Bash, for improvements in bobbins.

836 G. Fletcher, jun., for improvements in the evaporation and granulation of sugar, and in the apparatus or machinery connected therewith.

575 W. C. Sillar, R. G. Sillar, and C. Rawson, for improvements in treating and deodorising human excreta, and thereby facilitating the disposal and utilisation thereof.

841 J. Rawcliffe, jun., W. Bibby, and A. Fleming, for improvements in spinning mules.

936 N. H. Hughes, for improvements in cultivating land, and in the machinery or apparatus employed therefor.

8492 T. Grace, for improvements in apparatus for raising weights.

8493 J. Anderson, for improvements in reducing oxides, and in obtaining iron, sodium, potassium, phosphorus, chlorine, or their compounds, and in apparatus therefor.

3495 J. Mabson, for improvements in sewing machines, and in embroidering, cloth-cutting, and other attachments for the same, some of which improvements are also applicable to actuating or driving other machines.

498 E. W. Kelley, for improvements in horse-nail machines.

3501 W. A. Alcorn, for an improved method for the protection of bottles and other fragile substances.

3504 W. D. Ruck, for improvements in the manufacture of gas.

3517 J. A. Calantarients, for improved arrangements for preventing pipes or vessels containing water or liquid from bursting by the effects of frost or similar force suddenly brought into operation.

118 J. Madden, for improvements in cotton gins.

128 W. Spence, for improvements in the joints of the permanent way of railways.

1097 H. G. Keyworth, for improvements in cases or receptacles for receiving and retaining letters, papers, or documents in alphabetical or other order.

1167 J. Campbell, for improvements in the mode of getting at the external bottom of ships and vessels for the purpose of cleaning, repairing, and overhauling them.

1237 M. Combe, for improvements in sewing machines.

1257 W. R. Lake, for improved processes of treating phosphatic rock and other phosphatic substances for the extraction of the phosphoric acid or soluble phosphates therefrom.

1272 J. Ducomet, for an improved construction of packing case.

1278 R. McVey, for improvements in steam engines.

1285 E. Pace and J. H. Howard, for improvements in machinery or apparatus for cutting splints.

1348 T. J. Denne and A. Hentschel, for improvements in materials for finishing and currying leather.

1360 W. Ellis, for improvements in or application to machinery or apparatus for cutting wood to any required shape, pattern, or design.

1361 W. R. Lake, for improvements in the manufacture of knitted fabrics, and in machinery employed therefor.

1394 F. L. H. Danchell, for an improved filtering medium.

1408 W. R. Lake, for improvements in apparatus for producing compression upon metallic articles.

1418 W. R. Lake, for improvements in mules for spinning.

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ARTICLES.

THE WATCH, AND HOW TO REPAIR IT.

By "SECONDS' PRACTICAL WATCHMAKER."

THE watch was, at one time, a much honoured and prized necessity; after a time it became a valuable adjunct to every gentleman, and not unfrequently (about the year 1790) the order had to be given two years before it could be possessed. The watch I am referring to is that known by the term "horizontal." The cause why so long a time was necessary for its manufacture arose out of the fact that there were but few workmen qualified to produce that particular escapement and finish of the various other parts. This special kind of watch was invented, about 1725, by the celebrated George Graham, an apprentice of the talented Tompion, watchmaker, of London. Prior to the introduction of Graham's horizontal watch, one kind only was made—namely, that so well known in these days as the "verge" watch. We have no authentic date when the primitive watch was invented or introduced. We do gather this much, that they were originally introduced from Nuremburg, but they were oval in shape, about the size of an egg, having the appearance of an oval snuff-box. Those who may be interested in such antiquities will be well repaid by inspecting the classified series of ancient watches in the South Kensington Museum; there are there about fifty or sixty, the property of Mr. Morgan.

Although the English claim the invention of the watch, it is doubtful whether they have that right. It must be admitted that they produced the convenient and useful watch, which satisfied all requirements for a long period. But rivalry met them from the French. That nation produced a prettier and more convenient sized instrument, and at considerably less price; but then, even as now, they could not be depended upon for correct (in those days) timekeeping; and again, the parts wore away so rapidly, while the old English watch was proof against every trouble, and frequently against a fall, which the French watch very seldom escaped without breakage. The scientific men of Paris devoted much time to the perfection of the watch, but although we must admit that their watch of the period just prior to the introduction of Graham's horizontal one was a model of beautiful workmanship and mechanical contrivance—which in another chapter I intend introducing—so soon, however, as the wonderfully good timekeeping of Graham's new watch became known in Paris, the scientific men of that nation endeavoured to possess one, and Berthoud, then the most eminent of Paris watchmakers, procured one, and admitted that the English watchmakers were the most eminent in the world. Graham's watches were made use of in astronomical observations. This kind of watch continued in general use, and was valued for several years, until Thomas Mudge invented the "lever watch," which soon took the place of the horizontal one. Mudge made one for Charlotte, Queen of George III. This kind of watch of late years has been very much improved, and stands before the world at the present day as the most correct in performance. It is the most durable, goes longer than any other kind without cleaning or repairing, and will endure more rough usage than any other kind. When we consider that a daily rate can be obtained from a lever watch of the best make, horology is entitled to be ranked among the sciences, for there is no science established in which that of watchmaking does not share; therefore its connection with the sciences entitles it to be ranked even with that of navigation and astronomy. The English lever watch having held such a prominent place among the world's mercantile products, induced several manufacturers abroad to introduce the principle of the lever escapement to their watches, which has ended chiefly in disappointment. The foreign watches, therefore, are chiefly of the character termed "horizontal." It will be unnecessary here to expatiate upon the relative merits of English and foreign watches, for we shall see, in remarks upon "Repairing" what has often to be done to obtain a fair result. This is quite certain, that the horizontal Geneva watch is a copy from the original invention by Graham; and although Professor Robison examined the escapement very critically, our foreign neighbours have improved very much the angle of the escape-wheel tooth as well as the train of the movements—that is to say, they have increased the numbers of beats per hour, which materially assists in the watch keeping more accurate time than it did in the days of its early invention. Again, our continental neighbours have supplied to their escapement a wheel made of steel instead of a brass one, which was applied to Graham's escapement, for it was found that unless the cylinder of Graham's watch was jewelled (that is, made of some hard stone) the escapement-wheel, after about four or five years' wear, had cut or worn a notch in both edges of the cylinder; and hence the original plan and design of the escapement became destroyed so soon as the wearing became evident. And I would just remark here that unless a Geneva watch is of a very low type the cylinder is perfect after years of wear, owing, of course, to the steel wheel of the escapement acting upon its similarly constituted neighbour, the cylinder; and watches of a very superior class may be seen with perfect cylinders after twenty years of constant use.

The duplex watch, invented by Tyrer, and the chronometer, originally by the French, but perfected by our countrymen, stand unrivalled by any other invention, inasmuch as the duplex, under certain circumstances, will keep time wonderfully close, while the chronometer, when at sea, has been known to return with a rate, after two or three years, so close that, at the expiration of that period, it has been in error only five-hundredths of a second. See Dent's and Denison's works.

It is intended in the present series to devote most of our space to the encouragement of our youth and amateurs in connection with watch repairing, for our experience teaches us that there are many moving along in this particular branch of mechanics thoroughly in the dark. It is hoped that the chapters following will be the means of our youth and amateurs walking fairly in the broad light, instead of groping and feeling their way, and not finding that which they seek. It must be borne in mind that watch repairing is not to be obtained in an ordinary apprenticeship. Many hundreds require improvement after having served their articled period, and we are hoping, by careful attention and combined action, that the novice in watch repairing will rapidly improve in the general literature as well as in the general manipulation. Tools, materials, and trade secrets, whenever brought to view, will be dealt with whenever practicable. It will be our aim if possible to vary the subject-matter; thus one chapter will contain remarks upon the "verge" watch, the next one upon the "lever" watch, and then will follow materials for the Geneva jobber, so that throughout the series variety will be studied.

We will adduce an example concerning a Geneva watch which kept excellent time during the day, but through the night it gained fifteen minutes. Many causes might occasion a similar disaster, but one that is very common is the following:—The watch referred to was a cylinder one; the notch at the bottom of the cylinder was rather narrow, so that for the web of the escape-wheel to pass through freely neither the cylinder nor the escape-wheel should have excess of end-shake, and also very necessary that the escape-wheel should be flat. These conditions had been neglected; cylinder and escape-wheel had excessive end-shake, and the wheel was out of flat. When the watch was lying on the back (dial upwards), the weight of the balance and its attachments (cylinder, pendulum collet and spring) preponderated or fell toward the balance cock, and when in that position the part of the escape-wheel out of flat towards the balance caught the lower part of the impulse side of cylinder, the escape-wheel by that means was suddenly checked, so was also the balance in progress, and instead of the balance moving its whole arc of motion it was accelerated by the suddenness of the wheel's action on the cylinder. If that watch had been held in a position with dial horizontal, and the escape-wheel observed, it would have been noticed that at every revolution of the escape-wheel a sudden check of that wheel and also the balance would take place, therefore the hastening or gaining of the train which was indicated by the hands. Mode of remedy: Most watch wheels are made flat by "bumping," as it is termed—that is, a hollow punch is fixed in the vice, the wheel laid thereon, and the arm of wheel to be raised or lowered is struck by a smooth thin hammer, after which it is usual to place it in the calipers, and by a thin straight edge of bone test its flatness, and thus proceed till correct. But the steel wheel of the horizontal escapement is very thin and very brittle; therefore, it is better to try to rivet the wheel to its pinion a little more by placing the pinion face on a hard steel stake, then hold a half-round or crescent-shaped punch on that part of the rivets of the escape-wheel pinion when the wheel has to be lowered; if it requires raising, place the punch on the opposite side, then with a small hammer strike the punch slightly; frequently a very slight blow of the hammer will suffice, but if the wheel be thin at that part it may not yield; should it not, the better plan would be to polish away the lower portion of the cylinder lip which strikes against the rim or web of escape-wheel, which is accomplished in the following manner: Remove the pendulum collet and spring by pressing it off with a very thin-edged knife, place balance with the cylinder upward upon a piece of flat good cork fixed in the vice; make a steel polisher, rather light, say three-sixteenths of an inch broad, one-sixteenth thick, and about nine inches long, with the end made nearly pointed and quite knife-like at the edge; then see if it can be moved about a quarter of an inch backward and forward in the notch of the cylinder. Having prepared the polisher, provide yourself with some oilstone dust mixed with oil, which may for convenience be placed on a small tin box lid. With this on the steel polisher, and rubbing backward and forward, the cylinder, however hard, may be polished till the wheel is quite free. The pressure of the polisher must be somewhat light, else the cylinder will be in danger of breaking. To clean the cylinder from the oilstone dust, a piece of very small crumb of bread must be used. After the bread has been made somewhat the consistency of ordinary putty by pressing and partly rolling it between the palms of the hands, and when in the shape of a cone, press it lightly where dirty oil remains, and the bread will remove it. Two or three applications of the same bread will leave the cylinder perfectly clean. It may then be made bright by the usual application of a piece of pointed cut cork.

CHEMICAL PHYSIOLOGY.*

IN the little book which Dr. Thudichum has published under the title given below, he has done good service towards the advancement of medicine, and has afforded valuable information to the student of chemistry and physiology. The first portion was written and printed as an introduction to those valuable researches, intended to promote an improved chemical identification of diseases, which he has contributed to the reports of the medical officer of the Privy Council. Finding it useful in his own teaching, Dr. Thudichum determined to publish it for the benefit of medical students and others, who will find it a concise treatment on physiological or animal chemistry, a subject which is still neglected to a large extent. The second portion is an analytical guide for the use of those who may desire to become practically acquainted with the phenomena and constituents of animal bodies. The importance of an accurate knowledge of the subject in all its bearings, more especially to the medical man, cannot well be over-estimated, while an acquaintance with the chemical processes which go on within the human economy is deserving of study, and may be turned to commercial advantage by chemists and others.

The action of the saliva in turning the starch of the potato into sugar is tolerably well known to students of popular science; but few amongst the ordinary reading public are aware that this saliva consists of a variety of fluids, some of which prepare or predispose the food to change, while others merely serve mechanical objects. Of these the saliva secreted by the parotid glands contains a peculiar ferment named ptyaline, and this principle is the only agent in

* A Manual of Chemical Physiology, including its Points of Contact with Pathology. By J. L. W. THUDICHUM, M.D. London: Longmans.

saliva which has the power of transforming starch into sugar. The diastase of malt has a similar action, and a knowledge of this fact led Baron Liebig to employ diastase in the preparation of a food for infants "brought up by hand," which food supplies efficiently the want of ptyaline and alkaline fluids in the digestive juices. But little is known of the character of saliva in disease; that it is very materially affected cannot be doubted, and further research will probably throw more light on the subject. It is known that the administration of mercury causes a change in its constituents; several medicinal salts, such as iodide of potassium, pass very readily into the saliva from the blood, and, as is well known, the saliva is the bearer of the poison of hydrophobia. From these facts we derive information of a nature probably unthought of by many; for if ptyaline is the only substance in the human economy which can turn starch into sugar—for the gastric juice cannot, and the pancreatic fluid has only a trifling influence in this direction—we see at once how necessary and important it is to thoroughly masticate all food containing starch, not only in order to obtain the full nutritive value of what we eat, but also to prevent overloading the stomach with a mass of food, much of which is probably indigestible.

The study of the chemistry of digestion, too, has led to the invention and preparation of sundry semi-medicinal articles of diet. The comminated food, mixed with saliva, when it reaches the stomach excites that organ to both a chemical and mechanical action, and a knowledge of this fact shows us that to obtain natural digestion in full vigour it is necessary to supply the healthy stomach with a large quantity of matter containing nutriment, rather than with aliments of inappreciable bulk; for although it would be possible to extract all really nourishing substances from our food and support life with them for a time, healthy digestive action would cease, owing to the inability of the stomach to act mechanically on the small mass which would be sufficient if we could live on essences. This mechanical action of the stomach, so to speak, churns the food, and the chemical action consists in the discharge from small glands in the walls of the stomach of a fluid termed gastric juice which contains 8·0 per thousand of a substance called pepsine, with minute portions of hydrochloric acid, possibly lactic acid, and some of the chlorides of the alkalies and phosphates of earths. The gastric juice possesses the power of dissolving albuminous substances; it transforms the casein, fibrin, gluten, and other portions of the food into a thickish, turbid pap, called peptones; and the ptyaline of the saliva, still continuing to act in a modified degree, forms sugar. The partially-digested food, now called "chyme," mixed with water and a small quantity of air, passes through the pylorus into the duodenum, where it is mixed with bile and pancreatic juice, and undergoing further decomposition becomes chyle, passes through the chyle-ducts into the lymphatics, and enters the blood through a door in the sub-clavian, or under-the-collar-bone, vein. Such is but a very rudimentary description of the digestive process; but the knowledge we have of the influence of pepsine in preparing food for assimilation has led to the production of an article of dietary medicine which has, we believe, been found servicable in diseased conditions where the natural juices are, on tolerably good grounds, supposed to be deficient. But little is known of the physiology of the liquids which are the active agents in duodenal digestion; the secretory acts and influences are well understood, but the employment of the secretions has yet to be elucidated in a satisfactory manner. The pancreatic juice, says Dr. Thudichum, has probably three functions, of which one is the complete solution of fragments of meat and albumen, which are invariably present in the chyme when it issues from the stomach, another is the decomposition of fat into glycerine and fatty acid, and a third the emulging of neutral fat and its transformation into a condition in which it can pass through the pores of the mucous membrane into the chyle-ducts. The main function of the liver is to secrete bile, and its action is of such intricacy, connected as it is with the main features of digestion, that probably a volume might be written on this organ alone. "The quantity of bile secreted in the human body in a day has been estimated at 1,200 grammes, or the bulk which would fill a wine-bottle and a half." It is probably the most complicated fluid in the human body; influencing fat and fatty acids in the manner of a soap, communicating to the small absorbing tubes an attraction for fat, and excreting cholesterine, which is intimately related to the chemistry of the nerves. In diseased conditions the bile is retained, causing jaundice; and by its power of precipitating pepsine it completely stops digestion when regurgitated into the stomach. The digestive processes carried on in the small intestine are unfortunately but very imperfectly known, and require, says Dr. Thudichum, particular and great researches; for this part of the body is the principal seat of such diseased processes as typhus and typhoid fever, cholera and others, amongst which, but not the least important, are summer and autumn diarrhœa, so fatal to many persons, even when special epidemic influences are absent.

Not the least interesting branch of chemical physiology is the study of the action and properties of blood-corpuscles, which carry oxygen from the lungs to the most remote and hidden parts of the body, yielding it up to the muscles or to the oxidisable matters contained in their juices, where it is immediately used if required, or is retained and stored up, this being especially the case during sleep. Blood-corpuscles are not carriers of carbonic acid, although it affects their colour and condition; this gas is conveyed in the serum of the blood, being partly dissolved therein, in the same manner as in soda-water, but to a large extent it is combined with alkaline bases, especially sodium. Dr. Thudichum's theory of the excretion of carbonic acid is not generally held or widely known, and we therefore quote the passage bearing on it: "When the blood-corpuscles of the venous blood arrive in the lungs they have undergone a change which consists in the partial oxidation of a small quantity of their hematocrystalline,* and this is transformed into an acid which I will call hematic acid. This blood-acid contains nitrogen. It is not similar to any of the acids we know; it is not volatile, but fixed. It is evolved from the blood-corpuscles and passes into the serum at the very moment when the former arrive in the small breathing-cells of the lungs. There the blood-acid combines with the sodium, and the carbonic acid is set free, and is left to take its course, with water-vapour, through the lung tissue into the respiratory passage." In a note, Dr. Thudichum says that the excretion of carbonic acid from the lungs is an act of specific secretion, to which the presence of oxygen (and nitrogen) *may be a supplementary advantage* (as favouring diffusion), but is *not essential*.

In his researches on cholera Dr. Thudichum showed that in that disease the serum, being changed in its constitution, refuses to perform its proper functions, but so acts upon the blood-corpuscles that they cease to carry oxygen to the tissues of the body; the temperature falls, and what is known as the algid condition in cholera is produced. In other diseases the hematocrystalline of a portion of the blood-corpuscles leaves them, and is decomposed—in yellow fever, *e.g.*, colouring the skin yellow. Similar decomposition takes place in poisoning by arseniuretted hydrogen, and by the bites of venomous serpents, while such poisons as prussic acid, carbonic oxide, and sulphuretted hydrogen, kill by decomposing the hematocrystalline, or by combining with it to the exclusion of oxygen. Thus, says Dr. Thudichum, the study of many diseases requires an intimate knowledge of the constitution of the blood-corpuscles. The value of this we have only just begun to appreciate, and the chemical and optical methods of investigation applied with rigorous accuracy will bring us not only the explanation of normal phenomena at present obscure, but also information on the nature of diseases and the action of poisons, which will point the way to their prevention or cure.

The Analytical Guide which forms the latter portion of Dr. Thudichum's valuable little book, is, of course, intended for the use of students in the laboratory, and for this purpose it is admirably adapted, being concise yet replete with all that it is necessary to know, directing the experimenter how to proceed in order to obtain a certain result, leaving him, as a rule, to appreciate the result of the operation by his own reflection. To the reader who has not the means of entering into these investigations and performing the operations there is much matter for consideration, and much useful information. Thus in the analysis of brain-matter we find corroboration of the German aphorism *Ohne Phosphor kein Gedanke*, for the ash of mixed brain matter contains 9·15 per cent. of free phosphoric-acid, and large quantities of acid phosphates, especially of potassium and sodium. We learn also that there is more ash in white brain-matter than in gray; that the former contains free phosphoric acid and a large amount of acid phosphates, while the latter is alkaline, and contains a much smaller quantity of phosphates.

The latter portion of the book contains woodcuts of the characteristic spectra of certain substances found in the fluids of the body, which will be of great use to the student. The whole volume (the result of many years of patient inquiry) is one of the most valuable contributions to pathology ever published, and a great step towards placing therapeutics on a thoroughly scientific basis.

* Blood crystals; a substance of a red colour, containing carbon, hydrogen, nitrogen, iron, sulphur, and oxygen ($C_{600}H_{960}N_{154}FeS_3O_{179}$); it is this substance which gives the double-banded spectrum of arterial blood, and the one band of venous blood.

NOTES OF FRENCH SCIENCE.

THE production of sounds by certain fishes has recently been studied by M. Dufossé. There are two kinds of sea scorpion, the *Cottus scorpius* and the *Cottus bubalus*—fishes of small size and ugly aspect—which are put into a state of vibration when seized or touched by the hand, and this is often accompanied by a noise or cry, sometimes a continuous note. The phenomenon may be observed either in air or water. These vibrations, M. Dufossé thinks, are voluntary on the part of the fish, and are caused by the contraction of certain muscles, placed under the cranium, at the sides of the buccal and respiratory cavities. By certain motions, the fish can alter the form of these cavities, and they act as a kind of sounding-board, producing resonance. He traces an analogy between the action of these cavities and that of the thoracic and mouth-cavities in Vertebrates.

Workers in copper, it would appear, enjoy a certain immunity against attacks of cholera. M. Burg states that in Bagdad, where the disease wrought such ravages last year, there were, between the end of April and the end of October, about 800 victims of cholera in a population of 80,000. In the bazaar there were about 100 shops occupied by nearly 500 individuals engaged in the making or selling of copper articles, and among these there was not a single victim.

M. Decaisne, in a recent note on "The Progress of Depopulation in France," gives some striking statistics as to marriages and births in that country, as compared with others. In Prussia, the number of births is 460 per cent. of the marriages, in France it is only 300 per cent. The proportion of births annually, per cent. of the entire population, is in Prussia 3·98; in France only 2·55. The annual excess of births over deaths, calculated per million of the population, is 13,300 in Prussia, and only 2,400 in France. According to the above figures it will take 170 years for the whole population of France to be doubled, as against 42 years in Prussia, 52 in Great Britain, and 66 in Russia.

A remarkable consequence of the late war has been the spontaneous appearance of certain exotic forage plants in some localities that had been occupied by cavalry. At present many of these plants (which are mostly Algerian) are flourishing in regions which were formerly very barren, but are now become veritable oases. The phenomenon is best seen in the Department of the Loire-et-Cher, at Orleans, Blois, Cour Cheveray, and other places. M. Vibaye has counted (in March, 1872) as many as 157 different species. Of these, about a third part are *Leguminosæ*, while *Gramineæ* and *Compositæ* make each about one-fifth part. Twelve species of trefoil have been observed, and ten or eleven of medicago. Where the lands are not turned to pasturage or frequented by herb gatherers, the plants are being largely propagated. Several species were found to appear by the side of a forage dépôt in Cour Cheveray, for the first time in May this year, showing that the seeds had remained in the ground sixteen months without germinating. The frost of May last, which injured vines and the young shoots of conifers and other trees, wrought no harm to the exotics. The cause of the above phenomenon is obviously the importation of forage from abroad, the seeds of which had fallen into the soil.

M. Dumont describes to the Paris Academy the mode of supplying Rhone water to Nimes. The water is subjected to natural filtration in a lateral subterranean gallery of 500 metres length, and 11 metres internal breadth. This gallery is the largest known. The water is brought by means of two steam-engines of 200 horse-power each, a distance of 9,960 metres in a pipe 0·80 metres diameter. Connected with the pipe is a large air chamber 14 metres high, on which the pumps act, not directly, but through a number of smaller air-chambers joined to it; by this method, the immense column of water, weighing nearly 5,000 tons, is made more manageable. The steam-engines, which are vertical, with direct motion, only consume 1·400 kilogramme of coal per horse-power per hour. 30,000 cubic metres of water are furnished to Nîmes (which is 27 kilometres from the Rhone), at an expenditure (including original cost of works) of not above 6,000,000 francs. A. B. M.

ELECTRO-METALLURGY.—III.

By J. T. Sprague.

1. BATTERIES.—In these papers I intend to proceed step by step as though the reader were commencing the subject, so as to deal with it systematically. If any one hopes to learn at once how to rival Elkington in the art of electro-plating, or even, having got a Smee cell and half a pint of gilding solution, to at once proceed to gild his watch case or chain, he may as well resign himself to disappointment, for it is my intention to put him through an apprenticeship, by first learning thoroughly how to deposit copper in any required condition; this is a cheap and manageable process, and all the secrets of electro-metallurgy can be learnt there, and, once mastered, success in the other departments is assured, and only slight instruction necessary for each special case. The first thing essential to be considered is the source of the force, *i.e.*, for present purposes, the best form of battery to employ. We require a battery easy of management, giving a large current at moderate cost and of tolerable constancy. Much will depend upon the amount of use to be made of the apparatus, for the conditions are very different when the instrument is to be kept steadily at work, and when it is to be used only by fits and starts: in the latter case the common Smee is to be selected before any other ordinary form—viz., a platinised silver plate in a frame with two zinc plates held to the frame with a brass clamp. A few general principles will assist in selection. Large cells should be used; constancy is impossible if they will contain only a small quantity of liquid, because the exciting liquid becomes speedily inert by being charged with zinc salt; they should also be deep, so that this salt as formed may sink by its weight below the level of the plates; if this be attended to, much waste may be avoided by occasionally drawing off the lowest portion by means of a siphon and adding fresh liquid. From want of attention to this, it is a common occurrence for a heavy deposit of zinc to form on the lower part of the negative plate, which then requires to be removed by soaking in dilute acid. This more commonly happens in one of a series of cells in which there has been some over action, or change of liquid has been neglected; it then becomes, in fact, a decomposition cell instead of an active one. In some cases, for practical reasons it is best for the elements to be in the form of plates, but in many cells they are cylinders, and then the question arises, which should be the outer one, the zinc or the negative? This question may be put in another form: if the plates differ in size, which should be largest? This has been a good deal discussed, owing to consideration being directed to only a portion of the subject. There are two good reasons why the negative metals should be largest. 1. The zinc is subject to local action or waste, which contributes nothing to the work, and, therefore, its size should be reduced to just that amount which is requisite to maintain the current required. 2. The negative plate is subject to "polarisation" or deposit of hydrogen upon it, and should therefore be as large as possible.

After a great many trials I have come to the conclusion that the best possible arrangement is one in which the negative element is a cylinder fixed within the containing vessel, in the middle of which the zinc can be suspended. The next point is the best material for the negative plate.

2. *Copper Negative.*—This is the oldest form, and still used in many factories. As a rule, it is bad economy; on the small scale it is mere folly to employ it. The copper speedily becomes covered with a black coating, the current diminishes almost to nothing, and the plates must be cleaned with acids or made red hot. If used at all, the surface should be thoroughly coated with electrotyped copper to ensure pure metal and a highly granular surface. There is one form in which copper may be usefully employed for regular continuous working—viz., as a cylinder in a large vessel, with the zinc in a porous jar, the outer vessel charged with dilute sulphuric acid, say 1 to 20, and a little nitric acid added occasionally. In the porous cell a half saturated solution of zinc sulphate or common salt may be used, and the lower part occasionally removed with a siphon and replaced with water: if the cell stands idle the copper is dissolved if free nitric acid is present, or else becomes coated with an insoluble deposit. The cell cannot be recommended except for factory use on a large scale.

3.—*Silver Platinised.*—This is one of the most valuable negatives known. Smee discovered that hydrogen adhered less strongly to rough than to smooth surfaces, and from this developed the idea of depositing platinum as a fine powder on other metals, selecting silver as best on account of its slight liability to action from acids and its high conducting power. Substitutes are frequently proposed, as copper, lead, and an alloy of lead, tin, and antimony; they are all wretchedly bad economy, and it should be remembered that the silver, even if a little costly at first, has an intrinsic value of its own, even when worn out. Rolled silver can be obtained ready platinised, or ordinary thin sheet can be lightly roughed with fine glass-paper, or by dipping in nitric acid, and the platinum deposited on it thus:—Insert in a vessel with dilute acid, and connect it by a wire to a small slip of zinc in a porous vessel in the same acid; in fact, mount it as a battery, but exposing at first only a mere touch of the zinc to the liquid; drop in a few drops of platinic chloride, and stir; gradually a faint colour forms on the silver; add more platinum salt and increase the zinc surface, and after a good adherent coat is formed gradually increase the action till the surface is fairly covered with a black coating, which touch as little as possible. The platinum solution is made by dissolving scraps of thin platinum in a mixture of two parts of hydrochloric and one of nitric acids; the solution is very slow, and is best effected in a flask with a long neck, in which is inserted a test-tube filled with water, and stood by in a warm place; it is not necessary to drive off acid or to crystallise for this use, as the free acids are of no consequence. The most satisfactory single acid battery I have ever had consists of a tall glass cylinder, the upper half of which contains a cylinder of platinised sheet silver soldered to stout copper suspension wires leading to the binding screw; all the copper and solder is carefully covered with marine glue to prevent action upon it; the wires pass up through a thin sheet of cork or pasteboard well soaked in melted paraffin which fits firm into the glass, and the silver itself fits to the sides to prevent motion; in the middle is fixed a porous jar, the upper part of which is soaked in paraffin, and passes firmly into a hole in the middle of the cork, in which are also fitted a phial neck for filling at, and a small bent glass tube for leading off gas if required; all being thus placed, a mixture of melted resin and Bathbrick-dust, or other similar powder, is poured upon the cork, the use of which is mainly to enable this to be done; the top is thus closed with half an inch of cement, leaving only the porous cell from which any evaporation can take place; the top of the glass should be first warmed and coated with melted resin, containing a little melted oil; this insures adherence and prevents sulphate of zinc forcing its way up. This cell is always ready for action upon placing the zinc rod or plate in the porous cell. The same mode of construction applies to some other cells I shall mention presently. Of course, earthenware jars will do as well as glass, and the porous cell may be substituted by a glass or earthenware tube, only reaching the liquid; as described, the arrangement is perfect for every purpose, and may be modified according to the purpose desired. The objects aimed at are a large current, constancy, due to freedom from polarisation, use as a voltameter by measuring the gas given off, working for a long time on one charge, and remaining ready at any moment and any intervals without injury or trouble; in some I have soaked the bottom of the porous cell in paraffin, led down a protected wire leading from a binding screw and dipping into a layer of mercury; these only require a rod of zinc to be plunged into the mercury, and can be left coupled up, although the zincs are removed; or they may be used as odds and ends cells to utilise any scraps of old zincs which only require to be cleaned, amalgamated, and packed into the porous cell. The silver is platinised after the cell is completed.

4.—*Graphite Negatives* may be used in place of silver, and may be platinised in the same way with advantage; connection can be made to them by a clamp with a piece of platinum foil inserted, or a deposit of copper can be made upon the upper part and a binding screw soldered on; the carbon must then be warmed and carefully soaked with paraffin from the copper down to the part which will be in the liquid. An excellent cell may be constructed on a plan similar to that just described; stand a porous cell in the middle of the jar, insert also a plate or rod of graphite carbon, prepared and connected as described, and also a stout glass tube reaching to the bottom; crush up a piece of carbon, as obtained from the gas retorts, and sift out pieces from the size of a hazel nut to that of a pea, and pack these in the space between the two jars, taking care to have as good contact as possible with the carbon connection block; when two-thirds full, fit in the cork cover, and cement as before. This may be used as a single acid cell, or if high force is required nitric acid or bichromate of potash solution may be added to the outer cell. For single acid use a wicker basket, or any convenient substitute may replace the porous cell, as its purpose is simply to keep the materials in place. As the graphite contains a good deal of sulphide of iron, the gas given off is very offensive at first, and the cells should be allowed to work some time and be emptied once or twice before they are platinised, which renders them much more constant in action. They are not quite equal in all respects to the silver cell, chiefly because of the internal resistance at the carbon contacts, but they are cheaper at first, and once properly prepared will last for years in perfect order, working with great economy. As the current forces liquid from the zinc cell outwards it is as well to bore a small hole or two in the porous cell just below the proper level of the liquid, by which it can return; of course this must not be done with cells in which nitric acid is intended to be used. This same arrangement makes the best form of manganese cell: all that is necessary is to grind together equal bulks of fine peroxide of manganese and carbon, and pack this into the interstices of the carbon; this is far superior to the Leclanché form, as it gives so much more room for the material, and brings the zinc into its proper place, the middle. With this mixture the cell becomes useless for electrotype purposes, but it is so convenient for many purposes of testing and experiment that every electrician should possess one at least; it is also the most convenient form known for use with electric bells and domestic telegraphs.

5. *Daniell's Cell* is most valuable for experimental purposes, because of its constancy, but for occasional use is too troublesome to be recommended in electrometallurgy. It is also costly, but if the battery is made up of square plates and the negative plates are themselves articles on which deposit is to be made, I believe it would be found the most convenient and cheapest of all. For this purpose it would require the negative chamber to be fitted with connecting rods, &c., in the same manner as the depositing cell to be described; something of the sort is also shown in Fig 88, p. 196, Vol. XI. The chief objection to Daniell's cell is the deposit of copper on the zinc from salt which passes through by endosmose; for long continued experiments I have found it advantageous to use large cells with two porous jars or partitions, with a good space between filled with strong solution of sulphate of zinc, using the same solution with half water in the inner zinc cell and unamalgamated zinc. By occasionally drawing off the upper part of the intermediate solution much transfusion of copper salt is avoided (especially if a few coils of zinc are inserted in the middle cells), and the zinc can be cleaned in a moment by brushing. The solution withdrawn should be put in a bottle, or jar, with a few scraps of zinc, which will throw the copper down and fit the solution for use again. This plan adds to the internal resistance, of course, but that is the only drawback, while perfect constancy can be maintained. The Grove's and Bichromate cells are not used (and the latter would be useless and expensive) in electro-metallurgy, because high electro-motive force is not required; for some purposes that even of a single Smee is unnecessarily great, but this can always be controlled by adding resistance. The batteries described are the only ones of use, and I will give such practical information as to their applies to all.

6. *Zinc.*—The best rolled zinc should be employed; it gives a higher force than cast zinc, and is more economical, because cast zinc is subject to much more local action, owing to its porous condition. Cast zinc rods may be used with equal advantage in cells where it is only exposed to sulphate of zinc, or chlorides of sodium or ammonium, because these do not act by themselves on zinc.

Amalgamation. — The coating of zinc with mercury prevents the local action of the acid; it appears to effect this by giving a smooth surface, and so favouring the adhesion of hydrogen, which may be seen covering it in little bubbles; therefore, anything which tends to roughness of surface tends to increase local action and waste of zinc and acid, a point the learner should carefully fix in his memory as an axiom. The practical lesson is, keep your zincs thoroughly clean and well amalgamated. Care should be taken to use only pure mercury; much of that sold contains lead and tin, which are mischievous. The mercury should be kept for some time in a bottle, with dilute nitric acid over it, and occasionally shaken up. To amalgamate zinc, wash it first with strong soda to remove grease; then dip it in a vessel of water containing one-tenth of sulphuric acid, and as soon as strong action takes place transfer it to a dish (such as a soup plate); pour mercury over it, and rub it well till a bright silver-like film forms; then set it up to drain on edge, and before use rub off any globules which are set free. Whenever the zinc shows a gray granular surface (or rather before this) brush it well and reamalgamate, remembering that saving of mercury is no economy, and free use of it no waste—for it may all be recovered with a little care. Keep a convenient sized jar or vessel solely for washing zincs in, and brush into this the dirty gray powder which forms and is an amalgam of mercury with zinc, lead, tin, &c., and forms roughnesses which reduce the protection of amalgamation. Let this powder collect for a time and then transfer it to a bottle, in which wash it with sulphuric acid first, and then with dilute nitric acid, and you will recover the mercury. This washing should be done whenever a plate is removed, and never less than once a day if in regular use; the fibre brushes sold at 3d. and 4d. as coarse nail-brushes are excellent for these purposes, but of course must not be left soaking with acids.

NOTES OF COMMUNICATIONS TO THE ACADEMY OF SCIENCES, PARIS.*

FIREDAMP INDICATOR.—It consists of an alarum put into play by clockwork, the balance of which is held by a scale beam, with arms of an unequal weight; this kept in position by a cotton cord previously impregnated with purified saltpetre. It is inclosed in a case of wire gauze. The firedamp penetrating into this cage is ignited on reaching the inflammable point by a lamp burning in the inside. This consumes the cotton thread, the clockwork balance is released, and the alarum sounds, warning the miners of danger and indicating the necessity for more active measures of ventilation.—M. S. V. TURQUAN.

ZOOLOGY AND GEOLOGY.—From the examination of bones found in recent strata it would appear that the Mauritius have formed part of a large extent of land or group of islands, which have gradually sunk into, or been overwhelmed by, the sea, and these islands are the remains. They have served as the last refuge of the terrestrial population of those ancient epochs. Of these are the dodo, the solitaire, the aphanapterix, Newton's water-hen, large paroquets, &c. Madagascar had not been in communication with these islands, for when first visited by Europeans they did not find any mammals except some large bats. These did not exist at Mauritius. The study of the fossil birds leads to the same result. —M. ALPH. MILNE-EDWARDS.

PREHISTORIC ANTHROPOLOGY.—From the reindeer period man has always lived amongst the majestic débris of the talus at the station Eysies, in the valley of La Vezere, Dordogne; but the principal part of the talus was formed in the Palæolithic age. Notwithstanding some levelling that has occurred, more or less, the vestiges of the successive occupations show themselves at intervals. Here are traces of the bronze age, with remains of crucibles and of charming little vases in pottery, black and very fine, with geometrical designs, identical with some of those from Lake Bourget. In other parts hearths of the polished stone period, with bones of animals, its polishers and punches in bone, its hatchets, and coarser pottery. The last have not yet been found in the undisturbed reindeer strata, but constantly accompanies the remains of domestic animals. From time to time there have been falls of rocks at this spot, and the people have returned after each fall and profited by the intervals between the blocks to light their fires. Upon an occasion one of them became a victim to a downfall, having being overwhelmed whilst reclining on the back upon the hearth, and turned in vain to avoid the descending rocks. The skeleton was found under some of these, about three yards below the surface of the reindeer period. There could be no doubt of its era, and in this it is distinguished from the other skeletons of the polished stone period. Ordinary sepulture would not explain the circumstances under which it was found. The vertebral column had been crushed by the corner of a heavy rock and the pelvis was broken. Shells were found distributed about the skeleton; amongst them *Cyprea pyrum* (Gmel) and *C. lurida* (Linn.); two were on the forehead, two near the humerus, four near the knees, two on each foot. They were pierced with a gash or notch, and would have ornamented a garment. There is no appearance of their having formed parts of a necklace or bracelets.—M. ALPH. MILNE-EDWARDS.

APPLIED CHEMISTRY: ON A NEW METHOD FOR OBTAINING THE REPRODUCTION OF DESIGNS.—Trace upon rather stiff glazed paper the design with gummed ink, and scatter over it fine powder of bronze or brass. By this means a kind of plate may be obtained that will admit of the most various designs being taken off upon prepared paper. By softening the ink with vapour of alcohol the metallic powder can be renewed when spent by use. Specimens were submitted to the Academy.—M. B. RENAULT. JOHN L. LAKE.

* Translated and abstracted for the ENGLISH MECHANIC.

SINCE the completion of the Omaha Bridge over the Missouri River, there is an unbroken line of railroad from Oakland, California, to Boston, a distance of 3,239 miles.

HARMONIUM CONSTRUCTION.

THE improvements in the construction of harmoniums recently patented by Mr. Scantlebury, of Holloway, consist in a method of coupling the octaves, a new form of pallet bar for opening the valves of several rows of reeds, and a modification of the bellows action. The invention will be readily comprehended from the annexed engravings, in which Fig. 1 is a transverse section of the action; Fig. 2, a plan of part of keyboard and couplers; and Fig. 3 a form of pallet bar for opening the valves of 8 rows of reeds. In the coupler action the inventor places what are known as "backfalls" or levers F (the fulcrum, on rail D of which is at the centre of their length, by preference) in connection with the pallet or valve G, by means of a wire eye or other suitable means at one end, and a screw *a* from the under side of the finger key acting upon the other end. The couplers are placed diagonally as shown. A sticker is also arranged in connection with the same key to act upon its own pallet or valve G. The "coupler bar" D is raised so as to bring

FIG. 1

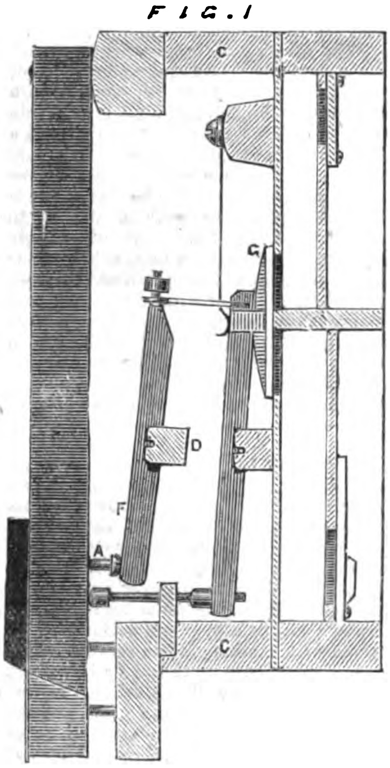


FIG. 2

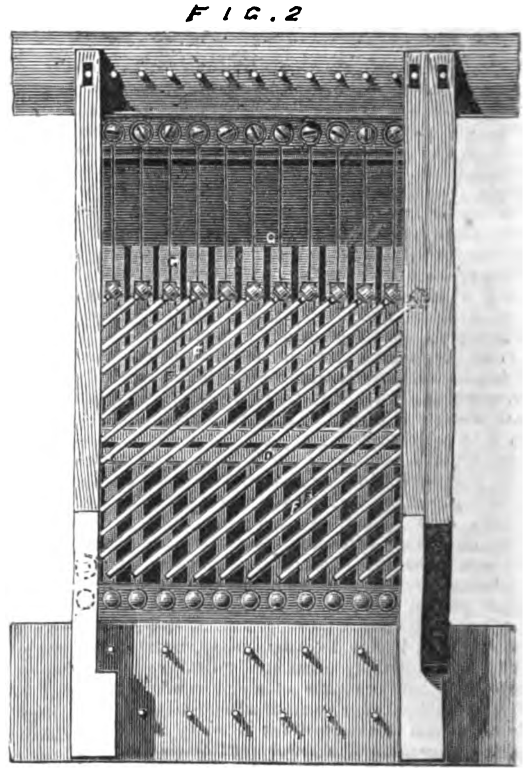
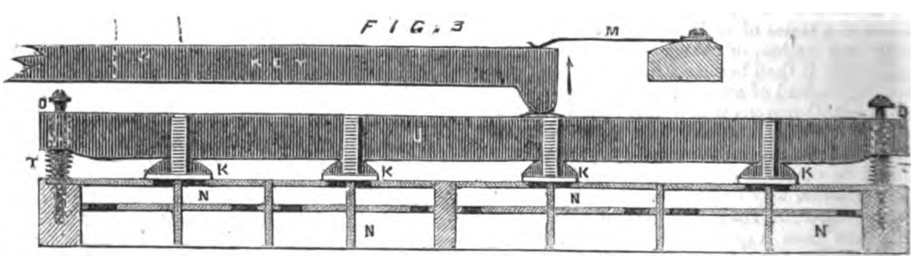


FIG. 3



the levers in contact with the screws *a* under the keys by any suitable mechanical motion for causing the "coupler" to rise and fall without lifting the pallets G from their seats until the key is depressed.

The improved mechanism for actuating the feeder or bellows of harmoniums consists in placing a roller or wheel at the bellows end of the lever, actuated by the foot-boards, which roller works upon a plate of metal placed upon the underside of the feeder, whereby friction as found in the ordinary bellows is reduced to a minimum and the blowing is performed by the player with much less exertion. By this arrangement the bellows may be placed nearer to the motive power for actuating them.

In adapting the coupler action the inventor raises the keys a short distance from the pallets (about three or four inches more or less as required) and incloses the space with a frame C as shown at Fig. 1, forming a strong resonant chamber or sounding-board C, whereby the ton-of the instrument is said to be considerably improved. By placing upon one note-board several sets of reeds, the whole of the respective openings in connection with which are under the control of one pallet or valve, only one spring is required to each key, an arrangement which lightens the touch, and simplifies the action and construction of the instrument; for in ordinary instruments it is usual or only practicable to cover two notes by one pallet or valve, each two notes requiring a pallet spring, thus occasioning heavy pressure on the keys, especially if the note-board is large. Fig. 3 shows a section of the improved form of pallet bar J, the pallets K being fastened to it in the usual manner of fastening a pallet to its stem, by means of a strip of leather, technically called a "strap." The arrangement shown is for an eight row sounding-board or "pan" N, but the pallet bar is suitable for a larger or smaller "pan." The holes for the screws O to pass through are bored larger than required, the screws being clothed with two small pieces of cloth or other suitable material, one at the bottom of the hole and the other at the top, an arrangement which imparts a better action than if the cloth passed through the holes. Under the head of each screw O a washer of cloth, baize, felt, or other suitable noiseless material is placed, to receive or stop the rise of the pallet bar J when released by the key, and raised by the light springs T, which are (by preference) spiral springs of brass wire of sufficient strength to raise the pallet bar J and its pallets K. It will thus be seen that the springs T materially assist in imparting lightness of touch to the action. The spring M is made strong enough to keep the pallets down.

THE VEGETABLE BEEF-STEAK.

THIS fungus (*Fistulina hepatica*), which resembles a great red tongue protruding from tree stems, when once known, can never be mistaken for any other species. When young it is a dull pale purplish red, but becomes more red, and passes through brown to black as it decays; the underside is cream-colour, with minute red points occasionally, becoming yellowish red as it grows. It generally confines itself to old (and often prostrate) oaks; but in Epping Forest it is not uncommon on the beech, and it has been observed on the chestnut, walnut, willow, and other trees.

Although such a large fungus, frequently weighing from four to six pounds, its growth is very rapid, soon appearing and again disappearing, on ancient trunks in the autumn. When cut, broken, or bruised, it distils a copious red juice like beef gravy. "When grilled," says Dr. Badham, "it is scarcely to be distinguished from broiled meat;" and Berkeley describes it as "one of the best things he ever ate, when prepared by a skilful cook." There is a very slight acid flavour in the fungus when cooked, which adds considerable piquancy to the dish; it is extremely tender, succulent, and juicy, and resembles tender steak or tongue in a remarkable manner, the juice it distils being in taste and appearance like gravy from an excellent broiled rumpsteak. Of course it should be gathered when quite young, fresh, aud clean, and at once prepared for the table in the following manner:—Wash and dry, cut into in. slices ¼in. wide, soak in scalding water for five minutes, and stew with butter and herbs; yelk of egg may then be added, and serve hot; or simply stew with a good steak, adding a scallion and parsley, salt, and pepper.

RUBBER GRAPHITE PAINT.

A NEW paint, which is said to be waterproof, and to possess other advantages, is announced by the *Scientific American*. A waterproof paint, for metal roofs, fences, bridges, ships, and every kind of wood structure, which, at the same time, could be relied upon to reduce the corrosive influences of exposure to the atmosphere, is an article for which the demand would appear to be almost without limit.

The rubber graphite paint is a solution of pure indiarubber in linseed oil, which is ground with graphite into a thick, elastic, smoothly flowing paint. Compositions of which indiarubber forms a part possess in the most eminent degree the quality of resisting the action of moisture and of corrosive gases carried in the air. In the graphite, we have a pure form of carbon; and it appears to be well known that paints containing carbon in any form last longer than other kinds not having it as an ingredient—holding their body and colour when the other paints are totally destroyed. We do not see why this compound, combining as it does these two valuable elements, should not form a paint of great durability and highly protective qualities. All shades of colour from black to gray, or cream colour and the drabs, can be made as desired.

THE BELL ANEROID.

THIS instrument (invented and designed by Captain Hans Busk) indicates, by ringing one or other of a series of ten different bells, any change in the atmospheric pressure amounting to one-tenth of an inch on the barometric scale. The mechanism is simple, and is put in action by a constant battery (one of Leclanché's) composed of twelve cells.

In the annexed woodcut (Fig. 1), representing a back view of the case, with the door removed, the position of the bells is shown. They are respectively indicated by the letters A A, and are irregularly placed round the centre one. At the back of the central and smallest bell is seen one of the soft iron magnets, by means of which motion is imparted in the usual way to the hammers C C C. The other magnets are hidden behind or under the bells. F F are insulated wires leading to the binding screws D D. By means of the insulated wires G H, a connection is established with the battery, and this can be broken at will, by means of the lever E.

The dial (Fig. 2) is formed of a disc of ebonite about three-sixteenths of an inch thick. This material was selected for the purpose, because it effectually insulates not only the steel index hand,

FIG. 1

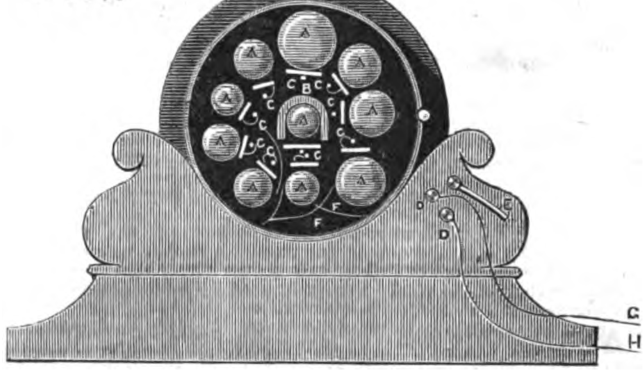
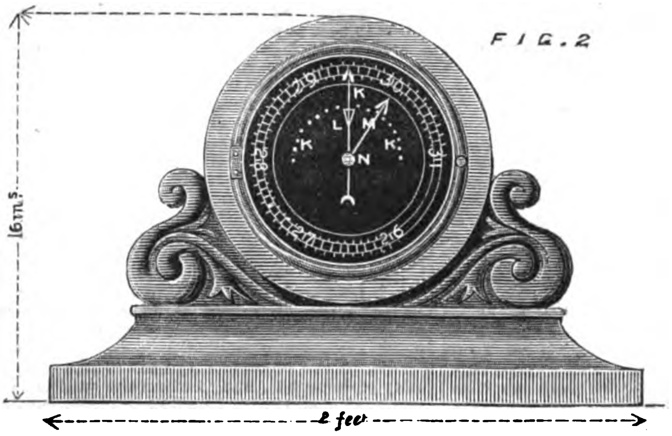


FIG. 2



but also the sixteen terminal platinum points of the wires marked K K K. To the index hand N, a thin strip of platinum foil is attached, marked L on the diagram. The hand, as it traverses —from "one tenth" to another—the face of the instrument, necessarily brings the platinum foil in contact with some one of the platinum points, thus establishing a connection with one of the soft iron magnets; the bell pertaining to that magnet is instantly rung, and continues ringing as long as the hand remains stationary, or until the lever E is withdrawn (as shown in Fig. 1) from contact with the screw D.

There are in Captain Busk's aneroid sixteen platinum points, and their extremities are carefully burnished off so as to cause no friction, and to offer no resistance to the movement of the foil. As there are only ten bells, six of these points (three at either extremity of the scale), and, consequently, those least frequently sounded, are each conected with two bells. As all the bells have a separate note of their own, it is perfectly easy to tell, even at some distance, whether the barometer is rising or falling: the deeper toned bells give warning, when the hand moves from 29·50in. towards 28in., while the higher notes are sounded as it passes from 29·50in. towards 31in. In variable and unsettled weather, more especially at sea, it is both curious and interesting to note the rapidity with which these changes occasionally succeed each other.

The bell aneroid was completed, under Captain Busk's directions, by Mr. Browning (the well-known scientific instrument maker), and he is at present alone authorised to construct aneroids of this particular kind.

The primary object of the inventor was to devise a simple and efficient apparatus which should indicate unerringly, on board ship, or to a person in charge of a lifeboat station, any important approaching alteration in the state of the atmosphere, and the result of his experiments has proved in all respects most satisfactory. It is not improbable that this form of aneroid would frequently be of material use to the agriculturist.

INFLUENCE OF RESPIRATION ON THE CIRCULATION.

IN a paper on this subject by Dr. Ewald Hering are given the results of a considerable series of experiments on dogs, undertaken with the view of determining the influence of respiration on the circulation. He states that during an examination of the influence of the vagus on the respiratory movements, he found artificial inflation of the lungs to exert a remarkable influence on the cardiac movements. If air be blown in through a canula, and its escape prevented by a stopcock, the beats of the heart increase in frequency. In his experiments he introduced one end of a T-tube into the trachea, and attached a second orifice to a manometer, while the third was left free, so that the animal might breathe by it, or through it insufflation might be carried on; a manometer was also introduced into the carotid. It was found that, when the tension of the air within the lungs was augmented, the pressure of the blood in the arteries fell to an extent increasing in proportion to the pressure of the air in the lungs. This effect is obviously due to the greater resistance the blood experiences on entering the chest, and to the obstacle the expanded lung presents to the passage of the blood through its capillaries. The heart's beats increased in frequency at the same time, and in proportion to the tension of the air in the lung; where the cardiac movements had previously been slow, they sometimes rose to three times their previous number. The animals were always under the influence of opium. Four questions suggested themselves in regard to this increased frequency of the beats. 1. Is it due to the greater pressure under which the heart acts? 2. Is it owing to the altered conditions of resistance to the current of the blood? 3. Does it arise from disturbances in the exchange of gases; or 4. Is it occasioned by a forcible dislocation of the heart. He considers the arguments in each case at length, and finally arrives at the conclusion that the acceleration of the cardiac beats on insufflation of the lungs is affected reflectorially through the vagi; the action of the centres of the inhibitory fibres of these nerves being lowered by the excitation of the sensory fibres distributed to the lungs.

Another Liquid Glue.—The following is a good recipe for liquid glue:—Take gum of shellac three parts; indiarubber one part, by weight. Dissolve the caoutchouc and shellac in separate vessels, in ether free from alcohol, applying a gentle heat. When thoroughly dissolved, mix the two solutions, and keep in a bottle tightly stoppered. This glue resists the action of water, both hot and cold, and most of the acids and alkalies. Pieces of wood, leather, or other substances, joined together by it, will part at any other point than at the joint just made. If the glue be thinned by the admixture of ether, and applied as a varnish to leather, it renders the joint or seam water-tight, and almost impossible to separate.

REVIEWS.

British Rainfall, 1871. By G. J. Symons, F.M.S., F.R.B.S. London: Edward Stanford. 1872.

This useful but unpretending annual collection of rainfall statistics has been only recently published, its completion having been delayed by the illness of the compiler, Mr. Symons. It contains the usual amount of information on an important subject. Among the papers contributed by rainfall observers there are two that demand a passing notice—one "On Rain-gauge Experiments at Hawsker, near Whitby, Yorkshire, 1871," by the Rev. F. W. Stow; the other "On the cause of the Decrease of Rain with Elevation," by G. F. Burder, M.D. A considerable portion of Mr. Stow's paper treats on the same subject as that by Dr. Burder. Mr. Stow's view is of this character, "that if the whole of a shower were intercepted 10ft. or 20ft. above the ground, there would be just about as much rainfall at that height as actually falls to the ground within the whole area covered by the shower; but that the fall on the ground is most unequally distributed by upward and downward currents of air; the latter prevailing in those places where we generally set our gauges, and causing, therefore, an excess in the fall at one foot, over that at a height less affected by the down currents." On the other hand, Dr. Burder suggests that there is a *real* increase of rain near the earth, especially within six inches of the surface. This view is founded on an analysis of Mr. Chrimes' observations with gauges elevated from 1ft. to 25ft. at Rotherham, and the Calne observations, 1867, between the surface level and 1ft. above the surface. In the Calne observations a gauge 6in. above the surface gave a decrease of 3·3 per cent. as compared with the quantity registered in the gauge, the mouth of which was on a level with the surface, and one at 12in. above the surface gave a decrease of 4·8 per cent. as compared with the same quantity. In the Rotherham observations the decrease between elevations of 1ft. and 5ft. is 6·0 per cent., while that between 20ft. and 25ft. is only 0·9 per cent. From these results Dr. Burder draws the following conclusions:—(1) That the formation of rain is not a continuous process. The bulk of the rain comes from the clouds; little or none is drawn from the air next below the clouds, but a large addition is derived from the strata in the immediate neighbourhood of the earth, the rate of addition being continually and rapidly accelerated until the rain reaches the ground. (2) That this rain formation near the earth is simply the effect of temperature. There is one circumstance in connection with the subject of decrease of rain-fall with elevation which appears to be anomalous; it is that Colour-Sergeant Arnold finds from three years' observations at Aldershot camp that two gauges of 5in. aperture, set at an angle of 45°, their faces being kept to the wind by vanes, collect as nearly as possible the same amounts of rain at heights of 6ft. and 3ft. respectively, while a gauge of 8in. aperture elevated 25ft. gathered about 76 per cent. of the quantity collected in the lower gauge. We believe no explanation has as yet been offered of these results. There is also another circumstance not noticed by Mr. Symons; it is that the horizontal gauge at 6ft. of elevation, gathered during the three years about 70 per cent. only of the rain collected by the inclined gauge at the same height. Similar observations at Rotherham, the elevation being 5ft., gave in the four years, 1868 to 1871, 71 per cent. in the horizontal gauge, as compared with 100 in the inclined gauge. These results are so near to each other as to indicate that at an inclination of 45° for the receiving aperture, the greatest quantity of rain is arrested, or, in other words, the greatest quantity of rain falls on a surface opposed to the wind, and inclined to the horizon at an angle of 45°. The observations of Sergeant Arnold with inclined rotating gauges appear to point to the fact that the strata of atmosphere below an elevation of 30ft. is *equally charged* with rain, while his experiments on the other hand, at elevations at 6ft. and 25ft. appear to point to an absolute increase of rain in the lower strata. The close agreement of the Aldershot and Rotherham observations, in showing that at the same elevation in the lower strata a horizontal gauge gathers about 30 per cent. less than a gauge inclined at 45° kept face to the wind, appears to indicate that the elevation differences are dependent upon the horizontality of the receiving apertures, and consequently on the angle which those apertures make with the normal angle of 45°. We have dwelt upon these portions of the "Rainfall" as bearing upon the *accuracy* of the present mode of measurement, and we hope that further attention will be given to so important a subject. The investigation relative to the duration, hourly frequency, and rate of rainfall, has been continued by Messrs. Sawyer and Bruce, with somewhat similar results to those of 1870. At Brighton, the greatest number of falls in any one hour occurred between 2 and 3 p.m.; in the next hour, 3 to 4 p.m., the number of falls was only one less; the result was precisely the same in 1870. At Bogside, Aberdeenshire, the greatest number of falls occurred between 3 and 4 p.m. As a practical result, we find that the period from 11 p.m. to 3 a.m. is marked by fewer falls of rain than any other of the 24 hours; falls are more frequent between 3 and 7 a.m., after which they decline until 11 a.m., increasing from that hour to 3 p.m., and then decreasing to 8 p.m., the remaining three hours being a period of greater frequency. Among the weather proverbs is found the following: "Rain before seven, clear before eleven," which is based upon the *hourly* frequency of rain. In the last two years and a half Mr. Sawyer found there was rain before 7 a.m. on 159 days. On 68 of these days, or nearly half, there was *no* rain after 11 a.m., and on 106 days or two-thirds of the whole, the weather cleared before 11 a.m., and there was no rain until 2 p.m. or after. From these facts Mr. Sawyer concludes that the proverb is well borne out, and it is in accordance with the periods of greater or less frequency alluded to above. In his remarks on the rainfall of certain districts, Mr. Symons calls attention to the discontinuance of the records taken round St. Mary's Loch, for the Edinburgh Water Trust, and remarks that "this is to be regretted, not only for scientific reasons, but because, sooner or later, the information would have possessed an actual money value far exceeding the cost of registration;" he further adds that "niggardliness in such matters often compels tenfold subsequent outlay." We have only room to notice that under the head of "Foreign Rainfall" the condition of India is spoken of as having been very remarkable during 1871: heavy falls in some places, great drought in others. For much interesting detail we must refer the reader to the volume itself, which is fully equal to its predecessors.

Iron as a Material of Construction. By W. Pole, F.R.S. London: E. and F. N. Spon.

What we may term the foundation-stone of this book was a series of lectures delivered at the Royal School of Naval Architecture on the use and application of iron in mechanical structures. These have been carefully revised, and with much additional matter form a text-book that cannot fail to be of use or to find numerous readers amongst students of that branch of the art of construction which deals principally with iron—a branch which is rapidly spreading and ramifying in an increasing number of directions. Mr. Pole was formerly professor of civil engineering in University College, London, is a member of the Government Iron Armour Committee, and with the aid of his forty years' experience brings no small amount of information to bear in writing this handbook for the use of students in engineering — information supplemented by diligent research into, and garnering from, the works of the best and most reliable authorities on the different branches of the subject. The book is devoted essentially to the practical part, though so much of the theoretical as was thought necessary is not omitted; and it will, doubtless, prove of service in assisting the student to acquire a knowledge of the nature and properties of iron as a material of construction. Mr. Pole, while carefully pointing out that book-learning can never supply the place of practical observation, is yet convinced that the acquirement of the requisite knowledge is immensely facilitated when practical observation is guided by previous study. "Many practical engineers have devoted the best years of their lives," he says, "to its acquisition, but there are many members of the profession who have had no opportunity of doing this, and to whom the want of such knowledge must always be a disadvantage, causing them to rely on others for judgment which it ought to be their own personal prerogative to apply." With iron entering, more or less, into every building of any pretensions erected nowadays, supplanting stone in bridges, and timber in houses, it is refreshing to find a practical man like our author saying that "it is questionable whether this substitution is not being carried too far, and whether the new perishable substance is not frequently adopted for the sake of cheapness, or facility of construction, in cases where the more durable but less tractable material, stone, would be more appropriate, more noble, and more worthy of the profession." This, however, is only an "aside." The engineer who wishes to be master of his art must be thoroughly conversant with the capabilities of iron as a material of construction, and able to adapt it to the various structural purposes which our wants demand. The book is divided into chapters headed—the Production of Pig Iron, Production of Malleable Iron, On the Mechanical Properties of Iron Generally, Cast Iron, and Malleable Iron, the essential principles of the manufacture being briefly but clearly indicated, while the properties of the metal as used in construction are very fully explained.

Practical Plane Geometry. By J. F. Heather, M.A. London: Lockwood and Co.

This volume forms the first course of the "Elements of Mathematical Drawing" in Weale's well-known series, and contains the simplest modes of constructing figures contained in one plane and directions for laying out geometrical constructions on the ground. The objects of the work are to give such a course of instruction in practical plane geometry as shall enable students to comprehend the constructions given in the papers at competitive examinations, and to form a complete introduction to the volumes on Projection and Descriptive Geometry, which are to follow. Mr. Heather has adopted the simplest mode of performing the constructions consistent with great accuracy, and as this necessitated variations from the methods of Euclid, as well for those problems which are contained in the Elements as for the numerous deductions therefrom which he makes use of in the book, proofs of the methods employed are given. The theorems are merely stated, however, references being given to the propositions of Euclid in which they are found. The book appears to have been carefully put together, and is worthy to take its place in the well-known and useful "Series" to which it belongs.

Conversations on Natural Philosophy. By Mrs. Marcet, Revised and Edited by the son of the author, Francis Marcet, F.R.S. London: Longmans.

This is the fourteenth edition of a well-known and deservedly popular work, and will doubtless find its way into the hands of many of the rising generation, and replace the older editions in the "seminaries" and "academies" where it is used as a class-book. In the "advertisement" to the present edition we are told that it has been thought desirable to introduce two additional conversations on Spectrum Analysis and Solar Chemistry, and on the title-page we are informed that the book has been "revised and edited," which we should understand to mean in the ordinary course of things that the statements made therein were consonant with the known facts of science at the present time. We regret to say, however, that whatever revision and editing it has undergone has not been well done; we regret to say this, because a book which, probably, first stirred the mind of the youthful Faraday to experiment in fields where he afterwards became a most eminent worker, and which, moreover, has been held in good repute almost from the commencement of the present century, is in a measure past criticism, and deserving of honour for the good work done in previous years. The subjects of heat, light, colour, electricity, are not brought up to our present knowledge, and in several instances incorrect statements are allowed to appear. Thus we find it said that "the ether which produces light cannot be an elastic fluid," and that "water is a non-elastic fluid." Errors, too, which might have been avoided by a careful revision have also escaped the printer, for we are informed that "the steam below the piston is *not* drawn into the condenser while that above it forces it down." The "not" spoils the whole sentence. Such spelling as the "spectre of metals" and "alcaline" is decidedly objectionable, and contradictory statements, like the distance of the earth from the sun being given in one place as 95,000,000 miles and in another "about 91,000,000," might at least be avoided. Under these circumstances, therefore, we cannot but desire a speedy issue of the "fifteenth and corrected" edition.

Healthy Houses. By William Eassie, C.E. London: Simpkin, Marshall, and Co.

This is a book with an attractive title, but we are afraid that many who take it up with the idea of learning how to make a house healthy will lay it down disappointed. Mr. Eassie, it appears, was assistant engineer to Renkioi hospital during the Crimean war, and has here published what he calls a handbook to the history, defects, and remedies of drainage, ventilation, warming, and kindred subjects, with estimates for the best systems in use, and upwards of 300 illustrations. In his preface the author says, that at length the sanitary Day (with a capital D) is dawning. Of course we are very glad to hear it, but while confessing that we do not know exactly what he means, we beg leave to assert that, so far as the public is concerned, there is, individually, very little appreciation of the necessity for sanitary laws, and a vast amount of ignorance of the evils of dirt and of the diseases which follow in its wake. Local authorities, save in some few exceptional instances, exhibit an amount of supineness which cannot long be tolerated: an indifference, in fact, which evinces the utter contempt with which they regard the teachings of sanitarians. Whether Mr. Eassie's book will effect an alteration of this unsatisfactory state of things remains to be seen. As an account of what has been done to improve our dwellings, and make them healthy, his little book has doubtless a certain value—giving, as it does, a collection of inventions, patented and otherwise, connected with drainage, ventilation, and heating; but we venture to think that the amateur builder who takes up this book with a view of discovering the best method of constructing and fitting a house according to the requirements of sanitary laws, will find himself endeavouring to sit on more than two stools at once. Besides, there is naturally a very great suspicion attached to the opinions of an author who does not hesitate to advertise the different wares of which he speaks, by giving their prices and the addresses of the manufacturers. Mr. Eassie considers that the earth and ash-closet systems "have much good work to perform;" but when a thorough "water drainage" is effected they may "wisely be dispensed with." He thinks that the carbon-closet system is, "without doubt, the best dry process yet invented." Speaking of the present arrangements for collecting dust, Mr. Eassie suggests what we presume he would call an improvement, which, in fact, it might be in Utopia, the happy land in which we do *not* live. He says, "If a person accustomed to a constitutional walk before breakfast-time avoids an occasional accident from the exposure of the many-shaped boxes of dust, he may consider himself lucky; but if he escape the inhalation of some disease from the well-packed weekly hampers of dirt and offal, he is doubly fortunate." We have heard of the "dangers of the streets," but we were not aware that so many pedestrians are the "doubly fortunate" individuals which Mr. Eassie makes them. Our author then suggests that the latter evil (the "inhalation of some disease") is "unquestionably to be remedied by the use of some deodorising disinfectant." The receptacles for the dust are to be so constructed that every time the lid of one is opened a quantity of a disinfecting powder is mixed with the rubbish put in; while the receptacle is to be so placed in the area, "that the pressure of the dustman's foot would cause it to rise to the pavement level." How this is to be done by apparatus of the requisite simplicity Mr. Eassie does not tell us, neither does he inform us whose duty it would be to see that the dust-bin had its proper supply of disinfecting powder. Nevertheless, his book will be found useful by those who wish to know what has been done to insure the most healthy conditions in dwelling houses—provided they are capable of judging for themselves of the relative merits of the articles mentioned.

A Pocket Dictionary of Technical Terms used in Arts and Manufactures. English - German-French. German - English - French. French-German-English. Abridged from the Technological Dictionary of Rumpf, Mothes, and Unverzagt. London: Trubner.

A TECHNOLOGICAL dictionary is nowadays so useful, not to say indispensable, a companion of the architect, engineer, and mechanic, that we cordially welcome the appearance of these three volumes. It would, it is true, be easy to point out many errors —in fact to make fun of sundry rather ludicrous misunderstandings of the compilers, but in spite of these this "pocket dictionary" is the best of its kind with which we are acquainted. Many words might be omitted with advantage, for it is difficult to see what use the term "bluebottle," referring to the cornflower, can be to technologists, especially as that is the only "meaning" given; nor are many persons likely to require the French or German equivalent for "bihydroguret of carbon," which, with its reference, occupies two lines. In the dictionary for Frenchmen, the English term for a *dame-jeanne* is said to be a "glass-balloon put in a basket," and a "carboy" appears to be known only when it contains nitric acid. The errors, in fact, are numerous, but those who have attempted to translate technical works into a foreign tongue can readily appreciate the difficulties experienced by a lexicographer in giving the correct meaning of the various trade terms and technical phrases, especially when they are not given in the dictionaries of the language spoken by those who use the terms. As a matter of fact, the definitions of tools, appliances, and materials of different industries are often erroneous in works professing to give them, while our ordinary dictionaries omit them as a rule. It will be seen, therefore, that to collect them for three languages is a labour of no slight difficulty, and mistakes of omission and commission may be expected to abound. The arrangement, as far as typography is concerned, is very clear, consistent with great condensation, but numerous printers' errors disfigure the pages.

We have also received *New Formulas for the Loads and Deflections of Solid Beams and Girders*, by William Donaldson, M.A., A.I.C.E. (E. and F. N. Spon), a work which will interest engineers, the formulas being "strictly based on the assumption" that *ut tensio sic vis*. Mr. Donaldson hopes to secure for his essay either a prompt refutation or an acknowledgment of its truth in the altered practice of engineers. He contends that as cast-iron beams are now constructed the upper flange is repeatedly subjected to its proof stress, and is therefore liable to more frequent failure; and he considers that in wrought-iron beams one-sixth of the weight has been hitherto wasted.—*The Strains in Trusses*, by Francis A. Ranken, M.A., C.E. (Longmans), is an attempt to set in a clear light the theory and method of computing by diagrams the strains in trusses bearing a constant load. There are twenty examples drawn to scale, and the work is worth the attention of engineers and builders.—*The Screw Cutters' Guide*, by James Martin, is a handy and reliable little book for the pocket of the mechanic. It contains tables of 2,165 trains of wheels for different pitches of threads, besides sundry other information that is always handy for reference by the screw-cutter. Every amateur lathe-worker should purchase the little book.—*Esse and Posse*, by H. T. Braithwaite, M.A. (Longmans); *Mankind, their Origin and Destiny*, by an M.A., of Balliol College (Longmans); *An Exposition of the Fallacies in the Hypothesis of Mr. Darwin*, by C. R. Bree, M.D. (Longmans); *Michael Faraday*, by Dr. Gladstone (Macmillan); *Ancient Stone Implements, Weapons, and Ornaments of Great Britain*, by John Evans, F.R.S. (Longmans); *Key to Harris's Arithmetic* (Longmans), notices of which we must postpone for the present.

HOW LUNG DISEASES ARE PRODUCED.

TWENTY years ago the so-called sizing of cotton consisted in using fermented flour and tallow to give tenacity to the warp and to lessen friction in the weaving process. Thereafter it came to be seen that the brownish colour given to cotton cloths by size made from inferior kinds of flour could be reduced by adding a little china clay to the size; while this material so far reduced the glutinous quality of the flour that the sized warps would weave easily with less tallow in the size. With the increased price of tallow in the Crimean War, china clay came to be still further substituted; the practice grew more and more general till the cotton famine of 1862 brought into use the poorer short-fibred cotton, which demands a larger amount of size than the better sorts. Another practice was introduced by the lack of cotton. "Weight for length" being the chief test of the goodness of yard-wide cloth, a fictitious weight was given to cloths containing less cotton, to make it appear that they contained more; "heavy sizing" became the custom, and for this purpose a size, composed mainly of flour and tallow, with the addition of Epsom salts, chloride of magnesium, sulphate and chloride of zinc, was resorted to. In weaving warps of inferior cotton, weighted with china clay and flour mixed with deliquescent salts, the weaving sheds must be kept damp, to prevent the brittle compound of clay, flour, and cotton from breaking, and increasing the weight of the cloth by the retained moisture. A mean of 62° Fahr., the external temperature being at 48° Fahr., with an excess of moisture and a careful avoidance of any draught that could dry the tender warp, were the conditions of work in the weaving-sheds, and were found so deleterious, says the *Lancet*, that the weavers addressed a remonstrance to the Privy Council. Dr. Buchanan was accordingly told off to investigate the matter, and found in thirteen sheds a haze caused by fine dust particles. The looms were in all cases covered with opaque dust, depending as to quantity on the kind of cloth that was being made. The clothes and hair of the weavers were white with dust, causing an intense irritation to the nose and in a less degree to the eyes and throat—an irritation to which the weavers get accustomed, though at the expense of their lungs. To judge of the effects of this mode of life on the weavers, Dr. Buchanan first examined the mortality statistics, next collected the local medical opinions, and finally made personal examination of the weavers themselves. In Todmorden, for example, Dr. Buchanan found that there was a considerable excess in the death-rate from lung diseases among persons over fifty-five years of age.

All the medical men concurred that lung diseases were greatly prevalent owing to the cotton manufacture, that the cotton worker bequeaths a consumptive habit to his progeny, and that dyspepsia is another ailment peculiar to those people. With some little divergence of opinion, the local practitioners agreed that the lungs of weavers suffered more now than formerly, and that they were approximating to carders in their liability to chest complaints. The weavers themselves were positive as to their incurring shortness of breath, emphysema, bronchitis, subacute dyspepsia, and permanent epistaxis from the conditions they lived under—diseases which disappeared or were relieved by cessation from work. "Fewer weavers now pass middle age without getting something the matter with their lungs," was the remark of an intelligent over-looker to Dr. Buchanan. Experience tells that the diseases due to dusty occupations are not rapidly fatal. "During the years that their victims are only disabled no record is kept of their prevalence. When at last," says Dr. Buchanan, "they kill, perhaps after having driven the worker to some other occupation, and having made his life miserable for ten or twenty years, then for the first time they get registered." To arrest the increase in the already excessive and heightened mortality in the cotton working community, important changes in the practice of sizing, or in other ways, must be introduced; and we hope the Local Government Board will lose no time in acting on the suggestions submitted to it by Dr. Buchanan.

ENGLAND IN RELATION TO MUSIC.

THE *Daily News* in an article asks: "Are the English a musical people?" and then answers the question by the following comments. The distinguished company at the recent jubilee dinner of the Royal Academy of Music, could have no difficulty in answering the question to their own satisfaction. We agree with Lord Dudley, the President of the Academy, that the English are a musical people, whatever foreigners may say or think about it. But when one speaks of the English as a musical people, it must be understood in the sense of a people who have an ear for music, and an instinctive affection for the concord of sweet sounds, rather than the will and the power of cultivating the science and the art of music, with all the imaginative and inventive genius which we devote to machinery and to turnips, to big guns and iron plates, to horse-racing and shipbuilding, to the pastimes of the sea and the sports of the field. The native love of music appears in all its freshness and sincerity in a thousand passages of English poetry; and the sister Muses are seldom far apart, if they do not always walk hand in hand. Musicians of the future have no mercy for a tune; but the old musicians of the past were not ashamed of being tuneful, and of bequeathing to after generations immortal melodies that, like the airs in Prospero's island, give delight and hurt not. No country is richer than our own if we include, not Great Britain only, but Ireland, in ballad music. Our sweet and simple minstrels have lent to the sadness and joy of the human heart a voice which the world will not willingly let die, though the minstrel's name may be often forgotten or unknown. Still, as Sir John Coleridge, himself an enthusiastic lover of the art, had the courage to avow the other day, when he was presiding over a musical and almost professional audience in St. James's Hall, there was always something provincial about the English school of music, if, indeed, a school could be said to exist. The catalogue of our composers for the cathedral contains a host of names which, with very few exceptions, can scarcely be called famous, even at home, and have never been pronounced abroad. What do France, Germany, or Italy know of our Purcells and our Arnes, not to mention our Boyces, our Greens, our Blows, our Smiths, our Arnolds, and a hundred other most respectable writers of Anthems? This provincialism is, perhaps, rather the misfortune than the fault of our masters of the fugue; the misfortune of living in an island before the seas were bridged by steam, and in ages when very few Englishmen made the Grand Tour, and our intercourse with the Continent was confined to soldiers and diplomatists. Still, even in these latter days of incessant intercommunication, there are scarcely more than one or two names of English composers that have crossed the channel; and the Anthem which Mr. Headlam heard at the Temple Church on Sunday last, and which he modestly declares was worthy of the best days of English music, was composed by perhaps the solitary Englishman whose fame has reached Paris, Vienna, and Berlin, if indeed it has passed beyond a select circle of professed musicians in those cities; and perhaps it is as a favourite pupil of Mendelssohn that the reputation of Sir Sterndale Bennett has arrived at Leipsic, rather than on account of the true and serious merit of his works. Speaking broadly, neither the public nor even the *dilettanti* of Continental Europe know of English music or English composers as we on this side of the water know of Verdi and Wagner, and Gounod and Offenbach. Why should we shrink from this confession of comparative obscurity? If England has not given birth to world-renowned musicians, it has been a fond and beloved nursing-mother to the greatest of them. Handel, who is only just beginning to be known to the Parisians, was an Englishman by adoption, by residence, and by predilection. It is true that he was only a naturalised Anglo-Saxon, and that we have to thank the House of Hanover for his coming among us; but it was in England that he lived and worked; it was to English institutions and English glories and English charities that his mighty musical genius was consecrated for nearly forty years. It was in England that his last work was written with his own hand, and it is in our national sanctuary that the pilgrims of all countries seek his monument and tomb. No doubt it is to our dynastic connection, and to the kinship of the two races, that we owe the fact of which we have the right to boast: that as Germany is the second country of our Shakespeare, so England has been the second country of her Haydn, her Handel, her Beethoven, her Mozart, and her Mendelssohn. Their works have been more played and sung in England than in all the rest of Europe; it was by English audiences that the finest of their works were first heard, and have been heard constantly and habitually, while in the "Capital of Civilisation," fifty years after the London Philharmonic Society had possessed and performed the masterpieces of Beethoven, that stupendous genius was almost "a barbarian" to the Conservatoire; and a quarter of a century after Mendelssohn had conducted his *Elijah* at Birmingham, an enthusiastic conductor of popular concerts ventured upon the experiment of playing the Italian symphony before a public who believed that Gluck was a Frenchman and M...

beer a native of the Boulevards, and Rossini the swan, not of Pesaro, but of Passy. It is scarcely an exaggeration to say that even now, to the Parisian public (exclusive of a few connoisseurs), the great German composers are almost as unfamiliar as the great composers (if any such there be) of China or Japan. However insular and parochial Englishmen may be in their political ideas, in art, and especially in music, they are (if Mr. Disraeli will pardon the word) essentially and admirably cosmopolitan. In some respects we are a "peculiar people" but in hospitality to Art and Genius we are true Gentiles, of the broadest church. Our neighbours are usually regarded as the most sympathetic and assimilative nation of the Western World; but nothing like our English faculty of naturalising foreign musical genius (a faculty which is almost genius in itself) can be found out of these islands.

PRESERVING BIRDS' EGGS.

THE following hints on the best method of preparing birds' eggs for preservation are from the pen of Dr. William Wood, and are extracted from the *American Naturalist*.

I wish to say a few words for the benefit of those engaged in collecting öological specimens. Twenty years ago all eggs were blown with two holes—one at each end, and until within ten years most eggs have been emptied with two holes as above, or at the side. Very many of the eggs which I now receive in my exchanges are similarly prepared. At the present time no experienced collector ever makes but one hole to remove the contents of the egg, using a blowpipe in some form to accomplish this object. The following rules should invariably be followed:—

1. Prepare your eggs neat and clean. There is no excuse for having a dirty set of eggs where water, soap, and a tooth-brush can be found. Some eggs will not bear washing, as the shell is so calcareous that the characteristic markings will wash away. There are, however, but few of this class, and I believe this peculiarity is confined to the water-birds. You can see it in the eggs of the grebes and flamingo, and some others. Having once seen it you will never mistake it for anything else.

2. Make but one hole, and that a small one in the middle of the egg; cover this hole, when the contents are removed, and the specimen is dry, with gold-beater skin or the paper number indicating the bird. Use an egg drill or a pointed wire of four or six sides to make the opening.

3. If the blowpipe does not readily remove the contents of the egg, inject water and shake the specimen thoroughly, then blow again, and repeat the operation until every particle of the egg is removed.

4. If the embryo is too far advanced to remove through a moderate sized hole, blow out what you can of the liquid part and fill the egg with water, wipe it dry and put it away in a covered box in some warm place, and every twenty-four or forty-eight hours shake it well and remove what you can, and then re-fill with water. Repeat this operation several times, and after a few days the contents will become sufficiently decomposed to take away.

5. After removing the contents of any egg, cleanse the shell thoroughly. Fill it with clean water and shake vigorously, blow out the contents and repeat the operation until the specimen is perfectly clean. This is particularly desirable in white eggs, as black spots will show through the shell after a time if the least particle of the egg or blood stains remains inside.

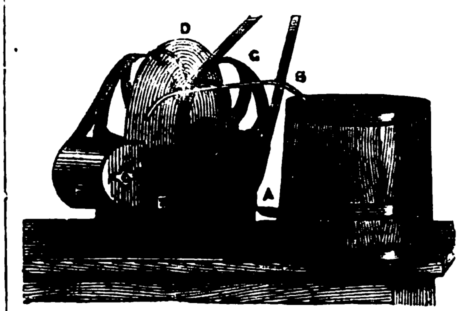
6. Save all your eggs in sets—that is, keep all the eggs each bird lays by themselves. This is the only way to form a correct knowledge of the eggs of any species, as a single egg, particularly of the blotched ones, frequently gives a very erroneous idea of the general markings—a very unsatisfactory representation of a set. For instance, in my collection are four eggs of the *Buteo lineatus*, found in the same nest, two of which are pure white and two blotched. It is not very uncommon to find great variations in markings in the same species and in the same nest.

7. Keep a memorandum of the place and date of collecting each set of eggs.

8. Use some kind of blowpipe in preparing your eggs for the cabinet. The common blowpipe, with the addition of a fine pointed tip, will answer; yet it is a severe tax on the lungs and brain if you have many eggs to blow. I have many a time been dizzy and almost blind from over-taxing my lungs in this operation. Within a few years Mr. E. W. Ellsworth, of East Windsor Hill, Conn., has invented a blowpipe which is operated by the thumb and finger, which works very perfectly and expeditiously. I would not be without it on any account. After using it for a time, and then letting it remain unused until the leather packing becomes dry, the instrument does not work satisfactorily to those unaccustomed to it. The remedy is simple. Take off the blowpipe and work the instrument submerged in a bowl of warm soapsuds, when the leather packing becomes pliable and works as well as new. I have used the same instrument for years, and it works to-day as well as when new, by following the above directions. The printed directions which accompany each instrument are intended to be a sufficient guide in case repairs are needed, and the maker can be referred to for any further information required.

DYNAMIC REFRIGERATOR.

M. TOSELLI, the inventor of a well-known ice machine, has recently constructed a cooling machine, which is denominated the dynamic refrigerator. It consists of a revolving disc, D, formed of a metallic tube bent into a complete spiral, having one end open, and with the other end communicating by a hollow shaft or axis of rotation with an external tube, A, communicating with a worm contained in a separate vessel, C, and terminating in a discharge pipe, B, with outlet into another vessel, E, containing the revolving disc to which a slow movement of revolution is imparted by a driving pulley and belt, G, making (say) one turn in a second of time. The disc is half immersed in cold water, and as the exterior surface of the disc above water is continually wet, it exposes considerable evaporating surface. At the same time a continuous stream of water is forced through the hollow spiral, parting with some of its heat under the influence of the external evaporation and radiation, which is intensified by the addition of a ventilator, F. The current, being thus lowered in temperature, refrigerates in its turn the liquid to be cooled in the vessel, C. The lowering of tempera-



ture thus obtained varies according to the hygrometric condition of the atmosphere; the minimum effect obtained under the most unfavourable circumstance amounts only to a difference of five to six degrees Fahrenheit; while the maximum difference obtained in sunlight is between 32 and 33 degrees Fahrenheit. The inventor considers that this machine will be of great service in many manufacturing processes—such as brewing, distilling, and making effervescent beverages—also in hydro-therapeutic establishments, and probably also on shipboard for the evaporation and distillation of sea-water, and its conversion into a potable fluid.

MECHANISM.*

(*Continued from p. 402.*)

THE relation which the machinist bears to the mechanist is easily defined. Setting aside the question of structure, the mechanist deals with designs; the machinist takes those designs and adapts them to his purposes. For the fitness of the designs for an end, they apply, when need be, to the mathematician. The mechanic takes the deductions of the machinist and the mathematician, and produces a machine as exactly adapted to the purpose required as the knowledge and experience of the time enables him to do. The distinction thus drawn between the machinist and the mechanician leads to modes of expression by these respective classes which, unfortunately, do not increase the respect of each for the other. For example, the mechanician aims only at a contrivance; the machinist or mechanic aims only at a commercial or manufacturing utility. A mechanician is contented with the most rude skeleton design; he does not care for either journals or plummer blocks being neatly and carefully curved out—anti-friction curves do not trouble him. On the blackboard are two skeleton drawings; here is a very rude one of two wheels and a crank—these answer the purpose of the mechanician. A mechanic would not be worthy of the name of mechanic if he executed such a piece of work; as a mechanical drawing it is perfectly ridiculous. You see by the side of it some specimens of mechanical drawing, one a diagrammatical one, and another a most beautifully-finished drawing of a locomotive, which, perhaps, appears to many to be an engraving. It, however, is done entirely by hand. There are also working drawings, such as are taken into the workshop, from which the actual machines are made. It would certainly be a great improvement on scientific books if there were some advance in the illustrations they contain, which at present are often even less worthy of commendation than the rude mechanistic skeleton one alluded to.

It is quite possible, and it would be even prudent, to make mechanism a study altogether apart from mechanics; it would not, however, be prudent on the present occasion to do so. Whilst, therefore, associating mechanism with mechanics—to which it is not allied, and mechanism from mathematics—to which it is necessarily allied, in this course of Cantor Lectures we approach the subject in a species of bondage, and must therefore ask that favourable consideration generally extended towards a comparatively strange friend by making use of our old friend, mechanics, for a favourable introduction and an occasional help.

With mechanics we are all familiar. We can neither eat, drink, nor sleep; we can neither sit, walk, nor talk, except by the exercise of those mechanical arrangements with which nature has endowed us. When, however, in the course of nature the vital energy ceases by which man is enabled to put in action the machinery of his frame, then, however beautiful and perfect the machinery may be, the object for which it was constructed cannot be performed. At this stage (the power of the machinery having gone—the kinetical element having been removed) the mechanist takes up the parts, and may be said to analyse the contrivances by which the vital energies exercise their various powers. But the mechanic cannot operate without a motive power. The mechanician cares for none. He deals with contrivances in relation to motion. His peculiar province is to devise plans by which the motion he has may be changed into the motion he wants, and the requirements he wants are singularly varied, and they fully warrant Mr. Anderson's expression of "endless," for to them there is "practically no limitation." Farmers do not make more varied demands upon the weather than machinists do upon mechanists in relation to motion. There is no end to the variety of demands made by the public upon the mechanician. One man comes and says he has motion which he wants accelerated. Another says he has a motion which he wants retarded. A third comes and says his motion is not quite continuous, he would like it to be so; another says he wants the motion to be intermittent. One man says he wants a circular motion when he has got a rectilineal; another says he wants a rectilineal when he has got a circular; another wants it variable; another says he wants it uniform; one says it must be alternate, going backwards and forwards; another says he wants his motion brought to a state of rest. Another says, here is velocity, convert it into power; and another, here is power, convert it into velocity. None of these, and the list might be wonderfully extended, are out of the province of the mechanician. For example, a knife is to be sharpened. There are various modes of doing it. The shelves of the Patent-office have many plans for sharpening knives, but we will take the representative one, in which the stone revolves. We have an apparatus here for which we are indebted to Messrs. Holtzapffel. The problem before the mechanist is to convert the perpendicular motion of the foot up and down about eighty times in a minute into a continuous motion of the stone of about 500ft. circumferential per minute. The plan adopted here is to have a treadle for the foot, by which the up-and-down motion is transferred to a wheel, from which there is a band to a small pulley connected with the stone, and by this contrivance we have got the up-and-down motion of the foot converted into the continuous rotary motion of 500ft. per minute. That mechanism is perfect for all purposes, not simply for the sharpening of a knife, or razor, or lancet, but, as a mechanical contrivance, it will do for a hatchet, scythe, or any other edged tool. The machine has left the mechanician's hands as a contrivance, but the mechanic takes it up, and adapts the question of its structure to the particular use for which it is required, using such proportion of treadle, crank, and wheel as he pleases. The mechanist has done with it when the contrivance is produced, and it then becomes the property of the mechanic. If, however, the problem had been set before the mechanist in another form, as, for example, if he had a weight falling, and that had to be converted, or if he got such a matter as the rise and fall of the tide, and that had to be converted, or, if he had got the explosive power of gunpowder, or the intense power at a short distance of electricity, or the elastic power of a steel spring, then clearly these would be new conditions imposed upon the mechanist, and a different piece of mechanism would have had to be designed for each of those cases. You have, therefore, according to the questions put before the mechanist, various machines, but one contrivance serving every purpose. In any case the mechanic takes the designs of the mechanician, and so avails himself of his own knowledge of material, and so adapts the amount of power at his disposal, and of that required to be utilised, as to make the machine.

Now it is clear that to sharpen a razor and a hatchet require from the mechanic two different machines—from the mechanician they require but one mechanistic contrivance.

Having thus explained and illustrated the position which mechanism holds in relation to other branches of mechanics with which it is allied, we should

* By the Rev. Arthur Rigg, M.A., being the Cantor Lectures delivered before the Society of Arts.

restrict ourselves to a consideration of the divisions and sub-divisions under which it may be usefully studied. To do so in the present course of lectures would be to make the subject not particularly inviting, and we must sometimes, therefore, overstep the boundaries, and take a short walk into the not very inviting mathematical and prohibited fields, and perhaps a longer one into the more inviting mechanical fields. In thus, to some extent, trespassing into tempting bye-paths from the highway which the literal meaning of the title of these lectures prescribes, the Council of the Society, and the audience, who do not despise mechanistic drawings, must permit action to take place under a precept which not existing in our Christian code, I must borrow from another:—

For what saith the Koran in chapter the third,
"Confine not thy neighbour too close to his word."

A consideration of the classification of mechanism, as suggested by Professor Willis, may form an appropriate introduction to the next lecture.

THE CONSTITUTION OF NATURE.*

WE cannot think of space as finite, for wherever in imagination we erect a boundary we are compelled to think of space as existing beyond that boundary. Thus, by the incessant dissolution of limits, we arrive at a more or less adequate idea of the infinity of space. But though compelled to think of space as unbounded, there is no mental necessity to compel us to think of it either as filled or as empty; whether it is filled or empty must be decided by experiment and observation. That it is not entirely void, the starry heavens declare, but the question still remains, are the stars themselves hung in vacuo? Are the vast regions which surround them, and across which their light is propagated, absolutely empty? A century ago the answer to this question would be, "No, for particles of light are incessantly shot through space." The reply of modern science is also negative, but on a somewhat different ground. It has the best possible reasons for rejecting the idea of luminiferous particles; but in support of the conclusion that the celestial spaces are occupied by matter, it is able to offer proofs almost as cogent as those which can be adduced for the existence of an atmosphere round the earth. Men's minds, indeed, rose to a conception of the celestial and universal atmosphere through the study of the terrestrial and local one. From the phenomena of sound as displayed in the air, they ascended to the phenomena of light, as displayed in the *ether;* which is the name given to the interstellar medium.

The notion of this medium must not be considered as a vague or fanciful conception on the part of scientific men. Of its reality most of them are as convinced as they are of the existence of the sun and moon. The luminiferous ether has definite mechanical properties. It is almost infinitely more attenuated than any known gas, but its properties are those of a solid rather than of a gas. It resembles jelly rather than air. A body thus constituted may have its boundaries; but, although the ether may not be co-extensive with space, we at all events know that it extends as far as the most distant visible stars. In fact it is the vehicle of their light, and without it they could not be seen. This all-pervading substance takes up their molecular tremors, and conveys them with inconceivable rapidity to our organs of vision. It is the transported shiver of bodies countless millions of miles distant which translates itself in human consciousness into the splendour of the firmament at night.

If the ether have a boundary, masses of ponderable matter might be conceived to exist beyond it, but they could emit no light. Beyond the ether dark suns might burn; there, under proper conditions, combustion might be carried on; fuel might consume unseen, and metals be heated to fusion in invisible fires. A body, moreover, once heated there, would continue for ever heated; a sun or planet once molten, would continue for ever molten. For, the loss of heat being simply the abstraction of molecular motion by the ether, where this medium is absent no cooling could occur. A sentient being, on approaching a heated body in this region, would be conscious of no augmentation of temperature. The gradations of warmth dependent on the laws of radiation would not exist, and actual contact would first reveal the heat of an extra ethereal sun.

Imagine a paddle-wheel placed in water and caused to rotate. From it as a centre waves would issue in all directions, and a wader as he approached the place of disturbance would be met by stronger and stronger waves. This gradual augmentation of the impressions made upon the wader's body is exactly analogous to the augmentation of light when we approach a luminous source. In the one case, however, the coarse common nerves of the body suffice; for the other we must have the finer optic nerve. But suppose the water withdrawn; the the action at a distance would then cease, and as far as the sense of touch is concerned, the wader would be first rendered conscious of the motion of the wheel by the actual blow of the paddles. The transference of motion from the paddles to the water is mechanically similar to the tranference of molecular motion from the heated body to the ether; and the propagation of waves through the liquid is mechanically similar to the propagation of light and radiant heat.

As far as our knowledge of space extends, we are to conceive it as the holder of the luminiferous ether, through which is interspersed, at enermous distances apart, the ponderous nuclei of the stars Associated with the star that most concerns us we have a group of dark planetary masses revolving at various distances round it, each again rotating on its own axis; and finally, associated with some of these planets we have dark bodies of minor note—the moons. Whether the other fixed stars have similar planetary companions or not is to us a matter of pure conjecture, which may or may not enter into our conception of the universe. But probably every thoughtful person believes, with regard to those distant suns, that there is in space something besides our system on which they shine.

Having thus obtained a general view of the present condition of space, and of the bodies contained in it, we may inquire whether things were so created at the beginning. Was space furnished at once, by the fiat of Omnipotence, with these burning orbs? To this question the man of science, if he confine himself within his own limits, will give no answer, though it must be remarked that in the formation of an opinion he has better materials to guide him than anybody else. He can clearly show, however, that the present state of things *may* be derivative. He can even assign reasons which render probable its derivative origin—that it was not originally what it now is. At all events, he can prove that out of common non-luminous matter this whole pomp of stars might have been evolved.

The law of gravitation enunciated by Newton is, that every particle of matter in the universe attracts every other particle with a force which diminishes as the square of the distance increases. Thus the sun and the earth mutually pull each other; thus the earth and the moon are kept in company; the force which holds every respective pair of masses together being the integrated force of their component parts. Under the operation of this force a stone falls to the ground and is warmed by the shock; under its operation meteors plunge into our atmosphere and rise to incandescence. Showers of such doubtless fall incessantly upon the sun. Acted on by this force, were it stopped in its orbit to-morrow, the earth would rush towards, and finally combine, with the sun. Heat would also be developed by this collision, and Mayer, Helmholtz, and Thompson have calculated its amount. It would equal that produced by the combustion of more than 5,000 worlds of solid coal, all this heat being generated at the instance of collision. In the attraction of gravity, therefore, acting upon non-luminous matter, we have a source of heat more powerful than could be derived from any terrestrial combustion. And were the matter of the universe cast in cold detached fragments into space, and there abandoned to the mutual gravitation of its own parts, the collision of the fragments would in the end produce the fires of the stars.

The action of gravity upon matter originally cold may, in fact, be the origin of *all* light and heat, and the proximate source of such other powers as are generated by light and heat. But we have now to inquire what is the light and what is the heat thus produced? This question has already been answered in a general way. Both light and heat are modes of motion. Two planets clash and come to rest; their motion, considered as masses, is destroyed, but it is really continued as a motion of their ultimate particles. It is this motion, taken up by the ether, and propagated through it with a velocity of 185,000 miles a second, that comes to us as the light and heat of suns and stars. The atoms of a hot body swing with inconceivable rapidity, but this power of vibration necessarily implies the operation of forces between the atoms themselves. It reveals to us that while they are held together by one force, they are kept asunder by another, their position at any moment depending on the equilibrium of attraction and repulsion. The atoms are virtually connected by elastic springs, which oppose at the same time their approach and their retreat, but which tolerate the vibration called heat. When two bodies drawn together by the force of gravity strike each other, the intensity of the ultimate vibration, or, in other words, the amount of heat generated is proportionable to the *vis viva* destroyed by the collision. The molecular motion once set up is instantly shared with the ether, and diffused by it throughout space.

We on the earth's surface live night and day in the midst of ethereal commotion. The medium is never still, the cloud canopy above us may be thick enough to shut out the light of the stars, but this canopy is itself a warm body, which radiates its motion through the ether. The earth also is warm, and sends its heat pulses incessantly forth. It is the waste of its molecular motion in space that chills the earth upon a clear night; it is the return of its motion from the clouds which prevents the earth's temperature on a cloudy night from falling so low. To the conception of space being filled, we must, therefore, add the conception of its being in a state of incessant tremor. The sources of vibration are the ponderable masses of the universe. Let us take a sample of these and examine it in detail. When we look to our planet we find it to be an aggregate of solids, liquids, and gases. When we look at any one of these, we generally find it composed of still more elementary parts. We learn, for example, that the water of our rivers is formed by the union, in definite proportions of two gases, oxygen and hydrogen. We know how to bring these constituents together, and to cause them to form water: we also know how to analyse the water, and recover from it its two constituents. So, likewise, as regards the solid proportions of the earth. Our chalk hills, for example, are formed by a combination of carbon, oxygen, and calcium. These are elements the union of which, in definite proportions, has resulted in the formation of chalk. The flints within the chalk we know to be a compound of oxygen and silicium, called silica; and our ordinary clay is, for the most part, formed by the union of silicium, oxygen, and the well-known light metal, aluminium. By far the greater portion of the earth's crust is compounded of the elementary substances mentioned in these few lines.

(*To be continued.*)

* By Professor TYNDALL.

SCIENTIFIC SOCIETIES.

SOCIETY OF ENGINEERS.

ON Tuesday week a party of Members and Associates of the Society of Engineers paid a visit of inspection to the Royal Arsenal, Woolwich, permission for which had been accorded by Colonel Campbell, R.A., the superintendent of the Gun Factories. The visitors numbered between sixty and seventy, and included Mr. Jabez Church, F.G.S., president of the society; Messrs. B. Latham, F. Colyer, G. Waller, members of council; Mr. A. Williams, honorary secretary and treasurer; Mr. P. F. Nursey, secretary; Messrs. Stephenson, Hurst, Gore, Rigg, Griffin, J. Church, Jun., Manwaring, Vallance, &c. They were received at the Gun Factories by Colonel Campbell, Captain Maitland, and Mr. Fraser, by whom they were conducted over the various departments of that establishment, the working details of which were fully explained. The first point of interest visited was the forging department, where, as also in the other shops, Colonel Campbell had made arrangements for illustrating the processes involved in the manufacture of the Woolwich guns. In the forge the visitors witnessed the coiling of a bar of iron 135ft. long, for a 10in., 18 ton gun. Under a steam hammer close by was a small coil for tubing a cast-iron gun on the Palliser principle, a number of these guns being in course of conversion from smooth-bored to rifled pieces. Near at hand was a 15 ton steam hammer pounding away at a trunnion coil for a 10in. gun, a muzzle coil being wrought at another hammer hard by. From the forge the visitors proceeded to the rolling mill, where the chief feature was the rolling of the 5in. bars from which the coils are made. The next process illustrated was the shrinking of a breach coil on the steel tube of a 10in. gun, the coil being brought up to a dull red heat, and lowered on the tube, within which a stream of water was playing, and upon which the coil shrinks in cooling. At this point were shown a number of 35 ton guns, in various stages of advancement toward completion. Ten of these 30 ton guns have already been finished, whilst a number more are in progress. The turneries, the boring department, the pattern room, were successively visited, and in each of which the various processes, carried on by the aid of some of the finest machinery in the world, were inspected with interest. Next came the shell foundry, where were seen Palliser projectiles in every stage of manufacture, from the moulding to the studding and finishing. The shells are lacquered inside with a resinous composition, to prevent rust, after which each shell is subjected to a hydraulic test of 100lb. per square inch. Here also were seen shrapnel shell of various sizes being made and filled. In another shop, submerged torpedoes of various kinds were being manufactured; and these included portions of the Whitehead torpedo, which, it is stated, has been made a success. The visitors were finally conducted over the laboratory, and witnessed the series of highly interesting processes connected with the manufacture of the service cartridges. Altogether a very instructive and pleasant afternoon was spent, which was rendered more agreeable by the courtesy of those in charge of the various departments, who afforded the visitors every information. A number of members concluded the day's proceedings by dining together at the Ship Hotel, Greenwich, in the evening.

A NEW drawing-room car on the Vandalia line has a cabinet organ and a handsome writing-desk for the accommodation of passengers.

CHEMICAL NOTES.

The Manufacture of Hydrofluoric Acid.—Mr. A. P. S. Stuart remarks that every one who has prepared hydrofluoric acid knows that sulphuric acid and fluor spar form an exceedingly hard, rock-like compound, and that it is very difficult to remove this from a platinum retort. The inconvenience may be avoided by mixing with the fluor spar about an equal weight of gypsum and the proper quantity of sulphuric acid. After the hydrofluoric acid has been expelled by heat, the mass in the retort is found to be of a pasty nature, and is easily removed by water.

Caustic Soda. — A new method of preparing caustic soda is given by M. Tessie du Motay, in *Les Mondes*. One equivalent of sulphuret of sodium is mixed and fused with one equivalent each of caustic soda, hydrate of lime, and metallic iron (cast or malleable); when these substances are heated to redness, the sulphuret of sodium is completely converted into caustic soda, and sulphuret of iron formed. M. du Motay considers that the water of the hydrate of soda or lime is decomposed by the iron, which, becoming oxidised, hydrogen is set free, oxide of sodium formed, and then sulphuret of iron; the soda being separated from the last-named substance by lixiviation with water. In another process the sulphuret of sodium is first converted into a basic phosphate of soda, and then into caustic soda by means of caustic lime.

Scarlet Dye for Wool and Silk.—Jegel proposes the following method of dyeing wool and silk scarlet by the simultaneous action of magenta and dinitronaphthol or naphthaline yellow. The less magenta is employed the better. The method is to heat a dilute aqueous solution of naphthaline yellow to near boiling, add so much magenta as amounts to two per cent. of the naphthaline yellow, and then dye. The dye liquor must not be mixed when cold. If this is done, all the magenta is thrown down in an amorphous flocculent state. If this has taken place, the subsequent application of a boiling temperature does not remedy the mischief, since a part only of the magenta thus precipitated is redissolved, the rest melting together into a greenish golden mass. In this state, the liquid is quite unfit for dyeing, and even if filtered gives no good shades.

Pure Indigotine.—According to M. Mehu, carbolic acid, with the aid of heat, has the power of readily dissolving indigo blue. On cooling, the greater portion is deposited in a crystalline state. The cold solution has an intense purple blue colour. In order to prevent the carbolic acid from congealing as it cools, a little alcohol may be added, which causes the greater part of the colour to be deposited. Instead of alcohol, camphor may be used to the extent of one-fifteenth, or benzine. By using 500 grammes of carbolic acid, we can obtain two grammes of pure indigo blue (indigotine) in crystals which, under the microscope, appear remarkably regular. Mehu employs indigo which has been previously washed, first with water, then with very dilute hydrochloric acid, and then repeatedly extracted with boiling alcohol.

Anthracene. — This hydrocarbon, under the name of "green grease," is sometimes sold as axle grease. It is found among the last products of the distillation of coal-tar, which consist, says Professor Phin, of a heavy oil, some naphthaline, and about 20 per cent. of anthracene. In the whole, the amount of anthracene in coal-tar is only from ½ to 1 per cent. In order to separate the oily products from the solid hydrocarbons, the soft mass is introduced into a centrifugal machine; the residue left is heated to about 110° F., and subjected to the action of an hydraulic press. If the crude material is thin, it is best to employ at once a filter press. The resulting mass, which contains about 60 per cent. of anthracene, is exhausted with benzole or gasoline, again subjected to the centrifugal machine, in order to separate the last portions from the light oils. There remains a greenish-white, paraffin-like mass, of a beautiful crystalline fracture, containing 95 per cent. of anthracene, from which, by sublimation, a perfectly pure product having a melting-point of 420° F. can be obtained. The anthracene may be conveniently obtained pure, if by means of a blower a strong current of air is directed into the retort while the anthracene is at the boiling-point.

Novel Railway Signal.—It is stated that a new danger signal has just been put in operation on a Massachusetts railroad. The signal consists of a globe made of sections of red, green, and white glass, upon which figures from one to fifteen are plainly marked, each figure denoting a minute. The signal is operated by the train, and moves back to the zero point when the locomotive goes by, and begins to revolve when the last car passes. It then begins to move like a clock, and the figures, which are visible through a single opening in the outside covering of the glass, denote the time that has elapsed since the passage of the train. The figures can be readily seen in day-time, and at night the glass is illuminated by a light placed inside the globe. In this way the engineer of a rear train can ascertain the time that has elapsed since the passage of the forward train.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

A MICROSCOPE AS AN EYEPIECE—TELESCOPE FOR STAR-GAZING—MEMOIRS OF THE ROYAL ASTRONOMICAL SOCIETY — FINDING THE MERIDIAN—HEAT OF MARS—AXIS OF VENUS — SUN SPOTS — AND TESTS FOR A 3⅜IN. REFRACTOR.

[4491.]—THE first part of the query (12274) of "Betsy Summercity," on p. 392, involves the assumption that the image formed by a Foucault speculum will not bear "magnification." What may be the precise signification attached to this word by "Betsy" it is not very easy to see, since the definition of one of Browning's reflectors is sensibly perfect with a power of 70 to every inch of aperture, and, under favourable circumstances, with greater amplification still. As for my querist's idea of substituting a Powell and Lealand microscope, with an object-glass of high power, for the ordinary Huyghenian eyepiece, a very few instants' reflection will suffice to show why that must fail. In the first place, let the original image formed in the focus of the large speculum be ever so perfect, the rays from it must pass through some eight or nine lenses before they reach the eye at all; and here we have source number one of indistinctness. In the next place, Powell's $\frac{1}{25}$ in. has an angular aperture of 160° (not a very low angle), and, what is more to our present purpose, gives a linear magnifying power with their No. 1 eyepiece of 1250, and with their No. 5 of 7500 diameters! If "Betsy Summercity," then, will remember that the light from her typical object, the moon, degrades, *not* directly in proportion to the increase in magnifying power, but *as its square*, she will see at once why the moon's image *must* become so exceedingly faint as hopelessly to counteract any possible advantage derivable from its enlargement. "Betsy" must be quite familiar with the sensible decrease in the moon's apparent brightness under a power of 200 linear, and she may thence form some conception as to the excessive dimness of the image when amplified 7500 times linear. A very simple arithmetical calculation will show her that $\left(\frac{7500}{200}\right)^2 =$ 1406·5, so that with the higher powers the light of the moon would only have $\frac{1}{1407}$th of the brilliancy that it would possess with the lower one. After this it is almost needless to notice another source of indistinctness, the magnification of the atmosphere itself.

In answer to "B." (query 12287, p. 392), I would say that, should he have decided on the purchase of a reflector, I would by all means recommend him to obtain one of Browning's Educational ones in preference to his smaller one of the same aperture. The "Educational" possesses several advantages: among others its increased length of focus, which, of course leaves less of the magnifying to be performed by the eyepieces; and also its mode of mounting, which is, in effect, equatorial, and enables the observer to follow a star by simply turning one handle. A 4½in. reflector is, of course, theoretically superior to a 3in. achromatic, both in light grasping and (considerably) in separating power. I must, however, tell "B." (and others) that he must not expect to get the same exquisite disc on a fixed star with *any* reflector that he would obtain with a good achromatic, albeit in the former the image would be smaller. Although having reference to a different subject, I may, perhaps, as well answer the second part of "B.'s" query here, and say that the "Memoirs of the Royal Astronomical Society" are published by Messrs. Williams and Norgate, 14, Henrietta-street, Covent Garden, London; and that while, doubtless, some odd volumes are still procurable, I question extremely if he will be able to obtain either Vols. I., II., or the first part of Vol. III. separate from a set.

If "Youngster" (query 12300, p. 393) will turn to p. 648 of Vol. X. of the ENGLISH MECHANIC, he will find a description, illustrated by a diagram, of the simplest mode with which I am acquainted of obtaining the meridian of any given place.

Who, if it be not a rude question, told Mr. Johnson (reply 12164, p. 390) that the heat of Mars "to ordinary animals would be destruction"?

Let me assure Mr. Proctor (let. 4449, p. 406) that I by no means employed the word "imagined," to which he takes exception, in the sense of merely fancying or inventing. All I intended to convey was that De Vico *supposed* from his observations that the axis of Venus was inclined 53° 11′ 26″ from a perpendicular to its orbit. Mr. Proctor will scarcely contend that he *demonstrated* it to be so. Every observer who reads these lines knows perfectly what an excessively difficult object Venus is, and I should certainly regard any alleged determination of the precise inclination of her axis as one to be received with very great caution. I must plead guilty to not having consulted Webb before penning my reply on p. 380; but Mr. Proctor's letter having induced me to refer to that invaluable book "Celestial Objects for Common Telescopes," I find its author saying in a footnote on p. 50: "But De Vico's style wants explicitness, and there are strange traces of inexperience or inattention in the Jesuit College, rendering the memoirs of that date less satisfactory than those of the present Director, Secchi, a man of a very different mould."

Might I venture to refer "A." (let. 4453, p. 406) to Mr. Proctor's "Sun" (a second edition of which has just been published by Longmans and Co.) for a little necessary rudimentary information?

I have much pleasure in responding to the request of Mr. Durrad (let. 4474, p. 411) for some star tests for his 3⅜in. object-glass; and would advise him to examine π Aquilæ, λ Ophiuchi, 73 Ophiuchi, Struve 2403 Draconis, Struve 2878 Pegasi, 20 Pegasi, and 36 Andromedæ, all of which are now conveniently situated for observation. He ought also to elongate or distort ζ Boötis, and ε Equulei.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

SOUND (OR UNSOUND) THEORY.

[4492.]—INVERTING, perhaps, the proper course of proceeding, and beginning my notice of letter 4416, p. 382, by reference to the postscript at the end of it, I really must beg "The Harmonious Blacksmith" to accept my most earnest assurance that I had no intention whatever, proximate or remote, of "chaffing" him, in what I wrote concerning his suggested fiddle. As he is good enough to speak in too flattering terms of my scientific acquirements, I will, if it will afford him the slightest gratification, say that I think it very possible that my acquaintance with astronomy, both observational and mathematical, as also my knowledge of geology and optics, may a little exceed his; but, having made this most handsome concession, I must ask him to be equally candid, and to admit that I am only speaking the bald literal truth when I say that, while I know a little of theoretical acoustics, I am simply not worthy to hold a candle for him to examine the internal structure of any one of those musical instruments of which he has such a profound practical knowledge.

Having thus I trust, once for all, set myself right in this matter, I will say, in reply to "The Harmonious Blacksmith's" question, that I should, decidedly object to a corrugated soundboard *at all*. A soundboard, as it seems to me, cannot be too elastic, and it is an elementary fact in applied mechanics that corrugation is employed to give increased rigidity to the material which is so treated. As Tyndall points out with reference to any imperfectly elastic wood, I should expect a corrugated soundboard to use up the greater part of the vibration communicated to it in the friction of its own molecules, and so to convert the motion, not into *sound*, but into *heat*. Theory I imagine to be wholly opposed to this form of construction.

And, while on the subject of musical instruments, I am tempted to advert to a passage in the letter (4421, p. 382) of "Suffolk Amateur." I refer to that in which he appears in doubt whether the diagram of "The Harmonious Blacksmith's" funny fiddle on p. 254 represents "a section of a box or body," or "a series of six open soundboards, connected by a jointed sound-post?" With reference to this I would remark that all my own notions of the possible effect of the combined violin and violoncello were formed on the supposition that the sketch in question really did represent "a section of a box or body." Assuming it to be intended for an elevation or perspective view of the proposed instrument, and that such instrument is only meant to consist of an open framework, such as is shown in the engraving, I must certainly modify my original expression of opinion as to its probable effect, and say that, under such conditions, I should expect a listener to repeat with reference to its tone what ladies say when they cry—"This is indeed weakness."

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE BEARING REIN.

[4493.]—I AM very glad to notice the letter (4434) of "Old Ploughman," on p. 384, with reference to that wholly needless piece of brutality, the bearing-rein. The excuse which we sometimes hear urged for it, that it makes a horse hold up his head and display himself, is a wholly fallacious one. Any man, with moderately decent hands, can do this by judicious use of the reins, without torturing the animal at all. Moreover, the bearing-rein is not only cruel, but it is dangerous, for, in the first place, a horse cannot use his eyes properly with his chin rigidly reined in; and in the next should he make a mistake going down hill, he is already as tightly borne up as he can be, in all probability comes down "all of a heap," and is not unlikely to bring his companion down with him. This last consideration may possibly operate with some who would regard the mere pain to which their animals may be subjected with tolerably equanimity.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

[4494.]—BEING a veterinary surgeon, I can claim some knowledge of the suffering to which that noble animal the horse is subjected by the use of the bearing rein. I have long desired to publish a touching protest on this subject, and shall be glad to receive any communication from the humane and praiseworthy "Ploughman."

Liverpool. J. T. LITTLE, M.R.C.V.S.

A GIANT PLANET.

[4495.]—THE objections raised against my views on the subject of Jupiter's condition, and against views which, though attributed to me, are not mine, seem based on a careful avoidance of all that I have written on the subject. I fear that, after all, I may have done "Hyrab Seen" injustice.

"L.'s" letter (4448, p. 405) is particularly open to this objection. (Of course I cannot object to his not reading what I have written, only such reading seems a desirable preliminary before objections are urged against what I have written).

"L." seems also to have misread the remarks of Webb and De La Rue on Jupiter's gibbosity in quadrature. Neither of these observers have recognised the phase in Arago's sense. Webb says that he has recognised and recorded "the *approach* of the gibbous form in a slight shade along the limb furthest from the sun." This darkening is perfectly obvious to observation in Jupiter's case, and with good telescopes in Saturn's. It is indicated in the frontispiece of my "Saturn and its System," the views in which (as stated in the preface) are shaded in accordance with mathematical calculations. But it is actually dwelt upon in the paper "L." is supposed to be criticising, in these words—"We would not insist too strongly on this inference" (namely, that Jupiter's inherent luminosity adds only to the brightness of the central parts of his disc), "because the darkening due to oblique incidence is, under certain circumstances, very obvious to direct observation." The parenthesis thrown in shows that "L.'s" reasoning, based on a mistake as to Webb's meaning, is applied to a mistaken view of a theory which he mistakenly supposes me to entertain. For I have distinctly said of Jupiter, in the very paper in question (as well as elsewhere), that he "does not possess any large degree of inherent lustre." (This refers, of course, not to the lustre of his real surface, but to his lustre as seen from without.)

"L.'s" remark about Mr. Browning's recognition of the orange belt is based on an insufficient examination of Mr. Browning's words. Moreover, so far as my remembrance extends, the Greenwich reports (as worded) imply *not* that the orange colour has been constantly observed, but that it has never been noticed at Greenwich. Mr. Lassell, who is an independent authority of the highest standing, has acknowledged that there has been a change.

"For my own part," adds "L." (*apropos des bottes*, apparently), "I see no reason why we should not allow that planets have atmospheres differing from our own in such a way that the heat and light rays of our sun are so mollified or intensified as to make Mercury and Venus as habitable as Uranus and Neptune for beings adapted to their respective situations." Neither do *I* see why we should not *allow* any theory whatever, provided we are too idle to examine the evidence for or against it. We might allow, for example, that the readers of the ENGLISH MECHANIC are eager to know what this or that correspondent for his own part sees no reason for not allowing; but practical experience shows that those readers care much more for reasoning than for mere statements of opinion.

Mr. J. W. Durrad (let. 4474, p. 411) will find how far my theory about Jupiter's internal heat agrees with the invisibility of the satellites in Jupiter's shadow, and how the comparative darkness of the satellites and their shadows in transit is adduced in its support, by reading what I have written on these respective points.

"E. L. G.'s" letter (4447)—full of excellent matter—would be more to the purpose if it were not based on "Hyrab Seen's" very singular presentation of my views. "E. L. G." bases a part of his reasoning on the supposition that the planet's total light is "three or four times" his possible reflection. This is not the case, or near it. Jupiter's light is three or four times that which he would give if his general reflective power were equal to that of Mars or the moon. Mars gives back something over ·2 of the light received, the moon something considerably short of this. Jupiter gives out something over ·6 of the light he receives. As stated in my article, Jupiter does not shine quite as brightly as if his whole globe were of snow or ordinary terrestrial cloud. And (also as there stated) if he were white and pretty uniform in lustre, there would be no occasion to believe in inherent luminosity at all; though there would be abundant reason for believing his real orb to be red-hot or even white-hot. My whole reasoning is based on his actual aspect—his belts, their behaviour colour and so on; on observed facts, not on assumptions of any sort. Moreover my theory does not go nearly so far as those who have hitherto dealt with my article seem to opine.

"E. L. G.'s" remark about comparative luminosity of red-hot or white-hot iron and sun-illumined white objects, seems incomplete. He says "this admits of easy proof," but he does not state the results of experiment. Now, there is an easier method of testing the matter than his. Let full sunlight be admitted through a tube into an otherwise dark chamber, and within that tube let a piece of white card be inclined at such an angle to the sun's rays that its illumination is one-twenty-seventh of what it would be if the card were square to those rays, and let that card be viewed through a tube by one eye. Let the other eye be directed through a similar tube upon a piece of red-hot iron. Under these circumstances we are comparing the illumination of a white object on Jupiter with the light of red-hot iron; and any of your readers who may try the experiment (as I have done) will hesitate greatly, I conceive, to affirm that the former is *many* times greater than the latter: But let them remember that the comparison is not with a white object so illuminated, but with an object reflecting about one-third of the light of a white object like paper or snow, and let them further remember that a large part of Jupiter's light-reflecting surface is presumably cloud covered, and reflects white light, and they will see that I have not theorised very wildly in putting forward as a probability the suggestion that the small balance unaccounted for is due to Jupiter's inherent luminosity. Then let them remember that I derive only a subsidiary argument from Jupiter's luminosity—that I adduce a complete array of other facts, not one of which has been questioned, and finally, that my theory is a very moderate one, having nothing to do with the question of Jupiter's inherent luminosity (viewed from without), with the habitability of his satellites, or like points,—being, in fact, simply this, that the movements in the Jovian atmosphere are mainly due to his own intense heat.

RICHARD A. PROCTOR.

THE ANCIENT CONSTELLATIONS.

[4496.]—I HAVE not time to discuss this subject (let. 4478, p. 411), but am glad my remark has called forth "E. L. G.'s" very interesting letter. I *do*, however, mean to say, and that with some degree of confidence, that the stars of the Argo region suggest in the most striking manner the figure of the poop of a ship—not of one of our modern ships, but rather like the stern of an ancient galley or of a large and well curved canoe. Our modern maps mar the resemblance, but taking the stars as they are, and without regarding the modern constellation boundaries, we have an unmistakeable half-ship. The principle on which the ancient constellations seem to have been formed is described in the introduction to my large star-atlas. If the description were shorter I should quote it as it stands.

The streams of stars from the water-jar of Aquarius are too obvious (as seen in suitable latitudes) to escape recognition. One such feature would suffice to suggest the whole figure, but the jar also is well marked.

I am surprised "E. L. G." does not make any reference to Aratus. There is much in Aratus which, taken in conjunction with the evident signs that he borrowed from a much earlier authority, serves to throw a most interesting light on the ancient constellations.

I have been rebuked by that unquestionable authority the *Saturday Review* for attaching any degree of weight to Bryant's "Analysis of Mythology," in the paper on Achilles' shield and its astronomical interpretation, which closes my "Light Science for Leisure Hours." I fear I am not convinced, and share a good deal of "E. L. G.'s" respect for some part at least of Bryant's labours.

Hydra coincided with the Celestial Equator in old times, and all the fish constellations except the Dolphin were originally south of the equator, only half the northernmost of the pair of Fishes being north of the equator. Corvus, the Crow, is I think, very clearly pictured in the stars forming the constellations. Our map-makers, who have turned Ara upside down (so that the Centaur is carefully applying his sacrifice to the bottom of the altar!), have also inverted Corvus.

RICHARD A. PROCTOR.

HOW THE TREBLES OF ORDINARY COTTAGE PIANOS MAY BE CHEAPLY IMPROVED, WITH SOME REMARKS ON METAL BRIDGES, STUDS, AND WREST-PLANKS.

[4497.]—I ONCE thought my three rather lengthy articles on the possible improvement of good sound old pianos, together with several others, printed from time to time, containing further suggestions, must have well nigh expressed all I could have to say on this subject, but it is the unhappy characteristic of my mind that it can't avoid the annoyance of being taught by further experience. So thoughts involuntarily crop up which occasionally appear to my, perhaps, partial judgment to be worth communicating, one of the evil effects of which is that I now proceed to bore my fellow readers again.

In most cottage and other upright pianos which have been and are now being made by good manufacturers, but little other defects exist than those which result from the employment of the inferior common action without an effective check for the hammer, and want of power and purity in their treble sounds.. How to remedy the former I have before shown at considerable length, so I now proceed to suggest cheap methods of enabling the treble to be rendered sufficiently powerful to compete with the bass and tenor, usually the best parts of ordinary pianofortes.

In most of such instruments the only method employed for determining the length of the vibrating portion of a string is to cause it to bear sideways against a wire pin driven into what is improperly termed the bridge, which is a mere fillet glued on the wrest-plank, because it is cheaper and more convenient to do this than to rebate the wrest-plank below, and incline its surface backward above where the string rests. For keeping the string from chattering on the surfaces on which it is supported, it is usually deflected in two directions—viz., downward and sideways, the said deflections being technically termed its side and down bearings.

A very little consideration will enable us to perceive the defects of this method of supporting and stopping the vibrations of strings. The pins—which are their real bridges—are, for preventing the strings from slipping off, inclined more or less (the less the better, so that they be not quite upright). It necessarily follows that the tendency of the hammer's blow must be to drive the strings into the wood and away from the pin. This, although of little or no importance when the hammer strikes the string from one and a half to two inches away from the pin, becomes a very great defect when its blow is delivered from an inch to less than a quarter of an inch from the pin, for it disturbs the string's connection with the latter to an extent sufficient considerably to deteriorate the clearness of the sounds produced. The less acute the angle formed by that portion of the string above the bridge-pin the less can the hammer's blow disturb the string's adhesion to the pin, simply because the more the string is deflected the harder it must press against and resist momentary separation from the pin. This fact was and is very well known to all practical pianoforte-makers, and as, *cæteris paribus*, the firmer the connection of the string with its pin or other support the clearer and purer will be the sounds obtained by its vibrations, we need not much wonder that—until bridges of a more scientific character than thin wire pins, against which the strings can only bear sideways, were introduced—pianoforte-makers went on unmercifully increasing the side bearings of thin strings (in other words, increasing the angle at which strings were deflected, too often without proportionally increasing the thickness of their pins) until they were estopped by the poor strings being broken at the bridge-pins.

This is no imaginary statement. Well I remember that the breaking of strings from this cause very often occurred in instruments, especially so in some cottage pianos and in the grands made by the late Mr. Zeiter from thirty-five to fifteen years ago. Probably the inferiority of the wire might have had something to do with it, for (although much better than the old German iron—certainly not steel—wire it superseded) our English steel music-wire of a quarter of a century ago was far inferior in tenacity to that now commonly produced. As it was the bending of the wire more sharply than it could bear, and not at all its subjection to excessive tension, which caused it to break, the natural and cheapest possible remedy is to substitute thicker bridge-pins—yes, even as thick as ordinary key pins, which must needs support the strings more firmly than thin pins can; and, to prevent the possibility of the strings chattering against the pin below its centre, after driving it into the wood, to file a flat surface extending up to its centre as shown in Fig. 1.

For bichord notes it would be a yet further improvement, at an inconsiderable increase of cost, to employ bridge-pins about two-tenths of an inch in diameter—more properly designated studs for single strings—whose top surfaces are filed in the manner shown by Fig. 3. Such pins or studs support the string not only sideways, but also underneath, instead of allowing it to rest on the wood of the so-called bridge. Such a pin forms a true stud or metal bridge, two things which differ only in length, for a metal bridge may be regarded as many studs united. The underneath and upper portions of the top surface of the stud or pin (Figs. 3 and 4) must, of course, be filed away before it is driven into the wrest-plank, but I prefer to file that portion on which the string rests or bears downward after driving; of course, no so-called wooden bridge can be required for either this or any other of these studs.

Considering that the sounds we obtain from the vibrations of pianoforte strings must (*cæteris paribus*) increase in clearness the more firmly they are supported on their wrest-plank bridges, it need not surprise us much that even without any consideration of the great facilities metal wrest-planks afford for bracing, they came into use at a comparatively early period, the earliest, I remember, being that patented by Schweiso, A.D. 1831, although I have a strong recollection that the invention is of yet earlier date. For horizontal grand pianos, whose strings are above their wrest-planks, metal wrest-planks are far preferable to those of wood, because not only is metal (say cast iron) much less liable than wood to be put into vibration so as to affect the timbre of the sounds, but, what is yet more important, a metal wrest-plank may be made sufficiently rigid if only one-third the thickness of a wooden one near where the hammers strike the strings. This allows the heads of the hammers to be reduced in length above their shanks to any extent which will afford space for attaching their felt coverings, and the shorter the hammer-head be made the less it can vibrate sideways on a given length of centre wire when it works or [illegible] equally free. A [illegible] and yet greater adv[illegible] from that [illegible] the wrest-plank [illegible] be[illegible] being thin—[illegible] of thick, which [illegible] the hammer [illegible] within abo[illegible] near as th[illegible] actions. [illegible] tance of perpendicularly (see No. 853, &c.) it is quite needless to repeat why it conduces to the production of sounds which are at once more powerful and of finer quality.

Metal wrest-planks, however desirable for horizontal grand pianos, are hardly worth their additional cost, which is considerable, for upright instruments whose "backs" are constructed in the ordinary way. The wrest-planks of such instruments, being behind their strings, may be made of any required thickness without being in the way of either their hammer-shanks or hammer-centres. Consequently, the latter may be as near their strings as the needful strength of the material of their butts and the avoidance of any risk of their strings touching the latter, when vibrating, allows. In the high treble, whose strings when vibrating do not, perhaps, move one-hundredth of an inch, the hammer-centres may be within two-tenths of an inch of the strings, but probably no human ears are "long" enough—however asinine their owners may be—to distinguish any difference in the timbre of the sounds produced when that distance is increased to eight-tenths of an inch.

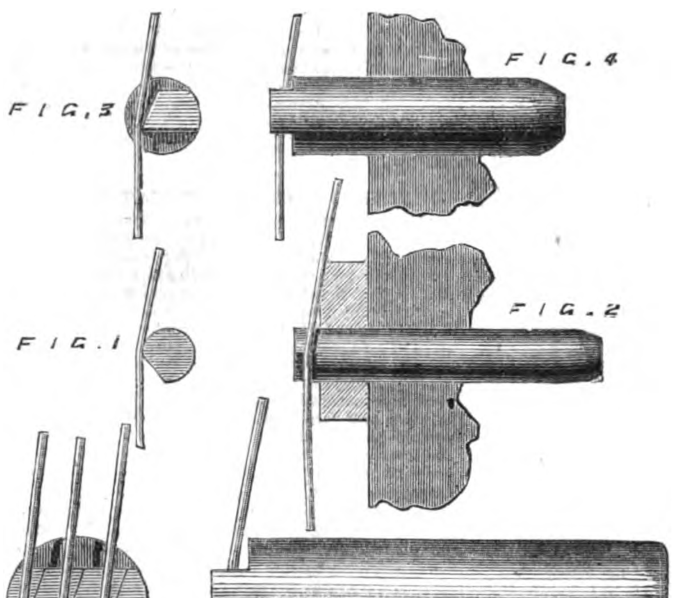
For the purpose of obtaining a sufficiently firm support for the strings of upright pianos whose actions are in front of their strings, several contrivances have been resorted to. A very common one is the imbedded wire bridge (fully described in the second part of my article on the bracing and bellying of cottage pianos, printed in No. 378, p. 358), which, by the way, is seldom so well carried out as I therein advised. Besides this wire bridge, solid continuous bridges of metal, of glass, and of stone ware or porcelain, have been employed, all of which, I believe, have been found to answer very well when properly bedded and firmly secured to the wrest-plank. However applicable these contrivances may be to new instruments in the course of construction, they are, however—unless thick pins or some analogous contrivance for guiding the strings be employed—not conveniently applicable to pianofortes originally made with common pinned wrest-plank bridges whose strings are deflected sideways. A continuous cast metal bridge might indeed be grooved or notched so as to keep the strings in their proper positions, although it would be difficult to do this to an imbedded wire. Examples of such notching may be seen in the treble brass bridges of some old square pianos, especially in those made by Messrs. W. Rolfe and Sons about twenty years ago, but after all I greatly doubt if this would afford any improvement in the trebles of upright pianos which could not be obtained by the use of such studs as those represented by Figs. 3, 4, 5, 6, and 7, none of which are very expensive to construct, and all of which are far easier for an amateur to fix than any continuous metal bridge I have seen.

I have made studs like those represented by Figs. 3 and 4 out of thick brass wire; those represented by Figs. 5 and 6 may be made of cast copper or brass rods which are kept in stock at most mechanical tool shops in the locality of Clerkenwell. I have found it cheaper, however, to use Fig. 7, which may be cast from a wooden, or, preferably, a metal pattern. Fig. 7 resembles an ordinary grand pianoforte stud, excepting that—for upright pianos—it don't need to have holes drilled in it. If made seven-sixteenths of an inch diameter, it may be grooved or notched for four strings, but as few pianofortes have more than three, even in their high trebles, it need not be more than ⅜in. full diameter. Fig. 7 need not have a screw cut on its shank because it is intended to be driven into the wrest plank; its head is, however, from ⅜in. to ½in. thick, which is greatly in excess of the thickness of the collar of a grand pianoforte stud; of course, this additional mass of metal affords a yet more firm support to the strings which bear downwards on it, and enables them to resist the blow of the hammer far better. Personally, I much prefer such studs as those represented by Figs. 5, 6, and 7, to those represented by Figs. 3 and 4, but the latter might be easier for amateurs to construct and apply, because the only thing necessary would be to extract the old bridge-pins, bore out their holes, and drive in either Figs. 2 or 4, supposing it be not intended to alter the scale, which amateurs who are not accustomed to marking off might find to be a difficulty to them. Supposing the amateur to possess sufficient ability to make a good pattern of Fig. 7, but little difficulty would be found in preparing the castings for use. If fine castings, moulded (or at least poured) with their faces downwards (which they ought to be, for obtaining a perfect and solid face for the strings to bear on), the notches which confine the strings might be cast in ready to receive them, and but very little trimming or dressing of the castings would be needful. Were such studs to come into general use —and I don't think anything much better will soon be contrived—I believe they could be manufactured and sold with profit for eighteenpence per dozen.

After what I have written on scales—*i.e.*, the lengths, &c., of pianoforte strings—in Nos. 372, 376, and other numbers of English Mechanic, I need hardly say that most existing cottage pianos would be greatly improved by the substitution of longer, if not thicker, strings in the treble. To effect this with such bridge-pins as those represented by Figs. 1 and 2, it is needful to remove the wooden bridge, and, after plugging the bridge-pin holes with hard wood, substituting a new one. This, although easily done in the workshop, would, I fear, be a difficult job for an amateur to do satisfactorily, unless he were an expert worker in wood, and well provided with tools. It is one of the advantages of using thicker pins without altering the scale that any person of ordinary ability can extract the original bridge-pins, enlarge their holes, and drive in new ones. Should, however, it be determined to lengthen the scale, without which no great improvement can be hoped for, I can't conceive any method of doing this which is more within amateur ability than taking off the old wooden bridge —or rather so much of its length as supports the strings of those notes whose length it is determined to increase—marking the places of, and boring the holes for, studs like those represented by Figs. 3 and 4—or yet better, such as those represented by Figs. 5, 6, and 7—and driving them into the wrest-plank. Being very "unpractical," I proceed to describe how I do it, and perhaps some of my practical (?) readers will be kind enough to describe better methods of effecting it if they can.

Having removed the old bridge or such portion thereof as may be needful, scraped, and fine glass-papered, the surface of the wrest-plank, I mark thereon the positions of the holes for the studs. As marking off correctly don't invariably compel correct boring, I take a bradawl about one-tenth of an inch diameter, and having previously ground its end into a conical point about ½in. long, I "prick" the plank to the depth of about ⅜in. After pricking all the holes I proceed to bore them with a small common centre-bit, which makes a hole about one-twentieth of an inch less diameter than the stud to be inserted, afterwards finishing each hole to its correct size with a spoon bit. A small brace is preferable to a large one for this kind of work. For such studs as those shown by Fig. 7, a pin bit—literally a pin drill properly formed for cutting wood—whose pin, about ⅜in. long, accurately fits the hole bored out to size by the spoon bit—is employed to enlarge its upper part to fit the thickest portion of the stud. Of course a guard collar is used to prevent the recesses which receive the heads or the enlarged portions of the studs being bored to unequal depths, and, before driving in the studs, don't forget to varnish the newly-scraped surface of the wrest-plank. It is also prudent to anoint each stud with a semi-fluid cement composed of white lead ground in oil, whiting, and a little oil gold size, which in a few days becomes much harder than the beech or other wood employed for wrest-planks, just as the steam boiler maker's "Beaumantique," which he employs to stop leaks, becomes, as he said, "stronger than any iron, sir," which, by the way, I take the liberty of doubting. Now, my "Beaumantique" saves a good deal of mere detail work, such as facing the shoulders and turning the sides of the heads of the studs to gauge in the lathe, for even if the stud's head be a trifle too small to fill the recess, my "Beaumantique" not only fills in the trifling empty spaces between the heads of the studs and the walls of the recesses, but also insures that the shoulders of the studs shall have firm solid beddings, which is of great importance if the head of the stud be made as thin as it usually is for grand pianofortes, but less so if it be from ⅜in. to ½in. thick, for then its great mass affords the strings a sufficiently solid support.

As it is desirable, if only for the look of the thing, that the holes which receive the studs shall be upright, I may as well describe a simple method by which I applied the automatic guide principle—so almost universally now carried out in mechanical operations—for insuring the verticality of those holes.



A hole about three-sixteenths of an inch in diameter was bored in a piece of hard wood about 2in. thick. A wire which fitted the hole, and had previously been carefully straightened, was introduced and tried in three directions by the square, a slip of wood being planed exactly to the thickness required to fill the space between the blade of the square and the wire at the place of greatest departure. The wire was then turned half round in the hole, and the square applied in the same three directions as before. The deviations being almost exactly alike, proved the wire to be very nearly straight, for they did not differ the twentieth part of an inch in 6in., an amount which could not cause any sensible deviation from verticality in a hole only 1in. deep. The wood was planed until its surface was at a right angle to the wire, and then gauged to uniform thickness. Of course, the hole was then perpendicular (instead of "slantendicular") to both its surfaces; and to insure that the holes in the wrest-plank should not be "slantendicular," I put the point of the same spoon-bit, with which the hole in this wooden guide-block was bored, through it, and into the "pricked" hole in the wrest-plank. The guide-block was at first clamped firmly down on the wrest-plank, and it guided the spoon-bit so perfectly that all the stud-holes bored in it were upright, but after some trials I found the use of the screw-clamp quite unnecessary; for when this guide-block was held down firmly by an assistant, and the spoon-bit rotated by a bow, instead of the small brace, it acted equally well, producing a bore which was quite an upright character, indeed, "the correct thing;" thus much time was saved.

It necessarily follows that if the supports of the strings be at a greater distance above the hammers' heads, the latter must be raised—at least in the treble—to enable them to strike the strings near enough to their bridges (studs are but short bridges) to produce clear sounds of pleasing quality. Although it is often better not to raise the hammers in the neighbourhood of middle C, and even several notes above it (provided the new longer strings be also considerably thicker than the original ones), this seems to be a *sine quâ non* in the treble. I think the cheapest way of doing it is to cut off the old hammers, bore out both them and their butts—if bored somewhat larger than before so that thicker shanks may be inserted, all the better—and to substitute new shanks of sufficient length to raise the hammer-heads high enough to cause them to strike at the (supposed) proper distance below the bridge or stud. This alteration is very easily effected in the workshop in which drilling-lathes and other proper tools abound, but is hardly a suitable job for the amateur, who seldom possesses them in abundance, and as it could be done for a merely trifling cost by any small work maker, I should not recommend amateurs to attempt it themselves.

While about it I may remark that it would seldom be required to alter the lengths of more than about three dozen hammers. As the production of sounds of greater power and finer quality depend so very greatly on the quality of hammers, which are seldom first-rate, even in what are termed good instruments; also that in most instances this job would be done to a piano which had been, more or less, used and worn; I would suggest that instead of using the old treble hammers, which ordinarily become much more worn by a few years' use than those in the tenor and bass, it would be real economy to incur the trifling additional cost of substituting new hammers of the very best quality for the old ones. I should certainly do this myself, being of opinion it is a much better "investment" (in the "line" of life assurance) to be hanged for a sheep than for a lamb. Being also one of that numerous sect who are followers of the celebrated "Josephus Grumbeltonius," in other words a—with common things in general, and especially with common pianoforte actions—very dissatisfied fellow, I "kalkalate" I should be strongly tempted to substitute one of the actions represented by Figs. 1 and 2 on page 95 of ENGLISH MECHANIC, No. 368. This, again, however desirable, would hardly be work for amateurs, but may I not be allowed to ask, why not have it done, if not by yet for us, *secundem artem*, by a professional pianoforte-maker for a reasonable monetary consideration? assuming any such professional can be found whose pecuniary charges are "reasonable," which may be doubtful. Of course, however, we must expect to pay pretty dearly for our "fads," &c., which often give much trouble to workmen.

DESCRIPTION OF THE FIGURES.

N.B.—All these figures are drawn about double the real size for facilitating the exhibiting of details, and the top surfaces are left unshaded for the same reason.

Figs. 1 and 2 represent the section of an ordinary wooden wrest-plank bridge *in situ* with a pin about 1/8in. diameter inserted, having a flat filed on its surface, so that the string cannot possible touch and jar against it below its centre. N.B.—The string is shown in Fig. 1 deflected sideways, in Fig. 2 deflected downwards, and, as it would appear, looking at it from the bass towards the treble.

Figs. 3 and 4, a thick bridge-pin, or more correctly, a thin stud about three-sixteenths of an inch in diameter, whose top is filed as shown in Fig. 3, so as to afford support for the string not only sideways, like Fig. 1 and all ordinary bridge-pins do, but also underneath, instead of employing the common wooden bridge for that purpose, which thus becomes quite unnecessary. Of course this pin is a true metal bridge or stud of small diameter, capable of supporting only one string, and a pair will be required for each bichord note, unless a stud like those represented by Figs. 5, 6, and 7—which is thick enough to support two, three, or even four strings—be preferred.

Figs. 5 and 6 represent this stud sufficiently enlarged in diameter to receive and support several strings. Three are shown, but either two or four might be used if the stud be seven-sixteenths of an inch diameter, and the strings near together. Practically, four No. 24 wires need not occupy more than 1/4in. in width, if made to diverge on the long bridge so that they cannot clash. The four unisonous strings of No. 25 wire on the fiddle G of my experimental grand piano only occupy a space 1/4in. wide.

Fig. 7 differs from Fig. 6 only in having its shank reduced in diameter for three-fifths of its length, and might be made out of Fig. 6 by turning down that portion in the lathe, but is far more cheaply formed by fine casting.

Figs. 1, 2, 3, 4, would, of course, be made of drawn brass or copper wire, and my only purpose in designing Fig. 6 was that it may assist those who cannot get fine brass castings executed. It may be made of the cast brass or copper rods, which are commonly kept in stock at some mechanical tool shops, especially those in which clock materials are sold. The top surfaces of Figs. 3, 5, and 7 should be bevelled sufficiently to prevent the strings from touching them more than about one-twentieth of an inch above their lower edges. Should it be determined to make the down bearing adjustable, which I very much prefer, the upper bevil ought to be greater to prevent the strings' contact when its downward deflection is increased. The sides of the notches are in Fig. 5 shown quite sufficiently bevilled to prevent the strings' contact above the surface it bears against sideways. For instruments whose strings have no side bearings on their upper bridges, of course, there can be no need to make notches in the studs, similar in form to the teeth of a saw. A round-bottomed groove (like the half of a drilled hole, which is about as much larger than the string as steel wire would be, which is a single size larger than that employed for the string) is, in my opinion, the very best possible bed for the string to rest on.

Were it not that I have seen amateurs, and workmen too, do very odd things, I should have refrained from cautioning the intended operator, that all these studs must be driven in with a punch—not by the hammer's own face—which should bear on the flat surfaces above and below the projecting part, which is grooved or notched to receive the strings, or those grooves or notches will certainly be disfigured.

THE HARMONIOUS BLACKSMITH.

STEAM-GUNS AND ANTI-NAUSEATING BOATS.

[4498.]—RATHER more than a year ago, Mr. Henry Bessemer announced that he had constructed an efficient steam-gun, which imparted the required velocity to the projectile although its barrel was not inconveniently long and the pressure of its steam not inconveniently great. Mr. B. also was said to have a vessel building in which the passengers were to be hung on gimbals, and so perfectly insulated from the pitching and rolling of the ship that sea sickness would become quite a thing of the barbarous and ignorant past, probably also a basin of mercury in the cabin might then be employed as an artificial horizon. Can any fellow-reader inform the ignorant blacksmith if these good things are yet realised, and suffering humanity not only saved from sea sickness, but also from the expense of gunpowder when engaged in works of necessity and benevolence to pigeons, partridges, pheasants, and peasants, the latter of whom at least are our fellow-creatures, even if military?

THE HARMONIOUS BLACKSMITH.

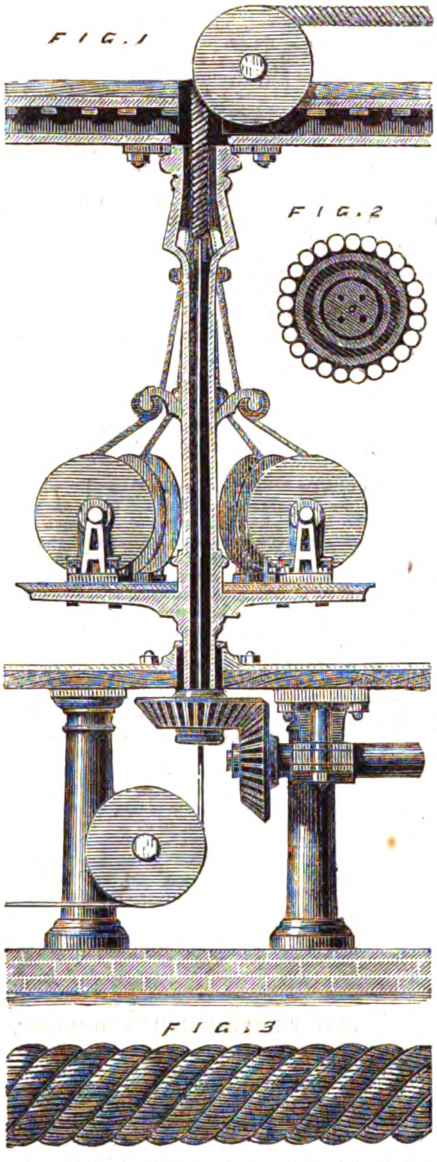
PLATO.

[4499.]—IN letter 4431 (p. 384, No. 379), "T. H. F." asks if I can inform him "whether there is a heap of débris near the centre of the floor of the crater." May I ask, in return, if he has met with a statement, printed or written, to the effect that there is such a heap? I do so because his query seems to indicate that he has been looking for it in consequence of having heard or read about it. So far as my observations extend I have never seen anything of the kind. I would also ask if he *really* saw, with 2in. aperture, the two white spots in the *hollows* of the shadow shown in his sketch, which, I think, will satisfy "E. B. F." as it does me.

W. R. BIRT.

WIRE-COVERING MACHINES.—III.

[4500.]—IN concluding this my last letter on the manufacture of oceanic telegraph cables, I think, as I have described every principal feature, nothing further is necessary. Such machines, I believe, have never been illustrated before. The diagram No. 1 shows the manufacture of the cable. I have shown only half



section. It will be seen the covered electric wire has an external covering of wire, and is covered so as to exclude all contact with water. The creels of outside wire are arranged on a revolving circular table, the covered guttapercha wire passing through the centre of machine; from below small, bands with steel springs inclosed prevent creel paying out too fast. No. 2, end section of cable; No. 3, side view of cable.

JOSEPH WILLIAM FENNELL.

A CHEAP SUPER FOR COTTAGE HIVES.

[4501.]—VISITING the apiary of a market gardener who farms a few hives, I was struck with the ingenuity he had shown in improvising a very useful and cheap super which he had in use, and as the idea may be welcome to many who cannot afford the glass ones on account of their cost, I hope you will give them the benefit of my observation. A moderately large flower-pot must have its bottom carefully chipped out, and a sheet of glass to which can be fixed a guide comb to entice the bees to ascend fastened thereon with putty and inserted over the hole in top of straw hive, and you will have a super that the bees will readily utilise for the storing of honey, and which is as open to observation as can be necessary.

R. SYMINGTON.

THE MYBORG BEE CABINET.

[4502.]—I AM very sorry that owing to absence at the seaside I did not see Mr. E. T. Grays' letter (4371, p. 354) soon enough to be able to reply to it earlier. I saw the description and engraving of the so-called "Improved Beehive," otherwise the "Myborg Bee Cabinet" (let. 4187, p. 251), and like Mr. Grays have waited to hear what anybody might have to say about it, and the result is a request for my opinion of it. Without prejudice, as the lawyers say, I am of opinion that there is not one feature in the so-called improved beehive which is any improvement at all, and I do not see anything in it worth imitating.

In the first place the comb frames run parallel with the front of the hive, which is against the natural habit of bees, or, perhaps, I ought to have said their instinct, and instinct seldom fails, and reason seems to argue that combs which are at right angles with the entrance to the hive must be easier of access than those which by running directly across the entrance obstruct both light and ventilation. Side-opening hives are now of the past in America, where bee culture is foremost and Myborg Bee Cabinets happily unknown. A new cabinet without any bees in it, like a new theory, will work like a charm, and the frames can be handled and slid about with perfect ease, and as long as there are no combs in the hive, which it must be borne in mind run parallel with the glass windows at back, the whole of the interior of the hive may be seen, and it would really appear as if bees ought to be quite at home there, but when the thing is filled with combs the matter is very different. By the bye, the expositioner of this wonderful hive does not say how he makes the bees build perfectly straight in the frames, nor how he gets the frames out if the bees propolise or build crosswise, and sometimes bees feel crosswise and build just like that. That's a bright notion putting a swarm into a partition containing three frames at top and three at bottom, and expecting the bees to carry their ideas of co-operation and subdivision of labour to such an extent as to form separate gangs, so that, as Paddy says, "they can hold fast below while them atop gets a fresh holt." Why should the dead air-spaces be crammed with hay? Chaff would be better, but dead air is the best non-conductor of all if it is dry, and the Myborg Bee Cabinet is rather dry!

The extraordinary "advantages of this hive" are "always being able to see all going on inside" (got transparent combs as well as windows, I suppose); "able to take any frame out in a few minutes;" exactly, No. 1—*i.e.*, that next front can be taken out after taking out all the others "in a few minutes," if the bees were not crosswise when they builded! "The bees also are not annoyed by the roof of their dwelling being taken off every time one wishes to examine or see to their welfare." Well, perhaps not; perhaps they rather prefer that burglary should be committed by the back way—*i.e.*, by pulling down the back wall of the house, and turning out all the inmates with their furniture and effects, to enable their self-styled master to get at their front door.

Mr. Grays wants to know how a swarm is to be introduced when the cabinet is completed? I do not know, but I once heard of a cabinet-maker who made a mouse-trap and could not set it. The next question implies that it would be better to insure "dead air space" all round the hive as well as at back and bottom, and this I cordially agree to without hay or chaff. Question No. 3 refers to a former letter of mine, in which also is quoted an opinion of Mr. Langstroth, as to tall hives being very good things when laid down. In that letter I asserted that the Woodbury hive is too small, and I adhere to the statement, although to novices in bee matters (I do not mean such "novices" as Mr. Grays) I generally recommend it as good for experimentalising, but for an expert it is hopelessly and ridiculously small, and totally unfit for bee culture for reasons given in the said letter, page 533, Vol. XIV., No. 350. If the compartment formed by Nos. 2 and 3 of the cabinet was simply laid on its back, it would be what Mr. Langstroth calls "a tall hive laid down," and it is curious to observe how nearly that approaches the hive which I have used for years, and have always found the best for all practical purposes (see letter). The Myborg would be, if laid down, about 18½in. from front to rear, and 12in. high, containing six frames, whereas the hive I have used and found so good is 17in. from front to rear, 11in. high, and contains eight frames; but that which I now recommend is described in p. 533 as aforesaid, subject to slight deviations.

I may say in passing that I shall shortly submit a photograph of this hive in several "forms" to our Editor, with such a description as a wayfarer need not err in, so that those who run may read, and those who read may make their own hives.

Question No. 4, which Mr. Grays thinks of most importance, refers to waste of heat in the tall hive, and he asks "Can this in any way be obviated?" Yes! lay the tall hive down.

"Novice," one of the most acute American bee keepers, writing in the American *Bee Journal*, says, in the June number of that invaluable periodical: "Well, Mr. Editor, we did examine carefully the thirty tall hives, and then an equal number of the flat ones, and the result was only *much more marked* [the italics are not mine] than we had supposed, from observations for the past three or four years. There seems to be a dislike to enlarging the brood circle *downward*, which they must do, as the brood is invariably in spring near the top bars. In the Langstroth (*i.e.*, the flat hive), the broad circle enlarges horizontally, and the result was to instantly transfer all the combs to the standard Langstroth frames. We have now got it all done neatly, and draw a long breath of relief when we realise that we shall no more be bothered with close-fitting tops and side openers." That, Mr. Editor, is the opinion of one of the foremost practical bee masters in America, although, like Mr. Grays, he calls himself a "Novice," and there are few people who can speak from larger experience. C. N. ABBOTT.

NEWSPAPER SCIENCE.

[4503.]—IN spite of the rubs which certain of our popular newspapers continually receive, they will persist in airing their science. Not long ago the "daily," whose "largest circulation in the world" is a very unfavourable testimonial to the intellectual calibre of its readers, displayed its ignorance by asking, in a manner which would be offensive if it were not idiotic, "What is a Joule?—or who is he, if a Joule is a human being, and not a vegetable—a weapon of offence, or something to drink, or a Phantom?" From a paper in the *Nautical Magazine* "we gather that the transformations of energy are in their nature similar to the operations of commerce; but with this difference, that in thermodynamics the relative values never vary. This, it seems, is the universal theorem of a Joule; and a red-hot poker must always bear the same relation to sixpence as the contents of a tea-kettle at boiling point bear to a five-pound note. . . Under the new dispensation the sovereign, 'to which all other forms of energy can be referred,' is to be an (*sic*) unit of heat. On the obverse is stamped 'Joule's equivalent,' and on the other side is inscribed 772 foot-pounds. One unit of heat is the amount required to raise the temperature of one pound of water one degree, and the equivalent for this coin is 772 foot-pounds of work—that is, the work required to be expended to raise one pound weight 772 feet. . . But what is the new 'Joule's equivalent' to be made of?—cobwebs, leather, or fresh butter?—and who wants to raise a pound weight 772ft.? As a problem of proportion, the theory is, of course, philosophical enough; but it would be just as easy to fix a unit of cold as well as a unit of heat; and, under any circumstances, until Joule comes into the open and tells us who he is, what he means, and when his equivalents are to be put into circulation, society, we fear, will decline to recognise a sovereign as a Joule, or thirty shillings as a Joule and a half."

Is it possible that 200,000 Englishmen daily digest such utter inanity as this? More recently, however, the same paper delivered a homily on the danger of eating wild plants, and as usual fell into errors which would be ludicrous if they were not dangerous. The occasion of this "lecture on Fleet-street Botany" was the death of two lads near Chester, poisoned through eating some deadly plant. The *Gardeners' Chronicle* has applied the stick very judiciously, though scarcely with sufficient severity, and I quote a portion of its remarks:—"Our contemporary speaks of the poison as having been afforded by the roots of the 'common hemlock, *Conium maculatum*.' 'Those who have seen a celery bed in full seed,' says the *Daily Telegraph*, 'will know how difficult it is for any but a practised botanist to distinguish the deadly *Conium maculatum* from its harmless [?] sister Umbellifer, *Apium graveolens*.' There is a little mistake here, as the writer would find if he indulged too freely in the 'sister Umbellifer' in its wild state. A parallel is then drawn between the case of these poor boys and that of Socrates, the symptoms are agonisingly detailed, and their severity explained by the fact, that 'hemlock, with scarce an exception, is the most deadly plant in our English Flora [?]—an opinion backed up by a quotation from Gerarde's "Herbal."' Our contemporary probably means water hemlock, though he distinctly says *Conium maculatum*, which is poisonous no doubt, but not nearly so much so as the *Cicuta* or the *Œnanthe*. To give further point to his remarks the leader-writer in the *Telegraph* goes on to tell us of ladies mistaking wild garlic for lily of the valley! and has a hit at 'crass gardeners' for mistaking the root of 'deadly monkshood' (aconite) for horse-radish, a mistake that has unfortunately too often been made, but not, we venture to assert, by any 'gardener,' for, contrary to our contemporary's assertion that it would puzzle Gerarde himself to distinguish the two roots (! !) we venture to think that to any one at all accustomed to look at plants no two things can well be more dissimilar than the root of aconite and the root stock of horse-radish. Certainly no gardener properly so-called would ever make so terrible a blunder. In the same strain our contemporary descants on other poisonous British plants, including the wood hellebore, 'spring's white rose' (! !) 'the sweet viscid pericarps of the yew, and the black deadly white cherries of the *Atropos belladonna*' (! !), &c."

The *Telegraph* goes on to assert that "all Umbellifers are deadly," which they probably are in one sense—viz., that a man may eat parsnips and carrots with impunity for fourscore years, yet they will eventually kill him—and it winds up with the very proper inquiry, "How long will it be before we recognise that a little knowledge of Nature and her ways is worth all the idle lore with which pedants, learned and unlearned, have encumbered the history of the Heptarchy and of the early Roman Kings?" There are signs on the horizon that it will not be long before a little "everyday science" is taught with the rudiments, but in the mean time would it not be as well if those who assume to teach the masses were themselves to obtain a little "knowledge of nature." The *Echo*, too, has recently been guilty of similar conduct, seizing on fragments of scientific intelligence, and with a ludicrous misapprehension of their meaning, endeavouring to turn them to use in paragraphs intended to be funny, but which must be utterly lost on its readers, for those of them who know nothing of the subject cannot understand the laboured joke, and those who do, can only pity the ignorance of the scribbler, and regret the waste of "energy" expended in accomplishing—nothing. SAUL RYMEA.

THE INDIAN PELLET-BOW, CROSS-BOWS—THE MODERN CATAPULT AND AIR-GUNS.

[4504.]—I AM not quite clear regarding "Suffolk Amateur's" design for an improved pellet-bow. Query, is the tube to be moved by the string? If so, its weight must considerably detract from the velocity which would otherwise be communicated to the pellet, and if not, how can the pellet be impelled unless the tube be slotted throughout such portion of its length as the string moves along, as in some toy cross-bows.

If any kind of bow be preferable to elastic india-rubber cords or compressed air, which seems to me very doubtful, would not a cross-bow be best? Truly, you have more "stock" to carry, but it gives "more power to your elbow," at least, it enables its force to be accumulated for use. We can employ a far more powerful bow, and bend it by a lever or suitable arrangement of levers, although requiring several hundred pounds to do so. Now, "drawing the long bow" is something beyond the powers of a truthful man if more than 80lb. be needed. A cross-bow may have two strings and a cup or pouch between them for the pellet or bullet; a tube might also be used if desired, which being no heavier than that for the long bow, would not require so large a proportion of the total force to move it. Cross-bows also throw bolts or short arrows, which may be feathered, but after all I can't help thinking the arrangement of elastic indiarubber cords, known as the modern catapult, is preferable, it being much lighter than a cross-bow with a heavy steel spring, *à la* arbalast, but I like a good air-gun yet better; however, the latter is not so convenient to accumulate the force in, as the stretching of a number of elastic cords singly in succession.

THE HARMONIOUS BLACKSMITH.

CUCUMBER CULTURE.

[4505.]—YOUR horticultural readers who like cucumbers may possibly obtain a wrinkle or two from the following experience of a correspondent of the *Horticulturist*:—

I had a narrow border, not more than 2½ft. wide, on the edge of a high fence. I planted three cucumber hills in the border, and laid some brush (such as is used for peas) between them and the fence. As soon as they crept up to the brush, I pinched off the ends, which thickened rapidly around the roots, and in every direction, throwing out the most vigorous foliage and profusion of flowers. I did not allow the cucumbers to grow, but watched them, and such as I wished to reserve for the table I picked as soon as they became of proper size; and all the rest were gathered every day for pickles, every day pinching off the bud at the end of each shoot. In this way the hill continued fresh and productive until they were touched by frost. Some judgment can be formed of the value of this practice when I add that more than a barrel of pickles were made from three hills, besides allowing a supply for the table. Whenever a leaf began to look rusty or yellowish, it was removed, and the cucumbers and leaves were cut off with large scissors, so as not to disturb or wound the plant. There is an advantage in having them run upon brush instead of trailing over the ground, because they are much injured by being trodden on. By being kept low on the bushes they can be easily and thoroughly examined over every day, which is essential, because if cucumbers are overlooked, and grow very large, it stops the yield of that plant.

E. Y.

SETTING OUT BUTTERFLIES AND MOTHS.

[4506.]—I HAVE read with much interest the papers on entomology in recent numbers, and derived some useful hints therefrom. But I tried the system of setting butterflies recommended on p. 266 some years ago, and found it very troublesome and unsatisfactory. Allow me to describe another method. My setting-boards are flat, made of very soft wood, a groove in the centre with a layer of cork in the bottom. Pin the insect to the cork so that the wings are on a level with the edges of the groove; arrange them with setting-needle, and place a small piece of glass on each wing. Hold the edge of the wing with the setting-needle, and put the glass edgeways near the root of the same; then let it fall gently, taking the needle away at the same time. With a little practice this can be easily done, not half the time or patience being required as for cardboard setting. Another advantage is that the insect is thus set in a natural position, and a good view of the underside is obtained by reversing the butterfly when it is pinned down. No collection is complete unless the upper and underside of the male and female of each specimen is shown. AJANEA.

ALCOR.

[4507.]—I HAVE little doubt that this is brighter than it was twelve years ago. To-night (July 5), at 10h., I stood 7ft. from a street lamp-post, so that the top of the lamp was projected 5° below Alcor, with the broad side of the flame shining full in the eyes, and the star was seen without difficulty. This is not a proof of its greater brightness, but points rather strongly to that view. T. H. BUFFHAM.

STEAM CARRIAGES ON COMMON ROADS AND ON TRAMWAYS.—THEIR RELATIVE ECONOMY.

[4508.]—THE advantages of the substitution of iron wheel-tracks for ordinary stone roads, and of some cheaper force (say steam) for the haulage of carriages by horses, are subjects which have exercised my mind for some years. I have tried to think out these subjects, and subjoin my ideas, but fear some of my conclusions are hardly so favourable, so far as its exclusive application to tramway-cars, as might be wished by their proprietors. It is, however, even if unpleasant, wiser to look at and investigate the unfavourable than to ignore it.

The only advantages, so far as I know, of iron, or rather steel, wheel-tracks for tramway-cars, are their enormous durability, and the saving of rather more than half that resistance by which the motion of a carriage is resisted on a macadamised road kept in good repair. It is nothing but this diminution of resistance which enables one large carriage, drawn by only two horses, to carry double the number of passengers an ordinary omnibus does. This is a clear saving of half the cost of horse-power; it also effects a saving of half the cost of wages, only one pair of men being required, however large the carriage, instead of the two pairs of helps needed for two smaller carriages. There is also, as I believe, a considerable saving in the cost of maintaining tramway carriages in repair compared with that of maintaining ordinary public carriages; the former are also, I presume, longer lived. I think I have stated all that can truly be said in their favour.

There can be no doubt that, so long as horses are employed, the cost of working the traffic on tramways must be very much less than it can be on any roads we can expect to have constructed of broken stones, *à la* Macadam; but it must be admitted the cost of "preparing the way" is, in the case of a tramway, "pretty considerable." I fear we may expect to find the cost of its maintenance will be "pretty considerable" also, at least near London, for I have observed nearly all the ordinary vehicular traffic—which, in some localities, is also "pretty considerable"—is conducted over the tramway pitching by persons who contribute nothing to the cost of "maintenance of way."

I cannot perceive the relative advantages of tramways over good common roads will be anything like so great as they now are, when some cheap motive power becomes substituted for horses. Steam, perhaps, costs only one-sixth as much as they do, consequently the saving will be tenpence out of every shilling of the present cost of traction on the tramway; but then the latter will then have no advantage over the common road, excepting that the same amount of haulage can be done on it for twopence, which will cost fourpence on the latter. A suitably-designed carriage, with wheels from 5ft. to 6ft. diameter, by 4in. to 6in. wide would run almost as smoothly on the common road as on the tramway, were it provided with thick indiarubber packing between its wheel-tires and wheels; it would be at least as easy, I believe far easier, to ride in than any tramway-car in existence; perhaps, also, quite as durable, for the destructive blows to which ordinary wheels are now subjected would be absorbed in the then extremely elastic hoop-tires of its wheels.

It seems to me the only practical question is, "Can such a carriage be worked cheaply enough to compete with the tramway-car?" No doubt the latter has the great advantage of being propelled for about half the cost of the former; but, to enable us to effect this saving, we are compelled to incur great expense. We have not only to make the road, at a cost of several thousands of pounds per mile, but also to keep it in repair for our own use (for which, when once well made, the road would probably endure for very many years), also for the use of all those—their name is legion—who condescend to travel on it. *Per contra*, our improved common road enlarged omnibus is not heavily weighted by these expenses, although it would carry just as many passengers as the tramway-car now does, and will cost no more for wages—one pair of honest (?) men being enough for each carriage. A further saving might be effected by constructing and working carriages to carry more passengers; but this could hardly be done in the case of tramway-cars, which must have a short wheel-base, because their tracks are necessarily laid in our existing roads, and therefore only admit of curves of extremely short radii for changing their direction—by the way, the adoption of the bogie principle might greatly diminish this evil. Longer carriages would not be so objectionable on common roads, because, not being confined to one track, they could be turned in much less space—yea, even turned half round—without a turn-table, which, by the way, a carriage on a tramway could not be. The engine might, indeed, be reversed.

The owners of a carriage which runs on a common road have the great pecuniary advantage of not having to pay for making the road. Doubtless they do help to pay, because, in common with their neighbours, they contribute to highway rates; but ordinary carriage proprietors, or rather the proprietors of ordinary carriages—whether they be of that celebrated class which indisputably demonstrates its respectability by keeping a gig, or of that, I fear, somewhat less respectable class who own "omnibii"—pay nothing additional for the use of the road since we ceased to conserve turnpikes. Under our enlightened commercial system, which delegates the making of our highways—railways and tramways are nothing else—to private enterprise, the proprietors defray the cost of constructing them, and can only obtain their profits by charging higher fares than would be required, did society make and mend its own ways. THE HARMONIOUS BLACKSMITH.

SPINNING-TOPS AND GYROSCOPES.

[4509.]—"A., Liverpool" (let. 4487, p. 412) apparently wants me to explain, and wants "E. H." to demonstrate, the second law of motion (by some reckoned the third). This is a little unreasonable. In his present stage "A." must be content to take a few things for granted, and amongst these are the laws of motion, which are by no means axiomatic, as some mistakenly imagine.

I would invite him to inquire *how much* the direction of motion of a swiftly travelling ball brought to the ground by gravity is actually changed. He will find that said direction of motion is, more or less, changed during the fall, according as the velocity is less or greater.

His asking "E. H." to drop assertions and catch cannon balls is amusing, but it is not reasoning. "E. H." is quite right on this point; or else the whole modern science of dynamics is wrong, and astronomy, too, must go by the board. But the celestial bodies persist in demonstrating by their movements what "A." so persistently questions. The moon moves (*in vacuo*) much more swiftly than the swiftest cannon ball, and terrestrial gravity is reduced greatly at her distance; yet she yields to the earth's attraction as obediently as a pebble dropped from a child's hand. She not only falls continually towards the earth from the line she is momentarily following; but her direction of motion is continually being changed, so that in about a week it is changed through a right angle. I have, as "A." opines, "experienced the resistance" (not at all "extraordinary," however) "which a swiftly rotating-wheel offers when," &c., &c. But this resistance is not wholly insuperable. For instance, if it were, our steamships —as well paddle-wheel as screw—would not answer the helm.

RICHARD A. PROCTOR.

[4510.]—IF I fully concur with "E. H." in rejecting what "Philo" calls the ordinary explanation of the spinning-top, it is not that I have any pleasure in pulling down established ideas. I desire to serve only the cause of truth and utility. The false nature of the common theory long since forced itself on my observation. I have also a solution to offer at the end of this letter, which I should like to submit to the criticism of Mr. Proctor, "Philo," and other able correspondents who have kindly noticed my previous remarks on this subject. It may possibly prove the true solution of this question.

Will Mr. Proctor allow me to suggest that the "almost insuperable difficulty" experienced in clearly expounding the ordinary theory lies in the impossibility of avoiding contact with the laws of mechanics and plain facts with which it cannot harmonise. These form so many rocks and shoals which the most skilful pilotage cannot avoid. If the popular theory comes off from the encounter with a semblance of soundness, it is only by the most dexterous craft that that appearance can be maintained.

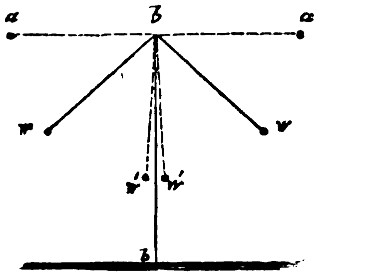
"In the case of a top flung through the air," he says, "the top's weight has time to act, and does eventually so act as to change the direction of flight." The reader naturally implies, then, that it is only *eventually* that it does so. He therefore carries away the idea that there is a *measure* of space passed over by the projectile in its flight, in which its direction is *not* altered by gravitation. Carrying this idea to the spinning-top, he may well imagine that in so small a space as that passed over by any particle in a top's body in "whisking round," as "A." expresses it, "to the other side," that particle will have no time to gravitate downwards. In imagination he may even extend this space to the whole distance travelled over by the particle from the commencement of the top's spinning to the end. Here, however, the fact that a top has spun in vacuo one hour and forty minutes affords a measure of space over which its weight cannot change its direction surpassing the utmost latitude of imagination to settle down upon.

This, however, in the above sentence, the reader is left to imply. I can hardly credit my senses when I read the next quotation, in which the writer broadly states that "the weight of the top is insufficient to change the direction in a brief interval." Here, surely, the vessel runs headlong upon a rock. Calculations in gunnery are, I believe, grounded on this among other fixed principles, that gravitation, always active, must act simultaneously with projectile force. The motion "sufficiently" rapid! Mathematicians will surely correct the sentence, and write *infinitely*; neither will the practical man be satisfied with the information that if the rifle bullet does not sink two inches or two-eighths of an inch in a hundred yards, it does not sink at all. Is the parallelogram of forces to be set at nought in this solitary case, which demands that when two forces act from different directions upon any body the consequent direction of the motion of that body must be a resultant or accommodation of those original directions? The archer and slinger know well that their shot will drop short of the mark at any distance if they are not made, by elevation, to drop into it. Again, what is the speed necessary in order to maintain the spinning motion? A very low degree suffices. In some cases the rotating force is so nearly expended before the vertical position is lost that the top scarcely retains force enough to roll more than a few inches.

Mechanical principles require, and common-sense requires, that the particle shall be lower when it has passed from the one side of the axis to the other, if there is *nothing to save it from so falling but want of time*. Its course, then, based on the principles of velocity and space, is not a horizontal, but an inclined plane, and if the projectile speed of the particle render that plane of descent very circuitous and long, the very speed which so prolongs it secures proportionate rapidity in the descent of the particle to the ground. "E. H." has hit the most glaring blot in the balance theory. The idea of supporting the centre of gravity by making it spin round the point of support is shown to have no necessary connection with the self-support of the spinning-top; for experience proves that the top will not fall, though the circle in which the centre of gravity circulates—nay, even the circle which an outside particle of the top describes—be wholly outside the point of support, or the vertical line which represents it.

Mr. Proctor appears to prove his case when, assuming a somewhat leaning position of the axis, the descent of a particle as it approaches the lower side is compensated, he infers, by its ascent to the upper. But the whole case is not here stated. Does he identify the force of gravitation with the projectile force communicated to the particle or not? If he does not, then gravitation will accelerate the downward motion and retard the return of the particle upward. In other words, it will pull it downwards at every point of its circuit. If he does, then this summary disposal of gravitation involves a result contradicted by facts, for then would a top spin with its axis in a horizontal position, without any need of a point to stand on, or a plane to support it; for it must not be allowed to escape observation that the value of his reasoning depends entirely upon the idea that the action of gravitation is wholly absorbed by and identified with the rotary force communicated to the particle. If it is not, nothing is proved. If it is, an impossibility is proved.

The suggestion I have now to offer is this: W W, being two particles in a top adjoining the revolving axis (t t), are acted on by gravitation. I assume them to be detached from their rigid connection with the body of the top, and capable of moving in obedience to a second force acting upon them from the point t—viz., centrifugal force. Let them be attached to this point by connecting links capable of motion in the plane of the axis. Without entering into the mechanical analysis of the resolution and composition of the forces named, the steam-engine governor practically proves that the weights W W will rise to an intermediate position (t W') between the limits shown by the dotted vertical and horizontal lines. These particles or weights will rise to a higher, or sink to a lower, level according as the centrifugal force is greater or less. It cannot reach the horizontal line (a, a) unless the centrifugal force be infinite, or gravitation (in other words) *nothing* in comparison with it.



Centrifugal force then, I infer, has not the power of retaining a particle in a horizontal plane against the action of gravitation. It has, however, the power of raising it from any lower to any higher position approximately near to the horizontal plane, though with more and more cost of power as higher levels are reached.

The same reasoning which applies to any pair of particles applies to the whole series of which the body of the top is composed. Now, as these particles are all rigidly connected, and cannot rearrange themselves at higher levels in the body of the top, and yet the lifting necessarily accompanies the exercise of the centrifugal force, the effect will be, I conclude, to lift the body of the top itself; just as when I pull at a small twig, the effort which detaches it, if detachable, will otherwise draw the plant itself towards me.

This centrifugal force acting with the greatest effect on those particles situated at the greatest distance from the axis, the point and lower part of the top will be the least affected by it. Hence, while the more bulky part of the body is most subject to the lifting power, the point is most affected by gravitation. It therefore rests on the table or other supporting surface, and as the body is lifted higher and higher is, so to speak, dragged under until the axis is vertical, aided probably as M. Paris suggests, by the shape of the point as by an inclined plane.

The non-propensity of a top when spinning, even in a very inclined position, to slip and fall even upon the most glassy surfaces, becomes a strong confirmation that the support of the point by the table is not the primary support of the top's weight. A man shod with nailed shoes standing on such a surface dare not lean to the slightest degree from the vertical position.

I should assume from the facts and phenomena observable from the action of the governor, that the impossibility of raising the balls to a higher level than the horizontal plane (a a), or even up to that level, amounts to a demonstration that a top constructed on the same principles cannot by any amount of centrifugal force be lifted off the table, and that the pressure of its point on the table must always be positive.

The test of this theory is manifest, but I have not at hand the means of applying it. The top should weigh less when spinning than when at rest, and less when spinning rapidly than when spinning slowly. Is it a known fact that the lower end of the vertical shaft of the governor presses less upon its bearing when in action than when at rest? J. M. TAYLOR.

Seer Green Vicarage, near Beaconsfield.

[4511.]—MR. PROCTOR (let. 4411, p. 381) says, but does not show, that I misapprehend the subject. The question is most certainly not at what rate? Mr. Proctor simply confuses the question by saying I confounded "A.'s" incorrect reasoning on one subject with his totally distinct line of reasoning on another. Mr. Proctor must have read my letter very carelessly not to have observed that I was obviously referring to "A.'s" ideas about the top (ideas extremely like Mr. Proctor's, whatever he may say), and not to those about the bullet. Mr. Proctor wants reasoning rather than assertions. I gave him quite enough reasoning on his attempted popular explanation of "one case, and one feature of that case." As to assertions, I admit I have made in your columns a great many on this subject, but the one quoted by Mr. Proctor is simply the statement of a positive fact verifiable by the experiment of simply spinning a top.

It is quite possible to correctly and intelligibly explain the many curious actions obtainable with a gyroscope without abstruse mathematics, but it certainly cannot be done in few words. It would also require several explanatory diagrams. Whenever the time arrives that the editor thinks the subject is of sufficient interest to justify it, I shall be willing to prepare a series of articles explanatory of the subject.

Mr. Proctor has not given me the information I desired about nutation; but I gather that nothing new has been recently brought forward on the subject, and I can, therefore, refer to the old authorities. With reference to the quotation from Herschel, I would remark that it does not necessarily follow that an explanation is correct because certain calculations associated therewith happen to agree with certain observed data.

Glasgow, June 29. E. H.

A BRIEF CONTRIBUTION TO THE EARLY HISTORY OF THE PIANOFORTE.

[4512.]—AT what date the pianoforte's predecessor, the dulcimer, first had a set of manuals added to it, and was thereby converted into a keyed dulcimer or "forte piano," with finger keys, we have no record. Probably, the earliest mechanism employed was a sort of upright drumstick stuck in the key, not unlike the mop or old man's head, afterwards used to lift a hinged hammer, which before its application for that purpose was employed to strike the string directly just as the tangent of the clavichord does. Indeed, a clavichord (which instrument we have the strongest reason to believe is far more ancient than the piano, at least in Germany and other parts of Western Europe) would become such a pianoforte as I have supposed, if its strings were tuned by plucking them when their total lengths were in vibration, and by covering the tops of its tangents with some soft material to prevent the harsh clang which would be elicited by striking its strings with an unclothed metallic surface, like the clapper of a bell. Of course, the touch of such an instrument must have been very unsatisfactory; it would resemble what we experience when we play on a piano whose hoppers do not escape, but block its hammers dead against its strings. Instead of holding its keys down firmly, which must be done when playing on the clavichord in its normal condition, we should be compelled to do what I was once much amused by seeing a clever salesman in a pianoforte warehouse do in the case, or rather instance, of a new unregulated piano whose hammers all blocked—viz., allow the key to rise a trifle instantly after striking the strings. If this necessity existed, we need not be very much surprised to find that it was said of the piano that it required a "peculiar touch." I think, also, the "Peculiar People" must have been required to play on it.

I have some reason to suspect the earliest improvement on this mere drumstick standing up from, but *fixed*, in the key was a modification of the harpsichord jack, or more properly an upright striker (resting on, but not affixed to, the key), which being suitably guided in sockets was lifted, or rather jerked up, by the key, the latter being prevented from descending in front and ascending at back far enough to raise this striker higher than within about ⅛in. of the string. As, under these circumstances, the striker must rebound from the string, it could not remain in contact therewith, i.e., blocked, and, therefore, could not prevent its vibrations. By employing very long keys, and placing these loaded strikers about five or six times as distant from the key balance as the latter is from the front end of the key, a tolerably powerful action, which strikes a blow of sufficient force to vibrate ordinary springs, may be constructed; but it must, even for the bass, be inferior to one having hinged hammers.

The earliest pianoforte of which any authentic record exists is that of Christofali, of Padua, A.D. 1711. In his action nearly all the best arrangements now known exist. The hammer moves on a centre wire, it is lifted by a true hopper, *i.e.*, one that escapes from under the notch or shoulder in the hammer butt, an[d] it is provided with a hammer-rest, which acts [as a] check, inasmuch that it prevents the hammer [re]bounding. The hopper is supported on a le[ver] mediate between the hammer and the key, allowing the latter to be taken out without disturbing the remainder of the action. This lever also carries the (underneath) damper, and (by the descent of its hinder arm) removes it from the strings when its front end is raised by the key to cause the hammer to strike. My practical readers will see Christofali's mechanism was considerably in advance of most of those commonly employed until that comparatively late period when some of its peculiarities were adopted by Sebastian Erard, afterwards by the late Mr. Squire and others.

The writer of the article "Pianoforte," in the fourth edition of the "Encyclopædia Brittanica," says the Germans had attempted to make what he terms keyed dulcimers, which without specifying what that was, he states were all constructed "on one principle, which required a peculiar touch of the finger difficult of acquisation, which spoiled it for the harpsichord." He adds, Mr. Mason "removed all these imperfections by detatching the mallet (hammer) entirely from the key, and giving them only a momentary connection." This statement, if true, would seem to indicate that the Germans had constructed pianofortes, or, as the writer terms them, keyed dulcimers, on the system above described for converting a clavichord into a pianoforte, but the statement must be taken *cum grano salis*. The Germans may have done this, but they certainly went beyond this before Mason did, even if they did not carry improvement so far. I have been unable to ascertain what kind of action was employed in Farinelli's piano made at Florence, A.D. 1730—by the way, Dr. Burney also states Farinelli possessed a transposing harpsichord, which, I believe, was far from being the first of its kind—very probably it may have been Christofali's action, or some modification of it. From its early date, and the yet earlier time of the publication of Christofali's invention, we may infer pianos were probably made in Italy before they were constructed in Germany, although it is related that Silberman made two at some early period which were not approved by S. Bach. I have found no record of their date or the kind of mechanism he employed, but he seems to have constructed several before A.D. 1747. His pupil Stein does not appear to have turned his attention to the piano very early, but was more known as a maker of harpsichords and clavichords; some of the latter he constructed with strings nearly double the usual length, and, by causing the tangents to strike them exactly in their middles, to produce sounds an octave above those they uttered when simply plucked. He also invented the *vis-à-vis* harpsichord, literally two harpsichords in one rectangular case, with keys at each end for two or four performers, just like Chickering's double-grand pianoforte in the 1851 Exhibition. When, however, Johan Stein did give his attention to pianos, he did so to some good purpose, for he invented the so-called Vienna action, which I am told is yet used in Germany, especially for cheap square pianos. Stein also employed levers moved by the performer's knees—like those afterwards used in the claviol by the late J. J. Hawkins, who facetiously said that as they were neither manuals nor pedals, of course they must be "needles," rather a sharp and pointed remark—to actuate the many stops then employed in pianofortes. Similar levers are now employed in harmoniums.

The first square pianoforte is said to have been made by John Adam Spaeth, which I take leave to doubt, and the first square piano with a soundboard nearly as large as its case (whose hammers were above its strings) was, it is asserted, constructed by Hildebrand. As early as A.D. 1760, Hancock patented the organised pianoforte, or, combination of organ pipes with the piano, an instrument afterwards constructed by S. Erard, with a shifting keyboard for transposition. The idea was by no means new, for as if to prove its antiquity, an organised harpsichord is now in the Loan Exhibition at South Kensington Museum, bearing the name of Crang, Londine, A.D. 1745. Verily there is little or nothing new sub sol. "What is has been, and what will be has gone before," so I will say no more.

THE HARMONIOUS BLACKSMITH.

LUNAR OBJECTS FOR OBSERVATION, AUGUST, 1872.

[4513.]—AUGUST 7, Mare Crisium, the east border, with the two promontories at the "pass;" August 8, Guttemberg (see ENGLISH MECHANIC, No. 323, June 2, 1871); Navigators' Nook, containing craters named after celebrated navigators, Magelhaens and others (see "Monthly Notices of the Royal Astronomical Society," Vol. XXIV., p. 20); August 9, Taruntius, objects in its interior; August 10, Posidonius and craters north of it. Notices of them have been given in former numbers of the ENGLISH MECHANIC, as well as in No. 308, p. 516. August 11, Mare Serenitatis, with longitude of terminator varying from 24° to 12° on the equator; the ridges of the Mare may be studied to advantage; August 12, Sabine, Ritter, *Gwilt Brothers*, two small craters north-east of Ritter, named in commemoration of the architects Joseph and George Gwilt; August 13, Archytas and the craters between it and Egede; August 14, Short, Newton, Cabeus; August 15, Ramsden, the valley and clefts in its neighbourhood; August 16, Anaximenes and *Herschel* II., which is the finest of a fine group of craters near the north-east limb, imperfectly described by Beer and Madler. See "Reports of the British Association for the Advancement of Science—Transaction of Sections," pp. 10—12, also "Monthly Notices of the Royal Astronomical Society," Vol. XXIV., p. 20. August 17, Scheiner, Blancanus, Gruemberger; August 18, Crüger, Byrgius, and *Rosse*, a large formation between Phocylides and Segner.

W. R. BIRT.

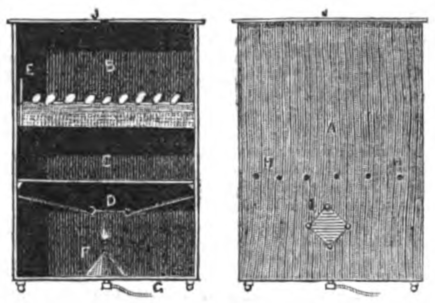
THE PHENOMENON OF ARGOSTOLI.

[4514.]—I CAN assure Mr. Rodwell (let. 4472, p. 410) that I am quite contented and able to live without a theory of where the water is gone to. Professor Ansted, in the volume I quoted, gives his theory, but confessedly only disposing of the water, not the salt, and not of even the water in a way I thought worth copying as among possible ones. In that category there is certainly one, propounded, I believe, by Dr. Frankland, and which must suggest itself to any reader of Mr. Mallet's earthquake theory opportunely brought up in p. 404. Of course, if internal shrinkage is creating vacuities for the exterior to "crush down" into (which I do not believe), there will be abundant room in pores to drink the sea dry in time, and for the atmosphere to follow or accompany it (whether our wisdom have by that time added the "coal-stores" to its weight or not); and it would become a question of some interest whether a cometfall occasionally might delay this awkward prospect by bringing some fresh water or air, and whether this be not rather to be desired than deprecated.

E. L. G.

AN IMPROVED INCUBATOR.

[4515.]—THE outside case A is made of stout wood dovetailed together, wood being less affected by change in the temperature of the atmosphere; B is the egg

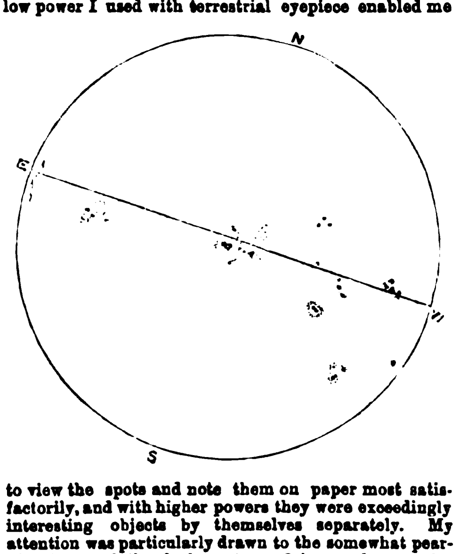


chamber, the eggs lying upon layers of flannel next a thin layer of sawdust. C is the boiler of tin, having a pipe communicating with the egg-chamber, which supplies the moisture required, avoiding the use of wet bags of sawdust, &c., which need continually changing. D is a tin plate suspended above the funnel burner F, radiating the heat, and preventing the flame touching the boiler. G is the gas-pipe, the burner let through the bottom of the case. H H are holes to carry off foul air (the burner emits no smoke). I is the aperture to light and observe the burner; J is a glass top covered with flannel, preventing the condensing of the moist air into drops.

TINTUB.

SUN SPOTS.

[4516.]—THE sketch I send herewith shows the appearance of our great luminary the sun at 30min. past 6 p.m. on Saturday evening, June 29, 1872. The low power I used with terrestrial eyepiece enabled me



to view the spots and note them on paper most satisfactorily, and with higher powers they were exceedingly interesting objects by themselves separately. My attention was particularly drawn to the somewhat pear-like shape of the dark spots, and in nearly every instance pointing E. and N.E.

JAMES H. WHISTLE.

COLOURED SUNS.

[4517.]—I AM glad to see that this neglected but interesting subject is cropping out in the pages of "our" MECHANIC. Mr. Buffham's letter, in your last issue, shows how necessary it is for observers to adopt a more definite nomenclature, or rather to avoid the use of merely descriptive terms altogether, and to pursue instead the very practical method first suggested by the late Admiral Smyth, by employing coloured discs for comparison. I have for many years used the valuable diagram of colours published in Smyth's "Sidereal Chromatics," and I hope shortly, with your permission, to publish a portion of the results of my observations.

BEDFORDIENSIS.

THE SUN'S MEAN PARALLAX.

[4518.]—THE mean distance of the sun, to astronomers and mathematicians, has been a subject of deep interest and scientific inquiry—in other words, the discovery of the sun's mean parallax, which, after much independent researches and calculations, has been given at 8·91", 8·92", 8·96", and 8·86". Between the two latter there is only a difference of one-tenth of a second of an arc, which, in the distance, makes 1,082,300 miles of difference. Between the two former there is only a difference of ·01 part of a second of an arc; yet, in the distance, there is a difference of 102,650 miles.

The value 8·86" appears to be the true value (very nearly), from the following simple principles of calculations, which include the application of the area of a circle, whose diameter is unity, the greatest distance of the sun, that of the mean distance being regarded as one, the angular diameters of the sun and moon, and the doctrine of ratios, one result of which has been the finding of the sun's mean parallax, the angle or corner which the semi-diameter of the earth makes at the mean distance of the former at 8·858074", which gives a mean distance of the sun, from the centre of the earth, at 92,183,210 miles.

Taking the moon's semi-diameter as given in the appendix to the *Nautical Almanac* of 1886, the greatest at 16′ 46", and the least 14′ 24", from which we obtain the moon's mean angular diameter equal to the logarithm 3·27058585, that of the sun being 3·2831141, both in seconds of an arc, the logarithm of the mean diameter of the earth 3·8983604, and the arc equal to radius being expressed in seconds, the logarithm of which equals 5·3144251. The application of the foregoing values is as under—viz., 3·27058585 : 5·3144251 : : 3·8983604 : 5·94219965, the fourth term or value thus found being subtracted from radius thus, 10·0000000 − 5·94219965 = 4·05780035, the square of which equals 8·1156007, and this value being divided by the logarithm of the area of a circle to diameter one, thus, 9·8950899 : unity : : 8·1156007 : 8·2505108, the numerical value of which equals 57′ 7", the moon's mean parallax.

The logarithm of the sun's angular diameter is as under—viz., 3·2831141 : 5·3144251 : : 3·8983604 : 5·9296714. And, doing the same with the fourth value thus found as we did in the case of the moon's fourth value—viz., 10·0000000 − 5·9296714 = 4·0703286, the square of which equals 8·1406572. $\frac{0.0144664}{9.8950899} =$

B

0·1198765 : unity : : 2·602063 : 2·4826865, and 2·4826865 : unity : : 8·1406572 : 5·6329142, the numerical value of which is equal to 8·858074", the sun's mean parallax. And, subtracting thus, 8·1406572 − 8·1156007 = 0·0250565, and taking this value from the logarithm 0·1198765 − 0·0250565 = 0·0948200, and 0·0948200 :

B

unity : : 2·6020680 : 2·5077480, and 2·5077480 : unity : : 8·1406572 : 5·6329142, the numerical value of which equals 8·858074", the sun's mean parallax as before found, and 5·6329142 : 10·0000000 : : 3·5973364 : 7·9644162, equal to 92,183,210 miles. By multiplying the logarithm of the moon's angular diameter by the logarithm of one second of an arc, thus, 3·27058585 + 4·6855749 = 7·95616075, and logarithm 5·94219965 : 3·8983604 : : 7·95616075 : 5·9128215. And logarithm

B

0·0250565 : unity : : 2·6020630 : 2·5770065. And 2·5770065 : unity : : 5·9123215 : 3·3353150, equal to the moon's mean diameter = 2164·287 miles. And, in like manner, multiplying the angular diameter of the sun, we obtain the logarithm 7·9686890, and 5·9296714 : 3·8983604 : : 7·9686890 : 5·9873780, the numerical value of which equals 865,721 miles, the sun's mean diameter.

5·9873780	3·8983604
3·8983604	3·3353150
2·0390176	0·5630454
	2·0390176
	B = 2·6020680

VERIFICATION.

A MORNING SUNSET.

[4519.]—BEING very fond of witnessing the phenomenon of sunrise in summer, on the morning of June 16 I found myself, with that object in view, at Chanctonbury Ring, a clump of trees on one of the summits of the South Downs, given in the ordnance survey map as 780ft. above the sea level. The sun rose shortly before 4, and the sight was grand in the extreme. But about 4.30, on walking round the clump, I saw something like a sunset in the west. Bright rays of light were radiating up from a point apparently about 1° below the horizon, varying in breadth and brightness, generally 30° in length, with the points merging into the surrounding sky, in fact, as before stated, presenting exactly the appearance of a sunset, when the body of the sun has disappeared a few minutes. The sky was sprinkled with small light clouds thickening into a mass towards the west; there was also a little mist, but the Isle of Wight was distinctly visible, also the sails of a ship moving up Chichester Harbour, distant twenty miles. The rays were visible for two hours, when they seemed gradually to fade and finally disappeared. A friend who was with me agrees in this description, but is equally unable to account for it. I thought if you could afford me space in your valuable journal some of your scientific readers would give me an explanation.

W. W. M.

COLOURS OF CLOUDS.

[4520.]—"T. W." (letter 4426, p. 383) asks, "Why are the clouds at various times of the following colours? He then enumerates certain tints which it will be more convenient to arrange under three heads—

Intense white	Dark gray	Ruddy brown
Yellow white	Blue gray	Blue brown

In the first place, those clouds which appear to the eye as most intensely white are, in reality, very very light blue; they are generally high up in the firmament, and have reflected on them some of the blue of the atmosphere. This very light blue appears so surpassingly white from the same cause that makes snow look so intensely white when there is a blue sky above, and our linen so beautifully white when the laundress has mixed a judicious quantity of blue in her starch; this very light blue is perhaps the nearest approach to pure white which we ever see in nature.

Yellow white clouds are those which, from their position, reflect to us less of the azure blue of the atmosphere, and more of the direct yellow rays of the sun.

Dark gray and blue gray are only seen on the shaded sides of clouds, or on clouds in the shade of other clouds intervening between them and the sun. The blueness of the gray depends on the amount of azure reflected on it from the sky. Brown tints in clouds are not often seen, but they do sometimes occur, especially in the lower surfaces of clouds passing over cities or land of a somewhat russet hue. I suppose that the russet hue is reflected upwards, and mixing with the gray of the shaded underside of the cloud produces a brownish tint. I never remember to have seen a brownish-looking cloud passing over the sea.

These remarks may perhaps in some measure explain the reason of some of the colours of the clouds in ordinary daylight; but what shall we say of the exceptional colours of the clouds at sunrise and sunset? I must confess that here I am at a loss. Can any correspondent in "our" journal explain the cause of the gold and crimson and purple of sunset, and the far different primrose salmon colour and rose-pink of early dawn? And what is the cause of the strange hue of some thunder clouds—a most peculiar colour like nothing else unless it be burnished copper? How "T. W." can successfully predict certain coloured clouds on certain days passes my conception. I am not profoundly sceptical with regard to meteorological prognostication. I have no doubt that ere long—

Old experience will attain
To something like prophetic strain.

But "T. W.'s" colour prediction seems to be something quite new, but there may be something in it. There certainly is some difference in the colour of the clouds at different times of the year. There is a creaminess in the clouds on a fine autumn day quite different from the silvery whiteness of some of the clouds of early summer, and in winter and early spring there are still further differences. "T. W." says his object is not to provoke discussion, but I always thought that it was understood that any correspondent starting a new subject invited discussion thereon. BOBO.

MICROSCOPE CASTINGS.

[4521.]—PERMIT me to rectify an error in my letter (4479) on the above subject. The objectives of my microscope are 1½in., 1in., ⅔in., ½in., and ¼in. I may also add that I am adapting the ⅔in. as an achromatic condenser; the cost of the apparatus, which will include a polarising plate, diaphragm, and mica plates, will not exceed half-a-crown.

I can indorse the statement of "J. D. H." (let. 4480) as to the difficulty in procuring castings of microscopes from opticians. I have applied to every manufacturing optician in one of the largest provincial towns, and could find only one who was willing to supply me with a set, for which he asked the very moderate sum of twenty-five shillings, at the same time informing me that I should only save about five shillings by purchasing the fittings, and making the instrument myself.

I do think there is a good opening for an enterprising man who would supply not only the unfinished, but also the finished parts of optical instruments, at a moderate charge. Why, in the name of common sense, should the thin glass covers for slides be charged 3s. 6d. per ounce by the optician, when the manufacturer's price is about 10d.? Surely a profit of (say) 100 per cent. ought to be sufficient. MICROS.

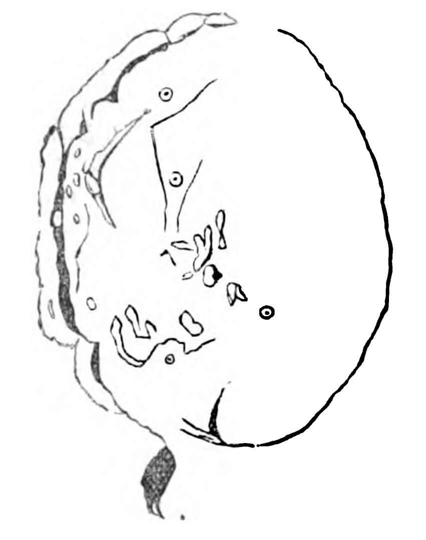
COAL AND THE ATMOSPHERE.

[4522.]—DOES "Philanthropist" (p. 385, No. 379) really imagine that all the carbonic acid daily produced on this earth remains to poison and contaminate the air, and to take up the place of free oxygen? &c., because, if so, he has but a very poor idea of the magnificent adaptation of things in nature. Is he not acquainted with the fact that this poison (if it be a poison) is what vegetables live on, and that they, under the influence of sunlight, consume it as fast as we produce it, assimilating the carbon and restoring the oxygen for animals to breathe and burn?

I have not the remotest fear of the effects of the exhaustion of our stores of coal, for if such a catastrophe were much more imminent than it really is, should we not discover a fresh fuel long before it took place? (I have an idea that we shall burn water before long). But at any rate, philanthropists need not torment themselves with the fear that the store of oxygen in our atmosphere is going to "give out," whatever they may think about the coal. SIRIUS.

GASSENDI.

[4523.]—Mr. NEISON has directed my attention to the south-western part of the floor of Gassendi, which he describes as a *dark patch* under high illumination. This, and indeed the whole of the southern portion of the floor, is interesting on account of the peculiar tint which it exhibits as compared with the rest of the floor. The part to which Mr. Neison alludes is *lower* than the rest of the floor, and is separated from it by a ridge on which the south-western of Schröter's two craters is situated. It is also lower than the adjacent surface of the Mare Humorum, from which it is separated by a low ridge stretching across the "pass" 22 in my sketch of Gassendi, Vol. XIV., p. 99. In Mr. Elger's sketch, Vol. XIV., p. 228, the southern part *a* is described as "darker than the floor." On this I remark that "coincident with the darker portion is a depression or hollow well seen at sunrise." Mr. Neison, under date of June 29, 1872, writes as follows:—The south-west portion at sunrise is perhaps slightly lighter than the rest of the floor, but as the sun rises the tint deepens until it becomes considerably darker than any portion of the lunar surface near. This spot is also noteworthy as being free from all ridges or mounds, and, as far as I can remember, free from all *streaks* at the sun's meridian passage. The rest of the floor of Gassendi becomes lighter as the sun's altitude increases, and is seen covered with streaks, and although it is not easy to observe them with precision, on account of the perplexing and irregular forms assumed by the ridges which are of similar colour, I think these streaks vary slightly in visibility. The tint of this spot may differ slightly in different lunations from alterations in the meridional solar altitude, or luni-solar declination, if I may so term it, but by comparing the tint with the rest of the floor of Gassendi and the Mare Humorum, which must vary from this cause in exactly the same manner, this difference must be practically eliminated, consequently I think we may assume that this spot is affected by solar altitude in exactly the same manner as Plato, and unlike a very large extent of the lunar surface by becoming darker instead of lighter as the sun's altitude increases." These remarks by Mr. Neison are highly interesting in connection with certain phenomena observed in Plato, and which may now be regarded as exponents of solar action.



On February 20, 1872, 7h. 10m. to 10h. 20m., the Rev. T. W. Webb specially studied the western part of the floor of Gassendi, which he sketched. The sketch preserved in his note-book is such an admirable companion to that of Mr. Elger, of March 5, 1868, that I forward a copy of it for publication, should you (Mr. Editor) deem it desirable. It is at a later stage of illumination than Mr. Elger's or Mr. Birmingham's, in No. 375, May 31, 1872, p. 277. The two projections *b* and *c* in Mr. Elger's sketch are quite distinct in Mr. Webb's. Mr. Birmingham's, which appears to be at rather an earlier epoch of illumination than Mr. Elger's, agrees with it in a larger extent of shadow from a portion of the western border, arising either from a hollow near the border or from increased height of the wall. Mr. Webb's sketch has a marking perfectly in accordance with the outline of the shadows in Mr. Elger's and Mr. Birmingham's drawings. Mr. Webb's sketch shows the retreat of the shadow from this marking. In his notes, Mr. Webb says: "The outpouring of the contents of the 'Spoon' over the floor of the larger crater was most evident; from want of half tones in the drawing, much less obvious there than in Nature." May I ask Mr. Birmingham if his feature *a* represents the outpouring mentioned by Mr. Webb? The depressed portion of the N.E. part of the floor of Gassendi is shown more or less in the three engravings; also the narrow opening in the S W. border of the "Spoon," through which it may be supposed the ejecta passed. Mr. Webb says "the much greater depth of the 'Spoon' is not exaggerated;" and of the three drawings, Mr. Birmingham's, being at the earliest epoch, brings out this feature with the greatest distinctness. In glancing at the remote history of Gassendi in selenological time, do we not perceive here in the "Spoon"—in the elevated mound forming its S.E. wall, more or less in the position of Mr. Birmingham's *b*; in the narrow pass of its S.W. border, and in the different aspects indicated by a different shading in Mr. Birmingham's sketch—evidences of explosive action, which, while confined to the N.W. portion of Gassendi, was accompanied either with the production or deepening of the "Spoon," and thus indicating that in studying the structure of Gassendi we have to take into account, as in other parts of the moon's surface, as well as on our own globe, successive instances of such action, separated, it may be, from each other by long intervals of selenological time? W. R. BIRT.

BALSAMED OBJECT-GLASS.

[4524.]—"C. B." (let. 4366, p. 358) will not find it answer to balsam two glasses if the curves differ much. It shortens the focus a good deal, and it is hardly possible to get the balsam hard or so homogeneous as to show properly. Where the curves are alike I have found it very useful, and it makes a considerable difference to the light. It is very easily done, and should not be hardened too much. Where this is not done I have not found any separation take place. Of course, any rough usage may produce it, but not fair care. E. T. S.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4525.]—MR. CASH (let. 4380, p. 355) is evidently so far from correction for achromatism with his object-glass that any suggestion for improvement must be useless until he has approached perfection in that respect. I have no doubt if he would only take the trouble to make it something like achromatic, he would find most of his strange phenomena vanish as if by magic. I do not fancy, either, that Mr. Oldfield is right in supposing the crown lens to be worthless from veins, for if so it would have been very difficult indeed for Mr. Cash himself not to have discovered them, as they are easily seen. I do not think, therefore, that he had better hastily throw aside his lens, but that he should alter its focus until the combination is properly corrected for colour. If he is determined to commence with new pieces of glass, I should strongly advise him to perfect a smaller glass as a model for further operations. With respect to the tools, Mr. Cash will find soft iron a very good material for grinding; but of course tools made of this metal are more difficult to finish than those made of brass, and they are rather apt to rust. It seems a pity when tools are properly formed and their radii ascertained that they should be re-turned; it would be better to preserve them for further use, as most probably if Mr. Cash should succeed with one object-glass he would not be contented until he had made another or two, and the tools already finished might be found useful, the serious operation of preparing new tools being thus, after a time, avoided. HENRY T. VIVIAN.

GOVERNMENT AND AMATEUR SCIENCE.—III.

[4526.]—IN my first letter I called attention to the unbroken series of the moon made under the auspices of the Government at the Royal Observatory, Greenwich, from its establishment to the present day; a great scientific work well worthy the patronage of the Government of a maritime and enlightened nation. In my second letter I glanced at the sources of patronage other than from the Government, and adduced the subject of binary stars as a branch of astronomy left entirely to amateur efforts. I now proceed to notice the little probability of patronage being extended generally to amateurs engaged in original scientific research. It is very rarely indeed that an amateur is possessed of such ample means that he himself can provide instruments, forms for registering, recording, and discussing his observations, and then presenting his results to the public in a *printed* form. In most instances gentlemen of fortune employ assistants to work out their views, and it is frequently the case that an amateur in the humbler walks of life enthusiastically devoted to the pursuit of science succeeds in obtaining an engagement with a gentleman involving duties in the discharge of which he not only satisfies his cravings for knowledge, but by the munificence of his patron contributes to augment the general store. All amateurs are, however, not so favourably situated. With small means and restricted leisure an amateur perseveres in the pursuit of knowledge, loving it for its own sake. It is this class of amateurs of all others that needs assistance, and that assistance may be rendered by the loan or gift of instruments, but more effectually by grants of money for some especial work. This suggests a notice of the channels through which such assistance may be administered. For this purpose there is nothing direct from the Government. Government aid to science is at present confined to Government establishments for working out definite scientific objects, or to Government expeditions for observing certain phenomena. It is true that a sum of £1,000 is annually voted to the Royal Society for encouraging original investigation. It is consequently the Royal Society that administers this and its other donation funds to the aid of such objects as may form the subjects of application, and an amateur to be a recipient of a portion of these funds must obtain the support of the majority of the committee appointed to administer them. Another channel through which assistance is rendered is the British Association for the Advancement of Science. At its annual gatherings sums varying in amount are voted by the General Committee to sub-committees appointed to superintend such scientific works as have received the consideration of the committees of the sections by which the particular branches of knowledge are cultivated. To obtain assistance through either of these channels, considerable interest is necessary. No doubt each application is thoroughly and well canvassed in the respective committees before a grant aiding the object is recommended; nevertheless, there is but little probability of an application meeting with success unless it be introduced and supported by gentlemen of known reputation in the particular branch of science with which it is connected.

Taking into consideration the large army of amateurs, and the very limited resources for aiding them, amateur science must at the very best be but *desultory*. While its triumphs have been great, perhaps, with the exception of the Government work at Greenwich, greater than any achieved by Government aid, still it has been of a desultory character, notwithstanding the societies which have been formed for its culture. Returning to the subject of binary stars, measurements of distance and position angles are comparatively easy, so that there is little fear of this branch of the science falling behind, provided there is an early publication of measures. It is here, at the outset, that we meet with want of system. Each observer chooses his own channel of publication, or it may be that he does not publish his observations at all, and they are ultimately lost. Now, before work in the second department can be efficiently accomplished, from this desultory mode of procedure, much labour must necessarily be incurred in looking through several publications, as the "Monthly Notices and Memoirs of the Royal Astronomical Society," and others, for records of measures which might be saved for the future by a little systematic arrangement, aided by a money grant for defraying the expenses of compiling and printing; the third department, that of computing the orbits of binary stars, requires a higher order of mind to cultivate, and must be left to the ability and convenience of gentlemen who are willing to devote their leisure to it. There can be no doubt that an autherised repository for the reception of double-star measures, with a provision for the issue of catalogues at stated intervals, would greatly facilitate the computation of orbits, and thus, with a moderate grant of money, the portion of astronomy devoted to double stars, while it remains as an amateur pursuit, would lose much of its desultory character, and assume that of a systematised branch of inquiry, a result within the reach of amateur astronomers, provided they set themselves energetically to the work.

W. R. Birt.

ARTIFICIAL MANURES.—STONE-COAL.

[4527.]—Stone-coal is a name used at Bridgwater for a smokeless coal or anthracite used by maltsters and for close stoves, coming from Wales through Cardiff, I think. I shall be glad to read further remarks from "Saul Rymea" on artificial manures. Has he any experience of the value of manure prepared on Mr. Moule's plan? I have tried blood manure, but am doubtful as to its value. Potash, I believe, exists in large proportion in the liquid manure of the stall and stye. If so, I have fully proved the truth of "Saul Rymea's" statement of the value of potash for the potato plant. The first experiment with this manure for potatoes arrested my attention by its success; so decidedly that I have not in twenty years forgotten the lesson. The excellent quality of the crop, the small percentage of diseased tubers and more than average weight, at a time when the disease produced its most disastrous effects, were remarkable. I thought at the time that manure, by promoting moderate but very healthy growth, gave the plant a power of resisting the progress of the disease, and every subsequent crop I have grown for many years has confirmed that impression.

Superphosphate applied last year to my failing crop of seedling onions at once revived the plant, and followed by a dose of house sewage, gave me an excellent and sound crop of onions on land which I am told has never, in my predecessor's time, produced a tolerable crop, if any crop at all, of this vegetable.

J. M. Taylor.

Seer Green Vicarage, near Beaconsfield.

THE NEGRO.

[4528.]—In confirmation of "Sigma's" remark (let. 4458), I quote the following from Sir A. Alison's "History of Europe," c. 47, p. 70:—"Jews are to be seen in many places (in India), whose Old Testament coming no further down than the Babylonish captivity, indicates that they have strayed to the east after that remarkable event." I quote the following from "The Races of the Old World," by Charles M. Brace (Boston: Scribner and Co.):—"A tribe of Jews is described by Mr. Tristram (quoted by Dr. Beddoe, Ethnological Trans., 1861), living in the oasis Waregla, about 32° north latitude, who are almost as black as negroes, without the slightest trace of negro features. Their lineaments are as distinctly Jewish as any clothes-dealer in Houndsditch. They were dark as the black Jews of Abyssinia; their hair was frizzled without being woolly. He considers the colour the effect of climate."

H. J. C.

[4529.]—Our learned "E. L. G." has made this question more interesting than I ever could have done, but the matter in hand—viz., the origin of the negro—still remains *in statu quo*, unless, indeed, by the Nephilim is meant a black-skinned people. But then I am placed in the dilemma of supposing that there were two distinct species of human beings on the earth—men and the sons of God. Which of these were descended from Adam? Josephus bridges this difficulty by stating the sons to be fallen angels. This I see agrees with the idea of heathen mythology having commenced with primal man (if I may use the term). If Adam was the father of these fallen angels, who was the father of the Nephilim? I do not deny, but I rather believe, that among Noah's posterity the Nephilim were continued, although called by other names, as Rephaim, Anikim, and the Sons of Anak, or of the Giants. There is no word of their being black-skinned, and, indeed, the fact that a white man could never produce a black progeny (supposing Noah's son to be their continuer) proves that they were not black. Some have questioned whether Adam was a black man, but his name implies otherwise. However, Josephus writes that Adam's third son, Seth, and his descendants, inhabited a country by themselves, were happy, studied astronomy, inscribing their discovery on pillars, one of which remained in the land of Syria at the time Josephus lived. This Seth or Sesostris he supposed to be a King of Egypt, and as the Egyptians were a dark, if not black, people, this seems to give some insight as to the origin of the negro. I know that Josephus is said to make a mistake in his supposition (the supposition may be more of ours than his); but considering what a truthful writer he was in general, and the opportunities he had of obtaining information from manuscripts now, alas! no more, may he not have been right? Of course, if we can palm off Seth as the great father of the black race, the question is so far settled; but how Seth become black himself we cannot know, although the knowledge of this secret might have been destroyed among a thousand others in the famous Alexandrian library. I ask some of "our" correspondents for some proofs of the great antiquity of man (one hundred thousand years is the latest estimate) in connection with the origin of the negro. Has he been considered at all as the maker of flint weapons or spear heads? Has a veritable negro's skull been found with them, for there would be no difficulty in deciding between a negro's cranium or a monkey's. I write this advisedly, for might not apes have had sufficient instinct to be able to make and use such implements? I think so even without consulting Darwin.

Fiddler.

PIANO IN CANADA.—To "H. D. W." and Others.

[4530.]—Weakness is far from being the only cause of pianofortes failing to stand well in tune. I believe that defect oftener results from the blows delivered by their actions (hammers) being too forcible for the weights and tensions of their strings to resist without becoming unduly stretched. The natural remedy for this is to substitute thicker and longer strings, or, what comes to about the same thing in practice, to tune the new thicker strings sharper, and thereby practically lengthen the scale.

If the instrument in the possession of "H. D. W." be a genuine Holdernesse and Holdernesse, which I rather doubt, I am very confident its complaint cannot be "weakness in the back," for I never yet saw a pianoforte made by that firm—I have examined some hundreds—whose back was not excessively strong in proportion to the tensile force of its strings. I possess an instrument of their make myself whose back has not been strengthened, the C's of which were originally of Nos. 21, 17, and 16 wire. I had them restrung with Nos. 25, 21, and 19, causing what "H. D. W.'s" Yankee neighbours would term a "pretty considerable" increase of tension. Perhaps, however, they, and my practical friends who manufacture pianos, may become surprised indeed when I tell them that besides the additional strain required to bring those unusually heavy wires up to pitch, I have since—more than a year ago—raised the pitch of the instrument until the strings originally struck by hammers moved by the A keys now sound C; in other words, it is a minor third above concert pitch, and its strings sounding middle C are now 26¼in. long, of No. 21 wire. Notwithstanding this very severe trial of its poor back, I can discover no symptoms of spinal weakness, and the instrument stands in tune admirably at its present high pitch.

Should "H. D. W.'s" piano really be weak in its back, there is no difficulty in administering what our respected fellow correspondent, Dr. Ussher, would term "tonic medicine;" in other words, in making it stronger, and I, being the physician "H. D. W." has "called in," now proceed to prescribe for it as under without indulging in unclassical "pharmaceutical Latin."

Considering that wood is easily procurable in his country, and the probability that "H. D. W." is more of a chopstick than a blacksmith, I would suggest that additional wooden bracings be introduced between the present ones, probably six or seven in number. If the new bracings be made of thick material, say 4in. or 3in., perhaps it will be found needful to groove them about ⅜in. wider and deeper than the belly-bars project into them; but, probably, if made of wood from 1½in. to 2in. thick, one new brace might be placed in contact with each side of every one of the present bracings, and leave room for the belly-bars between them. This would require double the number needed if thick wood be employed. In both cases the new bracings must be securely attached by screws or bolts to the wrest plank, to the bent side, and to the string plate, the latter being drilled or bored for the reception of the bolts or screws, and I need hardly add the new bracings must be firmly abutted under the wrest plank, and on the bottom, or on the string plate (if the instrument's back be made without a wooden bottom, and the lower ends of its braces in contact with the string plate, which is preferable). I think the best method of insuring sound abutments against both is to fit each brace accurately against the bottom of the wrest plank, and to insert a beech, or other hard wood, wedge, driving it in moderately tight, between the lower end of the brace and the string-plate or bottom. Of course the wedges must be formed correctly to the angle to which the bottom of each brace is cut, or rather a trifle more acute, so as to insure perfect contact between the bottom of the brace and the surface beneath it *at the front*, or part nearest the strings, which part is subjected to by far the greatest force of compression by their tension. "H. D. W." will find some useful information on strengthening cottage pianos in my rather lengthy article on the improvement of existing pianofortes, printed in Nos. 238, 239, and 240 of "our" journal.

Another method—described in the above article—by which the present wooden bracing may be strengthened is the application of bars of angle or T iron to their backs in the manner practised by the late Thos. Rolfe, about 1854. (See description thereof, in which it is so fully explained that I have nothing to add.)

Being a "blacksmith," I have a very natural proclivity to resort to iron for bracing pianofortes. For cottage instruments, especially those not originally designed to be braced in front of their soundboards, I consider the form thereof designed by Kohlman preferable to any other I have seen. "H. D. W." or any other man "standing in need" of additional support—I mean whose piano stands in need thereof, and therefore don't stand in tune—might introduce two or three iron bracings on Kohlman's system if they be constructed in the manner shown by Figs. 3, 6, and 7, fully described in Nos. 362 and 365 of the English Mechanic; but probably the space between the strings of each note—especially if a trichord instrument, which is very unlikely if it be a genuine Holdernesse—is not sufficient to admit a steel plate, O, ¼in. thick. To obtain the requisite strength, it may be made taller and thinner, say 3in. high by three-sixteenths of an inch thick. Messrs. Holdernesse (probably for facilitating the shifting of the hammers so that they may strike single strings fairly) ordinarily place their unisonous strings rather wide apart; consequently, even in their bichord instruments, the space between the uncovered strings of two consecutive notes seldom much exceeds three-tenths of an inch.

Unless "H. D. W." has had considerable experience in the art and mystery of "toning," I would not advise him to "meddle and muddle," or rather "needle" up the coverings of the hammers of his piano. Strange to say, although not difficult to do, this is a thing few tuners—or indeed any other men—do satisfactorily, and I have observed it is far easier to most of them to mar than to make the tone better. This I learned long ago by woeful experience to my cost. Picking up the top surface, however much it may temporarily improve the quality of the tone, don't last long, neither does glass papering, or brushing the surfaces of the hammers with wire-card or bristles. The proper method is to insert the needles considerably within the striking surfaces, and manipulate them *secundum artem*, which artistic manipulation, alas! is just the thing most tuners can't do. I learned this art of our late fellow correspondent "W. T.," who was a remarkably good toner as well as tuner, and he learned how to do it properly from a gentleman who then (many years ago) was intrusted to "tone" Messrs. Broadwood's grands, so we may be certain he had the advantage of having a good instructor. I may add that, being a clever fellow, he "bettered the instruction" in some details.

Harshness in the quality of the bass tones is often a consequence of *deficiency* of tension. In most pianos the strings of the lowest F—usually the lowest bichord note—are seldom tight enough to produce powerful and firm sounds, and but too often they will bear their pitch raised to A, or even to B. In an instrument whose 12 lowest strings did not differ much in length, and the covering wires of which were rather far from the bridges, I promoted—they were not gazetted—all the bichord covered strings from FF to G, 14 notes, in manner following—that is to say, the strings of—

G to G♯	C♯ to D♯	G to A♭
F♯ to G	C to D	F♯ to A
F to F♯	B to C♯	F to G♯
E to F	A to C	
D to E	G♯ to B	

Two pairs of new strings covered more heavily being used for F♯ and G.

I disposed of the single strings thus (they were all covered on No. 21 wire):—

The strings of D♯ and E were exactly alike, so I made of them an excellent pair for F♯.

The strings of D and D♯ were exactly alike, so I made of them an excellent pair for F.

The string of C♯ served for E.

The string of C served for D♯.

The string of B served for C♯.

The string of A served for C.

Three new strings heavily treble covered on No. 24 steel wire were made for the three lowest notes, and they are the finest bass notes in the piano. Probably I need not inform any practical man that I could not have taken such liberties with the strings, had not their tension originally been considerably less than it ought to have been. The increase of power and improvement in the quality of the tone which resulted was very remarkable in the two lower octaves, so much so that I doubt if the maker could have recognised his own handiwork by its sounds.

Shifting strings is a very ticklish operation, and unless performed in what an old workman I formerly knew termed "judgmatically," is almost certain to break them at the part uncoiled from the wrest-pin, but I believe skill, patience, perseverance, and last, not least, money, will, in time, as the late Sir Isaac Coffin said, accomplish all possible, and many so-called impossible, things. I found by costly experience that the "judgmatical" way of taking off a string was to pull it sideways from the pin pretty strongly while turning the wrest-pin backward, which it is seldom needful to do much more than half a revolution (the less the wire is uncoiled the better); having done this insert a pointed piece of steel—a strong marking awl serves admirably—into the top of the coil, and prise the bent end of the string out of the hole in the wrest-pin. The string may then be taken off. Should its intended new position require a string the same total length, or but one or two coils round the wrest-pin shorter, don't cut anything off its length, but merely slip the coil over the previously inserted wrest-pin, by which it will be turned; insert its bent end in the hole thereof, and "put on the screw"—I mean draw him or her up (for I forget whether a piano string is, in workshop parlance, masculine, or, like a ship and a steam-engine, feminine).

N.B.—This wrinkle is worth knowing, even by those eminently "practical" (and of course scientific) men, ye tuners (who I found when employed to shift some of the strings of a piano usually broke a much larger proportion thereof than even the "unpractical" blacksmith himself did, and who, although not exactly what is termed a "screw," has a wholesome horror of all waste), for it might save tuners some expense when shifting the strings of any piano which is their own property. Of course, if the piano belongs to a customer it don't matter how many covered strings are broken, for, by the custom of the trade, they, like children, must be paid for. In that case, the case of the piano, I mean the case of its strings, becomes very like the case of the nails which was a sort of "packing" case, concerning which the 'cute carpenter's apprentice afforded the individual at whose cost the works were being executed, the very satisfactory information that although swept away with the rubbish they would not be lost, because "you will find them all (packed) in the bill." Well, I suppose, all this kind of thing makes good for trade, to-wit, the trades of the pianoforte manufacturer and covered string maker, but it is rather queer political economy.

THE HARMONIOUS BLACKSMITH.

PERSPECTIVE.

[4531.]—I AGREE with much that "M. A." says (let. 4428, p. 388). I was speaking rather of the proportions of individual objects than of the relative scale of many different objects included in a single picture. My chief object in writing was to show that theoretically as well as practically, all lines really vertical must be drawn parallel in a picture, and that the convergency imagined by Dr. Carpenter is simply an absurdity. To reason on the matter seems almost equally absurd, but the actual mathematical proof may be given somewhat as follows:—Let A and B be any two vertical right lines; C, the plane of projection also vertical; P, the eye of observer. Then lines from P to A lie in a plane (Euclid XI., 3); and this plane is vertical (Euclid XI., 18), and therefore intersects the vertical plane C in a vertical right line (Euclid XI., 19)—that is, the projection of A is a vertical right line. In like manner the projection of B is a vertical right line. These projections are therefore parallel right lines (Euclid XI., 6). *Q. E. D.*

RICHARD A. PROCTOR.

DR. CARPENTER AND PERSPECTIVE.

[4532.]—IF you are not tired of this subject, I should like to ask M. Paris for an explanation of his letter (4427, p. 388). What is the fact, and with whose theory does it agree? I have a vague idea that he means he has made a drawing on a sheet of glass, and finds it agree with his theory. If so, I am puzzled to know how he did it, and think he ought to send you a copy of the drawing, so that your readers may have the benefit of his discovery.

"M. A.," in his letter (4428, p. 388), introduces a new subject which is very interesting, but has nothing to do with perspective. If there is any particular object in the view which the artist wishes to impress on the mind of the public, he may enlarge it as much as his conscience will allow him, but if he draw it out of perspective, it will certainly convey a false idea of its form. There is no doubt that photographs of distant mountains do not convey a correct impression of their magnitude, but place a pair of them in the stereoscope, and the mountains immediately assume their right proportions, which shows that each photograph must have been a correct representation of what each eye saw. The position of "violent perspective" may be avoided by the artist, but if he try to "temper or modify" the perspective, the result must be failure to represent the reality. As, however, the public do not have the real view by the side of the picture to compare with it, they do not care so long as the picture is good in itself.

B. D. T.

[4533.]—I AM curious to know whether among artists the attempt of Cruikshank to picture a converging, or I would rather say tapering, giant, is considered such a "complete failure," as Mr. Proctor seems to think it. To my eye the effect is not so absurd, and although I confess to no great feeling of awe when looking at the striding monster, I think that if the picture itself were considerably enlarged and more space allowed for him to stride in, the giant would look decidedly imposing. "E. L. G." (let. 4189) dwells upon the rectification by the eye of objects or lines on paper. Admitting that it must rectify to some extent, and of course allowing that "at the point of sight perspective is perspective, and absolutely true," I yet find that the eye in some cases will not sufficiently rectify to set distorted things aright. To take the old case of a series of columns viewed from the front in so-called parallel perspective, and drawn within the limit angle of 60°. As every one knows, the columns either way from the centre turn out thicker, whilst being further from the eye they should be thinner, nor will the eye, from the point of sight or any other point fully rectify the distortion. It is a perspective, and perfectly correct as such, but not a representation of what appears in reality. A common thing among draughtsmen is to take part of a circle for the plane of projection in order to avoid errors of this kind. On letter 4427 I would remark that it is time the illustration of tracing on a sheet of glass found in so many books on perspective were dropped. It involves an impossibility, since the eye cannot focus the objects beyond the sheet and the points on the sheet at one and the same time.

A. C. G.

ON THE CATALYTIC ACTION OF SPONGY PLATINUM.

[4534.]—I THINK I cannot better answer the questions of "H. H. G." addressed to me than by a short letter on the above subject.

That property of platinum of causing the combustion more or less rapid of combustible gases mixed with air, we call "catalytic" or "contact-action," because the platinum has no chemical attraction for the gases in question, but causes their combination without any change in itself.

This property is not peculiar to platinum, but is exhibited in a less degree by some other substances, chiefly porous bodies or metals in a fine state of division. But the property is more marked in platinum, not only in the spongy state, but when in sheet or wire. If a platinum crucible be heated to redness over a Bunsen burner, the gas quickly extinguished and turned on again immediately, the bottom of the crucible will continue at a red heat for hours, without ignition of the gas, by its slow combustion. But by obtaining it in a spongy state, by heating to redness ammonic-platinic chloride, a far greater surface of the metal is exposed to the action of the gas, and a greater catalytic activity is the consequence.

This property depends, doubtless, upon the power of platinum to absorb or "occlude" these gases, and thus bring them into a state in which they can more readily unite. It has been thought that this peculiar state is really an electric change in the condition of the gases, but it seems reasonable to conclude that, whatever it be, it depends upon this property of "occlusion."

A mixture of hydrogen and air (as in the hydrogen lamp), impinging on the surface of the finely divided metal, slow combustion (*i.e.*, chemical combination of hydrogen and oxygen) sets in, gradually accelerated as the temperature of the platinum is raised by the combustion, until eventually (and this is the work of a few seconds) such a temperature is reached that the mixture of hydrogen and oxygen between the jet and the platinum combines with a slight explosion, and ignites the hydrogen as it escapes from the jet. It is well known that, in course of time, the sponge loses somewhat of its activity. Whether this arises from the absorption of water, or whether the intense heat to which it is subjected condenses the metal and lessens its porosity, I am not certain. I have revivified it (so to speak) by heating to redness, but generally find it easier to replace it with some freshly-prepared sponge. I trust that "H. H. G." will see in this an explanation satisfactory to him. If he wishes to enter into a theoretical consideration of the phenomenon, he should read in Watts's "Dictionary" the articles on "Contact-Action," and "Absorption of Gases by Metals."

ANALYST.

ERRATUM.—In letter 4481, p. 411, *for* "few moths come out," *read* "few moths come to light much before midnight."

Obituary.—The death is announced of Mr. Ernest Theophron Chapman, a chemist well and favourably known by sundry original investigations presented to the Chemical Society, but more especially from the process of water analysis designed by him in conjunction with Professor Wanklyn. Mr. Chapman had accepted the post of director of a wood-distilling works in the Harz, and on June 25, whilst preparing some explosive compound for the use of miners, an accident occurred, which sent a promising and talented student of science to a premature grave. Mr. Chapman was a contributor to these columns during his residence in England, and although only twenty-seven years of age, had already attained an honourable position in his profession. His untimely fate will be regretted by many; for in his death Science loses one of the brightest ornaments among the ranks of her younger devotees.

A New Dryer.—M. Mène states that if 12 parts of best shellac and 4 of borax are dissolved in 100 parts by heat, and when cool, mingled with turpentine, an excellent and rapid dryer for oil paints will be produced. The solution may also, he says, be used as a varnish.

EXTRACTS FROM CORRESPONDENCE.

The Suspended Shilling (Qy. 12155).—It strikes me that "another reason" is still wanted to account for a similar phenomenon. How is it that if you carefully cut off the flower-stalk of a dandelion when the seed is nearly ripe, and blow three times, the number of seeds left on will correspond with the strokes of the parish clock? Isn't this a scientific fact, known to all the professors of buttercup-gathering in the world?—SAUL RYMEA.

The Negro.—I hope those who write on this question won't forget the *wool*. I do not speak positively, but I believe that no other race of men, *black* or white, have hair possessing the peculiar characteristics of the negro's wool. There is also a peculiarity, I think, in the joint of the leg and foot.—SAUL RYMEA.

Dr. Packman's Steam Engine.—"One" says: —"This engine must be a very clever invention, if everything stated be correct. But there is an engine very similar to it, which Dr. Packman would, perhaps, like to see. It is constantly at work. There is neither smoke, coals, nor water tank; it has a chimney, though. It is on four wheels, being of the shape called portable, and is out of doors all weathers; and I have not the least doubt, if Dr. Packman will visit Messrs. Howard's Agricultural Implement Works, Bedford, which are thrown open to visitors free, with the option of giving something to the sick fund, and inquire for the above engine, he will see something which, perhaps, resembles his own."

Tannate of Soda as a Preventive of Boiler Incrustation.—"Tyne Engineer" says:—"I notice in No. 378 that a composition, 'tannate of soda,' is used in America for removing and preventing scale in boilers; also the remark that none is made or imported into England. I have used this tannate of soda for upwards of 2½ years, which answers all my purposes, and which is now manufactured largely on the Tyne for the said purposes, and making its way most wonderfully."

Piano Alliance.—I wish to suggest that the Piano Alliance, or Club, should have a wider range in its objects, and should be, instead, a Piano, Harmonium, and American Organ Club.—V.

USEFUL AND SCIENTIFIC NOTES.

A Story of the Sea.—American papers state that the Agassiz expedition, at the latest accounts, was off Sandy Point, Patagonia, and that among the scientific curiosities noted by some members of the party were immense quantities of kelp. This is the largest known alga or seaweed, and grows on these coasts in from 6 to 20 fathoms of water, in vast beds, warning the mariner to beware a near approach, unless he wishes to be entangled in an inextricable network. It throws up from the oceanic depths stems of immense length, some of them from 700ft. to 1000ft., the greatest development reached by any member of the vegetable race now in existence. Patches of this seaweed were passed in open sea, with large sea-lions lying on its surface, who were apparently navigating in this novel manner with much satisfaction to themselves, and afforded much amusement to their scientific observers.

Storing Wheat and other Grain.—M. Lovel has brought before the French Academy a plan of storing wheat in portable sheet-iron granaries, in which a vacuum is maintained equal to at least from 3in. to 4in. of mercury, this being found sufficient to destroy all insect life (although a more perfect vacuum is preferred) and to insure the evaporation of any moisture in the grain. The apparatus is of cylindrical form, placed vertically, and with convex top and bottom. The top is provided with an opening through which the inlet of the grain is led, with a valved pipe through which the air is exhausted, and with a gauge by which the degree of exhaustion is indicated. The grain is removed through an opening in the bottom. In one experiment, where living insects were introduced in large quantities with the grain, it was found that they were all killed before doing mischief, and at the end of six months the wheat was found to be in as fine condition as at the outset.

Brandy from Sawdust.—In the immense lumber districts of the United States, where the great industry is that which goes on in the saw-mills, the sawdust that accumulates is worse than of no value, for some cost has to be incurred in removing it. The Commissioner of Agriculture, in his last published monthly report, states that the sawdust can be made to yield, under distillation, a good article of brandy. Pine and fir timber being the varieties of timber most plentiful in these regions the method of treating them is described, but it is added that, in all probability, many other kinds of wood would prove better adapted than pine and fir to the production of brandy. The sawdust of the pine and fir timber is mixed and moistened; then to 9 parts of moist sawdust there are added 33·7 parts of water, and ·7 parts of hydrochloric acid, so as to make 43·7 parts in all. These are boiled under steam pressure for 11 hours, when it is found that 19 per cent. of the mass is grape sugar. The acid is neutralised with lime, and the mash is supplied with yeast. After 96 hours' fermentation the distillation proceeds, and the brandy that runs off is perfectly free from the smell or taste of turpentine. The *Chicago Tribune* remarks upon the statement of the Commissioner of Agriculture that the preparation of spirit from waste sawdust is actually easier than from valuable grain.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10644.]—**Angle of Incidence and Reflection.**—At the request of "Jack the Flukeman," I have much pleasure in forwarding a few of the experiments of M. Athanase Dupré. I shall be happy to send more, but I am afraid the room they would occupy would be objected to. As the few I have sent are sufficient to establish the principle that the co-efficient of restitution diminishes with the increase of velocity and weight of ball, and as they are not, in so far as I am aware, to be found in any work in the English language, they may be acceptable to some of the readers of the ENGLISH MECHANIC. With regard to "Billiardist's" problem, I did not pretend to solve it—in the first place, I am sorry to say, I know little or nothing of the game, or the meaning of some of the terms used. I simply stated that it was a mistake to attribute the cause of the particular motions indicated to an increased momentum of ball, causing an increased co-efficient of restitution, as all experiment proved the contrary. I hinted at what I thought might be one cause, but not being sufficient of a billiard player to know the effects of the various ways of hitting the balls, the amount of rotary motion thereby communicated to them, the effect of the friction of the table, the amount of rolling motion thus communicated, the effect of the soft elastic cushion as compared with a hard elastic body in varying the ratio of angles of incidence and reflection, &c., I hoped that some one more qualified would take the matter up, but I have not yet seen a proper explanation given.

Extracts from Experiments made by M. Athanase Dupré on the Collision of Ivory Balls.

Balls employed in the experiments:—

No.	1	2	3	4	5	6	7
Diameters	1·24	1·47	1·71	2·07	2·12	2·21	2·38in.

Also a black marble slab 37in. × 13in. × 2·2in.

FIRST SET OF EXPERIMENTS.—The marble slab being horizontal, the balls were let fall from various heights h, rebounding to the heights h^1, given in milimetres, carefully measured by means of cathetometer:—

Ball No. 1. h	h^1	$\frac{h^1}{h}$	$v = \sqrt{\frac{h^1}{h}}$	Ball No. 2. h	h^1	$\frac{h^1}{h}$	$\sqrt{\frac{h^1}{h}}$	Ball No. 7. h	h^1	$\frac{h^1}{h}$	$\sqrt{\frac{h^1}{h}}$
mm. 20	16·00	·810	·894	mm. 20	14·25	·712	·844	mm. 20	13·77	·688	·829
40	31·48	·800	·887	40	28·33	·708	·841	40	27·03	·676	·822
60	46·33	·787	·879	60	42·00	·700	·837	60	40·10	·667	·817
80	60·38	·772	·869	80	55·42	·693	·832	80	52·43	·655	·809
100	74·08	·755	·861	100	68·89	·689	·830	100	65·03	·650	·806
120	87·37	·741	·853	120	81·80	·682	·826	120	76·83	·640	·800
140	100·30	·728	·846	140	94·75	·677	·823	140	88·47	·632	·795
160	112·72	·716	·840	160	107·4	·671	·819	160	100·00	·625	·791
180	125·83	·705	·836								
200	138·60	·699	·833								

From experiments with ball No. 1 we get $h^1 = \cdot 799083\,h - \cdot 000554\,h^2$. Ball No. 2, $h^1 = \cdot 71425\,h - \cdot 000268\,h^2$. Ball No. 7, $h^1 = \cdot 68575\,h - \cdot 000380\,h^2$.

SECOND SERIES OF EXPERIMENTS.—Same marble slab, placed vertical, and balls suspended from ceiling by threads 10ft. 2in. long, so that when at rest they just touched the marble; the balls were let go at various angles v, and the angles v^1, to which they rebounded, carefully measured with the following results:—

Ball No. 1. v	v^1	$\frac{v^1}{v}$	Ball No. 2. v	v^1	$\frac{v^1}{v}$	Ball No. 7. v	v^1	$\frac{v^1}{v}$
49·1	45·5	·927	50·0	46·0	·920	20·2	18·2	·901
99·8	92·2	·924	99·8	91·4	·910	70·2	61·8	·880
199·0	180·5	·908	199·3	179·8	·903	170·1	145·6	·856
297·8	264·1	·887	298·4	264·5	·886	269·8	226·6	·840
396·2	350·9	·886	397·1	351·2	·884	369·4	303·0	·820
494·0	433·9	·878	495·5	432·6	·878	468·0	380·0	·812
592·8	509·1	·859	594·5	504·5	·849	568·3	463·0	·815
690·2	587·7	·852	692·5	586·2	·846	667·5	536·5	·804
787·2	669·7	·851	790·1	668·2	·846	766·7	606·9	·792
883·8	746·3	·844	887·5	741·3	·835	865·7	681·0	·790
980·0	819·0	·836	984·6	815·5	·828	964·6	753·6	·781

v and $v1$ are the lengths in millimetres of the arcs of approach and rebound, and consequently are proportional to the respective velocities with which the balls strike and are reflected.—F. N.

[11589.]—**Dry Steam.**—"Superheated steam" (as our engineers term it)—*i.e.*, "dry" or drying steam—cannot be defined as "merely a higher pressure steam;" and "A." has not yet apprehended their meaning in the least, or he would not say that the "superheated" necessarily "contains more heat and less water in a given bulk," but would know that either wet or superheated steam may be of any density, any temperature, and any pressure. His new question is whether I suppose additional heat can be applied to steam "without converting it into higher pressure steam." Yes, to steam apart from water, it certainly *can*, provided the steam have room to expand; but to steam in contact with water it *cannot*. This is the essential distinction he has to keep in view. In a boiler there can never be superheated steam, raise the temperature as high as you will, so long as there is any water; for steam, to be superheated, must be heated away from water. Suppose now you have a boiler and its steam-chest, but at any moment you close all connection between them, the steam in each being of course identical, say of 250° temperature, and therefore 30lb. pressure (against vacuum). Now, let both be equally heated till one, the boiler, has its steam at twice this pressure, or 60lb. (against vacuum), which will happen, according to "Philo," p. 386, by heating it 46°. What does "A." suppose will be the pressure in the equally heated steam-chest? It will be under 33lb. instead of 60. The same heating that has doubled the elasticity of the wet steam has not added a tenth to that of the steam having no access to water, which it has made "superheated" or *dry* steam; indeed, in the language of meteorologists, steam "of 46° of dryness," or about the utmost dryness ever measured in the atmosphere of deserts, either under African sun or Siberian frost. Atmospheric steam (which "Caloric" will find by no means "a new term," but the correct and only name for the air's condensible part, used by Herschel, Glaisher, &c.) is always, unless in a raincloud, superheated one or a few degrees; that is, it has a few "degrees of dryness," rarely 10° in England; but there is no limit to the degrees of dryness possible in steam, as thus expressed, or the degrees of "superheating," as engineers say. There is another mode in which drought and moisture, indeed, are sometimes denoted, by percentage of saturation, so that 30 of drought means the same as 70 of moisture—namely, that there is only 70 per cent. of the pressure of steam that would be possible at the actual temperature; but statements of this kind are very uncertain, and though Glaisher has published an elaborate set of tables for estimating them, the real percentage, or the weight of steam present in a cubic foot, are really hypothetical till more shall be known of the law of density in steam near saturation, which is very different from that of elasticity, or from the gaseous law prevailing approximately in steam superheated more than 10°, and more nearly the drier it is. The only reliable way as yet of defining dryness is by the thermometric degrees the steam is superheated, or how many degrees its actual temperature exceeds its "dew-point," or the degree to which bodies must be cooled to condense it, or be wetted by it. Now, in the above steam-chest, the temperature we have supposed 296°, but the steam is no denser than when it was at 250°, and the chest or part thereof would have to cool to 250° before any would condense into water or dew. It is, therefore, at 296°, rightly said to be 46° dry. But the boiler steam, also at 296°, has not a single degree of dryness. If cooled to 295°, some would condense. It is simply wet steam. Atmospheric steam, where it is not raining, is dry steam (and usually some few degrees dry), even if resting on the sea, because it is not in equilibrium therewith, or does not prevent the sea evaporating. But the water in a close boiler, as long as its temperature is constant, is not evaporating at all. At 296° the steam has a certain density, and the rest is water. Not another particle of the water can become steam till either steam is let out or the temperature rises; as truly as not a particle of the steam can fall as liquid till either the temperature is less or the boiler's capacity reduced. "Caloric" and "A." must therefore observe that wet steam and dry or "superheated" steam may each be of any pressure, any temperature, and any density; but in wet steam these three are so connected that when one is given both the others are fixed, while in dry there is no such fixity. Thus, wet steam, to have double the atmospheric pressure, must be of 250° Fahr., and weigh a certain number of grains per cube foot. But steam weighing less than those grains may have that same double atmosphere force if it be hotter than 250°. It will not then be wet, but dry or superheated steam, and the degrees above 250° be its degrees of dryness or superheating. On the other hand, no steam, below 250° can have this elasticity, nor the density of the wet 250° steam, though it may have that of dry double atmosphere steam of a certain degree of dryness. All wet steam (and, therefore, boiler steam) is the coldest that can be either so dense or so elastic, and the densest that can exist with no greater heat, and the most elastic with no greater heat. Dry steam of the same pressure will necessarily be both hotter and less dense, but dry steam need not have the same pressure, nor any fixed pressure, or temperature, or density. In the case above supposed, the boiler steam and that of the steam-chest, both at 296°, would have their densities as 2 to 1, but pressures only as 60 to 33. Again, in the steam-chest, as originally shut off, at 250°, and as heated to 296°, the wet and dry steam are necessarily of the very same density, but the latter one-tenth more elastic, from containing more heat and no less matter. If allowed to expand one-tenth, without loss of temperature, it would be at the same pressure as it was at 250°, but contain more heat and less water in a cubic foot, being still superheated steam of 296°, and 46° of dryness. It might expand also to the low density and pressure corresponding to wet steam of 100° or of 0°, and would then be 196° dry, or 296° dry. So, if the steam in the air have only the density and pressure of wet steam of 32°, but its actual temperature be 40°, it is said by meteorologists to be 8° dry, which is the same that engineers mean by 8° of superheating. Now, when the atmospheric steam is a few degrees dry (as it usually is even in England), high pressure steam superheated many degrees (as Mr. Lee's appears to have been) would escape without forming visible cloud, which is all that "Caloric's" phenomenon (p. 106), seems to imply.—E. L. G.

[11650.]—**Black Varnish for Microscopic Objects (U.Q.).**—In answer to this query, which seems to have been overlooked by "our" more able microscopists, the best varnish I know of, for general use, is asphalte and gold-size in equal quantities. When made rather thicker it may be used as a cement for shallow cells for dry mounts, and has a very neat appearance. Asphalte is sometimes used alone for the above purposes, but is more likely to "fly" than if used with gold-size. For making cells of any kind of cement, a turntable is indispensable, as it is almost impossible to build a neat cell without it. It is thus described by Davies: "On Preparing and Mounting Microscopic Objects.—At one end of a small piece of hard wood is fixed an iron pivot about ½in. thick, projecting ½in. from the wood, which serves as a centre upon which a round brass table, 3in. in diameter, revolves. On the surface of this are two springs, about 1½in. apart, under which the slide is forced and so kept in position, whilst the central part is left open to be worked upon." Two or more rings are engraved on the table, which are useful in determining the size of any circle to be drawn. A few camel's-hair pencils and a little practice are all that is then required.—C. W.

[11742.]—**Painting Iron Bedstead.**—For the first coat reduce white lead to a working consistency by addition of equal parts of turpentine and boiled linseed oil; for second and third coats, use turpentine alone as a vehicle, the small quantity of oil with which the lead has been ground will be sufficient to bind it. Mix fresh paint for each coat, and allow each to dry well before the next is put on. A small quantity of blue is sometimes added to prevent the tendency to turn yellow. The paint mixed and applied as above will be beautifully white and flat, that is without gloss; should a glossy surface be desired, it may be varnished with clear copal varnish. Instructions for gilding and bronzing will be found at p. 168 of this volume, and gold-powder, which must be applied as directed for bronze, can be obtained of Messrs. Brodie and Middleton, who advertise in the same number. This powder is used for illuminating, and also in the manufacture of the finer descriptions of paper-hangings. To prevent the gold sticking where it is not wanted, the work may be washed over with diluted albumen before the application of the gold-size; the albumen and superfluous gold is removed when the gilding is finished by the aid of a sponge and clean water.—EDINON.

[11766.]—**Piano in Canada (U.Q.).**—A reply from "The Harmonious Blacksmith" appears among the letters.—ED.

[11773.]—**Cleaning Plain Blue Silk (U.Q.).**—Wash and pare some potatoes, cut them into small pieces, and cover with cold water. Let them stand five or six hours, pour the water into another vessel, and with it sponge the silk on the right side, rubbing briskly till clean; then, when not quite dry, smooth on the wrong side with a hot iron.—AJAXEA.

[11879.]—**Thermopile (U.Q.).**—I would advise A. C. Lowe to try bars or wires of German silver and iron for his pile instead of bismuth and antimony. They will be much cheaper and easier to work, and they produce a current of considerable power.—SIGMA.

[11883.]—**Sustaining Weight of Cast Iron Column (U. Q.).**—A solid column of the given dimensions will safely bear 165 tons. A hollow one, having the metal ½in. thick, will safely bear 84·5 tons. —EXCELSIOR.

[11892.]—**Steel Combs** (U. Q.).—I beg to inform "Dusty Miller" that they are made with steel pins or teeth and a metal back, composed of equal parts of lead and tin. The pins or teeth are placed in a mould, and the mixture run on them afterwards. They are dressed with a file. As "Dusty Miller" is not very explicit respecting how many teeth he wishes to put in his combs, or what length he wishes to make them, I am unable to inform him as to size of wire, &c.—R. H.

[11893.]—**B. Sc. of London** (U.Q.).—Professor Oliver's "Botany" (Macmillan), thoroughly got up, together with Dr. Lindley's pamphlet on "Descriptive Botany," are sufficient for the pass examination. The two plants given have to be described only, and Lindley's will do this well. Huxley's "Introduction to the Classification of Animals" will suffice for the zoology; but if thought too concise and dry, Nicholson's "Zoology" is excellent. A little physiology must be studied too, and for this Huxley's little book is by far the best.—SIRIUS.

[11910.]—**The London Encyclopædia** (U.Q.).—This valuable work, published by Thomas Tegg, was completed August, 1829, in 22 volumes, price £18, and was obtainable at the publishers, 73, Cheapside, London, as it probably is now.—THETAMU, Horsham.

[11984.]—**Tea Testing.**—As no one has replied to this query up to the time of writing, I venture to send what I know of the matter. The only method, then, of testing tea is by the taste, in the ordinary manner of the brokers or "tea-tasters." I do not see how any machine or chemical could possibly be introduced into the question. The value of tea is governed by its flavour, and men are paid good salaries for "tasting" it previous to buying for the firms employing them. Of course, "stomach" or "mouth" out of order, the "tea-taster" can't do his work, and it is partly in consequence of the self-denial he has to put in force that such large salaries are paid.—SAUL RYMEA.

[11990.]—**Ice Making.**—There are several machines suited to the requirements of "Anon." Many of them have been noticed in the ENGLISH MECHANIC, and to farther specify them would be very much like advertising. Carré's and Tellier's are tolerably well known, and serviceable machines.—E. M.

[11997.]—**Warming Greenhouses with Gas.** —To "HOUBLON."—I am exceedingly obliged to "Houblon" for his reply to my query in the number for June 28th; and as the cost of gas appears to be so low, I am inclined to try his plan, which I will do next autumn. If he can favour me with a drawing within the next two months or so, he will confer a favour on —H. B. E.

[12007.]—**Purification of Iron.**—How does Mr. Buel expect to utilise the superheated steam in purifying iron? The hydrogen *might* combine with the sulphur and phosphorus; but how about the oxygen? The process has never been used.—MIDDLESBRO.

[12013.]—**The First Watch and Clock Made.** —It seems to be rather difficult to prove when the first watch and clock was made, although we have some accounts of old dates on many watches. I have heard many tales of how time was measured previous to watches or clocks being heard of. It is said that some of the ancient kings had candles made to measure time, by means of figures placed on the outside, which indicated the hours as the candle burnt down; and I have heard of time being measured by means of a jar of water. The jar had a small hole in the bottom, and figures running down from the top to the bottom (inside), and when the jar was filled with water it escaped from the small hole, which of course lowered and indicated the hours from the figures inside. Another very ancient method was the sand glass, the sun and moon dials, &c. I have heard it said that the first clock made went by the force of water, something like our country mills at the present day.—A GLASGOW HIGHLANDER.

[12017.]—**Electro Iron.**—Does not the article on p. 54 supply the information required? If not, specify what is required, and I will try to explain.—ANODE.

[12033.]—**Waterproof Fishing Socks.** — Get some sheet indiarubber—that with a canvas or linen backing. Cut out the socks, stitch the edges, and cement all down with rubber dissolved in naphtha. You can buy the solution ready prepared. If you do not comprehend, write again. Rubber solution laid on canvas would not be "too sticky," but the prepared sheet is much better and cheaper.—E. M.

[12054.]—**The Needle Lock.**—No very detailed description of this lock can be required. It consists essentially of a number of steel wire springs or needles so arranged on the bolt, that when the proper key is put in they are lifted so as to enter holes in a plate, and allow the bolt to be shot back. A number of depressions or dummy holes are made in the plate, so that any attempt to tamper with the lock is foiled by the springs or lever bars entering the dummy holes, and so rendering it impossible to get the bolt back. It is one of the best locks ever invented, for only a key made for it will open it.—SAUL RYMEA.

[12090.]—**Strawberries.**—I think that the chief reason for consolidating the soil in which this plant is grown consists in the suitability to the requirements of the roots thus attained. Stone fruits in like manner thrive in extremely hard ground, forming hard fibrous roots, highly conducive to health and fruitfulness. It is an important part of the gardener's art to study the requirements of different plants in this particular. Potatoes like a comparatively open condition of the ground, yet if too open a total failure of the crop may result. I experienced this a few years since, when my potato-ground included the site of an old hayrick, and the rubbish dug in prevented a proper settlement of the soil. Nothing could look more promising than the plant, and no case of failure in produce more total. Stems half an inch thick; roots long and tough, with a very firm hold of the soil; potatoes the size of peas or beans, distorted in shape. These were the singular features of the case, and the same thing has been experienced in this neighbourhood by using abundance of dead leaves as a manure. It seems that a certain amount of resistance is necessary for the swelling of the tubers. Mr. T. D. Fish has, on this principle, advocated the use of the garden-roller and paviour's rammer on the seed-bed intended for onions. I have used an iron rammer to consolidate the soil in boxes for stone fruits with very encouraging results. I have found that digging between the rows of potatoes during the early period of their growth favours that growth greatly, but I intend to try the effect this year of hard treading close to the stems on a small plot of late potatoes about the time of the swelling of the tubers. I am inclined to think this will tend to prevent the distortion of such sorts as Sutton's red-skin. It is worth a trial. Perhaps some of your correspondents will try the same experiment.—Rev. J. M. TAYLOR, Seer Green Vicarage, near Beaconsfield.

[12092.]—**Curl in Peach.**—"Derf Errac" will find his trees look very different if, just before the buds break, he paints them over with some soft soap and sulphur boiled a few minutes in water; use cold; and every now and then give them a syringing with a weak solution of sulphuret of lime. I make mine myself, but I dare say it is easily bought, though I never asked if it was kept. In this way he will keep his trees clean, and free from aphides.—E. T. S.

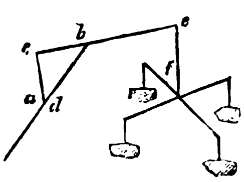
[12094.]—**Preserving Caterpillars.**—The Rev. J. T. Wood recommends hot sand as the best substance with which to fill preserved caterpillars.—AJANBA.

[12130.]—**Electricity.**—I am obliged to "Sigma" for his notice of my question, but what I meant was how far might it be possible to imitate the effects of a galvanic battery by means of common electricity? Some of Faraday's experiments in electro-magnetism can be done by it, and the same effect of a very quick succession of shocks; and the magnetising and the contrary of a needle by the mere stream of it from the conductor without contact with the needle; and then the best way of firing gunpowder brings it nearer to galvanism. I made some experiments once about this but have not seen similar ones mentioned.— E. T. S.

[12131.]—**Electricity Applied to Engraving.** —I have tried the thinly coated plate business, but it proved a complete failure. If you use a thick ground it is impossible to draw on it.—XYLOGRAPHER.

[12144.]—**Timber Houses.**—"Rat-Tat," at p. 389, advises the valuable precaution of inclosing a layer of dead air all round the building to make it damp proof, and he might have added nearly cold proof also. I wish he would inform us if he has tested the difference in effect of a thick and thin layer of inclosed air, for I suspect the difference is very slight, and it may be in favour of a thin layer, for air when nearly motionless carries heat very slowly, and a thin layer of inclosed air must be more nearly motionless than when it has more room to move in.—PHILO.

[12156.]—**Mice Eating Peas.**—I see various plans given to prevent this. I think the most effectual is to put the peas into a deep and widish drill, and then to cover them with dry sand, and rake the earth over all. If the mice come the sand keeps falling down, and so baffles them. I have never known it fail. When the peas are just up the birds do the mischief, and to keep them away fix a stick slanting into the ground, *a*; fix another on the top, so as to be movable, and fix a string *c d* from *e*; hang a string with two sticks, *f* crossed. To the four ends hang some pieces of bright tin. The wind moves these in all directions. They reflect the sunbeams, and most effectually keep away the birds.—E. T. S.



[12172.]—**Constipation.**—An insatiate devourer of books and a greedy seeker after knowledge in every shape and form, I still, in the midst of many and pressing avocations, find time for the perusal of the delightful and profitable columns of the ENGLISH MECHANIC, and am desirous of showing my gratitude accordingly. Constipation is the malady of civilised life. I have seen something, nay, a good deal, of savage life, and I never (speaking of savage life) came across anything of the kind. Under natural conditions the bowels act like "clockwork." Their periodic and regular evacuation is just as needful to animal life as is the motion of the stars to life, or at least being, in the sidereal spaces. When the feculence is not fitly discharged, the more fluid portions thereof are absorbed, the breath is vitiated, the secretions are tainted, the hemorhoidal vessels become pressed upon and obstructed; in short, the whole system is disordered and deranged. A habit of periodicity ought to be established, and this may be realised at any given hour. But the best and most convenient period, perhaps, is after the first meal of the day, or after breakfast. This meal concluded, the individual ought to rise and not assume again the ordinary seat until after the bowels have acted. Nature is more readily solicited in the erect than in the sitting posture, the period of the discharge, of course, excepted. Man, it is to be observed, is, perhaps, the only warm-blooded animal in which one evacuation of the bowels suffices within the twenty-four hours. All other creatures evacuate their bowels more or less repeatedly during the day and night. Had this been the case with man, it would have greatly militated against his dignity and comfort. When Nature asks so little, and when the periodicity of the function is so very very important, human beings ought surely to prove compliant. If we turn lazy and inattentive, the bowels become lazy and inattentive also, and the wholesome economy of our material existence is outraged. The principal if not the only cause of constipation in civilised life is the habitual use of white bread. Our food is too concentrated. There is not a sufficient abundance of coarse neutral material. Green vegetable food is not adequately resorted to. The inferior animals that browse on green food, as the ox tribe, know nothing of constipation. We cannot thus browse, it is true, still we might eat more green food than we do. But in any case the excessive resort to white bread should be avoided. The yellow Indian corn meal, simply wetted with boiling water, adding a pinch of salt and a pinch of sugar, makes beautiful and most wholesome bread, either as cakes or loaves, taking care only to butter the tin rim or pan in which the dough is placed. Rice bread and rye bread are excellent, and so are barley scones and oaten cakes. All these, being eaten, tend less to constipation than does white bread. But, in any case, the certain and unfailing remedy for constipation is the employment of the entire wheat. Let people only consume the furmity or frumenty, that for generations was the food of our forefathers, and constipation will become a thing unknown. Frumenty consists of the whole grain of wheat, kept just covered with water, and simmered for a matter of four hours or so beside the fire. Furmity may be eaten cold or warm, with milk, soup, preserves, sugar, or, simply, a little salt. It may be eaten before, at, or after every or any meal, and when prepared, must be kept in an airy place and in an uncovered vessel. Wheat crushed or cracked, well boiled into porridge, ordinary meal porridge, whole meal puddings, also brown or whole meal bread or biscuits, constitute very good food, but I find the entire wheat, well cooked and plentifully eaten (and if there were adiquate demand people would prepare it for sale) a perfectly efficient and entirely reliable remedy for constipation.—A PHYSICIAN.

[12176.]—**Hydrogen Flame.**—The easiest way to avoid explosion is to use a bottle or tube in which to form the hydrogen, which has a hole at the bottom as I described at p. 399 in reply to query 11835. If "Whitaker" has not got a small tube with a stopcock he can use a bit of tobacco-pipe closed with a piece of soft wax, but a still smaller opening is better, and a stopcock is convenient to regulate the size of the flame.—PHILO.

[12182.]—**Roses.**—Run a sharp penknife through the shoot to be layered, slightly twisting it so as to open the bark. The incision must be made at a joint. Secure it with a hooked peg and tread the soil firmly about it. It will soon form roots, and can then be removed. This works very well for moss roses, and I do not see why it should not do for others.—SARAH.

[12197.]—**Roses.**—Baroness Rothschild, Duke of Edinburgh, Prince C. de Rohan, La France, La Belle Lejounaise, Comtesse d'Oxford, Emilie Hamsburg, Gloire de Dijon.—SARAH.

[12197.]—**Roses.** — Very Select Roses. Proved. Eugene Appert, Prince Camille de Rohan, Souvenir de Count Cavour, Jean Cherpen, all very dark; Senateur Vaisse, Mad. Victor Verdier, Princess of Wales, Alfred Colomb, medium; John Hopper, Anne Alexieff, Centifolia Rosea, Comtesse Chabrilliant, blush; Baron Maynard, Belinden Kerr, White Provence, Mrs. Bosanquet, white.—CORNUBIA.

[12214.]—**The Game of Quoits.**—If the quoit does not allow the whole of the place where the peg ought to be to be seen, it does not count as a ringer, but if it should go over one half of the stick and leave enough for the thickness of the other half to go between the quoit and broken part of stick it is a fair ringer. You must measure the nearest part in sight, but are not allowed to move the clay from the top of the quoit, but measure over it. Eighteen yards is a very good distance, but it is often played at twenty-one yards. I have never seen the rules in print, but have played a good deal myself.—J. G.

[12226.]—**The Portuguese Language.**—Your correspondent need not continue a needless search further for any system upon Portuguese, for two reasons. Several years since I went out to Brazil to superintend the erection of some machinery, and endeavoured to procure a Portuguese grammar, but was informed by Mr. Stanford, of Charing-cross, that there was not one in existence. I took merely a dictionary, but even this I had very seldom recourse to since the language spoken in Brazil is not pure Portuguese; the best way to acquire a thorough mastery over it is to learn it by actual acquaintance with the natives. If your correspondent has a good knowledge of Latin he can readily pick it up. Spanish is only a source of trouble in acquiring it, though similar apart, but different when heard together; this I know from experience, since I was formerly and am now acquainted with the Spanish language. Respecting the latter part of your querist's request for information about Brazil, there are many things necessary to know prior to saying or recommending any peculiar locality. The principal things to be considered are—health, trade or calling, means, intentions as regards pursuits, married or single. If your correspondent can furnish a general, if not a detailed, idea of the above, I will endeavour to answer for his and others information, I having been in the Empire some five years.—J. GILLAIRD.

[12237.]—**The Organ.**—The defect may be caused by the pallets not bedding properly on the bars, or by the key action being screwed up too tight, thereby opening the pallets, or by the openings of the bars behind the pallets not being covered. The first cause is the most serious, and would necessitate taking down the soundboard and bedding the pallets and re-leathering them. The other causes are easily to be remedied.—PNEUMATIC LEVER.

[12258.]—**Organ Construction.**—Several sketches of couplers have appeared in former numbers. The following would be a good selection of stops for a small chamber organ of eight speaking stops:—

GREAT ORGAN.

1.	Lieblich Gedacht	8ft. wood and metal.
2.	Dulciana	8ft. metal.
3.	Principal	4ft. metal.

SWELL ORGAN.

1.	Salicional	8ft. metal.
2.	Vox Celestis	8ft. metal.
3.	Gemshorn	4ft. metal.
4.	Flute	4ft. wood.

PEDAL ORGAN.

1.	Bourdon	16ft. wood.

—PNEUMATIC LEVER.

[12255.]—**Hair.**—My beard, of about the same age as C. Watson's, inflicted upon me at one time the same annoyance as that alluded to, with the addition of (literal, not argumentative) hair-splitting. The "knots like nits" that C. Watson alludes to, are nothing, I think, but the broken and frayed ends of the hair, which seems to break without separating, as a tough stick would do. I cured my beard by applying "brilliantine" every other morning—much against my convictions. I suppose any good oil of a non-drying character would do as well. I think it is dryness, but scarcely a "disease."—H. H. G.

[12256.] — **Preserving Garden Produce.** — I think the most likely thing to suit "Emigrant" would be a garden pit. Considering the cold of Canada it should be a good depth. The pots should be set in ashes, if possible, and a frame with a good thickness of straw or fern for the covering. Take care to give as little water as possible. In the same place, carrots and parsnips might be kept buried in sand. The pit is the best where expense is concerned, and very effectual.—E. T. S.

[12260.]—**Cleaning Back of Teeth.**—"Beauty" need only inquire of the first respectable chemist, and he will get a complete answer to his query, as the course he suggests is common to most cleanly people.—R. M. HATCH.

[12260.]—**Cleaning Back of Teeth.**—As a dentifrice charcoal in the state of an impalpable powder is unrivalled, at once whitening the sound teeth and sweetening the breath, by neutralising the fetor that arises from those which are carious or from a scorbutic state of the gums. Therefore, if "Beauty" takes a small quantity of charcoal, powdered, and applies it with a cloth to the back of the teeth three or four times a week she will need no other remedy. Tried.—WOODMAN.

[12260.]—**Cleaning Back of Teeth.**—"Beauty" may find that the tongue, during the mastication, does all the work of a tooth-brush at the back of the teeth. If the teeth are irregular, which cannot be supposed of such a fair querist, a peculiar form of tooth-brush is used, one in which the back is bent at the middle to a certain angle, so that the teeth in brushing are inclosed in the angle formed, and the back and front brushed at the same time. I have never seen these brushes in use, and the suggestion, which "Beauty" may find useful for some of her friends, may be original.—RAT-TAT.

[12262.]—**Press for Cutting Paper, Card, &c.**—An ordinary machine in which books or other articles are submitted to pressure would do for "Country Printer's" purpose. The cutting edges may be set in suitable form, and soldered to the top or bottom of the working parts of the press, and made to descend on the paper or cardboard. Descriptions of contrivances for cutting paper and envelopes have been given in back numbers.—RAT-TAT.

[12263.]—**Circular Saw Driving.**—If Mr. Davies does not like using a drum or pulley on his main shaft above 3ft. 6in., he must use the 9in. pulley on the intermediate shaft, and attach only a 2½in. spindle to the saw, which would not work well. He must, therefore, use a fly-wheel or drum of larger diameter on the main, say 6ft., 9in., and 4in., or 6ft., 3ft., and 4½in. pulleys on respective shafts.—RAT-TAT.

[12263.] — **Circular Saw Driving.**—Pulley on main shaft 42in., driving pulley of 16in. on counter-shaft; on last-named shaft, a pulley of 60in., driving pulley of 9in. on saw spindle, will give 700 revolutions per minute.—S. J.

[12263.]—**Circular Saw Driving.**—James Davies can obtain the speed he requires for his circular saw by putting a 42in. drum on his main shaft, and a 13in. pulley and 48in. drum on the intermediate shaft. Thus

$$\frac{40 \text{ revolutions} \times 42\text{in.} \times 48\text{in. drum}}{9\text{in.} \times 13\text{in. pulleys.}} = 488 \text{ revolutions}$$

—WOODMAN.

[12264.]—**Freemasonry.**—Let "Edgar" purchase "An Authentic Key to Freemasonry Revealed," 1s. Or, better still, if he purchases the following book, 3s. 6d., Carlile's "Manual of Freemasonry."—UN FRANCAIS.

[12265.]—**Pig Feeding.**—If "C. R." wants his pig for his own eating after he is fed, I would advise him to use barley meal in preference to bran and Indian corn, as the latter does not make the flesh so sound or well flavoured as the former; and, so far as my experience goes, barley meal is the cheaper.—WOODMAN.

[12266.]—**Photographic.**—The cause of your negatives fading away on exposure to light most likely is that your fixing solution is not strong enough. This cannot be too strong. Fill a large glass bottle as full as possible with hyposulphite of soda, leaving room for a small quantity of water, as the solution is used add more water. Thus you will get different strengths, the best of which, of course, you will use. The whole of the creamy film which is on the plate after developing must be dissolved, which leaves the picture clear and distinct.—J. H. H.

[12268.]—**Strengths of Wrought-Iron Shafts.**

$$\frac{(\text{Diameter in inches})^3 \times \text{rev. per min.}}{200} = \text{horse-power.}$$

$$\frac{(2\tfrac{1}{2})^3 \times 170}{200} = 18{\cdot}28 \text{ horse-power.}$$—S. J.

[12270.]—**Charcoal Furnace for Model Boiler.**—It would be best to allow the boiler to sit in a cast-iron vessel somewhat larger, with a small opening at top for the smoke and blast steam to escape. By this arrangement the spirit lamp mentioned could be used, leaving a space at the bottom for either lamp or charcoal, with furnace door and draft holes underneath. A lamp of the dimensions given, with three jets, ought to raise steam enough.—RAT-TAT.

[12273.]—**Water Power.**—"Bœtis" may allow the water to descend through a wide tube for about 12ft. from his mill. There will be a considerable rush of air and water through the bottom of the pipe by which he can utilise by employing a fan-wheel.—RAT-TAT.

[12273.]—**Water Power.**—As "Bœtis" neglects to give the measure of water that flows in any given time through his ½in. tap, no practical reply can be given to his query.—S. T.

[12275.]—**Test for Arsenic.**—The following is Bettendorff's test for arsenic (Zeitschrift f. Chem. [2] V. 492). When a solution of stannous chloride in fuming hydrochloric acid is added to a solution of arsenious or arsenic oxide in the same acid, a brown precipitate is formed, which, after proper washing and drying, consists of metallic arsenic mixed with a small quantity of stannic oxide. In an aqueous solution of arsenious or arsenic acid, stannous chloride produces no precipitate; but on adding strong hydrochloric acid till the liquid fumes slightly, precipitation takes place. Arseniferous hydrochloric acid of specific gravity 1·182 to 1·185 gives an immediate precipitate; the same diluted to specific gravity 1·100 no precipitation takes place. From this it may be inferred that the reaction occurs only between stannous chloride and arsenious chloride; further, that in a solution of arsenious acid in hydrochloric acid of specific gravity 1·115 part of the arsenic is present as chloride, but that hydrochloric acid of specific gravity 1·100 dissolves arsenious acid as such, without converting it into chloride. The reaction above described is extremely delicate and capable of detecting one part of arsenic in a million parts of solution. On antimony compounds stannous chloride exerts no reducing action, even after prolonged heating; hence, the above described reaction may be used to detect arsenic in antimony compounds, the solution having been previously saturated with hydrochloric acid. Another useful application of the same reaction is to the preparation of hydrochloric acid free from arsenic, 412 grammes of specific gravity 1·164 were mixed with a fuming solution of stannous chloride, the precipitate separated by filtration, and after twenty-four hours the hydrochloric acid distilled, the receiver being changed after the first tenth had passed over, and the remainder distilled nearly to dryness. The acid thus obtained gave not the slightest indications of arsenic, either by Marsh's test or by precipitation with hydrogen sulphide. In testing for arsenic acid with silver nitrate, the delicacy of the reaction is impaired by the solubility of silver arsenate, not only in free nitric acid and free ammonia, but also in ammonia nitrate. According to C. Avery (Sill. Am. J. [2] xlviii., 25), the reaction is greatly facilitated by adding to the solution of arsenic acid in nitric acid a few drops of a strong solution of an alkaline acetate, and then a drop or two of ammoniacal silver nitrate. Another very good mode of testing is to drop the nitric acid solution of arsenic on recently prepared silver carbonate, the red silver arsenate then showing itself very conspicuous on the white ground. Metallic arsenic and arsenious acid are easily oxidised by a mixture of potassium chlorate and nitric acid to arsenic acid, which may then be estimated as ammonio-magnesian arsenate. — Watts' "Dictionary of Chemistry."—R. E. W.

[12277.]—**Aniline Black.**—The following is from Watts' "Dictionary of Chemistry:"—Boil together 1 litres of water, 2 kilogs. of starch, 2 kilogs. of roasted starch, 2 kilogs. of aniline, 1 kilog. of sal ammoniac, and 1 kilog. of potassic chlorate. When the mixture has cooled, and immediately before printing, add 1 kilog. of cupric sulphide and 2 kilogs. of tartaric acid. The cupric sulphide may be conveniently prepared by dissolving 1 kilog. of flowers of sulphur without the aid of heat in 4 litres of caustic soda of 38° Bm., and adding this liquid to a solution of 5 kilogs. of cupric sulphate, in 120 litres of water, the solution being heated to 120°. Also by mixing 100 grms. of light aniline (heavy aniline gives brown instead of black) with 80 grms. of hydrochloric acid, 10 grms. of manganese oxide, and 1,000 grms. of water. The precipitate is washed by decantation, and then mixed with ammonia, whereupon its colour changes from green to black, and if the absorption of oxygen from the air be assisted by due agitation, the colour becomes developed throughout the entire mass.—R. E. W.

[12284.]—**Essence of Phosphorus.**—Essence of phosphorus is made by dissolving one gramme of phosphorus in 100 grammes of rectified ether. This should then be diluted in the proportion of one part of the solution to ten of rectified spirits of wine, and one drop is a sufficient dose.—R. M. HATCH.

[12285.]—**Logarithms.**—See answers to query 9886 towards the close of last volume.—EXCELSIOR.

[12294.] — **Engraving by Graphotype.**—Graphotype is not superior to wood engraving at all. In the graphotype process, if the lines of a tint are under a certain width apart, the brush will not clear it sufficiently, and, consequently, it will print dirty. Another fault is, that the ends of the lines are not lowered; therefore they print hard.—XYLOGRAPHER.

[12296.]—**The Nightingale.**—I have waited a week, expecting some of our friends in the East Riding to reply to this query, to which I can reply in the affirmative. There has been two nightingales heard nightly in Aketon wood, about two miles from Castleford, during the whole of the spring months of the present year. They were so near together that they could be heard at one and the same time. I myself only went on one occasion, and then only heard one of them, but two of my sons whom I left behind heard them both the same night; as did scores of my neighbours both before and after that time.—BOD.

[12300.]—**Direction of the Terrestrial Meridian.**—If "Youngster" will take the trouble to consult replies to queries in the last few volumes he will find numerous directions for finding a meridian line, which I suppose is the line he wants. I am too much engaged at present, or I would refer to the volumes for him. Try about May, June, and July, 1870.—W. R. BIRT.

[12304.]—**Phrenology.** — The period of characteristic development differs very much in different individuals, and I should recommend "Saul Rymea" to go into his garden, make a few observations in writing respecting the period of development of his plants indoor and outdoor, apply the same or synonymous terms to the human plants he sees every day, and he will arrive at a correct solution of his query. Some children manifest their characteristic qualities at a very early age, are precocious—*i.e.*, developed too early, a diseased condition, often superinduced by parental vanity—the sequel, early death. Others arrive at thirty years of age before they show a spark of intellectuality, others are idiotic and never do. "Saul Rymea "(says "if "the brain exercises any influence on the shape of the cranium, to which I reply that all growth is from within, and would ask, does the bark of a tree obstruct its growth? And now for the horns of the dilemma. "Saul Rymea" guesses correctly in supposing the brain capable of influencing the shape of the cranium before the latter has assumed its osseous nature, but "Saul Rymea" must learn that education, as he applies the term, is quite a misnomer, for he seems to labour under the fashionable error of regarding it as a cramming process, whereas the etymology of the word itself furnishes a complete solution of our friend's difficulty. The fact is, our education begins before our birth. But to be brief, and not lay myself open to the charge of monopolising space, I conclude by asking "Saul Rymea's" attention to the following:—(1) The pre-natal influences are nearly everything—to prove it read biography. (2) The soft and impressible state of the infant brain: mere physical pain, as in teething, often produces death, by shattering its nerves to pieces—these are the mother's words—by convulsions. (3) The sutures of the cranium, which Nature has not forgotten to provide, to facilitate the synchronous growth of brain and cranium. "Saul Rymea" should ask any old woman about this point. (4) As regards education, I now refer, of course, to post-natal influences; it is a fact that every look, smile, frown, angry word, or tone, educes similar feelings in the child; but "Saul Rymea" will find it necessary, in all his inquiries, to remember that in each of these influences Lord Bacon's concise remark, "it feedeth what it findeth," applies with incontestable force. "Saul Rymea" must not, however, think my remarks in the slightest degree tainted with materialism, fatalism, &c., as the views I have expressed are perfectly consistent with a progressive spirit; and since no child is consulted as to when and where, in what age and country it will be born, neither can it eradicate after its birth any of its powers; the only thing it, or "Saul Rymea," can do is to modify their manifestation.—ULTRA-MARINE.

[12304.] — **Phrenology.** — Phrenologists will not allow that they are in the dilemma "Saul Rymea" supposes, for they allege that the bones of the skull as they grow are moulded so as to fit the brain, and that they continue to grow long after education commences, and that if the intellectual faculties and moral sentiments be more educated by exercise than what they call the animal propensities, the fore and upper part of the head gives more and becomes larger in proportion than the hind part of the head. They further allege that the shape of the head may alter very considerably, though more slowly in adults, and does alter if some organs of the mind, as they call certain portions of the brain, be more exercised than others. I do not consider what is called phrenology either precise enough or proved enough to rank with established science, but it is far more like a science than its opponents would represent it, and a great deal of useful knowledge is taught by phrenologists, along with not a little that has but little foundation in true observation. —PHILO.

[12304.]—**Phrenology.**—"Saul Rymea" asks at what period of life the organs are developed. As our motto is *Res non verba quaeso*, I will answer him as briefly as possible. There is no period of life at which the organs will not grow if vigorously exercised. In childhood the propensities preponderate. Then the intellect becomes developed, and next the moral faculties. There is no definite time for the development of organisation after birth; circumstances tend greatly towards developing particular organs. If "Saul Rymea" is at all conversant with anatomy he must know that the brain is first formed before the boney particles are laid down, consequently the bones of the skull adapt themselves to the brain, and are not completely ossified for several years after birth. Now for the dilemma into which he presumes phrenology to be placed—viz., that the organs cannot grow after the skull becomes ossified. Two processes are continually at work in the human frame—viz., absorption and deposition. Presuming an organ to be actively exercised, there is a considerable friction between the convolutions in action and the corresponding interior part of the cranium, and as a matter of course the waste matter is carried off by the absorbents. So active is this that in many cases of madness the skull becomes quite sore and painful to the touch; in some cases quite worn through. I possess the skull of a drunkard worn in this manner in the region of the temples. Let "Saul" take a skull of any person (if known all the better), and place a light within it, and he will see the active organs where the light shines through. As to his belief or non-belief it matters little, the facts are the same, and we can say with Gall, This is truth, although at variance with the philosophy of ages.—W. CRISP.

[12304.]—**Phrenology.**—"Saul Rymea" appears to think that the organs of the brain, according to phrenology, are indicated by "bumps" on the skull, whereas, in general, the surface of the skull is perfectly smooth, and it is only when an organ is developed in excess of the neighbouring organs that an elevation or protuberance is presented. The brain of a child at birth weighs about 10oz., and that of an adult from 2½lb. to 3¼lb. (Cuvier's weighed 4lb. 10oz.); and as the brain of a child completely fills the skull, the latter must, of consequence, be considerably expanded and enlarged to contain the additional volume of brain when it reaches maturity. Any anatomist, without appealing to phrenology, will satisfy "Saul Rymea" on this point. Cuvier states that the brain moulds itself in the cavity of the skull, which it fills exactly in such manner that knowledge of the bony part gives us information at least of the form of the exterior of the brain. It is patent to every one that the brain and skull of a child are considerably smaller than that of an adult, and hence both of them must be enlarged to a considerable extent before they arrive at maturity. How could this occur if the bones of the head are not "distorted by the soft mass of the brain"? The skull is not an adamantine barrier confining the brain within specific boundaries. Although a strong, it is a changeable covering, and will always accommodate itself to the development of the brain during its growth. There are many instances on record where in certain diseases of the brain the head has been enlarged to twice its normal dimensions. How could this happen if the skull did not expand to meet the requirements of the enlarged brain? I hardly know what "Saul Rymea" means when he states that "either the brain must have received its peculiar development before education steps in," &c. Surely, he does not suppose that education either creates or develops organs. It only intensifies their action or gives them more vigour, but Nature herself gives the tools, and education only applies them to their legitimate use.—NORTHUMBRIA.

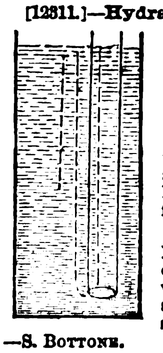
[12305.]—**Locomotives.**—The principal advantage is that the heat is more fully utilised in a long-barrelled locomotive than in a short one, and, as a consequence more steam generated by the greater area of heating surface. There are also many disadvantages; a greater waste of boiler tubes by the blast cinders, and cost of repairs: but some engineers think that the one or two advantages of long-barrelled locomotives more than counterbalance their numerous defects.—RAT-TAT.

[12306.] — **Botanical Names.** — The botanical name of the Persian or French willow is *Epilobium angustifolium*, the flowers, which are purple, grow on a long spike; the plant is a native of Britain—it will grow almost everywhere, even in the confined air of London. Its congener, *Epilobium hirsutum*, is a fine, showy plant, with large rose-coloured flowers. It thrives well in damp situations.—W. R. BIRT.

[12306.] — **Botanical Names.** — The French willow is *Epilobium angustifolium*, natural order, *Onagraceæ*. I cannot find such a name as rose-pea in any of my books. It may be *Ononis campestris*, a plant with pea-like, rose-coloured flowers, and leaves accompanied by spines and prickles.—CORNUBIA.

[12311.]—**Hydraulic.**—The well being 25ft. in depth, containing 10ft. of brackish water, there are 15ft. of rain water added to it, which, being intimately mixed, renders it tolerably palatable, and as long as the water is above the spring level, of course, no more brackish water will flow in. "Glaston's" error appears to be that he imagines that the two kinds of water ought to keep separate. Now, beer and water, differing considerably in specific gravity, can only be filled into a tumbler and caused to keep separate by interposing a silk handkerchief, and the slightest disturbance, such as pumping, would inevitably cause instant commingling. I very much doubt the possibility of any two sorts of water being introduced into one receptacle without instantly intermixing. Also, it must be taken into account that when the natural spring level is added to, that it will flow back out of the well until the one balances the other.—A., Liverpool.

[12311.]—**Hydraulic.**—The light water is on the top not only in the well but also in the tube, and therefore the light water comes out of the tube and the top of the tube is immediately again filled up with light water. The water moves round as the dotted lines show. The water moves like the air in this respect. If you open a barrel of beer, wine, &c., in the lower part you will get the fluid from the top.—H. MEYER.



[12317.]—**Red Prussiate of Potash** may be prepared by acting on a solution of yellow prussiate with chlorine till it no longer gives a blue precipitate with iron persalts, evaporating and crystallising. —S. BOTTONE.

[12318.]—**Artificial Oils.**—The oils mentioned are isomers, but have not as yet been converted into one another. Oil of cinnamon and oil of winter green can be prepared artificially. See Roscoe's "Chemistry," 1871 edition.—S. BOTTONE.

[12319.]—**Dyeing Pulp for Sugar Paper.**—Add a small quantity of green copperas. You can get it as dark as you like by increasing the dose.—S. BOTTONE.

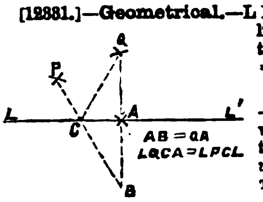
[12321.]—**Chess Player.**—I have stated in my chess columns in the *Gentleman's Journal*, and also in the *Echo Americano*, that the automaton chess player at the Crystal Palace is moved and worked by a man who is concealed in the figure. I wrote a longer article on it about three or four years ago, which appeared in two or more German papers and was afterwards translated for the Dutch paper *Sissa*.—H. MEYER.

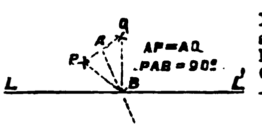
[12328.]—**Scarecrows.**—Try a set of model windmills, carrying pieces of looking-glass on the arms. Proved.—S. BOTTONE.

[12331.]—**Geometrical.**—Let the given points be called A and B; join them. If the line A B be at right angles to the given line it is impossible to solve the problem, unless the points A and B be equidistant from the given line. If A B be not at right angles, bisect it, and through the point of bisection draw a straight line at right angles to A B. Produce it, and it will cut the given line in the required point. Prove by Euclid's "Elements," Book I., Prop. 4.—CERVUS.

[12331.]—**Geometrical.**—With any radius exceeding half the distance between the points (their full distance is a good radius to take) strike arcs from each of them intersecting; and a straight line through their two intersections has any point in it equidistant from the two centres; consequently will cross your given line at the point required.—E. L. G.

[12331.]—**Geometrical.**—L L¹ = the given straight line. P and Q are the two given points. B P = B Q.—H. MEYER.





[12336.]—**Vine Root.**—Cuttings from the vine may be struck in the early spring months, *under glass*.—S. BOTTONE.

[12338.]—**Hyacinth Bulbs** are dried and stored in paper bags hung up. Plant out in October or November. —S. BOTTONE.

[12340.] — **Flour Paste.**—A few drops of carbolic acid, or a few grains of corrosive sublimate, added to each pound of paste made, will prevent mouldiness. Essential oil of cloves is also recommended.—S. BOTTONE.

[12348.]—**Spanish Pronunciation.**—The "th" sound is the only correct pronunciation; the "ss" is slovenly.—S. BOTTONE.

[12348.] — **Spanish Pronunciation.** — I wish some competent traveller would answer one part of this query—namely, whether what the grammars say of every *z*, or every *theta* (as Spaniards call it) really applies to that letter when final, as in the words *vez, paz, cruz*? I have heard natives of Spanish America, except when decidedly vulgar, so constantly give the *th* sound (sharp as in *think*) to both *ce, ci*, and the initial and medial *z*, as to leave no doubt of its correctness; and also give the final *d*, as of *Verdad, Madrid*, very near our flat *th*, as in *the*; but a final *z* I have only heard sounded like English *z*, and I should like to know whether this is an Americanism?—E. L. G.

[12348.]—**Spanish Pronunciation.**—I beg to assure "Cast Steel" that the Castilians and inhabitants generally of the Northern provinces of Spain do most certainly pronounce the *c* before *e* or *i*, and the *z* before any vowel, as *th* (hard), and not as *s*. They talk of Zaragoza, which they pronounce as if written Tharagotha, and they say Ciencia (pronounced Theénthia), meaning science. These peculiarities I myself have heard in North Spain, especially in Old Castile, but I was told that in the southern provinces, especially in Andalusia, the sounds given above are changed to that of *s* sharp, and such words would be pronounced Saragosa, and séensia. Though the Castilian is the purest form of prenunciation, I am inclined to think that the Andalusian form is of wider use, and it is the one which is almost invariably used in South America and the Spanish settlements.—WM. WRAY.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "C. W." has answered 11650; "The Harmonious Blacksmith," 11766; "Ajanes," 11773; "Sirius," 11879, 11893; "Excelsior," 11883; "R. H." 11892; "Thetamu," 11910.

11986 Chemical Properties of Tea Leaves, p. 288
11989 Extract of Tea, 288
11992 Edward's Graphogenic Apparatus, 288
11998 Dry Solder, 288
11999 Chuck, 288
12000 Hair Turning White.—To "Auld Reekie," 288
12003 Keeping Dust from Turret Clocks, 288
12006 Liquor Oils, 288
12015 The Gyro Pigeon, p. 289
12023 Dissolving Bone, 289
12030 Sun Screen, 289
12032 Fishing Nets, 289
12037 Mining Query, 289
12042 Boiler, 289
12043 Poultry Breeding, 289
12044 Rosin Grease, 289
12049 Aërated Water Machines, 289
12053 Canaries, 289

QUERIES.

[12359.]—**Sulphurous Smell after Thunderstorms.**—A gentleman asked me the other day if I knew what was the cause of the sulphurous smell which succeeds a thunderstorm. I replied that it was generally attributed to the formation of ozone. But he said that it is a well known fact that there is no ozone in China (according to the usual tests), and yet the same peculiar smell is noticed. If any of your correspondents can verify or explain the circumstance, I shall be greatly obliged.—B. C.

[12360.]—**Pivots.**—Will any brother inform me the best way to harden small drills for putting pivots into staffs, &c.?—NO SOFT SOLDER.

[12361.]—**Carbon or Charcoal Pipes.**—I wish to make some tobacco pipes of the above material. Will any reader describe the process?—W. ALLAN.

[12362.] – **Formula.**—What is the formula for finding the content of the middle frustrum of a circular spindle? —W. ALLAN.

[12363.] — **Recovering Indigo.** — I should feel obliged if any of "our" chemical correspondents would inform me how to recover indigo from other blues, grease, and dirt. I have a great quantity, and it should contain about 25 per cent. of indigo.—J. B.

[12364.]—**Hoist.**—I have made a hoist from a sketch by H. R. Gwastad, given in your very valuable journal, Feb. 9, 1872, reply 10551. Everything is fitted up in the best possible manner, friction pulleys are 4in. wide, and turned driving pulley on A shaft is 12in. diameter, strap 2in. wide. It will lift 60lb. well, but I want to lift 140lb. This it will not do. Will H. R. Gwastad or some other obliging correspondent tell me through your journal where I am at fault, as I have been at a considerable expense in fitting it up?—BOLTON TROTTER.

[12365.]—**Elder Flower Wine.**—To each gallon of water put 4lb. of fine brown sugar, one lemon, and 1lb. of raisins. The raisins are to be picked, chopped, and put into the cask; boil the sugar and water, and pour it over the elder flowers, and when new milk warm, put a little yeast, and for each gallon of liquor put half a pint of elder flowers, which must be picked off when just ready to fall off the trees; pick them clear from stalks, then let all work in the tub a day or two, then turn into the cask on the raisins, and when done working bung up and keep for two months. The above is an excellent recipe, with this exception, the wine is never brisk and sparkling as it ought to be. Can any of your readers inform me wherein I fail to make it so?—WAYNFLETE.

[12366.]—**Pianoforte without Strings.**—I am much obliged to "The Harmonious Blacksmith" for his kind attention to my query respecting soundboards (12175). In his reply (p. 357) he alludes to a piano without strings, the patent of Mr. Goldsworthy, and also to one which he possesses, formed with vibrating spring bars, of which, probably, the sounding wire of an American clock is a rude yet apt illustration. Doubtless, as "The Harmonious Blacksmith" is a most ingenious and scientific mechanic, this piano of his is not only curious but harmonious—even an improvement on Mr. Goldsworthy's instrument, and, therefore, a description of it could not fail to be highly interesting to the readers of the English Mechanic. I trust he may regard it in this light, and be induced to give his fellow mechanics such a practical account of it as will set them all either constructing or thinking. A piano of this class has the pleasing peculiarity of remaining continually in tune, never requiring but the first tuning, a quality eminently desirable on shipboard. I think, too, it could be constructed more cheaply than the ordinary instrument.—E. B. Fennessy.

[12367.]—**Oval Turning.**—I require to turn a number of pieces of hard wood of an oval form about ¾in. in thickness, and 3½in. length of oval—having only a simple lathe I am confined to circles. Can any of "our" correspondents kindly inform me if any special form of lathe is required for ovals, or can it be managed by a chuck? If so, where are such chucks to be procured, and the probable cost? Any information on the subject of oval turning will be acceptable.—Photo. Bristoliensis.

[12368.]—**Imitation Bronze.**—I am exceedingly obliged to M. W. Bolton for the imitation bronze recipe, the effect of which is excellent. I, however, find a great difficulty in dissolving the corrosive sublimate. Ought it to be boiled in the vinegar, or would it be better to dissolve it in some kind of acid?—J. W. C.

[12369.]—**Water Powder.**—I want to get an instrument to make water powder (French poudre d'eau). On the continent I have met with a small apparatus in indiarubber of English make and patent, much cheaper and working nearly as well. Can any subscriber give me some information, as the makers I have asked about it do not know such instrument?—L. J. V. G.

[12370.]—**Liquid Rosin.**—Will "Fiddler" allow me to ask him if he has tried the colophonium or liquid rosin lately advertised, and with what result?—L. J. V. G.

[12371.]—**Truss.**—I shall be much obliged to any of your readers who can inform me where I can get a truss for rupture, that can be worn when bathing; or whether there is anything of the sort made specially for the purpose. The suffering is so intense when swimming that I am afraid I shall soon have to forego that pleasure unless I can get relief.—Nosbor.

[12372.]—**German Concertina.**—I have been repairing a German concertina of my own at home, and I should like to know if any of "our" readers can tell me how to get out of my trouble, for I have made a set of four plates of tongues in steel instead of metal, but I cannot make them speak. I have tried every way, but I have failed.—Amateur.

[12373.]—**Softening Spring Water.**—I have a deep well of excellent spring water, but unfortunately too hard for general domestic use. The interior circle of well is 3ft. 6in. diameter, with an average depth of 2ft. in water, which does not flow over at any time, nor fail in supply even in extreme dry seasons. I wish to know if some chemical production cannot be periodically put into the well, in proportion to the daily consumption of water, and thereby render the same more soft and effectual for its many services. As each bucket of water dipped from the well would probably weaken the action of any chemical influence through the continued supply from the spring, would it be more effectual if contained in a tank for daily use? Perhaps your talented and instructive correspondent, Mr. Bottone, will favour me with his suggestions for relief in this difficulty.—Gillem, Ontario.

[12374.]—**Ancient Wrought Iron.**—We are told by Mr. Forbes, F.R.S., in his report on the progress of the iron and steel industries (Feb., 1872), as a proof of the antiquity of iron smelting in India, and also of the large forgings in wrought iron which could be executed by a people who now appear to have entirely lost the art, the fact that Mr. Mallet has directed attention to a wrought-iron pillar situated at the mosque of the Kutub, near Delhi, which must be more than 1000, and may be as old as 1500, years; yet is as large as the screw-shaft of some of our largest steamships; that part of the column above the level of the soil being 48ft. high, with a diameter of 14ft. 4in. at the base, and 12in. at the top immediately below the elaborately chiselled capital. Are there any among your obliging correspondents who can throw more light upon this eventful period of early handicraft *v.* the present age of machinery?—Gillem, Ontario.

[12375.]—**Metallic Stain for Wood.**—I have heard of such giving a very dark—almost black appearance to deal; afterwards to be varnished. Will one of "our" correspondents oblige me with name and mode of preparation?—Gillem, Ontario.

[12376.]—**To "The Harmonious Blacksmith."**—It would give me great pleasure to comply with the request contained in the postscript to letter 2416; but I scarcely know what it is on which my opinion is desired. If our friend will kindly lighten my darkness on this subject, he will oblige—Beacon Lough.

[12377.]—**Fall of a Bullet.**—I was about sending a question on the following subject, when I happened to see Mr. Proctor's letter on "Spinning Tops and Gyroscopes" in your last issue. In this letter he says:—"It is, of course, perfectly true that gravity draws down the most swiftly travelling bullet—fired horizontally—so that it reaches the ground as quickly as a ball dropped from rest from the same height." In a book on practical mechanics a similar sentence to this is modified by the words "from the top of a high tower," being added to the phrase "fired horizontally." I can conceive of a bullet fired, and a ball or bullet simultaneously dropped, from the top of a tower 200ft. high reaching the ground simultaneously; but it seems to me impossible that a ball dropped from the height of 4ft. from the ground should take as long in falling as a bullet fired horizontally from the same height. I should be much obliged if Mr. Proctor would make this matter a little more clear—by diagrams if necessary—now that he has performed a similar operation for the upward deflection of bullets.—Puzzled.

[12378.]—**Bat Making.**—What tool does a bat maker use in smoothing; and how do they make them hard so that they will not dent with the ball? Which is the best glue for gluing in handles? Where can I get cane for handles?—Tim.

[12379.]—**Packing Piston Rings.**—Referring to query 12158, concerning packing rings of piston, I would like to know whether "A., Liverpool" intends the piece of sheet brass to be fastened inside. I would also like to ask if gun metal would do for rings, as I have an iron cylinder I would like to put up.—Dundalk.

[12380.]—**Light.**—Let there be a darkened room with no entrance save a door facing the sun; in that door let a hole be bored, and a ray of light comes in; cover the hole; what has become of that ray of light?—Dai Bach y Ship.

[12381.]—**Education.**—In common with many other subscribers I have boys to educate, and as I am not tied down to any part of the country, I should be glad to know what towns offer the greatest advantages. I want an education to fit them either for professional or business life, and it must be cheap. There are, I believe, some institutions in which boys are educated with a view to the royal and merchant navy; also a college where the relations of medical men enjoy certain advantages as to fees, &c. I should prefer a seaport town or the neighbourhood of London, but this is not essential. Any particulars will be very acceptable to—Paterfamilias.

[12382.]—**Electrical.**—I should feel grateful to Mr. Tonkes or any other electrician, if he would inform me in what book the particular subject of determining internal resistance of a battery by means of a tangent galvanometer, the power of the two cells, amount of external resistance brought in by the introduction of coils. Although this is an old subject, yet in the books on the subject which I have studied, I have found it either entirely omitted or else skimmed over. Accordingly, if Mr. Tonkes would explain it fully or else name some book in which it is so done, I should be most deeply obliged, showing how the sine galvanometer differs from the tangent in construction. In reading a work on electricity, I saw it mentioned that a machine entirely made of guttapercha with rubbers of hareskin was both less expensive and also more powerful than a plate glass machine of the same size. I should be obliged if any of your contributors that have tried it would state their experience, and also the cost as compared to an average plate machine.—E. N. D.

[12383.]—**Working Perfect Plane Surfaces.**—Will any reader kindly describe a good method of grinding perfect plane surfaces, and polishing the same?—R. Roberts.

[12384.]—**Coppering Carbon.**—Will some reader of the Mechanic please have the kindness to tell the easiest way of preparing carbon, so that copper plate may be soldered to it?—F. J. Wall.

[12385.]—**Sulphur in Wall Papers.**—I have recently had an air-tight glass case papered with an ultramarine paper, and find silver goods put in it discolour very rapidly, and as this stultifies the object of a glass case, I should be obliged if any "mechanic" would suggest a remedy to me. My idea is that there is sulphur in the colour, from the character of the tarnish. If so, I suppose there is no remedy but tearing off the paper and putting a new one.—Gour.

[12386.]—**The Prevention of Incrustation in Steam Boilers.**—Having proved that the use of a few pieces of oak (the greener the better) in a steam boiler prevents incrustation, I should like to inquire the why and wherefore of this. A dark powder results from the use of the oak, which half an hour's work will remove from the boiler, whereas formerly it occupied two of my workmen for two days, at intervals of a month, to chip off the incrustation with hammers, this being, besides, a hot, arduous, and irksome task.—J. D. K.

[12387.]—**Amateur Organ Building.**—Thanks to "J. D." for kind attention to query 11837. I am sorry I did not mention at the time that the only room I have available is 18ft. long by 3ft. 6in. wide, so that I shall, under these circumstances, have to elongate the dimensions given, making the same area—viz., 7ft. by 2ft., allowing for Bourdon, which will have to be put at the back. Will bellows of these dimensions be more difficult to make, and will double feeders be advisable to make it do its work well? Would it be better to make the Bourdon on a larger scale than 6in. by 5½in. CCC, for the organ in the above mentioned query, or will it be powerful enough on a 2½in. wind? Which is best, a Bourdon of small scale, well blown up, or one on a large scale, moderately winded? Of course, where room is the greatest consideration, the former is best, but which is really most efficient? I am glad to see that "J. D." is better, and hope to see soon a continuation of his interesting papers, as no doubt a great many besides myself are at a standstill for further instructions.—Y. Z.

[12388.]—**Onions.**—Will any reader tell me which is the best kind of onion seed to sow at the end of July, in order to have very large onions for exhibition next summer, and yet have the property of keeping well. I have tried the Tripolian onion, but it does not keep very well after it is taken up.—A Coal Miner.

[12389.]—**Dirty Mercury.**—I have a lot of mercury which seems to be adulterated with lead, tin, or some other combustible. Will any kind reader of the English Mechanic please to give some information as to the best way of cleaning out the adulteration? Also, how is a barometer tube cleaned after being filled with the above?—C., Glasgow.

[12390.]—**Chemical.**—The writer would be obliged to any of your readers who can inform him of one of the best works on elementary chemistry suitable for a —Home Student.

[12391.]—**National Losses.**—Have any political economists formed any estimate of the absolute loss under all heads which we, as a nation, are called on to make good annually?—Excelsior.

[12392.]—**Bee Management.**—In November last I became the possessor of three stocks of bees in straw hives. I know nothing of bee management, and the result was that two out of the three stocks died in May; the remaining stock is very light. In taking up the hives I found on the floor board a number of maggots ½in. long, and protected with something like wool. In taking out the comb I found that the maggots had made roads through it in all directions. I also found six maggots on the floor-board of my remaining hive. I have made a wooden hive 11in. square. My wish is to transfer the bees from straw hive to the wooden hive, how to do so I know not, as the straw and wooden hive are not the same size and shape. I wish to know how to transfer them, and when.—W. T. L.

[12393.]—**To Steady a Sketching Board.**—May I trouble a correspondent to advise me about steadying a drawing-board, to which is attached an optical instrument, such as a camera lucida, in any place? I suppose a tripod stand is the most likely thing, but even that puzzles me in endeavouring to steady it, on stone pavement, for instance, and how about the wind?—Poloski.

[12394.]—**Fret Saw.**—I have a fret saw, which makes a rare clatter. What is the best arrangement for making the least noise?—Chip.

[12395.]—**Extracting Wax from Old Comb.**—How can I extract the wax from some old comb? I have tried boiling and straining it, but can get no wax. I have been turning out some old hives, and want to do something with the comb, which is mostly black with age.—W. Hawkins.

[12396.]—**Rouge.**—Will any kind friend tell me the practical method of preparing rouge or plate powder as made in factories (rouge and putty powder works) from sulphate of iron?—L. T. W.

[12397.]—**Boatbuilding.**—Will some reader kindly inform me what sort of wood the ribs and planking of boats are made of, whether the ribs are bent or cut to the required shape? Also, what shape the planks are cut so as to get a straight gunwale; are they cut tapering on both sides or only one?—W. S.

[12398.]—**Silver and Gilt Articles.**—Can some of the numerous readers of this journal give me a few hints on the best means of cleaning and restoring to its original colour old gilt, parcel gilt, and silver articles, without injuring the articles? Also, tell me how frosted silver can be cleaned and whitened? Is there any work on this subject from which I could get any information? Is frosting, burnishing, oxydising, &c., beyond the skill of an amateur?—Spero.

[12399.]—**Organ Building.**—Will any of "our" readers interested in organ construction kindly give a description of the viol d'amour stop? Also say if there is any difference between the Wald and Claribel flutes, and which is the best way to arrange the pedal Bourdon when the room is only 8ft. high: to lay the pipes down and have vertical windchest, or to elbow them as reeds are sometimes done?—Y. Z.

[12400.]—**Parrots.**—Can any reader tell me the name of a pair of parrots that I have? Breasts and tops of heads bright scarlet, throats blue, backs red and black, lower parts of wings green and blue, tails light blue underneath and very dark blue on top, slate coloured feet, horn coloured bills. They are about 12in. or 13in. in length, half of which is tail. I also want to know if they are likely to breed, for they feed each other like pigeons.—F. S. M. W.

[12401.]—**House Painting.**—I am about to do some painting. Will any of "our" readers inform me what proportions of white lead, turps, boiled oil, and driers to use?—J. W. C.

[12402.]—**Grease on Leather Bands.**—Can any fellow subscriber inform me if it is possible to take out grease from leather bands, so as to look new again?—Wholesale.

[12403.]—**Brass Moulding.**—Can any reader inform me what process lead has to undergo before it will mix with copper and zinc? I have been told that it can be killed by some chemical.—Nottingham.

[12404.] — **Trigonometrical Theorems.** — The following theorems can be deduced from Legendre, liv. III., pr. 18, or from Euclid VI., 3.—

$$\text{Sec. } 2\,A = \frac{\tan.\,2\,A - \tan.\,A}{\tan.\,A} : \quad (1)$$

$$\text{Sec. } A = \frac{\tan.\,A - \tan.\,\frac{A}{2}}{\tan.\,\frac{A}{2}} : \quad (2)$$

Will some mathematician furnish the deductions, either from Euclid or Legendre, and prove the same by trigonometry?—Thetamu (Horsham).

[12405.]—**Boiler for Model Steamboat.**—Can any subscriber tell me what should be the shape and size of a boiler I should want for a model paddle steamboat 3½in. depth of hold, 4½in. beam, and 2ft. 8in. long? the size of my cylinders are four-fifths of an inch diameter, and 1½in. deep. What material would be best?—A. W. D.

[12406.]—**Worm-Eaten Violin.**—I have an old violin, rather badly worm eaten, can any one tell me how to prevent further decay?—F. S.

[12407.]—**Checkering Tool.**—Can any correspondent inform me how to make a checkering tool for checkering hard wood or ivory; also how to make steel rings, 2in. long, 1in. diameter, ⅛in. thick, which must be sound?—A Trimmer.

[12408.]—**Quill Pens.**—How are quills prepared to fit them for making pens.—Spero.

[12409.]—**Transferring Pencil Drawings on Paper to Boxwood for Engraving.**—Can any of your numerous readers inform me how to transfer pencil drawings on paper to boxwood for engraving the same.—E. B.

[12410.]—**Chemical.**—Will any of your subscribers kindly inform me of one, or some of the simplest and most effectual ingredients, or basis of ingredients, which would have the power of preventing marine, animal, and vegetable matter from adhering to iron, but at the same time free from any damaging or corrosive effects on iron? The substance I inquire about need not possess adhesive qualities. I want to apply it in conjunction with a composition which has the last named quality.—W. J.

[12411.]—**Expansion Joints.**—Will any subscriber give description of one or two of the best expansion joints for a long cast-iron gutter? State how far apart it is advisable to place them.—Excelsior.

[12412.]—**Skew Bridge.**—In a skew bridge should counterforts be placed at right angles to abutments, or parallel to face of arch?—Excelsior.

[12413.]—**Harmonium.**—Will "Pneumatic Lever" oblige me with a design for a 4½ row harmonium with dimensions?—P. M.

[12414.]—**Cleaning Feathers.**—Will any one let me know how to clean white feathers on the skin from grease and blood stains?—A. S.

[12415.] — **Provision for Child.** — What is the present value for five shillings per week to be paid with a child twelve months old until thirteen years old? How can I calculate this, or what must I allow for the child's risk of dying?—J. R.

[12416.]—**Spinning.**—How many revolutions per minute does the spindle make in spinning? How many twists are there per inch in twist, and also how many weft? I desire that the answer be particularly for cotton, but answers for other materials will be gratefully accepted.—J. R.

[12417.]—**Hardening Spiral Springs.**—If some brother reader would kindly inform me I should feel obliged. I have been hardening them in water and letting them blaze off with tallow, but I find them sometimes too hard, and more often too soft; they are $^1/_{16}$in., ⅛in., and ¼in. steel wire. I have tried putting them in oil without letting down, but they are too soft. The springs you buy are hardened very well, but you cannot always get them to suit you.—SPRINGS.

[12418.]—**Resistance of Steel Plate to Air Pressure.** — Will any one let me know what would be the greatest air pressure a ¼in. steel plate chamber would resist, and if an atmospheric engine has ever been tried on a railway?—A STOKER.

[12419.]—**Photography.**—Will some one kindly tell me what is the fixing solution for pictures taken on the bichromate of potash and gelatine, or gum mixture; and also describe the whole process, if there is anything at all peculiar in it?—A.

[12420.]—**American Chucks.**—Could you, or some of "our" subscribers to the ENGLISH MECHANIC, give myself and others detail plans of the American scroll chuck, the Warwick chuck, Excelsior chuck, also the Beach chuck? They are extremely expensive to purchase for some of us humble mechanics, and we might possibly make them at our leisure if we had detail plans. Not required to scale; we could make our own proportions. If this request could have attention it would greatly oblige myself and other friends. Could we also be favoured with the mode of cutting the spiral flute on the drills as sold by Buck, &c.?—CHARLES BOWLER.

[12421.] — **Enlarging Photographs.** — Can any reader kindly inform me how photographs may be enlarged by the aid of magnesium light?—INDUSTRIOUS WILL.

[12422.]—**Steam Power.**—Would any competent engineer enlighten me on the following:—I have a portable steam engine driving a machine making 1000 revolutions per minute, and I find it very difficult to keep up steam, the engine crank shaft making 140 revolutions per minute, stroke 18in., diameter of cylinder 8½in. Would it be better to introduce a counter shaft with an additional fly-wheel and reduce the speed of engine?—PAT.

[12423.]—**More Light Wanted.**—In a range of shops three stories are built along two sides of a piece of ground. How is it possible in a cheap way to give more light to the corners where the shops come together at right angles? The owners of the property adjoining will not allow any windows to overlook them so that there is a considerable space in each shop that cannot be used.—ANTE LUCEM.

[12424.]—**Preserving Green Peas and Gooseberries.**—As green peas and gooseberries will soon become plentiful I should be glad if some correspondent would give us the method adopted for preserving them fresh in tins for winter use.—J. N.

[12425.]—**The Belgian Glass Trade.**—Can any reader of the MECHANIC give any information about the Belgian glass trade, when it was established, who by, and where, its present extent, and any other particulars of its history and development?—E. HOLMES.

[12426.]—**Piano.**—Having purchased a piano a few weeks since, when I got it home and began to practice on it I was surprised to hear a terrible rattling of the wires, which, on examining, I found to proceed from a part of the soundboard having become divided and waved. Could any of my brother readers tell me the cause, and a remedy?—A SUBSCRIBER.

[12427.]—**Entomological.**—Can any of your entomological readers tell me of what insect the maggot found in decaying cabbage-leaves is the larva? The maggot can often be found in the mid rib of the lower leaves when they have turned yellow, as it seems to bore its way upwards from the stem, travelling along the natural canals or passages in the substance of the leaf-stem. The same or similar larvæ may be found in other members of the tribe of Brassicæ when the lower leaves decay. I should like to know what they are, and how they got there.—MIMOSA.

[12428.]—**Air Vessel for Pump.**—How can I ascertain what size to make an air vessel for an ordinary force pump? The pump has a 2in. barrel, and delivers a pint at each stroke, the water being forced out through a valve at the top part of the barrel. Is it immaterial what sized air-chamber is used, so long as it is large enough, or must it be suited to the other dimensions of the pump? If the latter, what is the best material and shape of which to make it? It is wanted to deliver a constant stream through ⅜in. rubber hose with ⅛in. delivery jet, fitted with tap to regulate the quantity of water.—F. S.

[12429.] — **An Engineering Inquiry.** — I am twenty-one years of age, and have always had a taste for engineering, but unfortunately, never had an opportunity of learning that particular business until now. What would you recommend me to learn so as I may be fitted for a situation as engineer on board a steamer, and also how long should I serve in a foundry or machine-shop.—J. A. P. SPENCE.

"**Flint Jack" Again.**—The notorious forger of antiquities (who gives the name of Edward Simpson, of Whitby) has, it appears, being very active of late. He has turned up at Stamford, where it is stated he has been busy manufacturing rings, monastic seals, and flint arrow heads. Mr. A. C. Elliott, of Stamford, has had the man photographed, and intends to circulate copies, that the young collectors may recognise the fabricator on his first visit.

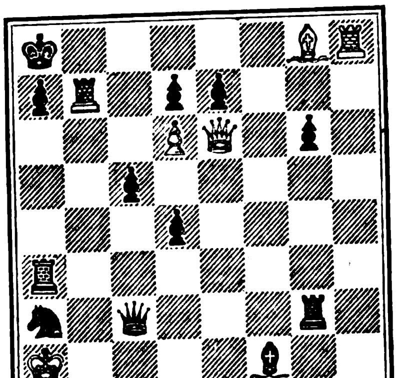
CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

THE "WESTMINSTER PAPERS."—The *Westminster Papers* is now recognised as the leading exponent of British chess, and for raciness and general ability nothing like it has ever appeared in the periodical literature of the game. None of the affectation of learning and research which characterised most of its predecessors is to be found in its pages; its news is not "ancient history," and its problems and games are neither "curious reprints" nor, as the phrase is, "selected from various sources." Every number contains a summary of the proceedings of the fraternity in all parts of the world during the past month, the latest games of the best English and foreign players, accompanied by judicious notes and instructive analyses, and at least thirteen problems of more than average merit. We may add, although the subjects are out of our province, that the *Westminster Papers* is also the received authority upon whist, each number containing three or four games from actual play by the finest contemporary whist players in London, besides articles on croquet and other games of skill.

PROBLEM VI.—BY HENRY TURTON.

Black.



White.

White to play and mate in two moves.

SOLUTION TO PROBLEM V.

White.	*Black.*
1. B to K Kt 5	1. P takes B
2. B to K 2	2. Anything
3. B or Kt mates acc	

TO CORRESPONDENTS.

E. L. G.—We should like to re-publish the article on "Republican Chess," but to do so would lead to many inquiries which could not be satisfactorily replied to.

E. T. GRAYS.—We shall, in an early number, commence publishing positions in the form of enigmas. If you will send us your name and address, the problem you mention shall be forwarded.

A. W. COOPER.—Problem I. is easy. Problem II. is a good problem, and if it stands the test of further examination it shall appear.

W. AIREY.—Problems of more than four moves deep are not favourably received by the majority of solvers. We propose to give yours as an enigma.

G. SLATER.—Problem I. admits of a solution in two moves—

$$(1)\ \frac{\text{Q to R sq. (ch.)}}{\text{Q interposes}}\ (2)\ \text{B mates.}$$

The other is an interesting composition, and it shall be published in due course.

J. P. (Bedford).—The problem in four moves can be solved thus—

$$(1)\ \frac{\text{K to B 2}}{\text{P moves}}\ (2)\ \frac{\text{R to P}}{\text{K moves}}\ (3)\ \frac{\text{B takes B}}{\text{anything}}\ (4)\ \text{R mates.}$$

The one in three moves in which the W K stands on Q R 3 is also wrong—1 B to Kt 4, &c. The other is correct and pretty, and it shall speedily appear.

G. C. HEYWOOD.—Send the promised problem. We shall be glad to hear from you at any time.

G. WHITFIELD and A. L. (Dulwich).—Problems safely to hand.

S. M. BANKER.—Your communication *not* relating to chess has been forwarded to the proper quarter.

SOLUTIONS to Problem IV. (continued).—Wiseaf (Dulwich); Hermes; J. Beresford (Vauxhall); C. J. L. (Portsmouth); G. C. Heywood (Great Torrington).

CORRECT solutions to Problem V. have been received from W. N. P.; H. Dyer (Cardiff); J. Wareham; A. W. Cooper; W. Airey (Worsley); C. Yeo (Paignton); Inductorium; E. T. Grays; C. J. L. (Portsmouth); G. V. Grand (Newcastle); G. Whitfield (Atford); S. M. Banker; A. L. (Dulwich); J Beresford (Vauxhall). All others are wrong.

USEFUL AND SCIENTIFIC NOTES.

THERE is but little doubt that many broken wheels result from expansion at the hub caused by heated journals. Since the American railroad companies have adopted a strict system of inspection of cars and wheels they have had far less breakage of wheels.

Drinking Fountains.—Some information as to the cost of these public conveniences was disclosed at the meeting of the Metropolitan Drinking Fountain and Cattle Trough Association held lately. There are more than 300 troughs and fountains under the care of the society, and all are visited, cleaned, supplied with cups, and reported at the office every week. The cost of the fountains for repair and water supply averages nearly £10 a year each, but the cost of the cattle troughs varies with their size and locality. The small dog troughs are supplied entirely with the waste water from the fountains, but for the larger troughs the water-rate alone is in some cases as much as £30 per annum, more than 1,200 horses, besides other animals, frequently drinking at one trough in twenty-four hours.

A Novelty in the Building Trade.—An Exeter correspondent writes:—"A twenty-roomed house, complete with grates, stoves, and fittings, has just been brought by ship to Exmouth, for transmission by rail to North Tawton (North Devon). The house was built in Norway for a gentleman at North Tawton named Vicary. It is mostly built of wood, and, it is said, can easily be taken to pieces and put up again in any locality desired. The house will be unshipped at Exmouth, and conveyed over the London and South Western line to its destination. Great interest is being taken in this novel cargo alike by employers and employed in the building trade. Until, however, the house is put up and inhabited any opinion upon the stability or suitability of the structure must be withheld. It should be stated that men have been brought from Norway to put it up, so that the owner will be altogether independent of home labour."

Schools of Art in the Potteries.—The Schools of Art in the Potteries have this year been very successful in the examination of works sent to South Kensington. Hitherto the district has not reached the dignity of a gold medal award, but this year two have been taken—one by Hanley, and the other by Stoke School. The gold medal for Hanley is awarded to Joseph Ellis, for modelling; and that for Stoke to Robert Abraham, for painting from nature. Hanley School also takes two silver medals and three Queen's prizes, and seven pupils have free studentships, besides which the works of twelve students are selected for national competition. Nearly double the number of students have been successful this year in comparison with last year. Besides the gold medal, Stoke School has been awarded a bronze medal and eight free studentships. In the case of Stoke, also, there is a great increase in prizes over last year. The monetary results of the examination to Hanley School are 40 per cent. in advance of last year.

Testing Inflammable Oils. — A method of testing petroleum and other inflammable fluids, and also of determining their specific gravity, has been patented in the United States. The apparatus consists of an upright glass cylinder supported in the top of a chamber formed in the upper part of a base or stand. A lamp is placed in the base, the heat from which is transmitted through the chamber to the lower part of the glass cylinder, and the chamber may be made to contain air, water, &c., as required to regulate its intensity. The glass cylinder contains a thermometer, which is fixed therein, and is closed at the top with a brass cover. The burning fluid to be tested is made to completely fill the glass cylinder, so that the thermometer is entirely submerged, and cannot be affected by the surrounding atmosphere. An orifice in the brass cover is opened to allow the escape of vapour from the fluid under test, and, when necessary, the lamp is lighted. A flame is held over the orifice, and at the moment the evolved vapour is ignited the temperature of the fluid is correctly indicated by the thermometer. In ascertaining specific gravities by this instrument a hydrometer is also placed within the glass cylinder in such a manner that its scale tube is free to move up or down through a hole in the brass cover. The surface of the fluid tested is plainly visible through the glass cylinder, and the scale may be accurately read.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 81, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£336	5	1
J. A. F.	0	1	0
	£336	6	1

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 81, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, July 9, and unacknowledged elsewhere:—

Rev. W. H. Dallinger.—A. S. Lewis.—Mrs. Ethel.—J. T. Petty.—Thomas Scully.—F. R. A. S.—Paper Maker.—S. Bottone.—M. B. Adams.—Gillem.—Collier and Son.—Cutter.—LL.D.—Dr. Hy. MacCormac.—Lecturer.—C. F. Hornby.—W. E. Lee.—James R. Gooden.—Whitley Partners.—Whiteman and Mann.—C. Hodges.—Henry Warry.—Conrad Bergman.—Rev. J. H. Cole.—James Peters.—Marsh and Pattison.—W. S. S.—F. R. A. S.—The Welsh Shepherd.—Falstaff.—J. W.—J. H. Schucht.—L. T. Holehouse.—Arotes.—Glatton.—C. N. Williamson.—A Member.—H. R. Bayly.—H. R. Roberts.—R. M.—H. Science.—J. Barwick.—T. H. Ward, Surgeon.—A Patternmaker.—Jigger.—A. A. F.—Tel. Eng.—Conatus.—Zakynthos.—Constant Subscriber.—S. R. S. G. B.—G. H. A.—E. Johnson.—The Harmonious Blacksmith.—A. L.—J. Bateman.—Jno. 495.—G. M.—Wm. Thompson.—Upholsterer.—Afternoon.—Paperhanger.—Jonathan Turner.—Bob.—J. E. Lines.—Inquirer.—J. Selwin.—C. Watson.—E. H.—P. S. T.—Subscriber.—Caer Glou.—Tom-Tit.—Iron Ore.—H. G. S.—Sirius.—John Wright.—Phœnix.—Private Student.—C. Gaudibert.—T. W.—Alfred H. Allen.—P. W. H. J.—George Wright.—J. W. Fennell.—Hipparchus.—W. and B.—R. and S.—Old Boots.—Homewood.—W. J. Ball.—John Yeoman.—Rev. A. Willan.—G. W. Roberts.—John Lane.—Rev. H. C. Key.—Suffra.—G. W. S.—T. A.—J. W. E.—R. Owen.—R. A. H.—D. C.—Clinchey.—Zurich.—Sarah.—J. D.—X. M. S.—David W. Braid.—Wm. McCulloch.—J. W. G.—W. T. R.—A. Hoskins.—J. H. Whistle.—Marcus Wicks.—L. Newton.—E. Fowler.—Amateur Photographer.—Rat-Tat.—W. Hill.—H. B. E.—T. H. M.—Johan.—George Henshaw.—Joe.—Saxum.—Seed Grower.—Horti.—R. R. Smith.—Aleph.—McGregor.—Esor.—W. M. Colles.—R. P.—Science and Art.—Lines.—J. W. Abbott.—S. M. Banker.—Simplex.—Inquirer.—Philo.—Hone Ko Jo.—S. Bottone.—C. B.—S. G. H.—Arthur Rogers.—Sigma.—Xenophon.—Pembroke.—R. Crawley.—Three Years' Subscriber.—Brickmaker.—J. P. W.—E. J. H.—P. W.—J. H. Johns.—Pedestrian.—Shell Collector.—E. Burnside.—G. H. G.—W. P.—Sheet Anchor.—Utile.—E. M.—W. G. Roberts.—Rev. A. Jarrow.—A Surgeon.—J. B. Yonge.—E. B. Moysey.—J. Foster.—J. Pell.—Wm. Grosvenor.—T. C. Ebdy.—Robert Hartley.—C. P. Stannard.—John France.—J. J. Haselgrove.—E. R. S.—J. Henry.—Secretary of Smithsonian Institution.—M. B. Adams.—Secretary of Society of Engineers.—A. Williams.—R. Botterill.—East End Mechanic.—T. W. T.—W. L. Warren.—G. W. Bacon and Co.—Orlando Hanks.—James Largon.—J. H. W.

C. F. C., Holborn Admirer, Young Snip, and J. P. James.—Your queries are advertisements. See "Hints to Correspondents."

E. J.—Not practicable.

E. B. J.—See first article this week.

Jack of All Trades has given us a call on his way home after passing upwards of four weeks at Matlock, and a week with "Khoda Bux." He promises a letter for the next number.

Sirius.—Your letter, as you will see, was superseded by one from Mr. Proctor and one from "E. L. G."

Zoo Andra.—Your query would be of no service to any one but yourself.

E. S.—Yes, it came to hand, and was found unsuitable.

Parker.—Your first query is an advertisement, and your second is only useful to yourself.

W. H. Fleet.—We do not know the address, and if we did it would be contrary to our rules to give it you.

W. B.—We do not know why Mr. Tonkes is silent.

W. Webly.—An American publication, and American publications are very frequently echoes of English journals.

E. N. H. asks, "Why does not the English Mechanic devote a small portion of its space to legal as well as medical questions? Points of law are continually arising on which light might be thrown by some of our correspondents."

John Matthews.—You cannot vulcanise rubber discs after they are manufactured. The soft rubber is mixed with sulphur, and afterwards submitted to heat and pressure—the latter process being the vulcanising.

John Manhinney.—The data are insufficient to advise upon. You say the wall is "slightly damp" in one place, and in another speak of the "damp spot." If the dampness is confined to a spot it might probably be easily remedied. See Vol. XIV., pp. 313, 337, &c.

Ancoats, T. B., Atlas, E. N. D. (first query), Hoop Iron, W. Watson, A Working B., are referred to back volumes.

A Poor Man.—The method given on p. 336 to mask the taste of castor oil will do very well. Milk, sherry, or lemon-juice are also good.

A. C. G.—For music-ruling pens see pp. 50, 104, 159, and 209, Vol. XIV.

Excelsior.—We do not understand your third query on Political Economy.

Communications which can only appear as advertisements to hand from J. Y., H. Elfes, Drum Maker.

E. Johnson.—It is quite true; the matter has been fully discussed in back volumes. See indices.

J. Streabber.—See "Hints to Correspondents."

G. Richardson.—AEI form the Greek words meaning "For ever."

J. Gillaird.—Your reply only promises the information, but really contains none. If you like to send sketch and details we will insert them. Your other proposal does not seem at all practical, or one likely to be entertained.

Ignoramus.—The compass was known and used by the Chinese. The phrase used by St. Paul does not apply to a compass, but means that he sailed in a circular direction.

Simere Sperens.—Your suggestion about perpetual motion is not worth the paper on which it is written. Read some elementary scientific book.

R. P. says:—"I quite agree with your querist (12329) that a series of good papers on mechanics for beginners would, in these days of science examinations, be very valuable to many of your readers. If some one could do for statics and dynamics what Messrs. Sprague and Bottone are doing for their respective subjects, the usefulness of your paper would be much increased."

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JULY 2, 1872.

1864 W. E. Newton, Chancery-lane, for improvements in stench traps, and in apparatus for making the same and other curved or partly curved articles. A communication.

1865 W. E. Kochs, Manchester, for improvements in piers, jetties, and landing stages, and in means for effecting the transference of railway trains to and from ferry-boats and floating vessels, and for staying the said trains when on board such boats or vessels.

1866 J. T. Fitzmaurice, Porthpean, Cornwall, for improvements in apparatus for lowering boats.

1867 W. Robertson and J. G. Orchar, Dundee, and M. A. Muir and J. McIlwham, Glasgow, for improvements in apparatus for winding yarn or thread.

1868 G. Maxwell, Lancashire, for improvements in the construction of machinery or apparatus used for making bricks and tiles.

1869 T. Davis, Warrington, for improvements in furnaces for heating metals.

1870 J. Calvert, Oldham, for an improved lamp for moulders or artisans.

1871 I. Fenno and P. Howe, Boston, U.S., for improvements in machines for cutting cloth and other textile or fibrous material.

1872 S. T. Waite, Smith-street, Northampton-square, and J. J. White and J. O. Wise, Sekford-street, Clerkenwell, for the lighting of fires.

1873 G. T. Bousfield, Loughborough-park, Brixton, for improvements in rotary ploughs. A communication.

1874 J. G. Horsey, Broad-wall, Lambeth, for improvements in the manufacture of brushes and brooms, and in the machinery or apparatus employed therein.

1875 E. Turner, Leicester, for improvements in door springs.

1876 S. B. Smith, Birmingham, and J. W. Willans, Middlesbrough, for improvements in the process of and apparatus for smelting iron ores and other ores, and reheating iron and other metals, parts of which improvements may also be applied to other purposes.

1877 G. Burge, jun., Rochester, Kent, for improvements in kilns for burning cement, lime, and other substances.

1878 J. Tourre, Avignon, France, for improvements in obtaining colouring matters derivable from madder, manjeet, and other allied roots.

1879 W. Birch, Penrose-street, Walworth-road, for improvements in the mode of and apparatus for treating horny and other analogous animal substances for the purpose of converting them into an elastic substance to be used in place of whalebone, bristles, and for other purposes for which such elastic substance may be applicable.

1880 W. M. Brown, Southampton-buildings, for an improved apparatus for extracting ammonia in the form of liquid ammonia from crude ammoniacal liquors. A communication.

1881 E. Milner, Springfield, Lancashire, for improvements in the method of producing white pigments from lead.

1882 B. Wrigley, Arundel-street, Strand, for improvements in kilns for burning bricks, pottery, and lime.

1883 J. Campbell, Founders-court, City, for improvements in the modes of decreasing the rolling of vessels.

1884 J. Arthur, Sandycroft, Flintshire, for improvements in screw bolts and nuts.

1885 J. Horsley, Cheltenham, for an improvement in the manufacture of an explosive compound and a new mode of firing explosive compounds.

1886 J. Thomas, Middlesbrough, for improvements in furnaces for generating gas and melting metals.

1887 J. Kirby, Preston, for improvements in machinery or apparatus to be used in frames for winding linen or other yarns.

1888 J. Tabor, Leadenhall-street, City, for a mechanical arrangement or "tell tale" for registering the number of packages taken to or from vessels, vehicles, warehouses, and other places.

1889 W. R. Lake, Southampton-buildings, for improved check tickets and methods of forming packages of the same, chiefly designed for use on railways and steamboats. A communication.

1890 L. D. Newell, Aldersgate-street, City, for improvements in ships' berths and sofas.

1891 B. Burleigh, Adelphi-place, Camberwell, for improved lever apparatus for railway switches.

1892 G. A. Dorsett, Rotherhithe, for improvements in obtaining anthracine from heavy oils and in apparatus employed therein.

1893 W. Beale, Bridgwater, for improvements in apparatus for turning over the leaves of music.

1894 T. Redmayne, Sheffield, for improvements in the construction of desks, seats, and music stands, applicable to the use of schools and other purposes.

1895 J. F. Swinburn, Birmingham, for improvements in breech-loading small arms.

1896 G. Davidson, Aberdeen, for improvements in machinery for washing fibrous pulp or material for the manufacture of paper.

1897 H. P. F. Palmer, Carnarvon, for improvements in cases or crates for containing roofing slates while in transit and other articles requiring packing cases to preserve them from injury.

1898 T. Atkins, Saint Albans, Herts, for improvements in pumps, parts of which improvements are also applicable to other purposes.

1899 P. E. Chappius, Fleet-street, for improvements in the manufacture and application of reflecting surfaces for the better reflection and diffusion of light.

1900 J. Sagar, Leeds, for improvements in machinery or apparatus for raising and forcing water or other fluids.

1901 E. Salt, Darwen, Lancashire, for improvements in rag engines, washing engines or beaters employed in the production of pulp or paper "stuff."

1902 E. P. H. Vaughan, F.C.S., Chancery-lane, for improvements in furnaces, stoves, and other apparatus for consuming fuel. A communication.

1903 B. Hunt, Serle-street, Lincoln's Inn, for improvements in apparatus for shearing or clipping sheep, horses, and other animals. A communication.

1904 A. Taylor, Stockport, for improvements in apparatus used for bleaching yarns and cloth.

1905 W. E. Newton, Chancery-lane, for improvements in the manufacture of vinegar and in the acidulation or treatment of various liquids, and in the apparatus employed therein. A communication.

1906 W. Phillips, Farndon, Cheshire, for an improved pea range adapted for supporting and protecting peas during their growth, for protecting half-hardy plants, and as a forcing frame.

1907 J. Ricketts and A. Lutschaunig, Liverpool, for an improved mode of and apparatus for defacing postage stamps.

1908 J. Woods and E. Woods, Warrington, for improvements in apparatus employed in drawing wire.

1909 M. Burke, Liverpool, for improvements in screw propellers.

1910 J. Hartley and Z. Sugden, Halifax, Yorkshire, for improvements in boilers for heating of water for warming buildings and other like uses.

1911 J. L. Norton, Ludgate-hill, and J. H. Carter, Mark-lane, City, for improvements in decorticating, hulling, or polishing wheat and other grain or seed, and in dusting bran, and in apparatus employed for such purposes.

1912 W. Young, Blandford-square, Middlesex, for improvements in printing and in the production of printing surfaces, also in apparatus to be used for these purposes.

1913 A. M. Clark, Chancery-lane, for an improved distress rudder and drag for vessels. A communication.

1914 J. Townsend, Glasgow, for improvements in furnaces or apparatus for obtaining heat or gases from coal or other substances containing carbon.

1915 W. Harvie, Glasgow, for improvements in lenses and in lamps wherewith such are or may be used.

1916 W. Macrone and W. McKenzie, Glasgow, for improvements in the production of stereotype plates, and in apparatus employed therefor.

1917 S. J. Wallis, Spalding, Lincolnshire, for new or improved mechanism for discharging both locks or barrels of a double-barrelled gun by one trigger.

1918 W. Sissons and P. P. White, Kingston-upon-Hull, for improvements in steam pile-driving apparatus.

1919 C. W. Siemens, Great George-street, Westminster, for improvements in the means of obtaining and applying magneto-electric currents, and apparatus therefor. A communication.

1920 C. Caselton and H. Toogood, Hull, for improvements in saw frames or machinery for cutting tile, slate, and other laths, boards, deals, battens, and other woods and materials usually cut by saws.

1921 J. Merrylees, Glasgow, for improvements in weaving ornamental fabrics, and in apparatus therefor.

1922 T. Gibson, Stamford, Lincolnshire, for an improved machine for cutting lump sugar.

1923 J. E. T. Woods, Hammersmith, and J. Clark, Kensington, for an improved alloy for anti-acid metal and for other purposes.

1924 E. G. Brewer, Chancery-lane, for improvements in the modes of and in the means or apparatus for operating the rotating parts of sewing machines and of other analogous machinery. A communication.

1925 R. E. Middleton, Cannon-row, Westminster, for improvements in machinery or apparatus for breaking stones, ores, and other like substances.

1926 R. G. How, Carshalton, for improved mechanism for indicating and recording the speed of railway trains.

1927 W. Corney and S. S. Turner, Westborough, U.S., for improvements in stop motion for looms.

1928 P. Poggi, College-street, Chelsea, for an improved mechanical combination, constituting improved motive-power machinery adapted for industrial and other purposes. A communication.

1929 R. W. Simpson, R. Hopps, and D. Johnson, Leeds, for improvements in machinery for scribbling wool and other fibrous substances.

1930 O. McC. Chamberlain, New York, U.S., for an improved attachment for sewing machines for folding plaits.

1931 J. S. Christopher and J. F. Lackersteen, Lombard-court, City, for improvements in the manufacture of hydrogen gas.

1932 B. F. Stevens, Henrietta-street, Covent-garden, for improvements in apparatus for raising, lowering, and securing, ships' boats. A communication.

1933 G. Whitaker and J. Ashworth, Rochdale, for an improved process for preparing wool or other animal fibre for carding or combing.

1934 A. M. Clark, Chancery-lane, for an improved apparatus for feeding and drying whitelead and other pulpy or semi fluid substances, and for feeding oily and pasty substances. A communication.

1935 R. A. Purkis, Cheam, Surrey, for improvements in the mode of and apparatus for refrigerating liquids.

1936 W. H. Denham, Southsea, P. V. Denham, and A. A. Denham, Putney, for improvements in water-closets and in apparatus connected therewith, parts of which improvements are applicable to other purposes.

1937 W. R. Lake, Southampton-buildings, for improvements in gathering, ruffling, or plaiting apparatus for sewing machines. A communication.

1938 A. Hookham, Southwark-bridge-road, for improvements in money tills.

1939 M. Paul and J. Haythorn, Dumbarton, N.B., for improvements in and connected with steering apparatus.

1940 W. Wright, Sheffield, for improvements in taps and apparatus for flushing water-closets, and in taps for other purposes.

1941 J. R. Cazier, North East, U.S., for an improvement in the application of safety valves to steam boilers.

1942 J. W. Ward and J. C. Rouse, Halifax, for improvements in jacquard machinery or apparatus.

1943 J. S. Cooke, Yorkshire, for improvements in machinery or apparatus to be employed in dyeing wool, silk, cotton, flax, or other fibrous substances in the hank or skein.

1944 J. H. Johnson, Lincoln's Inn-fields, for improvements in sifting or bolting machines. A communication.

1945 J. Millward, Birmingham, for improvements in hydrants for supplying fire-engines from street mains. A communication.

1946 J. G. Tongue, Southampton-buildings, for improvements in the manufacture of artificial flowers, foliage, fruit, and other similar objects or ornaments. A communication.

1947 W. M. Parker and J. R. Robson, Alton, Hants, for improvements in steam and other motive-power engines and pumps.

1948 F. J. Cheesbrough, Liverpool, for improvements in the process of manufacturing oil and oil cake from seeds, and in the machinery to be used therein. A communication.

1949 J. Fletcher, Lancashire, for improvements in machinery for forging and riveting.

1950 G. Yule, Wakefield-street, London, for improvements in cylindrical and other rulers for office and general use.

1951 J. H. Johnson, Lincoln's Inn-fields, for improvements in preserving butter and other fatty matters, and in the apparatus or means employed therein. A communication.

1952 A. C. Kirk, Glasgow, for improvements in steering apparatus and in motive-power apparatus for working the same, or for working, winding, hoisting, or other apparatus at a distance.

1953 H. Giroud, Paris, for a new or improved system of rheometric regulator used with a gas burner only.

1954 S. Chatwood, Bolton, and J. H. Collins, Falmouth, for improvements in separating or dressing tin and other ores.

1955 T. S. Derham and C. W. Thalrlwall, Leeds, for improvements in machinery for manufacturing bricks.

1956 T. H. Phillips, Barbican, City, for an improved apparatus or appliances applicable for heating, cooking, and lighting purposes.

1957 W. R. Lake, Southampton-buildings, for improvements in fastenings for uniting and securing the parts of bedsteads and for other like purposes. A communication.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JULY 19, 1872.

ARTICLES.

ON SELF-DECEPTION IN OBSERVATION.

BY RICHARD A. PROCTOR, B.A. (Cambridge).

Honorary Secretary of the Royal Astronomical Society.

MOST of those who have at any time had occasion to make observations in connection with a strongly entertained theory must have been led to notice the readiness with which the mind lends itself to such a view of observed results as may be most in favour of the observer's theory. When a series of measurements is being made, which should run in a certain way if a certain theory is correct, it will unquestionably run more nearly in that way if the observer looks with favour on the theory than if he is opposed to it. If colour-tests, light-tests, or estimates of shape be in question, then still the predominant theory will exert its influence. No matter how conscientious the observer may be, he finds it almost impossible to avoid falling into an error of the sort, unless in his eagerness to be strictly impartial he avoids Scylla to fall into Charybdis, actually favouring the evidence against his theory rather than do aught in its support not strictly justified by the facts.

Let it not be supposed that the self-deception here spoken of is practised only by inferior observers, or that it is of the nature of "a mistake made on purpose." The very best observers have repeatedly found themselves going astray in this particular way; and by their readiness to admit that they have done so have shown that no desire unfairly to advance their theories has been in question. The longer an observer's career has been, the more clearly does he recognise the necessity of watchfulness over himself, unless he can devise some arrangement by which he will be rendered unconscious of the bearing of his observations on his theories. The worst of the matter is, that observations *ought* to be made in subservience to some theory, since otherwise they will almost certainly be wanting in precision and system. The best observations ever yet made have been conducted in connection with theory, and in every instance where observations have been made by those who boast that they have no theory at all on the subject under observation, the results have been of little value. Indeed, I may notice in passing, that those make a great mistake who attach exceptional weight to observations made by persons who have no special views on the subject of observation. Though the object of this paper is to dwell upon the errors made by observers strongly prepossessed in favour of a particular theory, I should be sorry indeed to seem to give any support to the notion that the best observations will be made by persons having no theory at all. To say that a person has no theory at all on a subject, is to say that either he knows very little about the subject, or that he has no brains worth mentioning. No man who has a respectable supply of reasoning faculties can fail to form opinions as the facts relating to any subject are brought to his knowledge. It would, indeed, be very unwise for him to arrive at conclusions at an early stage of his study of the subject. He should be prepared to modify his opinions; and he may regard hereafter as unlikely the views which he had at first entertained as probable. But we may be well assured that one who forms no opinions as his study of a subject proceeds, who is not ready to form hypotheses explanatory of the facts brought to his knowledge, who is continually waiting to know more before entertaining any theory at all, will never have an opinion worth listening to. Not only is it true, to use Sir W. Herschel's words, that to observe without theorising is to "depart from the very purpose for which observations are made," but the observations themselves suffer when they are carried out in so purposeless a way.

My object, then, is to indicate the necessity for the devisal of methods for freeing the mind from the influence of preconceived opinions, not, assuredly, to advocate such an avoidance of theory as can only be attained by the weak-minded. It is for the former purpose that I adduce some instances which seem to throw light on the subject of self-deception in observation. They are at once interesting and instructive.

In the first place, I will cite a series of instances relating to a single subject.

It is well known that the family and school of Cassini maintained that the polar diameter of the earth is longer than the equatorial diameter, while Newton and his followers maintained the contrary opinion.* Originally, Cassini had believed the earth to be oblate, and from a passage in the article, "Figure de la Terre," by D'Alembert, in the original "Encyclopédie," it appears that Cassini inferred that in consequence of this oblateness the length of a degree would *decrease* from the equator to the pole. Starting with this erroneous assumption, the school of Cassini "*arrived at the same result by observation and measurement.*" When it was shown that the assumption was erroneous the Cassinians maintained the accuracy of their observations, and thus necessarily adopted the theory that the earth is a prolate spheroid, the polar axis being the greatest diameter. But "there can be no doubt," says Mr. Todhunter, "that at least Maupertius and Clairaut, who were the most eminent of the French party sent to measure the Lapland arc in 1736, "held the correct Newtonian theory as to the figure of the earth; and their result was *rather too decided* in its confirmation of this theory. Now the geodetical angles could scarcely be influenced by the opinions of the observers, because it would not be obvious in what way the result would be affected by an error in the angle. But on measuring the base it would of course be obvious that the larger was the value obtained the stronger was the evidence for the oblate form. Similarly, in estimating the amplitude of the arc, the smaller the value obtained the stronger was the evidence for an oblate form. In these two parts of the survey, then, it would be necessary to be on the watch lest the conviction of what the result ought to be should influence the impression of what the observation really gives. It is curious that Maupertius and his party seem to have thought at first that their success was too decided, and, therefore, their amplitude too small, and that on their second determination *they should have made it between three and four seconds larger than at first.*" Svanberg was sent to Lapland with a strong expectation that he would obtain a less value of a degree of the meridian than that of Maupertius; and according to the best estimates of the value of a degree for the part of Lapland where the arc was measured, Svanberg's value was *below the true value.*

Striking as are these facts, however, the eclipse observations of last December afforded yet more remarkable evidence of the self-deception which may arise from the effect of a preconceived opinion.

It may be remembered that Dr. Oudemans had expressed the opinion that the solar corona is due to the illumination of matter close by the moon. This theory is mathematically defensible so far as the shapes of the coronal rays and rifts are concerned,† if only certain phenomena are observed during totality. It is perfectly clear, since the theory explains the rays and rifts as due to the passage of the solar rays past valleys and mountains on the moon's limb, that as the moon passes athwart the sun's face the rays and rifts should change in position, shape, length, and so on.

Now, as a matter of fact, the evidence obtained during the eclipse of December, 1870, had completely disposed of Oudemans' theory. It is perfectly well known that the doubts expressed as to the agreement between the photographs taken by Willard, at Xerez, and by Brothers, at Syracuse, were based on imperfect drawings of these photographs, and though these doubts were not ostensibly withdrawn, the photographs themselves completely disposed of them. But to Oudemans, at Batavia, this news did not penetrate. He set forth to view the total eclipse of last December with unshaken faith in his lunar cosmical dust theory, and with a perfectly clear recognition of the phenomena which *should* make their appearance if the theory were true.

Far away, to the west of Dr. Oudemans, was stationed Mr. Lockyer, at Baicull. To him the theory still remained dear, that the corona is, in the main, a phenomenon of our atmosphere. What were the particular appearances which he expected to see in demonstration of this hypothesis deponent sayeth not—probably we shall never know. But that he did expect to see such appearances—nay, that whatever they were he did actually see them, will appear in the sequel.

At Baicull, also, and at Dodabetta, 8,000ft. above the sea-level, were stationed certain inanimate, but very efficient, observers, who were certainly not prepossessed in favour of any theory, and who possessed to a very remarkable extent that quality which has been called by Doré "collodion in the eye:" I refer to the photographic apparatus set up by Mr. Davis at Baicull, and by Col. Tennant at Dodabetta.

The moon's shadow came and went, and the observers, animate and inanimate, did their work; the results are most instructive.

The totality was scarcely over when there went forth from Mr. Lockyer, at Baicull, to the observers at Jaffna (just preparing for totality) this startling telegraphic message, "*The corona is almost wholly an atmospheric phenomenon.*" In some unknown way the atmospheric glare theory which had possession of his mind caused the observed appearances to seem demonstrative of its correctness.

Dr. Oudemans, in the east, was similarly favoured. He writes to Mr. Lockyer, "My observations and those of my party" (inoculated, we may fairly imagine, with the lunar theory) "have given me the conviction of the existence of an optical phenomenon besides the purely solar phenomena; *not of an atmospheric origin* (*there is no question whatever of this*), but of rays variable during the totality, too variable to be attributed to solar matter emerging from the body of the sun itself. I could follow the rays and rifts as far as the moon's edge."

But alas for the rival theories which had thus so completely demonstrated themselves and disposed of each other! the inanimate photographic observers had been at work, and had done their work in such a way as to dispose of both the rival theories at once. At each station five photographs had been taken (not counting one imperfect one at Dodabetta). Each photograph of each set shows a multitude of rays and rifts very peculiar in form. I suppose that upwards of a hundred well-marked features can be counted in each picture. These features are absolutely identical in all the five pictures of either set. The pictures of one set are absolutely identical with those of the other set. Comparing the pictures of either set of five, we see the moon measurably traversing the corona as the eclipse progressed, thus definitively disposing of the lunar theory;* while, comparing the two sets, we find the features photographed at Baicull, on the west coast of India, close by the sea-level, absolutely identical with those photographed at Dodabetta, on the Neilgherries, 8,000ft. above the level—thus definitively disposing of the atmospheric theory.

In passing, it may be remarked that perhaps it was a little hard of Mr. Lockyer to publish the parts of Dr. Oudemans' letter which relate to the lunar theory of the corona. Oudemans wrote in complete unconsciousness of the photographic evidence which has been so long in the hands of European men of science; had he heard of the photographs he would doubtless have wished to withdraw his remarks on the lunar hypothesis. Still, the lesson derived from these matters is so

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* I quote from a most valuable paper, by Mr. Todhunter, "On the Arc of the Meridian Measured in Lapland"—*Transactions of the Cambridge Philosophical Society*, Vol. XII., Part I.

† It is completely answered, I conceive, by the objections I have urged against it on account of the smallness of the total quantity of light which would be received from the region in question, as compared with the quantity received—*according to the theory itself when all its consequences are considered*—from matter beyond the moon. I submitted this objection to Sir John Herschel, and in his reply he expressed his perfect agreement with what I had urged on the subject.

* Dr. De La Rue (once, by the way, an advocate of Oudemann's theory) informs me that in Col. Tennant's negative the features of the corona can be seen (and identified in the several pictures) to a distance of one and one-seventh diameters of the sun. In Lord Lindsay's series, the negatives of which I have had the pleasure of examining, with oxyhydrogen illumination, precisely as set for the engraver to work from, the features can be traced very nearly as far. They are not by any means mere straight rifts or rays, but of most remarkable figure, here a short spiky projection, there an irregularly-shaped obelisk of light, in another place a long ray of double curvature, in yet another a complicated knot of streaks—altogether the most marvellous astronomical picture my eyes have yet rested on. Janssen's description, with its marked reference to "special shapes altogether irreconcileable with an atmospheric theory," is strongly recalled and fully justified. Yet the photographs show but a portion of the extension of these strange figures. That excellent observer, Capt. Tupman, who drew a capital picture of the corona, agreeing well with the photographs, could trace these features much farther.

By the way, when are the reports of the eclipse expedition to be available for study? What occult cause is preventing us from hearing what was done?

instructive that perhaps Mr. Lockyer did well in bringing it before us. We cannot be taught too emphatically that in observation extreme caution is required lest preconceived opinions should mislead us; and this lesson may now be said to have been enforced by example as well as by precept.

In conclusion, I may remark that I formerly took strong exception to the assertion that one who theorised respecting the corona, in that stage of the inquiry which we had reached two years ago, "simply made himself ridiculous." It may be (such is human weakness) that it was the application of this remark to myself which led me to take exception to it. But I think I may now not unfairly point to the results recently obtained as affording strong evidence in favour of my view, that no man can make himself ridiculous by announcing carefully-considered views, even though those views should prove to be erroneous. It is a mere matter of detail that my ideas respecting the corona have been justified, and are now accepted by all whose opinion is of any weight. But I would venture to express a hope that at the present time Mr. Lockyer no longer regards the enunciation of possibly erroneous views respecting the corona as altogether so ridiculous a proceeding as it once appeared to him. If so, the recent eclipse observations will have had this pleasing result, that while they have enabled Mr. Lockyer to illustrate (unconsciously) a teaching which is of the highest importance and value to all observers, they have conveyed to himself a not uninstructive lesson.

THE WATCH, AND HOW TO REPAIR IT.

By "Seconds' Practical Watchmaker."

(Continued from page 421.)

THE little box of wheels called a watch seldom at first sight has bestowed upon it much thought, and when it is thought about, it more frequently happens than otherwise that that thought arises out of its apparent unwillingness to register time with its accustomed regularity; and should the watch be one the regularity of whose general performance is prized by its possessor, the thought then, in the majority of instances which have fallen under my notice, is this: "My watch never requires alteration. He must have been a very clever person who invented the watch." And with this kind of soliloquy the watch is returned to its place of keeping.

The series of articles on the above-named subject will be designed with the intention of attracting attention to a common fact, that the watch deserves a great deal more care and thought from the general wearer than is usually allotted to it, for the readers will have placed before them some facts relating to the care and management necessary for each kind of watch, as well as a description of each particular construction, for this "little monitor of our daily engagements" has connected with it a host of scientific connections, for from its commencement to completion its associations with the sciences entitle it to more careful attention from persons who profess a love for philosophic inquiry than has come under my notice after several years of observation on the subject.

The history of the watch will be traced from the earliest existing models, and when the connecting link by model fails, quotations from the most reliable authorities will be made use of. By these means it is intended to trace the history of the watch from its earliest period to the present time. This section of the subject, I am inclined to think, is a very important one, for we can look back on an age, not long departed, when the subject (watchwork and watchmaking) was considered of such importance that the most influential and the wisest men of that time deemed it an honour to be connected with the art. Thus, out of their united energies, was the "toy-watch" made a scientific wonder. So that in these days of mechanical and scientific progress, by a knowledge of the past with the present improvements, many additions may yet come before the world from those who, without the knowledge of the gradual improvements of the watch, would not think of turning their thoughts to the subject. Mr. Charles Frodsham has thus stated, referring to the subject: "Indeed, I think there is little doubt that there has been more time spent by great minds upon clocks and watches than upon any other art or science, and they may be truly said to have been the nursery of engineering and mechanical skill." The history of the watch is a combination of several years' incessant application among those who may with fairness be termed its pioneers, because, as previously stated, prior to the year 1720 there was but one kind of watch, and the special arrangement of its parts was the same as we now term the verge watch. Other arrangements were adopted as the watch became improved from its originators—although in the present day we might, with a degree of truth, term such instruments "pocket clocks," for they were six or seven inches in diameter and two and a half inches thick, several of which may be seen at the South Kensington Museum, Section 34, from Nos. 7445 to 7461, including seventeen choice specimens; and although they are catalogued as "Clocks," their construction is identical, with respect to their time-keeping arrangements, to the original watch referred to; and although these ponderous instruments, from their dimensions, may surprise some readers, many among us can remember the ponderous watch when removed from the fob of our relative or neighbour. Many watches are at the present day in use weighing about eight ounces.

The watch continued for several years without much marked improvement, but when the era in watchwork dawned, especially among the English, there was no effort dormant. As I have stated, the subject was of such importance that it attracted the attention and the persevering study of the best mechanics, mathematicians, astronomers, and divines, out of whose combined assiduity the problem of time-measuring, to purposes the most useful, came — namely, the carpenter Harrison's timepiece for determining the longitude at sea, by which means vessels were not only more safely conducted across the ocean, but with more speed and precision directed to their destinations. This wonderful piece of mechanism was nothing more than an improved large watch of that date—namely, A.D., 1736, and no wonder that the production of such a marvellous instrument should have gained the Parliamentary reward of £20,000. But, then, we must not forget that Harrison laboured at his idol machine nearly all his life—about forty years. This identical instrument is now at the Royal Observatory, Greenwich, and is treasured by the officers of that institution. It was the production of this wonderful automaton which caused men of genius to direct their attention towards improving the pocket watch, and from such emulation came another marvel — namely, the horizontal one, commenced by Tompion and completed by Graham, as previously stated.

It is more than probable that few persons are aware that the different terms applied to watches by which they are distinguished, such as vertical, horizontal, duplex, and chronometer, refer to the kind of escapement applied; nor is it generally known, even among working watchmakers, that all the escapements introduced to good watches, whether at home or abroad, were invented by Englishmen. It is true that many ingenious contrivances have been introduced at different times by French and other artists; but they themselves have ceased to apply them, and with the exception of the vertical escapement, they generally adopt those principles only which were devised by English watchmakers.

In this first chapter it is intended chiefly to introduce the watch in its popular form, leaving details to follow, and thus, while we have somewhat before us the horizontal or first improved watch, a few words more concerning the foreign one will be necessary.

The foreign watch is frequently denominated a Geneva by persons who do not know that there is any difference between the two terms, Geneva and Swiss, which of late years have become so familiar amongst the English.

The Geneva watch is, in many instances, miscalled, for it more frequently happens that the so-called Geneva watch is a Swiss one; which latter watches have been imported in such vast quantities as to cause no little astonishment concerning their disposal. This statement probably may require some explanation.

The watches made in Geneva are usually of superior make and finish, and are, therefore, high in price. Few, comparatively, are made there, which may probably be accounted for by the fact that in many instances an English watch can be obtained for very little more than has to be charged for the Geneva one. Swiss watches, on the contrary, are produced in great quantities. They are made with great rapidity by machinery, to facilitate which most of the parts are left very soft, and are less carefully finished than those of the Geneva kind; and further, the watch made at the latter place is examined and completed with more care than the Swiss one. Thus the difference in price of the Geneva is double that of the other. But the casual purchaser, or wearer, cannot judge of the relative qualities of the two kinds, and not unfrequently pays for the Swiss watch a price equal to that which would be charged for the Geneva made one. This fact is before us, that the Geneva watch is very durable, while the Swiss one wears out quickly. There is an unerring rule by which the one may be selected from the other—namely, by opening the back of the case and examining the stamp. The Geneva one will have the inner part of the back of the case stamped, and in the inclosure of such stamp will be seen the letter G., without such no watch is of Geneva manufacture. On the other hand, the Swiss watch-case will frequently—but mark, not always—have a stamp resembling zig-zag of two lines, but all Swiss watch-cases do not bear the stamp. Therefore, any watch-case having no stamp is not of Geneva manufacture. In closing this introductory chapter I am induced to quote a few lines written by that painstaking antiquarian, Mr. E. J. Wood, in a volume entitled "Curiosities of Clocks and Watches from the Earliest Times." He thus proceeds: "How many of the folk who so often, in the course of a day, pull out their watches to see the hour, give a thought to the history of those mechanical contrivances for measuring the flight of moments. Very few, we think. It is sufficient for most people if their watches keep correct time, and whatever historical interest may be appertaining to the little machines, lies shut up and unobserved among the wheels and springs which the cases inclose. Let us take our timekeeper out of our pocket, and to the tune of its unceasing nervous voice—like an audible theme—we will jot down some gathered notes from its scattered history, with the ambitious hope that he or she who may peruse our collectanea and notanda may the more prize, for dear memory's sake, the large old-fashioned family silver watch, with the ribbon and pinchbeck seals, which now lies neglected and almost forgotten in his or her relic-drawer; but which was a highly-valued part of the personal effects of grandfather before he went into that land wherein time-measurers are not needed. Only a little sketch of imagination is required in order to give to the small admonitory moralist which lies on the table before us an articulate utterance, so pregnant in its 'tick, tick,' as if it were counting old grandsire Time's gains of golden moments into heaps, one by one, as each falls sounding into the past."

(To be continued.)

LESSONS ON CHEMISTRY.*

By Selimo R. Bottone.

(Late of the Istituto Bellino, Novara, Italy.)

(Continued from p. 397.)

198.—Being now in a position to understand somewhat of the theories which we briefly laid before him at the commencement of the lessons, the student will do well to follow us in the review which we propose making of many of the compounds which we have studied, especially with relation to the ancient and received theories, nomenclature, &c.

We have pointed out the *fact* at paragraphs 9 and 10 that all bodies, in combining with each other, unite in certain definite proportions; or, if one body can unite with another in several proportions, yet the numbers representing these proportions will invariably be multiples or submultiples of the number representing the proportion in which the first combination took place. As a knowledge of this fact is of the highest importance to the chemist, the student is particularly advised to bear it constantly in mind, and to commit to memory these combining proportions. By so doing he will be enabled to calculate, without difficulty, the quantity of certain given elements required to form a given compound; or, *vice versa*, he will be in a position to specify the exact amount of a given compound requisite to eliminate two or more given elements. The compounds of chlorine with hydrogen, with oxygen, and with sulphur, also those of sulphur with oxygen and hydrogen, furnish us with numerous examples of the law of *combining proportions*.

Hydrogen (36) being the lightest body known and entering into combination with almost every

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known element, has been generally* accepted as the standard or unity of comparison for determining the combining weights of bodies. Hence it is customary to give its combining weight as 1·00. Now, we have seen, at paragraph 53, that chlorine combines with hydrogen, and at paragraph 54 we have learnt that one volume of hydrogen requires exactly one volume of chlorine to saturate it. On weighing the volumes of chlorine and hydrogen employed, we find that the volume of chlorine is 35·5 times as heavy as the equal volume of hydrogen: hence we are justified in stating that *the combining weight of hydrogen being* 1·00, *that of chlorine is* 35·5. In other words, hydrochloric acid contains, by weight, 35·5 parts of chlorine united to 1 part of hydrogen.

199.—Both chlorine and hydrogen combine with oxygen, the former in several, the latter in only two proportions. Thus, taking a given volume of hydrogen, weighing, for example, 1 gramme, we shall find that the quantity, by weight, of oxygen required to form with it the first compound, *water*, is exactly 8 grammes, while to form the second compound 16 grammes of oxygen are requisite. Chlorine forms several oxides (see Section 6B), and the quantities of oxygen in grammes required to form these oxides, with 35·5 grammes of oxygen, is tabulated below:—

	Chlorine.	Oxygen.
Chlorine monoxide	= 35·5	$8 = 8 \times 1$
Chlorine trioxide	= 35·5	$24 = 8 \times 3$
Chlorine tetroxide	= 35·5	$32 = 8 \times 4$
Chlorine pentoxide	= 35·5	$40 = 8 \times 5$
Chlorine heptoxide	= 35·5	$56 = 8 \times 7$

From the composition of these compounds we are led to infer that the relative combining weights of oxygen, hydrogen, and chlorine, are respectively 8, 1·00, and 35·5. So far we have kept ourselves within the strict boundary of fact, but the mind of man is so constituted as to render him desirous of being able to see or imagine a *cause* for every *effect* that comes under his notice. Hence several theories have been propounded, with the intention of explaining these invariable "combining proportions" of the elements. These theories, though plausible and possibly correct, do not seem to admit of direct proof, therefore the student must always bear in mind that though the law of "fixed" and "multiple" combining proportions is a physical fact, yet the theories deduced therefrom are only *hypothesis*, which may at any moment be disproved on the discovery of new and antagonistic *facts*.

200.—The first general attempt to explain the law of combining proportions was made by Dalton, in 1804. This celebrated chemist applied an idea which had been held by several Greek philosophers to chemistry, and the result of this application was the "Atomic Theory."

The atomic theory supposes all matter to be constituted of congeries of infinitesimally small, indivisible particles, called *atoms*. The atom of each element possesses uniformly the same size and weight, though the atoms of different elements differ from each other both in size and weight. In order to understand this more clearly let us represent the atoms of the elements under consideration by circles, thus:—

Hydrogen ......

Oxygen ....

Chlorine ....

Carbon ....

According to the theory, each of these different atoms has a constant weight, different for each element, and we can represent the difference in weight by placing a number in the circle, which will point out the relative weight of each atom, thus:—

Hydrogen ... 1

Oxygen 8

Chlorine ...... 35·5

Carbon......... 6

Granting the above suppositions to be correct, it is easy to understand why combination can only take place in certain fixed proportions. Let us suppose that hydrogen be about to unite with oxygen. It will be at once evident that less than one atom cannot enter into combination at a time, the atom being indivisible. Hence the simplest compound which can possibly exist will be one consisting of 1 atom of hydrogen united to 1 atom of oxygen, thus:—

1—8

It also becomes evident that if other compounds containing hydrogen and oxygen can exist, the proportions in which these two elements will unite must always be multiples of the weight of their atoms, *id est*, multiples of 1 and of 8. Such, in fact, is found to be the case. We have, therefore, water—

1—8

And hydrogen dioxide—

1—8—8

Hydrochloric acid............ 1—35·5

Sulphur monoxide........... 16—8

Sulphur dioxide.............. 16—8—8

Sulphur trioxide .... 16—8—8—8

Carbon monoxide .... 6—8

Carbon dioxide .... 6—8—8

201.—This theory is so consistent with observed facts, and gives so satisfactory an explanation of the reason for which combination can only take place in definite proportions (differing, however, for each element), that it was almost universally adopted by chemists. Consequently, it became customary to designate the weights in which elements combined with each other by the term "atomic weights." Some chemists, while admitting the plausibility of the theory, were adverse to considering the theory as fully proved, and consequently preferred giving the name of "equivalents" to the weights in which elements combine with each other.

202.—Another theory which modified considerably the one just described soon arose. This, the "molecular theory," was based on observations made by Avogadro, Boyle, Mariotte, Gay-Lussac, Ampère, Dulong, Petit, &c. The principal facts brought to light by these observations were the following:—

1st. When two elements (in the gaseous state) unite *in equal volumes*, the volume of the resulting compound is equal to the sum of the volumes employed; in other words, *no contraction takes place*. To render this clearer, the following graphic illustration of the result of the action of one volume of chlorine on one volume of hydrogen, may be of service:—

$\boxed{Cl} + \boxed{H} = \boxed{H \quad Cl}$

2nd. When two elements (in the gaseous state) unite in *unequal* volumes, the volume of the resulting compound *is less than* the sum of the volumes employed, and in all known cases is equal to two volumes only; *id est, contraction takes place*. The following illustration of the result of the action of one volume of oxygen, on two volumes of hydrogen, will elucidate this:—

$\boxed{H} + \boxed{H} + \boxed{O} = \boxed{H_2 \quad O}$

Here we see that when two volumes of hydrogen unite with only one volume of oxygen, *only two volumes* of water gas are produced, *and not three volumes*, as might at first sight be expected.

We will give another example of this case, as is well to fix the fact in the reader's mind. One volume of nitrogen unites with three volumes of hydrogen to form two volumes of ammonia, thus:

$\boxed{N} + \boxed{H} + \boxed{H} + \boxed{H} = \boxed{N \quad H_3}$

Making these facts his starting point, Avogadro devised the following theory, which, with some slight modification, is the accepted theory of the day:—

203.—Matter is constituted of indivisible particles, termed *atoms*. These atoms being gifted with the power of attraction, *cannot exist separately for any appreciable space of time*, but tend to unite in little groups of two or more atoms, termed molecules.*

The molecules, though infinitesimally small, and indistinguishable by the most powerful means at our disposal, *can exist separately*. All bodies when brought to the state of gas, contain in equal volumes an equal number of molecules,† in other words, *the size of the molecule of all gases is the same at equal temperatures*. The molecule of all gases is constituted of two atoms. Hence the relative weight of equal volumes of any simple gases will be the relative weight of their respective atoms.

204.—This is, briefly stated, the theory of molecules, as proposed by Avogadro. Let us now see how far it is in accordance with facts. We weigh a given volume (say 11·2 litres) of hydrogen gas, and we find it to weigh exactly one gramme. On weighing equal volumes of the following gases, we obtain the results tabulated below:—

11·2 litres of oxygen	weigh	16	grammes.
„ chlorine	„	35·5	„
„ bromine gas	„	80·	„
„ iodine gas	„	127·	„
„ nitrogen	„	14·	„
„ sulphur gas	„	32·	„

If then, the above theory be correct, these numbers represent the relative weights of the atoms of these seven bodies, and we find that they agree perfectly with the results obtained by experiment. We observe, however, a peculiarity with regard to the relative weights of the volumes of hydrogen and oxygen, which, taken in conjunction with the weight of oxygen necessary to saturate the weight of one volume of hydrogen, seems at first blush at variance with the experiment.

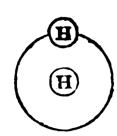
We have seen (200), that 1 gramme of hydrogen unites with 8 grammes of oxygen to form 9 grammes of water. This would lead us to suppose that the relative weights of the atoms of hydrogen and oxygen were respectively 1 and 8.

We have also seen (204) that the weights of two equal volumes, one of hydrogen, and the other of oxygen, are as 1 to 16. According to Avogadro's theory, the inference would naturally be that 1 and 16, and not 1 and 8, are the true atomic weights of these two elements. Both these theories cannot be right; the question then is, Which is correct? Without further evidence, it would be very difficult to decide; but on applying other tests with which subsequent discoveries have furnished us, the balance of probabilities seems to point in favour of Avogadro's view—viz., that the atomic weight of hydrogen being 1, that of oxygen is 16.

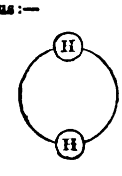
In the first place, granting that condensation takes place during combination between an unequal number of atoms, we find an additional reason for believing that the above numbers represent the true atomic weights of hydrogen and oxygen in the fact that when hydrogen and oxygen unite, contraction does take place, exactly

* For several years continental chemists took oxygen as the standard, fixing its combining weight at 100.

* It is not inconsistent with sound reasoning to believe that these atoms are spheres, and that in the molecules they perform revolutions round a common centre, which may either be one of the atoms or else the common centre of attractive force. To illustrate this let the annexed cuts represent the molecule of hydrogen. We can imagine, first, that one atom performs a revolution round the other thus:—



Or, secondly, that both atoms are revolving around a common centre, thus:—



Either of these views adapts itself to the explanation of the behaviour of gases during combination.

† At equal temperatures.

to the amount indicated by the theory. Thus, let us take two volumes of hydrogen—

$\boxed{H}$ $\boxed{H}$

each weighing one gramme, and one volume of oxygen—

$\boxed{O}$

weighing 16 grammes, and we shall find that after combination the product will occupy only two volumes, while weighing 18 grammes.

We therefore conclude that the constitution of this compound (water) is $\overset{1}{H}_2\overset{16}{O}$, and not $\overset{1}{H}\overset{8}{O}$.

205.—So far either theory explains the fact of "combination in definite proportions," while Avogadro's theory goes a step further, and gives us the probable reason of the contraction which takes place in the volume of gases when combination ensues between unequal volumes. Several facts have conduced to render this latter theory more probable; none have had so much influence as the experiments of Messrs. Dulong, Petit, and Regnault on the specific heat of the elements.

WEATHER MAPS.

THEIR CHARACTERISTICS AND TEACHINGS—AN UNOFFICIAL WEATHER REPORT.

By W. R. BIRT, F.R.A.S., F.M.S.

A FEW words will suffice for the first part of this subject. Lines of equal pressure and temperature, the prevailing winds and weather, as clouds, rain, hail, or snow, and the roughness of the sea, are the principal features of these maps. We see at a glance the distribution of "weather elements" over Great Britain and Ireland, France, Belgium, Denmark, and Norway, and we have, in addition, the numerical values of these elements given on the opposite page.

A word or two in addition on these characteristics. The lines of equal temperature show us the distribution of heat over the countries mentioned, and mark out the direction of the zones of warm and cold air. The lines of equal pressure exhibit regions of high and low barometers, and combined with the wind make us acquainted with localities of storm and calm. The isotherms, or equal temperature lines, need no comment, but as regards the isobars, or equal pressure lines, it is necessary to mention that they do not represent the existence of any one given phenomenon, *per se*. And on this we are the more disposed to *insist*, as we have reason to believe that the "laws" already ascertained of the motions of vast bodies of air, to which the designation "atmospheric waves" has been given, *have not been recognised*. As the barometric curve at any one station is a compound effect of several co-existent phenomena expressed as to succession in time, so the isobar is merely the effect of the same co-existent phenomena expressed as to geographical distribution. To read the one requires as much study as to read the other, but when read each contributes to elucidate the phenomena which give rise to them.

There is nothing of greater utility in reading natural phenomena than *theory*; even if the theory employed be worthless it enables the theorist to connect and classify facts. In order to set forth a portion of the "teachings" of the weather maps we shall make use of a theory which, we apprehend, will connect many of the facts recorded, and to elucidate these facts the more fully we shall present the reader with a series of barometric curves projected from readings at eight distinct stations, viz., Thurso and Christiansund, on the extreme north-west of the area embraced by the weather maps. Plymouth and Valencia on the south-west, Rochefort and Biarritz on the south, and Brussels and Dover towards the eastern part of the same area. The theory is that of "Atmospheric Waves," already given in "our" journal, Vol. XIII., Nos. 323, 329, and 331, pp. 248, 398, and 449. To exhibit the passage of these waves with greater distinctness, we shall examine the barometric effects on three lines—(1) Biarritz, near the south-east angle of the Bay of Biscay, Plymouth, and Thurso; (2) Biarritz, Dover, and Christiansund; (3) Valencia, Dover, and Brussels. The waves from the north-west with north-east and south-west winds will be designated by large Roman characters, A, B, and so on, and those from the south-west with north-west and south-east winds, by *small Italic* characters, *a*, *b*, &c.

Although the movements of the barometer are very complex on account of the simultaneous progression of the two sets of waves, accompanied in some cases with waves of smaller dimensions riding on their slopes, it is quite possible to determine the elements of passing waves by noting the connection between the barometer, the wind, and the weather. From the 18th to the 30th of March inclusive a well marked wave of the N.W. system (B) transited the Board of Trade area; its *anterior trough* impinged on our shores on the 18th; its *anterior slope*, characterised by keen north-easterly winds, accompanied by hard frosts in some parts, and by showers of snow and hail, mingled with rain, in others, occupied four days in its passage; on the 23rd its *crest* extended in the direction, Christiansund, 30·27; Thurso, 30·21; and Valencia, 30·10, rising at Thurso and Valencia, wind north-east, temperature from 30° to 40° Fahrenheit, cloudy, with snow showers, thunder, and hail. From the 23rd to the 27th the barometer *fell* at nearly all the selected stations, yet the posterior slope had not made its appearance, for the relative geographical distribution remained the same, *i.e.*, the gradients of its *anterior slope* extended from north-west to south-east, or, in other words, the *crest* lingered over the north-west portion of the area, passing Plymouth on the 26th, the barometer meanwhile falling. The wind, however, continued northerly until the 27th, when the southerly and south-westerly winds became established as the *posterior slope* passed, and as the *posterior trough* approached. On and after the 27th until the 30th, the isotherms of 40° and 50° extended northerly and north-easterly, correspondent with the establishment of the south-westerly wind. The *posterior trough* passed Thurso on the 28th, barometer 29·16; Christiansund and Valencia on the 29th, the barometer reading at Christiansund 29·06, and Valencia 29·02; Plymouth and Dover on the 30th, barometer at Plymouth 29·26, and at D... 29.33.

FIG. 1

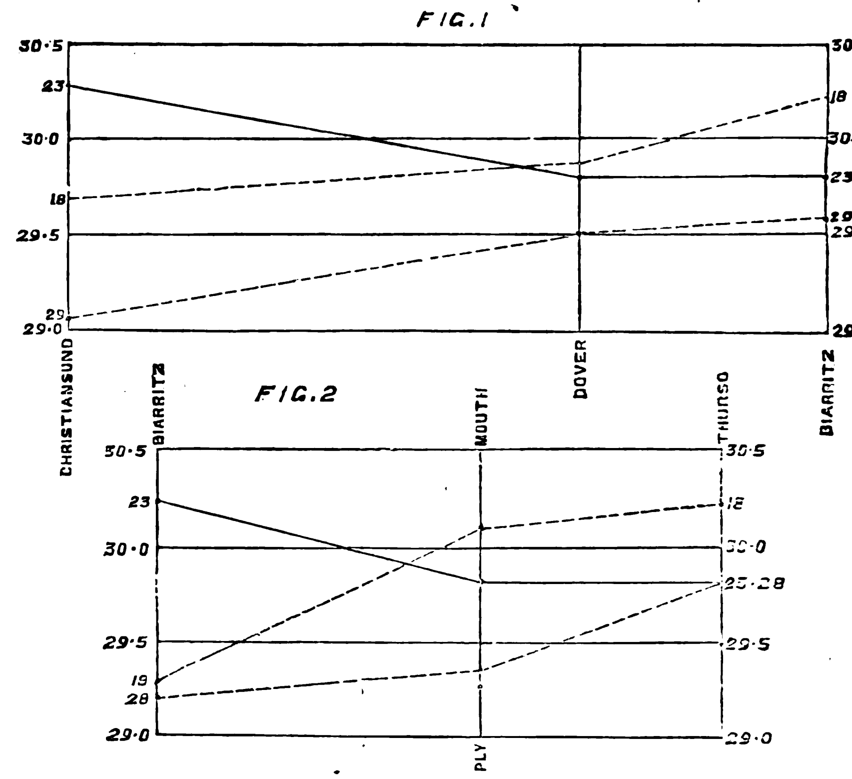


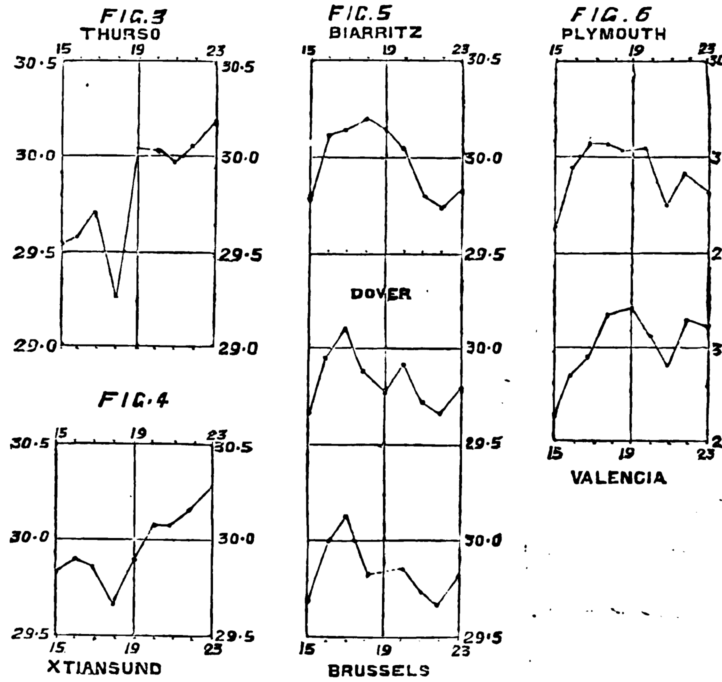
FIG. 2

FIG. 3 THURSO

FIG. 4 XTIANSUND

FIG. 5 BIARRITZ

FIG. 6 PLYMOUTH



The close connection so very clearly shown by the aid of the weather maps between the barometer, wind and weather generally, and in particular instance the contemporaneity of progression of the weather with the transit of waves, are important features for study.

The late Sir John Herschel, in the year ... speaking of the winds as connected with ...

metrical movements, refers to those which arise from barometric *oscillation*, and which are connected with such oscillation in a direct and intimate manner. Every wave-like movement in a fluid consists of two distinct things—*an advancing form* and *a molecular* movement. Now the *advancing form* is indicated to us by the barometer, the *molecular movement* by the wind, and between these two phenomena there subsists of necessity a close and purely dynamical connection. "It would," says Sir John Herschel, "be no small meteorological discovery, if by the study of the characters and progress of barometrical fluctuations, we could either make out any law of the greater ones which would enable us even roughly to predict them or any peculiarity in their physiognomy by which we could recognise them in their earlier stages, as by this we might possibly be led to the prediction of great storms."

The theory employed supposes that the barometric movements of the sixteen days from March 15 to 30 inclusive were due to two sets of oppositely directed winds; one blowing from north-east, which were compensated by south-west winds, the other from north-west with south-east compensating winds. These winds, advancing laterally and *simultaneously* from north-west and south-west, occasioned much complexity in the treated more as simple than complex exponents of phenomena, and the question has been put, "Is the statical force—*i.e.*, the excess of barometric readings at one station, as compared with another, an exponent of the existent wind?" We shall not enter upon the mathematical treatment of this question, but simply remark, as it appears to us, that the difficulty of arriving at any definite conclusions as to weather forecasts or storm previsions, for which purposes statical force has been employed, mainly results from the *non-recognition* of the existence of the two simultaneous sets of waves, of which we find abundant evidence in the weather maps.

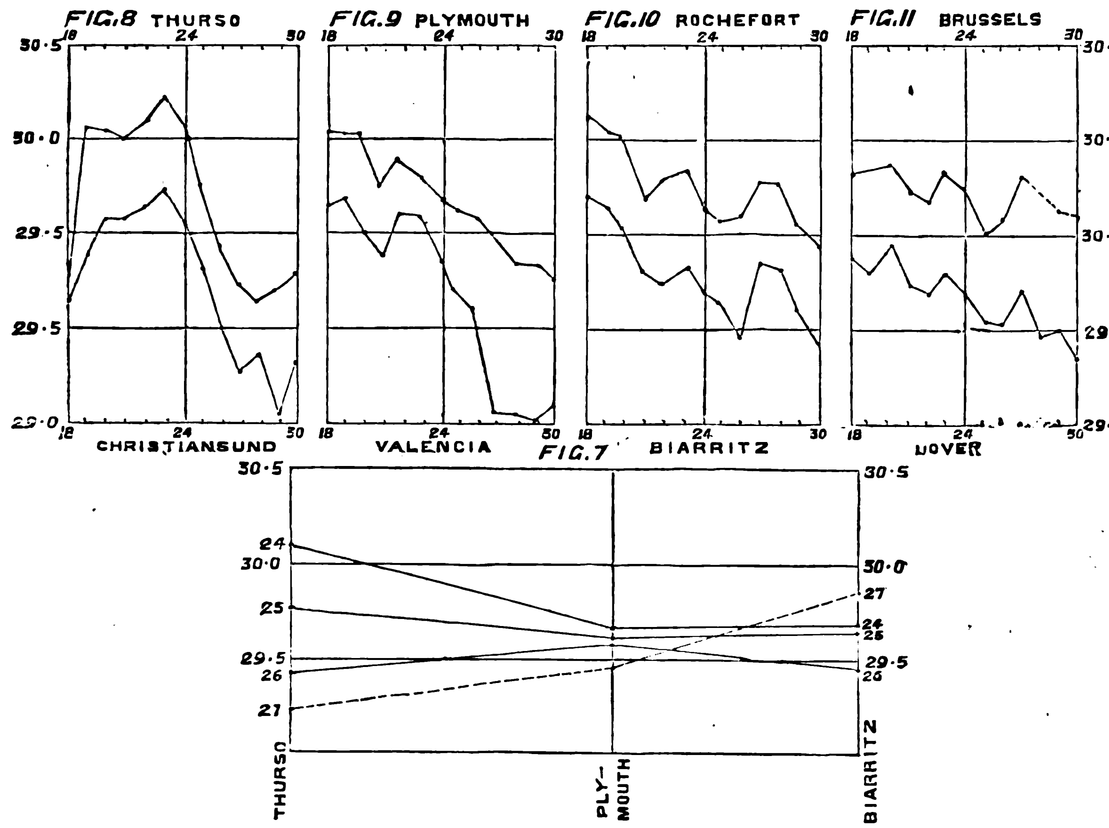
Illustrations.

Fig. 1.—Barometric Sections.—Biarritz, Dover, and Christiansund, March 18, 23, and 29. The dotted lines (18th and 29th) show the dips towards the north.

Fig. 2.—Barometric Sections.—Biarritz, Plymouth, and Thurso, March 18, 23, and 28. The dotted lines (18th and 28th) show the dips towards the depression near Thurso.

Figs. 3 and 4.—Barometric curves at the northern stations, Thurso, and Christiansund, showing the minimum of the 18th, produced by the anterior trough of wave *b*.

In order to exhibit the barometric affections resulting from the transits of the two waves B and *b*, eight curves, arranged in pairs, have been selected; these are so given as to show the gradual *diminution of range* from the north-west towards Brussels, the curves of greater range being placed on the left, with the largest range of each pair below its fellow. The localities are Fig. 8, Thurso and Christiansund on the extreme north-west of the area; Fig. 9, Plymouth and Valencia on the south-west; Fig. 10, Rochefort and Biarritz on the southern part; and Fig. 11, Brussels and Dover towards the eastern part of area. A mere glance at these curves is sufficient to show that the greatest range occurs in the north-west, the least in the neighbourhood of Brussels; also that during the thirteen days from the 18th to the 30th, inclusive, the movements of the barometer at each pair of stations selected were such as to lead to the expectation that the entire area may be divided into barometric districts of specific types, such as the Hyperborean, including the north of Scotland, the North Sea, and Norway; the Atlantic, referring principally to the western shores of Ireland and the entrance to the Channel; the Biscayan, as the north of Spain and the west of France; the Mediterranean, comprising the south of France, and the *Nodal*,



phenomena and also in the maps; but by the help of sections and curves it is possible to unravel this complexity. Taking as a principle that the winds are regularly disposed on each side of a line of barometric *maxima* or *minima*, north-east winds require, according to "Buy's Ballot's Law," that a maximum should exist to the right, or in the north-west, and south-west winds require that the same maximum should be found also to the right or in the south-east. The same principle applies to the north-west and south-east winds, so that with the weather maps before us the direction of the wind in most cases points out the quarters in which we may look for high or low barometers. As just noticed, the simultaneous existence of these winds render the maps very complex, some days the north-east winds being predominant, on others the north-west or south-east, but if sections be drawn, as, for example, that from Biarritz to Thurso on the 18th (see Fig. 2), when the crest of wave *b* passed the southern station and the troughs of waves B and *a* intersected not far from Thurso, we shall gain a clearer idea of the distribution of pressure than from the isobars alone, and if these sections be accompanied with curves, as, for example, the eight herewith given, we may be able still more distinctly to trace the passages of the crests and troughs across the area. Up to the present time isobars have been

Fig. 5.—Barometric curves at the eastern stations, Biarritz, Dover, and Brussels, showing the maxima of the 17th and 18th, arising from the crest of wave A, and those of he 20th from the crest of wave *b*. The opposition of the maximum at Biarritz, to the minima at Thurso and Christiansund (Figs. 3 and 4, and 5), indicates approximately the semi-amplitude of wave *b*, but the area is too small for the determination of the amplitude.

Fig. 6.—Barometric curves at Plymouth and Valencia, showing the maxima, forming the crest of wave *b*, and the minima of the 21st produced as the anterior slope of wave B passed over.

Fig. 7.—Barometric Sections, Biarritz, Plymouth, and Thurso, March 24 and 25, showing the anterior slope of wave B, the higher readings occurring at Thurso, wind north-east, and at Plymouth wind north north-east, which is quite in accordance with "Buy's Ballot's Law." The section on the 26th shows a crest passing Plymouth, which although not sufficiently pronounced to raise the barometer, is, nevertheless, apparent on the Plymouth curve as a slight bulge (see Fig. 9). The section of the 27th (dotted line) shows that the posterior slope of wave B had passed on to Biarritz, wind at Plymouth south-west accordant with "Buy's Ballot's Law."

of which Brussels may be regarded as the centre. From the data supplied by the Meteorological Office, the laws of barometric sequence and range in each of these regions may be determined.

It will be seen from the curves that at the southern and eastern stations maxima of the barometer occurred on the 27th and 28th of March, and on consulting the weather tables for these days it will be found that at Paris the barometer attained a maximum on the 27th, but it was not until the 28th that maxima passed Lyons and Toulon. Sections from Toulon to Thurso on these days show that these maxima were the crest of wave B passing off towards the south-east. The sections are as follows:—

Stations.	March 27.		March 28.
Toulon.........	29·91	...	30·14
Lyons	·90	...	30 00
Paris	·82	...	29·73
Dover	·71	...	·46
London	·66	...	·41
Liverpool......	·59	...	·30
Leith	·46	...	·20
Nairn	·38	...	·20
Thurso.........	·23	...	·16

On the 28th the posterior trough of wave B passed Thurso, so that the amplitude of the posterior slope, or semi-amplitude of the wave, was

represented by the space between Toulon and Thurso, and this was about the extent of the amplitude of the anterior slope. It is probable the entire wave extended over double the distance of Thurso from Toulon.

MICHAEL FARADAY.*

THE life-story of Michael Faraday is one of the few which cannot be told too frequently. The son of a journeyman blacksmith, by the force of his innate genius he made his name known in every part of the globe, and by a limited circle of friends he was loved and revered, not so much for his scientific attainments as for his moral worth and kindly good-nature. For this reason we cordially welcome the appearance of the little book by Dr. Gladstone; for although Dr. Tyndall has written the life of Faraday from a scientific point of view, and Dr. Bence Jones has published a biography, hitherto there has been no volume which showed us Faraday as a man as well as a philosopher. Dr. Gladstone, however, has succeeded in combining enough of the scientific record of his life with much of those inner and, as presented to the general public, unseen features of his character. It appears that in a review of the "Life and Letters," Dr. Gladstone mentioned that he thought of giving to the public his own reminiscences of the great philosopher, and urged by his friends he has put the idea into shape, the result being this little book, designed for those of Faraday's "fellow-countrymen who venerate his noble character without being able to follow his scientific researches." For the various facts mentioned in this volume Dr. Gladstone is indebted in some instances to the works of Prof. Tyndall and Dr. Bence Jones, to the Corporation of the Trinity House, to several friends, and to his own personal recollections; but where practicable he has preferred to illustrate the character of Faraday by documents or incidents not previously published. The book is divided into five sections, under the following heads—the Story of his Life, Study of his Character, Fruits of his Experience, his Method of Working, and the Value of his Discoveries. The character in which Michael Faraday is first introduced to us is as an "inquisitive boy," minding his baby sister, playing at marbles, learning the three R's at a day-school, and residing at Jacob's Well-mews in the neighbourhood of Manchester-square. He was the third child of James and Margaret Faraday, and was born in Newington Butts, on September 22, 1791. His parents being only poor, hard-working people, young Michael was sent to work as soon as he was able and an opportunity offered, his first situation being as errand boy to a bookseller named Riebau, an intelligent man, with a "leaning to astrology," who was so satisfied that he afterwards took him as an apprentice without a premium. Once in the shop, with permission to look at the books on the shelves, Faraday made every use of his position, devouring such works as Mrs. Marcet's "Conversations on Chemistry," and Watts's "Improvement of the Mind," and carefully reading, as well as binding, the various scientific books which found their way to Mr. Riebau's premises. At this early period of his career of scientific research we find the ruling characteristic of his treatment of natural phenomena strongly developed, for, although doubtless he accepted the statements of Mrs. Marcet as correct, he was not satisfied till he had demonstrated their truth—at least of those for which his limited means permitted the necessary expenditure. Thus he made an electrical machine with a phial, but afterwards obtained a "real cylinder," and constructed other electrical apparatus in a similar rudimentary manner—a manner which served him through after life, even for some of his most accurate investigations.

The most important feature of this period of his life, which probably formed a turning point or a starting-point in his career, was his attendance at the lectures on Natural Philosophy delivered by Mr. Tatum, the needful shillings being furnished by his elder brother Robert, an "investment" the latter could never have regretted. Here Faraday made his first acquaintance with scientific lectures, and at the same time, with other earnest students, with some of whom a life-long friendship was formed—notably with Benjamin Abbot, who was well educated, and held a responsible post in the city. It was in Mr. Abbott's house—in the kitchen, and from the end of the kitchen-table—that Faraday made his early experiments and delivered his first lecture. The lectures delivered by Tatum fell on no careless or inappreciative ears: his words found no unprepared seed-ground in the brain of Faraday, who took copious notes, and afterwards wrote out a clear copy, with descriptions of the experiments and neat drawings of the apparatus,—binding the whole afterwards in four volumes, with exhaustive indices, and dedicating them to his master, Mr. Riebau, as evidence that the permission to examine the books in the shop had not been used for idle purposes. At this time there was a lodger at his master's, M. Masquerier, a French emigré and distinguished artist, who, struck with the intelligence of the lad, lent him his books and taught him perspective; and among the visitors to the shop was a Mr. Dance, who took Faraday to hear some of the lectures of Sir Humphry Davy, which he followed with eager and intense interest, taking copious notes, which he afterwards wrote out in the same manner as he had done with Tatum's. Soon after this Sir H. Davy injured his eyes by an explosion of chloride of nitrogen, and Faraday was fortunate enough to obtain the post of amanuensis, probably, says Dr. Gladstone, through the introduction of his artist friend, Masquerier. This, however, lasted a very short time, but the appointment was so far fortunate for the youthful philosopher that it appears to have determined him to write to Sir H. Davy, telling him his desire to study Science, and forwarding the notes of his lectures. Davy wrote an answer, and in the personal interview which followed, advised the bookseller to stick to his business, promising him the work of the Institution and his own besides. Soon after this, however, the laboratory assistant at the Royal Institution was discharged, and Sir Humphry remembered Faraday, who was thus installed in the post on March 1, 1813, at a salary of 25s. a week and a room in the house. His duties were to assist and attend the lecturers and professors, to keep the models and instruments free from dust, and to take charge of the apparatus and furniture of the laboratory and lecture-room generally. From the very first Faraday began experimenting; for a few days after the appointment he was extracting sugar from beet, and before the middle of April had been exposed to terrible risks in assisting Sir Humphry with his investigation of chloride of nitrogen, no fewer than four separate explosions occurring, in one of which he was suddenly stunned and rather severely wounded.

About this time he joined the "City Philosophical Society," consisting of some thirty or forty members, composed of the middle and lower classes, who met together for mutual instruction and improvement; half a dozen of these would meet to criticise the work of each other, with results which Faraday describes as "most valuable," from the "discipline being very sturdy and the remarks very plain and open." Seven months after his appointment, Sir Humphry, wishing to travel, took him as an amanuensis, and for a year and a half, in the company of that great philosopher, he wandered about France, Italy, Switzerland, and passed through Germany, the Tyrol, and Holland, keeping a journal, the most interesting and valuable portions of which are reproduced by Dr. Bence Jones in the "Life and Letters." "This year and a half," says Dr. Gladstone, "may be considered as the time of Faraday's education; it was the period of his life that best corresponds with the collegiate course of other men who have attained high distinction in the world of thought. But his university was Europe; his professors the master whom he served, and those illustrious men to whom the renown of Davy introduced the travellers. It made him personally known, also, to foreign savants, at a time when there was little intercourse between Great Britain and the Continent; and thus he was associated with the French Academy of Sciences while still young, his works found a welcome all over Europe, and some of the best representatives of foreign science became his most intimate friends."

In 1815 he obtained a "somewhat higher position" and an increase of salary, which was further augmented to £100 per annum in the following year. It was in September, 1815, that he took the position formerly occupied by Brande, as the change of handwriting in the laboratory note-book shows. His first lecture was given on January 17, 1816, at the City Philosophical Society, and in the same year his first paper was published in the *Quarterly Journal of Science*. Just before his marriage to Sarah Barnard, the daughter of a silversmith in Paternoster-row, which took place in 1821, he was appointed superintendent of the house and laboratory, and in February, 1825, became director, a position of greater responsibility and influence. One of the first innovations consequent on this was an invitation to the members to spend a scientific evening in the laboratory, and thus arose the well-known "Friday evenings," which in his hands and in those of his successors, have done much to popularise science. "Up to 1833 Faraday was bringing the forces of nature in subjection to man on a salary of only £100 per annum;" then John Fuller founded a Professorship of Chemistry, and appointed Faraday to the post with the endowment of nearly £100 a year for life. But during the earlier part of his career Faraday made commercial analyses, and did other professional work, which in 1830 and 1831 brought in an income of certainly £1,000 a year, but just then he discovered the evolution of electricity from magnetism, and the choice had to be made between science alone and a limited purse, or professional work, a full purse, and an abandonment of those investigations which were to lead to great discoveries. "The choice was deliberately made: Nature revealed to him more and more of her secrets, but his professional gains sank in 1832 to £155 9s., and during no subsequent year did they amount even to that." In 1836 he accepted the appointment of scientific adviser to the Trinity House, which made a slight increase in his income; but the story of his life shows that the talents which he brought to bear on scientific research would, turned in other directions, have enabled him to retire in middle age on a large fortune. To Faraday, however, the pursuit of science was the *summum bonum* of earthly existence; to him science brought a reward which he could have found in no other direction; and as he frequently expresses it, his life was all he desired. Honours were showered upon him in all directions, but he refused the highest honour in the power of science to confer—the presidentship of the Royal Society, saying to the friend who so worthily follows him, "Tyndall, I must remain plain Michael Faraday to the last; and let me now tell you that if I accepted the honour which the Royal Society desires to confer upon me, I would not answer for the integrity of my intellect for a single year." In 1835 he accepted a pension from the Government, and in 1858 the Queen offered him a house at Hampton Court, where he spent the greater portion of his remaining years, and died on the 25th of August, 1867. He was buried in Highgate Cemetery, and the world mourned the "prince of investigators," the blacksmith's son, who was decorated with no fewer than ninety-five titles and marks of merit, and was a member of so many learned bodies that M. Riess, the celebrated Berlin electrician, once addressed a letter to him as "Professor Michael Faraday, Member of all Academies of Science, London."

These are a few of the salient points in the career of the "great philosopher," the story of whose life is a grandly-shining beacon to guide the toiling followers of his footsteps, and English mechanics and students of science will do well to carefully read and commit to memory the words of Dr. Gladstone's little book. The volume teems with anecdotes which exhibit the character of the man, and "his method of working" is a chapter that cannot be too frequently studied. His opinions on those questions of public importance which it has become more imperatively necessary to solve at the present day, when the full effect of his work is beginning to be felt, are marked by clear common-sense. He was examined on the scientific education question before the Public Schools Commission in 1862, and his opinion was emphatic—"That the natural knowledge which has been given to the world in such abundance during the last fifty years should remain untouched, and that no sufficient attempt should be made to convey it to the young mind growing up and obtaining its first views of those things, is to me a matter *so strange* that I find it *difficult to understand*. Though I think I see the opposition breaking away, it is yet a very hard one to overcome. That it ought to be overcome I have not *the least doubt in the world*." Faraday thought that science should be taught at an early age. He would teach "all those things that come before classics in the programme of the London University—mechanics, hydrostatics, hydraulics, pneumatics, acoustics, and optics. They are very simple and easily understood when they are looked at with attention by both man and boy. With a candle, a lamp, and a lens or two,

* Michael Faraday. By J. H. Gladstone, Ph.D., F.R.S. London: Macmillan.

intelligent instructor might teach optics in a very short time; and so with chemistry." Faraday, the prince of lecturers himself, naturally saw that lectures alone "would give a very poor knowledge of natural things," the student must experiment for himself. This was his own habit: he accepted nothing on trust that it was possible for him to verify. Mr. R. Mallet, F.R.S., gives a remarkable instance of this. On one of his visits to the philosopher he took some slips of Muntz's yellow metal, and showed him that, though flexible and tough, they were made instantaneously brittle and rigid when dipped into solution of per-nitrate of mercury. Faraday, however, "took one of the slips, bent it forwards and backwards, dipped it, and broke it up into short bits between his own fingers. He had not before spoken. *Then* he said, 'Yes, it *is* pliable, and it *does* become instantly brittle.'" This method of convincing himself was the natural habit of the man, and it cannot be doubted that to it much of his success as an investigator was due. Many of Faraday's most important experiments, too, were made with the simplest means, and his skill in devising the necessary apparatus for elaborate investigations was unparalleled. An instance is given by Sir Frederick Arrow, the occasion being an expedition of the Elder Brethren to witness the trial of the electric light at Dungeness. "Before we left Dover," he says, "Faraday, with his usual bright smile, in great glee showed me a little common paper box, and said, 'I must take care of this; it's my special photometer—and then, opening it, produced a lady's ordinary black shawl-pin—jet, or imitation perhaps—and then holding it a little way off the candle showed me the image very distinct; and then, putting it a little further off, placed another candle near it, and the relative distance was shown by the size of the image." We must give one more anecdote, and take leave of this interesting and truly valuable book. "An artist was once maintaining that in natural appearances and in pictures, up and down, and high and low, were fixed, indubitable realities; but Faraday told him that they were merely conventional acceptations, based on standards often arbitrary. The disputant could not be convinced that ideas which he had hitherto never doubted had such shifting foundations. 'Well,' said Faraday, 'hold a walking-stick between your chin and your great toe; look along it and say which is the upper end.' The experiment was tried and the artist found his idea of perspective at complete variance with his sense of reality; either end of the stick might be called upper—pictorially it was one, physically it was the other."

The life of Faraday should be as familiar to our youth as "household words," for he was an ornament and a benefactor to the whole human race—not the hero of one nation and the scourge of another.

FOCAL LENGTH AND MAGNIFYING POWER OF OBJECT-GLASSES.

THE following paper was read by Dr. Royston-Pigott before the members of the Quekett Club and is extracted from their journal:—

Though strange, it is nevertheless true, that two observers, with the same eyepiece and objective, do not always see an object magnified to the same amplitude. A change of focus may be necessary. A short sighted person sees the virtual image of the magnified object at a distance of perhaps 6in.; the long-sighted adjusts it perhaps at 12in or even 18in.; the distinct plane of vision, called the field of view, is variably placed according to the focal length of the eye of the observer, and therefore at distances of considerable variety. Under these circumstances, if two observers, the one very short, and the other very long-sighted, both agree to observe together, their powers of vision proportionally vary. It is necessary, then, to fix a standard for estimation. Most persons can see distinctly at 10in. distance. In this case the power of any lens at this distance is found by dividing ten by the focal length f or

$$\text{Magnifying power} = 10 \div \text{focal length } f$$

$$\text{or} = \frac{10}{f} \text{ or } 10 \div f$$

To persons unread in optical principles, there appears some little difficulty in understanding the variable foci of a lens, and I may, perhaps, be excused for introducing the following illustration, known, I believe, to very few working opticians:—

If we take a lens (say 3in. focus), and form the image of a candle (or much better, the image of a small perforation in a brass plate placed before it) upon a sheet of white paper, it is well-known that if you move the candle from the lens you must move up the paper towards it, in order to obtain a clear image. Now, the special point which I wish to bring out is this, that exactly at the position where the image is formed clearly at the same distance from the paper as the candle is, the distance between the candle and image is the least possible, or a minimum. A most useful result is now obtained; in every case this minimum distance is exactly four times the focal length of the lens. In the case of a 3in. lens this minimum image distance will be found to be exactly 12in.

We will now suppose that instead of the 3in. lens a 2in. objective is used in precisely the same way. The minimum image distance between a candle and its image will be found much less than 8in., so that the real focal length* is 14/36 or rather less than 1½in. There are two or three preliminary points which may not be uninteresting. To find the focal length of a plano-convex lens, turn the flat side to the sun, and measure the exact distance from the sharpest image on a card to the convex surface. If the lens be equiconvex, half the thickness must be added. If the lens be used as a convexo-plane, and the plane side is towards the image, when the aberration is reduced, two-thirds of the thickness must be added. The minimum image-distance avoids these inconveniences of measurement altogether. In every case the true focal length will be more accurately determined by using only a small central aperture applied to the lens in question.

I have designed an instrument of considerable accuracy for measuring the focal length of ordinary lenses, consisting of a perforated metal plate, and a white screen, or piece of ground glass, with a carrier for the object-glass or lens. By means of a long screw, tapped with similar right-handed and left-handed dies, the perforated plate and lamp and the screen are simultaneously made to approach or recede from the lens, which is thus kept always exactly equidistant from the plate and from the screen. The lens to be measured being fixed, the screw is turned, until an exact image is formed upon the screen, of the perforations; one-fourth of the distance between them is exactly the focal length required. I term this instrument a Focimeter. But in the case of very minute lenses, considerable difficulty is experienced in finding their exact focal length by measurement of their curves. In this case, the focal length can be obtained most readily by the following artifice:—If the magnifying power be great, a stage micrometer is to be placed exactly at 10in. distance from the ground-glass screen. If a microscope be used, by taking out the field and eye-glasses of the eyepieces, an ordinary circular 1-100th micrometer may be inserted; then replacing the eye lens only, the image of the stage micrometer must be accurately observed, and the magnitude of a 1-100th nicely determined in the divisions of the eyepiece micrometer. Suppose this to be (m), the actual focal length of the lens in question will be found for small lenses as follows:

Divide ten by this number (m), increased by two. Larger lenses will required a correction to be hereafter explained.

Example.—A small lens is found to magnify a hundredth of an inch upon the stage to measure thirty-five hundredths at 10in. distance from the stage, within the field of an eyepiece, deprived of its field lens. Find the focal length; also for a plano convex find the curvature of the tool to grind the lens.

$$N = 35. \quad f = 10 \div (M + 2) = 10 \div 37$$
$$= 0''\cdot 27027 \text{ nearly.}$$

In a plano-convex lens radius of curvature for flint—

$$= \tfrac{1}{2} \text{ focal length} = 0''\cdot 13513\text{in.}$$

Example 2.—A compound lens forming an object-glass of great power enlarges the thousandth of an inch to 158 divisions in 1000ths, as before at 10in. Find the approximate focal length. Here

$$f = 10 \div (158 + 2) = 10 \div 160 = \frac{1}{61}$$

From this it appears that an exact sixteenth should produce an image precisely 158 times as large when the object is exactly 10in. from the field of the eye-lens at the stop of the eyepiece.

For practical purposes, therefore, an eye-lens magnifying ten times would enlarge the object in this case 1,580 times. Now a C eyepiece of Powell and Lealand is just equivalent to an 1in. lens; therefore, when these makers announce their sixteenth to magnify 1,600 times with a C eyepiece, this objective is nearly the one-sixteenth of an inch focal length within a small decimal.

The magnifying power employed at any moment is often so great a desideratum, and yet so unattainable (when one is closely engaged in some delicate investigation, and using a variety of objectives), without great loss of time, that the following observations upon a simple method exhibited at a meeting of the Fellows of the Royal Microscopical Society recently may, it is hoped, prove acceptable. Having met with many persons and some opticians who experienced a difficulty in understanding the reason of the thing, I trust that the preceding remarks will clear the difficulty away.

If we settle it as an axiom for very high powers, such as the one-eighth and one-sixteenth, that at 10in. distance of the stop of an eyepiece, without the field-glass, the enlargement of thousandths on the stage will give the focal length simply by dividing ten by the amplification increased by two, then it is evident that by using a single lens of 1in. focal length magnifying ten times, if we count how many hundredths of an inch in the stop correspond to a hundredth on the stage micrometer, ten times that amount with an inch or C eyepiece is the magnifying power. Now replace the field-lens (usually of 3in. focus) for an eyepiece of 2in. focal length, having an eye-lens of 1in., the magnifying power will be reduced considerably in the proportion shown by the new reading. Whatever object-glass is now used, and whatever length of tube happens to be in use, so long as the eye-lens is 1in. focal length, ten times the apparent amplification of the stage micrometer will give the power under employment.

I keep an eyepiece (2in.) with 1in. eye-lens, armed with a glass micrometer, ready for use. Every microscopist should demand that the optician mark the focal length of each of his eyepieces. Powell and Lealand's C eyepiece is exactly 1in. focal length; and at the usual distance of 10in. the power of any object-glass with it is at once found by multiplying the reciprocal of the focal length (eight is the reciprocal of one-eighth) by one hundred.

The standard rule by which nominal "inches," "quarters," "eighths," "sixteenths," and "twentieths" are constructed is, therefore, most properly taken, so that with a C eyepiece of 1in. focal length and the stop of the eyepiece being exactly 10in. from the stage, their respective magnifying powers shall be:—

(Objectives)	Inch	Quarter	Eighth	Sixteenth	Twentieth
(Powers)....	100	400	800	1,600	2,000

I have found Nobert's lines to form very beautiful stage micrometers; but as they are fractions of the Paris line, observations with them require laborious reduction to the English standard. But I wish to acknowledge here the kindness of Mr. Baker, the optician, in placing at my disposal Jackson's own beautifully ruled micrometer lines, 2,000 to the inch. With the aid of this, and a micrometer in the stop of the eyepiece, I found the power of Powell and Lealand's new ¼in., with a 1in. Kellner of Browning's make and searcher (with a fine definition), to be 5,250 diameters.

Without searcher and 1in. eye-piece:—

			nearly.
Andrew Ross..	1851..	"quarter"..	power, 540 = one-fifth.
Wray........	1870..	one-fifth ..	power, 540*

Resume.

1.—The focal length of a lens is one-fourth the least distance between image and object at which it can be distinctly formed.

2.—If a distance of 10in. between object and image be taken (to simplify the calculation), and the amplification measured for a division, then in the case of small lenses, the focal length is found by dividing ten by the divisor increased by two.

3.—The magnifying power of an object-glass for any length of tube can be ascertained by using an eye-lens of 1in. focal length, with or without a field-lens, by measuring the amplification of a stage micrometer upon another placed in the stop of the eyepiece, and then multiplying it by ten.

4.—Different eyepieces being compared by the Camera Lucida, or marked in focal length, by the maker, all other powers are immediately ascertained by the simple rule of proportion.†

* Focal point of a lens is generally known to be the focus of parallel rays.

* The actual focal length = 10 ÷ (54 + 2 + 1-54th) = 10 ÷ (56·0185); or a power of 540 represents a focal length about 2-100ths of an inch less than a true one-fifth.

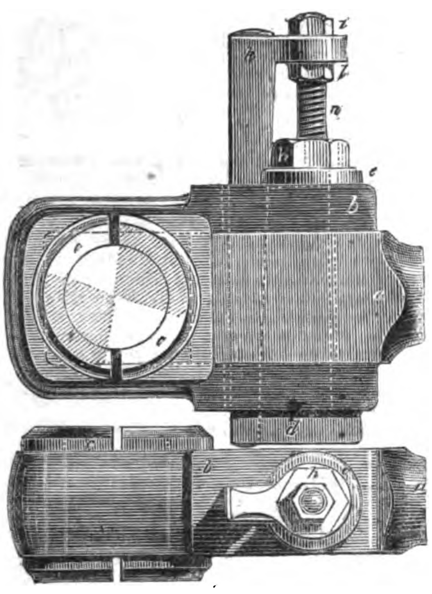
† A ½in. eyepiece will, of course, be twice the power of the inch, and so forth.

POOR MAN'S PROVENDER.

A MARKED, but unfortunate trait, in the character of the average Briton, consists, says the *Food Journal*, in the fact that he unhesitatingly rejects and repudiates every unaccustomed article of food introduced to his notice, if it happens to be cheap; and the lower in the social scale the individual happens to be, the more strenuous is his opposition. Although preserved Australian beef and mutton have been before the public now for a considerable time, and have even gained admittance into one of the leading West-end clubs, we wonder on how many working men's tables they appear. If such is the slow progress of a really delicious and cheap preparation, we fear our advocacy of an inexpensive and nourishing German viand can scarcely hope for more favour. Nevertheless, as food journalists, it seems to be our duty to make known everything likely to benefit the son of toil as well as his master. Sauer-kraut, an efficacious preservative against scurvy, is thus prepared:—When cabbage has arrived at maturity, and is compact and hard, it is divested of its outer leaves, the stalk cut away, and the remainder shred finely and packed in layers in large earthenware pots or barrels. Between each layer salt is sprinkled, along with carraway seeds and juniper berries. When full, the vessels are covered each with a heavy weight, and in a month the contents are fit, after four hours' boiling, for use. After the Sauer-kraut is ready for cooking, it will keep sound for years if the stock is always covered with brine. With Australian beef as a basis, this as a vegetable, and a little brown bread or potatoes, as accessories, we venture to think that even the poorest might extemporise a good dinner within his means.

STUB-END FOR CONNECTING ROD.

THE annexed illustration of a method of strengthening stub-ends of connecting rods is extracted from the *Journal of the Franklin Institute*, and may be found useful in some cases. In this stub the block *a*, strap *b*, and boxes *c c*, are made in the usual way. The key *k*, has a lug, through which the bolt *n*, an extension of the gib, passes, a slot hole being provided to allow for draft of key, and nuts *i i*, to hold key securely in place. The head *d* of gib holds the strap in the usual way, but on the other end a nut *h* is placed, resting on a circular washer *e*, notched at the key. The diameter of this part of the gib is made more than the thickness of the gib, to gain strength, but the extension *n* may



be made less. This plan may be resorted to with advantage to strengthen existing stubs, giving the bolt to the strap and screw adjustment and holding to the key.

THE BARRON STEEL PROCESS.

THE Barron Steel Process is attracting considerable attention in the United States, and judging by the results which are said to be obtained, it must be a very satisfactory method of making steel as well as the most economical. According to the *Iron Age* it was invented by Mr. Thomas J. Barron, in 1868, who associated himself with others, and a company was formed to introduce tools of steel made by this process. After devoting two years to careful experiments and study of the conditions of success, the manufactory began operations on the 1st of March last, and now employs forty hands. Thus far the success is reported to be very encouraging, and enlargement of the establishment is in contemplation. From an article in the Louisville *Commercial*, we obtain the following particulars respecting the process:—Tools, such as axes, hatchets, hoes, and adzes, to the manufacture of which chief attention has been paid, are first fashioned of iron by the usual methods. They are then placed in revolving drums, where the roughness and foreign substances which belong to them when they come from the moulds are worn off by attrition. They are then packed in layers in iron boxes, closely covered with clay, and subjected to the action of oxide of iron and chemical substances, which decarbonise the iron of which they are composed. Herein is the secret of the process. In these boxes the tools are subjected to an annealing process, which lasts for from three to six days, when, being decarbonised, purified, and malleable, they are ready to be changed into steel. A retort holding about a ton of the tools, occupies the centre of a large oven, which is kept at a temperature just below the point of fusion. In this they absorb gasoline, introduced from a tank near by, and pure charcoal gas, generated in a retort on the top of the furnace. The iron becomes steel in from eight to ten minutes, when the tools are removed to be tempered, ground, and polished for the market. It is claimed that this process is the quickest and the best yet discovered. The company is now melting about a ton and a half of iron a day, and as soon as proper facilities are provided will begin the manufacture of steel rails. Professor Newberry, of Columbia College, New York, makes the following report of a practical test of the steel produced in this way:—"With tailor's shears cast in shape, made malleable, and then converted by the Barron process, I have cut Florence silk so nicely as to prove the edge perfect; then, with the same shears, have cut up sheets of tin and untempered steel; and returning to the silk, have found the edge wholly unimpaired, and this after a repetition of more than twenty times." Arrangements are making to start a large establishment at Pittsburg for the manufacture of tools by this process.

LOCK NUTS AND WASHERS.

A NEW arrangement of locking nut and washer, with a spanner adapted to the special requirements of the arrangement, has been patented by Messrs. Blakemore, Sherring, and Horstman. The invention consists essentially in the employment of a washer, having a cut or slit in it whereby the washer or a portion thereof is caused to act as a spring. This washer fits over the bolt, which is grooved or cut away longitudinally throughout the screwed portion thereof, the hole in the washer being formed correspondingly to prevent it from turning; the underside of the nut is notched or made with ratchet teeth, so that when the nut is screwed down, the slotted cut or slit portion of the washer springs up and takes into one or other of the notches or ratchet teeth. These notches or teeth may be over the whole or only partially across the face of the underside of the nut; and the slit or cut in the washer may be made in any desired direction, as practice may suggest. By another arrangement, and when using a nut with a plain inside face, the washer may be cut or a slit made therein at one side thereof so as to form a tongue; the washer being placed over the bolt, as the nut is screwed home the cut or tongue portion of the washer springs up and stops against one of the sides, or in succession against two or more of the sides of the nut, thus preventing the latter from unscrewing. Another form likewise used with a plain faced nut is where the cut portion of the washer is turned up at right angles to the face of the washer, and so springs against the edges of the nut, thus offering a certain amount of resistance to unscrewing. The washer may be of any irregular or other form suitable for preventing it from turning; in many cases this may be accomplished by turning a portion of the same over the edge of the work to be fixed to prevent its turning on the bolt. The inventors prefer, however, to make the nuts bevilled on their edges and to use a spanner bevilled on its edges to adapt itself and to correspond with the bevil or bevils on the nut, and thereby to press down the spring portion of the washer when it is required to unscrew the nut. The nut may be made with a projecting collar at or near its outside surface; but in that case the inventors use a spanner of a tapering thickness, so that when the spanner is fully inserted between the collar and the washer the spring tongue or tongues of the latter are pressed down, and the nut is released from the washer and may be unscrewed. For fish plates and other purposes where the bolt holes are sufficiently close together, they employ a double or compound washer having two or several holes therein with cuts in the metal to secure the several bolts as before described.

FIG. 1

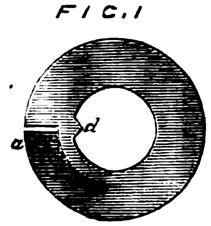


FIG. 2

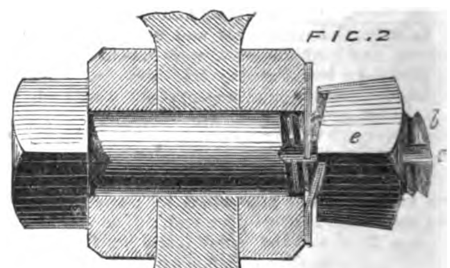


Fig. 1 is a plan of the form of washer which the patentees prefer, and Fig. 2 exhibits so much of a rail in section with nut and washer applied as may be required to comprehend the construction. In these figures *a* is the slit or cut in the washer, *b* is the bolt, *c* is the groove or cut therein, and *d* is the corresponding projection on the washer which takes into the groove *c* to prevent the washer from turning on its bolt; *e* is the nut bevilled on its sides and notched on the underside, as seen at Fig. 2. To secure the nut place the washer on the bolt *b* with the projection *d*, taking into the groove *a*, screw the nut down on the washer, when the spring portion formed by the slit *a* rises and takes into one or other of the notches, and thereby prevents the nut *e* from becoming loose. In order to unscrew the nut, a spanner made to correspond with the bevil of the nut is pushed on, forcing down the spring-portion of the washer and releasing the nut.

TEST FOR ALUM IN BREAD.

WHAT is known as the logwood test is now generally accepted as the best method of detecting alum in bread. It was communicated by the author, Mr. Horsley, to the *Chemical News*, and is as follows:—

1. Make a tincture of logwood by digesting for eight hours 2 drachms of freshly-cut logwood chips in 5oz. of methylated spirit in a wide-mouthed phial, and filter.

2. Make a saturated solution of carbonate of ammonia in distilled water.

A teaspoonful of each solution mixed with a wine-glassful of water in a white-ware dish forms a pink-coloured liquid. Bread containing alum immersed in it for five minutes or so, and stood upon a plate to drain, will in an hour or two go blue on drying; but, if no alum is present, the pink colour fades away. If, on drying, a greenish tinge appears, that is an indication of copper, as carbonate of ammonia produces that colour, but never a blue. As a counter-check for iron, a piece of the moist blue-coloured bread may be drenched with a few drops of glacial acetic acid, when that containing iron will be bleached of a dirty-white colour, but with alum a rose-pink or slight buff colour will be observed.

Or it may be tried another way, thus:—Take a piece of the bread in its plain state, and having digested it in dilute acetic acid for an hour or so, press out the liquor and filter; then put in a lump of carbonate of ammonia, and, when all effervescence ceases, add to the clear liquor a few drops of solution of sulphide of potassium or sodium. If iron is present, it will be indicated by a dark colour, there being no colour produced with alum; but the addition of a little tincture of logwood immediately reveals it. I might even go further, and say that, if necessary, you may quantitatively estimate the alumina thus:—Take (say) ½lb., of crumb bread, digest it in a clean basin with some dilute acetic acid, and allow it to stand a few hours; then break up the mass and pass the liquor through a glass percolator, the rim being covered with calico, repeating the percolation two or three times until the liquor is clear. Throw in carbonate of ammonia to saturation, and add tincture of logwood in excess, when, if alum is present, a dark blue colour will be produced, with a flocculent blue precipitate on standing awhile. Collect this precipitate on a filter, wash it off into a dish with dilute nitric acid, and evaporate the red liquor to dryness. Collect the residue in a small Berlin crucible and ignite it at a red heat, when a white powder will be obtained, consisting of alumina, with possibly a little lime; treat this with liquor potassæ to dissolve out the alumina, mix with a little water, filter, and boil with carbonate of ammonia to obtain the pure alumina.

Our Coal Stores.—Professor Ramsay, F.G.S., member of the Coal Commission, in a recent address to the Dudley Geological Society, expressed a strong and encouraging opinion as to the presence of coal beneath the New Red and Permian. He believes that the majority of the coal-fields of this country have been joined together in one large area, and that by downthrow and other faults, the fields separated; but that the intervening spaces covered the coal, which, still further buried by the forces, brought about the separation. Some had, no doubt, been too deeply buried to pay for getting, and some was too thin for remunerative results, though at workable depths. He calculated that more coal lay at workable depths than appeared in the fields. The South Staffordshire field was supposed to contain 3,201,672,216 tons of coal, but beneath the Permian attached were 10,880,000,000 tons; the Warwickshire field contained 458,652,714 tons, but that concealed should be put down at 2,494,000,000 tons; and the Leicestershire coal-field contained 836,799,734 tons, but beneath the Permian were 1,790,000,000 tons of coal.

MECHANISM.*

(Continued from p. 429.)

ALL machinery can be reduced to a classified list of elementary combinations in mechanism, the character of any portion being assigned to it from its general features, and not from any minute detail. For instance, all those pieces of mechanism in which motion is mainly communicated from piece to piece by what is called "rolling contact," where the principal moving parts are in actual contact and roll one upon another, should be classified under such division as that of "rolling."

The next division might include those contrivances by which one moving part in actual contact with another communicates motion through a process of "sliding." Cams and screws communicate motion by "sliding." The Archimedean drill, generally used for light work, is an example of this kind of communicated motion.

Another mode of communicating motion results from the wrapping or folding of cords or chains over bodies, rigid, and generally circular, although they may be of any form; straps or bands over wheels are of this class. Again, there are numbers of contrivances in which motion is transmitted from piece to piece by means of bent or straight rods and bars. Very perplexing, though very useful motions, result from these. The grouping of them is distinguished by the name of "links." There are contrivances which depend chiefly upon the folding over, again and again, of cords or straps; to the class comprehending these the name communication of motion by "reduplication" is given. It is illustrated in the case of double and treble sets of pulleys.

Another is the transmission of motion by means of an intervening fluid. Sir William Armstrong's hydraulic machine, with its accumulator, is an example. Motion communicated by an intervening fluid has been adapted to facilitate telegraphic delivery in London. Telegrams received in Telegraph-street are put into little cylindrical "carpet-bags," which are placed in tubes and moved forward by air at high pressure, and so shot to the post-office at Charing-cross, or to such places as the tubes are laid. The messages are taken out of the carpet-bags, put into envelopes, and sent to their destination. The speaking-tubes in this building and in offices are examples of motion communicated by fluids.

Under each of these, six heads there may be arranged three and even more classes of motion. A tabular view of these divisional characteristics of modes of communicating motion, and a classification in reference to the relations of direction, and the ratios of the velocities, may be useful for future reference:—

Division.	Character.	
A	Motion communicated by	Rolling.
B	"	Sliding.
C	"	Wrapping.
D	"	Links.
E	"	Reduplication.
F	"	Fluid.

Of each there are at least three classes:—

Class.	Directional relation.	Velocity ratio.
1 ..	constant ..	constant.
2 ..	constant ..	varying.
3 ..	varying ..	constant or varying.

On Monday last, after the lecture was over, a gentleman remarked, "You said that mechanicians, as distinguished from mechanics, thought nothing about plummer-blocks and anti-friction curves." He asked, what is an anti-friction curve? An anti-friction curve has nothing to do with pure mechanism, but it has to do with the workshop, and it may be permitted, although beside the exact title of these lectures, to produce an anti-friction pen for the purpose of forming an anti-friction curve. Some years ago—a great many years ago—there was a discussion in the mathematical papers respecting the curve of least friction for rotating shafts. At the lower end of a vertical shaft the friction upon the bearing is a proportional part of the pressure. The question was how should that bearing be formed, and the mode in which it should be formed is given by this pen. Any skilled mechanic may make the pen. It is a piece of brass wire 6in. long, freely movable about a pin put into a piece of wood, 2in. long, and ¾in. broad, and ¼in. thick. There is bent over the wire a small piece of steel brought down so as to allow ink to be inserted between the two jaws; the ink will therefore flow as from a pen. The mode in which the pen is used is this. Supposing a bearing to be of a certain size in the lower diameter, and of a known dimension in the upper, the question is, to ascertain the curve to be formed between those two diameters. At right angles to a straight line, set off the two radii at their proper distance apart. Parallel to this straight line place a straight edge. Against this edge, where it crosses the larger radius, place the wood, to which the wire of the pen is attached. Slide the steel pen along the wire until it is at the extremity of the radius. Then adjust the straight edge, and draw the wood along it until the pen crosses the extremity of the shorter radius. The path of the pen describes what is called an anti-friction curve, and the bearing of a shaft made with that vertical section is the one of least friction.

To return to the tabular characteristics of mechanism. It has perhaps been truly said that if there were no exceptions there need be no rules. There are before you, in illustration of this, two pieces of mechanism which cannot be arranged under the tabulated heads. One is called Atwood's machine—a machine designed about the close of the last century, and to which we are indebted for our knowledge of the influence of gravity on falling bodies. The free motion of falling bodies becomes so rapid that the velocity cannot be observed. Mr. Atwood suggested and carried out the idea that if, whilst permitting gravity to exercise its full and usual influence, that influence could be distributed through a balanced mass, then, although the velocity were retarded, yet the law of that velocity would remain, and might be ascertained.

The arrangement of mechanism by which he accomplished this is here. Two equal weights are attached to the ends of a very flexible silk cord, about twelve feet long. This cord being laid over a pulley, the weights being equal, they might be placed in any position, and would so remain. Mr. Atwood reasoned that if he could reduce to the smallest possible quantity the friction on the bearings of the pulley, he might determine the laws of falling bodies. Thus to reduce it, led to the contrivance of placing the bearings of the pulley upon the rims of four other pulleys—in fact, as far as possible, he converted a sliding into a rolling contact.

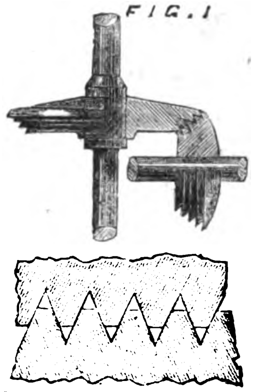
The silken cord was placed with one of the equal weights near the ground and the other near the pulley. A small and known weight being placed upon the upper one, caused a motion in the mass of the two connected weights, and dependent upon the relations of the small weight and the mass so the velocity of descent was retarded. By means of a vertical scale the rate of descent could be observed, and the laws of gravity be thence deduced.*

As a piece of mechanism, this instrument cannot well be placed under any of the heads specified in the table.

Here is another illustration of a machine which cannot be classed. It is one in which we are all interested, because by means of it coals are prepared for London free from slack. A waggon of coals, as brought out of the pit, is not ready for special sale, and the question is how are those coals to be screened and made fit for the market, such a market, at any rate, as you have in London. The manner in which the slack is to be separated is not our business at present; we have simply to do with the motion, not the separation. On the table is a model of a railway waggon into which the larger lumps will be shot. Here is another into which what we may call the first class of slack will be shot, and, here is another into which will be shot the dust, or that which is really little better than dust, out of which artificial fuel is made. This waggon of mixed coal direct from the pit is run into the apparatus. Observe the motion on the withdrawal of the hand from the break. The apparatus gently rotates—the coals are slid and not thrown on the screens, and the work being done the apparatus returns to its original position. To accomplish these reverse actions no special contrivance of mechanism is required. It is done by a change of the centre of gravity of the moving machinery, consequent upon the discharge of the coals from the pit waggon. When the coals are in the waggon, the centre of gravity is at one side of the horizontal axis, and so causes the motion by which the mixed coals are discharged. Then the centre of gravity is at the other side, and so causes the apparatus to return to its original position. Such mechanism cannot be placed in one of the tabulated divisions.

The subject of the lecture more especially intended for this evening is on the communication of motion by rolling contact. The necessity for getting shafts to rotate so that one should cause the other to move must have arisen in very early days. You remember even so recently as Jewish times we read that "Two women should be grinding at the mill," so that it seemed to need two people to cause one shaft to rotate, for the millstone was driven by two people. To fold a cord round one shaft and then round another so as to communicate a motion, would not be a difficult matter, but to bring these shafts into a relation that needed no cords at all, that would then have seemed to be the perfection of mechanism. We have an example here* of such rolling contact. On these two wheels there are no teeth, but they roll on one another only. It would be very desirable to dispense with teeth, but it is quite clear that mechanics have not yet attained to such perfection that two wheels shall truly roll with regard to each other whilst acting on shafts in fixed bearings. The one wheel here on the upper shaft drops, and so contact of the circumferences is preserved. This was one contrivance to keep up contact. It is found in the blower we have so constantly in use where one wheel is held by a spring against the other. In another case, one wheel is covered with leather in order to secure a rolling contact. Other modes, prior to the introduction of teeth, have been adopted in order to preserve this rolling contact. Perhaps none is better than that of covering each of the rollers with brushes of hair. We are thus led to the origin of teeth upon wheels. We all know that teeth are generally placed across the wheel in the way you see here, so that the contact is secured. Some persons have adopted the suggestion of what may be called teeth running in a direction parallel to the plane of the wheel. This is the case in Robertson's friction gearing, a plan much adopted for the communication of motion by means of pulleys, grooved parallel to the face of the pulley. Wheels used as described are generally called "pulleys." In ordinary cases, teeth run parallel to the shaft; in this case, at right angles to the shaft. For the purpose of throwing in and out of gear the latter are safe, and free from the objection which the ordinary teeth have—namely, the great liability to be broken if a sudden strain comes upon them. These wheels are still manufactured by the Patent Gearing Company at Glasgow, and to them we are indebted for the model before you, of which Fig. 1 is a diagram.

FIG. 1



In other cases, one pulley is put into a swing frame. The upper pulley in this model, sliding in a groove, is then merely hung upon a hinged frame, which allows weight to be borne by it, and so increase is given to the pressure upon the lower pulley. That is another contrivance for getting this motion by rolling contact. Others are formed by loading the axles with weights. These practices, however, have been abandoned where the communication of power is concerned, and toothed-wheels have taken their place. All other plans but teeth are objectionable, because they fail to communicate or keep up a true velocity ratio, and still fail where definite relations of motion must be established. If it is essential that motion should take place in the ratio of one to twelve, or one to twenty, no mode of pure rolling can accomplish it, but if it is simply essential to secure rolling contact for the purpose of high velocity, and for the purpose of converting high velocity into power, it has of late years been most successfully accomplished by Mr. Ramsbottom, at Crewe.

We are much indebted to the authorities at Crewe for the machinery now on the table. Heavy weights are at Crewe lifted by the agency of a cord travelling at a very high velocity.* Here are pieces of the cord used for that purpose. One, an old piece, has done its work, and the other, a new piece, had it not been cut off, would have had to do its work. It is a cotton cord, made very pliable, and caused to move at the rate of 5,000ft. a minute, and, as 5,280ft. are a mile, we may say it travels at the rate of a mile a minute. This speed is converted into power, and that is done by pure rolling contact. It is accom-

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

* The following illustration of a mode of using Atwood's machine for the purpose named in the lecture may be of interest to some readers. Let M be the mass of one weight, M + m the other, and R the resistance, friction, &c., of the machine. Now the moving force = mass multiplied by acceleration, expressed algebraically thus: P = M.f. Therefore in the experiment—

$$(M + \overline{M + m} + R) . f = m . g \qquad (1)$$

where (g) is the required force of gravity. Again, if we take a second similar experiment with other masses. Then

$$(M^1 + \overline{M^1 + m^1} + R) f^1 = m^1 . g \qquad (2)$$

combining equations (1) and (2).

$$g = \left\{\frac{2(M - M^1) + (m - m^1)}{m . f^1 - m^1 . f}\right\} f . f^1$$

In this equation all is known except f and f^1, and by Atwood's machine these can be obtained thus:—First arrange M and M + m on the machine, and allow the heavier to fall from one point to another at a known distance from the starting-point. Observe most carefully and accurately the time occupied by its motion. Then, by a well-known law, viz.:—

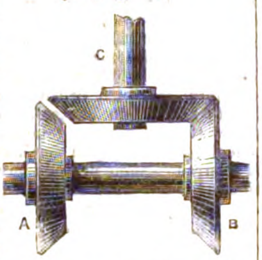
$$s = \frac{1}{2} f . t^2 \quad \text{And therefore } f = \frac{2s}{t^2}$$

Now, from this experiment, s and t are known, and therefore f can be found. Similarly, f^1 can be found, therefore in (3) all is known except (g). Therefore (g) can be found, and it is found to be = 32·2ft.

* On the table were two plain broad wheels of wood. The one was rotated in a vertical plane, by being placed on a wooden axle in a horizontal plane. The other wheel was also on a horizontal axle, which was guided in a vertical slide above the former axle, and consequently the circumference of this latter wheel was always in contact with that of the lower wheel.

plished thus. At the top of the vertical part of a crane there is a pulley on a shaft which passes down through the crane in a vertical direction, and the pulley being driven communicates motion to this vertical shaft. Let us for the present rest content with the fact that we have a vertical shaft rotating rapidly. The mode in which that motion is communicated is this. That grooved pulley on the table is at the top of the shaft. It is one of the actual pulleys. The high velocity cord does not pass round this pulley—it is simply pressed against it by means of two other grooved pulleys, one on each side, and thus is caused to bear upon a portion of the grooved circumference. You may judge, there fore, that assuming there was no loss of motion, the rim of the pulley fixed upon the vertical shaft would travel at the rate of a circumferential velocity of a mile per minute. Of course, there is a certain amount of slip which reduces this velocity. Now let us see what is done by this motion. Remember we deal with it only as a question of rolling contact, independent of the teeth of wheels, to show what can be done by rolling contact only. This shaft with the pulley at the top descends to the lower part of the crane, and there it comes upon the gearing now on the table. You have then a descending shaft. At the end of that descending shaft is a cone pulley which is made of pasteboard. It consists of two cast iron faces with pieces or sheets of pasteboard strongly clamped between them, and that is turned in a lathe to the shape required. On one casting there are two cone wheels, with such a distance between the surfaces that they only just do not touch this paste board one when it is placed as in the figure between them. Suppose that C (Fig. 2) is the vertical shaft and the bevel wheel upon it is the pasteboard one. The bevel wheels, A and B, are upon a horizontal shaft, which is capable of an end-long motion. If the wheel B be in contact with the rotating wheel, motion will be communicated to the horizontal shaft in one direction. Give now the end-long motion that shall bring A into contact, then the horizontal shaft will be caused to rotate in the other direction. There is a handle, by the motion of which either of the two cone pulleys may be brought into contact with the pasteboard one, and therefore, whatever motion is being given to the pasteboard one, can be communicated to one of the two. The actual gearing of one of these cranes was on the table. As a piece of mechanism it might have been made of wood, but as a piece of machinery it is made of cast-iron, and was sent from Crewe for the purpose of the lecture. This cardboard pulley is driven direct, being keyed upon the vertical shaft, and therefore rotating with a very high velocity. When contact is made with the pulley on one side of it, the horizontal shaft rotates, and with it a worm-wheel at the end. If the contact is made with the second cone the worm-wheel is driven in the other direction. That is sufficient for our present purpose. With the machine, of which a part is here, large driving-wheels of locomotives and heavy pieces of machinery are lifted and moved from place to place; by similar arrangements even locomotives themselves are raised.

FIG. 2



The exact velocity of these pulleys can be given. The speed of the cord passing round the top pulley is 5,000ft. per minute, and the pulley itself makes 1,958 rotations per minute. Therefore the cone below also makes 1,958 rotations, and as it is not quite of the same diameter of the other, but rather larger, upon the law of reduction of these pulleys the pulley on the horizontal shaft makes 2,238 rotations per minute. Therefore the worm at the end moves at the rate of 2,238 rotations per minute, and then by the worm arrangement a very rapid reduction takes place until the wheels, by means of which loads are raised and carried from place to place, move with a circumferential velocity of only 79ft. per minute, so that the velocity of one mile is reduced to 79ft. as a question of travelling, for the smaller class of these cranes travel along lines, and so convey from place to place the heavy weights they may have lifted. It is also reduced to about 79ft. as a question of lifting, the two motions being kept distinct. This illustration will be sufficient for an example of the communication of motion by rolling contact where there are no teeth.

Although "rolling contact" is the especial purpose of this evening, yet it will be essential to say a few words in reference to a machine, of which an elementary portion is before you. The Registrar-General, with great kindness—a kindness which has met us on every hand in reference to illustrations for these lectures—has supplied these parts of the calculating machine made by Messrs. Scheutz.

Before describing the simple and durable apparatus, it may be well to explain the objects contemplated by those who have given their minds to the construction of calculating machines.

Perhaps Mr. Babbage was the first to direct attention to a peculiar mathematical relationship existing in almost all tables of numbers in sequence. He had observed that, if a consecutive series of these numbers were taken, and each subtracted from the next higher number, a deduced table of smaller numbers could be obtained. Performing a similar operation of subtraction upon the lines in this second table, a third table of still smaller figures resulted. Proceeding thus, he found that generally there resulted a series of the same, or nearly the same, numbers. For example, take the squares of the first nine digits; these squares are:—

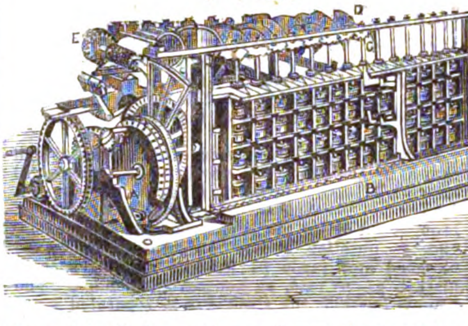
Square Numbers	1	4	9	16	25	36	49	64	81
First Differences	3	5	7	9	11	13	15	17	
Second Differences	2	2	2	2	2	2	2		

If, now, mechanism were so contrived that the lower line was constantly added to the one above, and this (the second line), so increased, were added to the first, a series of figures would be obtained which, in the illustration given, would constitute a series of square numbers.

Such was the foundation of the scheme which Mr. Babbage laid as that on which to rear the superstructure of a calculating machine. Mr. Babbage's views, so far as they have received "body, form, and fashion," are now in the Museum at South Kensington. Two gentlemen—one a Mr. Schentz, of Stockholm, the other a gentleman of England—partly from the published intentions and views of Mr. Babbage, and partly following out their own ideas, devised mechanism to do the work of calculation. Two machines on the plan of Messrs. Scheutz and his son have been made. One is at the Observatory at Albany, in America, the other at Somerset House.

The woodcut, Fig. 3, represents the general appearance of the machine. In each of the small recesses at the front is a wheel, or ring, or what may more correctly be called slice, about ½in. deep

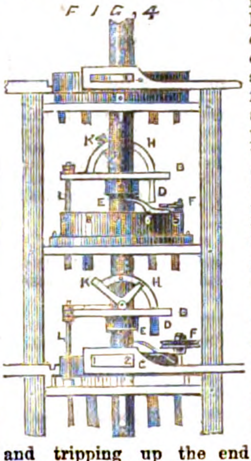
FIG. 3



of a metal cylinder, resting, as it were, in a groove, and having ten short pieces or legs projecting below. The woodcut (Fig. 4) may serve to show the general arrangement in two of the small recesses. These cylinder slices are not attached to the vertical shafts which pass through each recess. Attached, however, to the shafts are contrivances which not only are carried round with the shaft, but have upon them pins or studs capable of a vertical motion. This pin can be seen at G, between K and H, in the lower recess of Fig. 4.

It may be observed that as the shaft rotates, a projecting trigger or pin D will be tripped up by the inclined plane E, attached to the lower cylinder-slice. Thus tripped up, the pin G, previously referred to, will be lifted out of the bell-crank K H. This bell-crank is loaded at K, and that end, therefore, falls. The consequence is that the pin G is supported upon the other arm H of the bell-crank, when the trigger D has passed over the inclined plane E, and so held between what we have called the legs of the upper cylinder-slice. So long, therefore, as the shaft moves the cylinder will be moved. The rotation, however, brings the bell-crank into contact with a small inclined plane, not visible in Fig. A, and tripping up the end K of the bell-crank releases G, which falls down, and so discontinues the rotation of the cylinder-slice. This reliance upon the influence of gravity is a peculiar feature in this mechanism, and is not found in other machines dealing with calculations. It will be observed that around the cylinder slices, or rings, the figures from 0 to 9 are engraved. Any one of these figures may be brought by the hand or by the mechanism into the front vertical line, they are then

FIG. 4



regarded as the figures which are to enter into the calculations.

The lecturer, by enlarged working models, explained the action of other parts of the machine so far as related to the calculating mechanism. The combined action of these parts conveyed to the upper line of the machine, shown in Fig. 3, the various additions indicated by the laws of differences as previously illustrated.

It will be observed that hitherto no mechanism has been described for the operation of carrying. For example—if the two lines $\frac{362}{473}$ were to be added, the figures indicated would be 735 instead of 835. Messrs. Scheutz had, therefore, to provide for this carrying. In Fig. 3, it will be observed there is an upright marked B, this is called a Traveller. By a mangle wheel arrangement at the left-hand side of the figure, and a chain, acted upon by a toothed wheel, into the links of which the teeth enter, this Traveller passes in front of the recesses. It will be observed that the Traveller has two projecting arms. By means of these arms he is enabled to advance one figure on any wheel where the mechanism indicates that such an advance must be made. A similar traveller at the back does the same for the rows of wheels not operated upon by the front one. Thus, after each complete revolution of the wheel-work, the upper row of figures indicates the successive lines in the series being calculated.

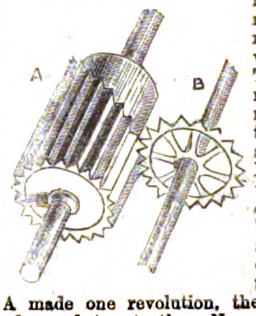
It remains to state briefly how the figures thus made apparent are to be transferred to the type wheels and so impressed, either upon stereo-metal or upon a matrix of paper pulp, from which type-metal casts may be taken.

To say that it is done by a series of stepped cams something similar to the snail cam, by which the number of strokes made by the hammer of a clock is determined, would be a brief but not very sufficient explanation. This much must, however, suffice for the present, and those who wish for further information can obtain it on reference to the patent of Messrs. Scheutz.

Now that the mechanism of calculating machines is before us, it may be well to direct attention to that of arithmetical machines. These are for performing the ordinary operations of addition, subtraction, multiplication, and division, and not for the calculations of series by a law of differences. The one now produced is simple in construction, compact in arrangement, and satisfactory in use. Similar ones are made by Mr. Thomas, of Colmar, and are used in many parts of Europe and England.

Exclusive of the progressive parts, which are similar to those of counting, or numbering, or paging machinery, there is a very ingenious and simple arrangement for committing to the machinery any number that the operator may desire. By directing small pointers to the figures on which an operation (say) of multiplication is to be performed, and turning a handle, these figures appear in the machine. The mechanism for this is what we must now look at. The pointer to which reference has been made moves a small-toothed wheel along a square bar or shaft B. In gear with this wheel are teeth on a cylinder or pinion A. Ten of such long teeth surround about half of the cylinder. If, therefore, the cylinder A made one revolution, the wheel B would be advanced ten teeth. Now, an inspection of Fig. 5 will show that a portion of each tooth is cut off, so that the position of the wheel B upon the small squared shaft determines the number of teeth it may be advanced, and therefore enables any figure to be introduced into the machine. Although between the small shafts, A and B, the communication of motion is by cylinders of circular section, yet the amount of motion communicated is variable, being dependent upon the position of the wheel on B.

FIG. 5



(*To be continued.*)

Professor Gunning claims that the Niagara river has been in existence about 200,000 years—that a barrier 30ft. high at the head of the rapids would throw the water back into Lake Michigan.

The Glenfield Patent Starch Case.—Sheriff Davidson has rejected the appeal against Sheriff Campbell's decision in the case of Wotherspoon against J. C. Anderson, grocer, Edinburgh, by which the latter was fined £21 and expenses, for selling an imitation of the Glenfield Starch, and has granted the additional expenses.

THE CONSTITUTION OF NATURE.*

(Continued from p. 429.)

THE principle of gravitation has been already described as an attraction which every particle of matter, however small, has for every other particle. With gravity there is no selection; no particular atoms choose, by preference, other particular atoms as objects of attraction; the attraction of gravitation is proportional to the quantity of the attracting matter, regardless of its quality. But in the molecular world which we have now entered matters are otherwise arranged. Here we have atoms between which a strong attraction is exercised, and also atoms between which a weak attraction is exercised. One atom can jostle another out of its place in virtue of a superior force of attraction. But though the amount of force exerted varies thus from atom to atom, it is still an attraction of the same mechanical quality, if I may use the term, as that of gravity itself. Its intensity might be measured in the same way—namely, by the amount of motion which it can impart in a certain time. Thus the attraction of gravity at the earth's surface is expressed by the number 32, because, when acting freely on a body for a second of time, it imparts to the body a velocity of 32ft. a second. In like manner the mutual attraction of oxygen and hydrogen might be measured by the velocity imparted to the atoms in their rushing together. Of course such a unit of time as a second is not here to be thought of, the whole interval required by the atoms to cross the minute spaces which separate them not amounting probably to more than an inconceivably small fraction of a second.

It has been stated that when a body falls to the earth it is warmed by the shock. Here we have what we may call a mechanical combination of the earth and the body. Suffer the falling body and the earth to dwindle in imagination to the size of atoms, and for the attraction of gravity substitute that of chemical affinity, which is the name given to the molecular attraction, we have then what is called a chemical combination. The effect of the union in this case also is the development of heat, and from the amount of heat generated we can infer the intensity of the atomic pull. Measured by ordinary mechanical standard, this is enormous. Mix 8lb. of oxygen with 1lb. of hydrogen, and pass a spark through the mixture; the gases instantly combine, their atoms rushing over the little distances between them. Take a weight of 47,000lb. to an elevation of 1,000ft. above the earth's surface, and let it fall; the energy with which it would strike the earth would not exceed that of the 8lb. of oxygen atoms as they dash against 1lb. of hydrogen atoms to form water.

It is sometimes stated that the force of gravity is distinguished from all other forces by the fact of its resisting conversion into any other. Chemical affinity, it is said, can be converted into heat and light, and these again into magnetism and electricity. But gravity refuses to be so converted; it is a force which maintains itself under all circumstances, and is not capable of disappearing to give place to another. If by this is meant that a particle of matter can never be deprived of its weight, the assertion is correct; but the law which affirms the convertibility of natural forces was never meant, in the minds of those who understood it, to affirm that such a conversion as that here implied occurs in any case whatever. As regards convertibility into heat, gravity and chemical affinity stand on precisely the same footing. The attraction in the one case is as indestructible as in the other. Nobody affirms that when a stone rests upon the surface of the earth the mutual attraction of the earth and stone is abolished; nobody means to affirm that the mutual attraction of oxygen for hydrogen ceases after the atoms have combined to form water. What is meant in the case of chemical affinity is, that the pull of that affinity, acting through a certain space, imparts a motion of translation of the one atom towards the other. This motion of translation is not heat, nor is the force that produces it heat. But when the atoms strike and recoil, the motion of translation is converted into a motion of vibration, and this latter motion is heat. But the vibration, so far from causing the extinction of the original attraction, is in part carried on by that attraction. The atoms recoil in virtue of the elastic force which opposes actual contact, and in the recoil they are driven too far back. The original attraction then triumphs over the force of recoil, and urges the atoms once more together. Thus, like a pendulum, they oscillate, until their motion is imparted to the surrounding ether; or, in other words, until their heat becomes radiant heat.

In this sense, and this sense only, is chemical affinity converted into heat. There is, first of all, the attraction between the atoms; there is, secondly, space between them. Across this space the attraction urges them. They collide, they recoil, they oscillate. There is a change in the form of the motion, but there is no real loss. It is so with the attraction of gravity. To produce motion here space must also intervene between the attracting bodies: when they strike motion is apparently destroyed, but in reality there is no destruction. Their atoms are suddenly urged together by the shock; by their own perfect elasticity these atoms recoil; and thus is set up the molecular oscillation which announces itself to the nerves as heat.

It was formerly universally supposed that by the collision of unelastic bodies force was destroyed. Men saw, for example, when two spheres of clay, or painter's putty, or lead, were urged together, that the motion possessed by the masses prior to impact was more or less annihilated. They believed in an absolute destruction of the force of impact. Until recent times, indeed, no difficulty was experienced in believing this, whereas, at present, the ideas of force and its destruction refuse to be united in most philosophic minds. In the collision of elastic bodies, on the contrary, it was observed that the motion with which they clashed together was in great part restored by the resiliency of the masses, the more perfect the elasticity the more complete being the restitution. This led to the idea of perfectly elastic bodies—bodies competent to restore by their recoil the whole of the motion which they possessed before impact.

Hence the idea of the conservation of force, as opposed to the destruction of force, which was supposed to occur when inelastic bodies met in collision.

We now know that the principle of conservation holds equally good with elastic and inelastic bodies. Perfectly elastic bodies develop no heat on collision. They retain their motion afterwards, though its direction may be changed; and it is only when sensible motion is, in whole or in part, destroyed that heat is generated. This always occurs in inelastic collision, the heat developed being the exact equivalent of the motion extinguished. This heat virtually declares that the property of elasticity, denied to the masses, exists among their atoms, and by their recoil and oscillation the principle of conservation is vindicated.

But ambiguity in the use of the term "force" has been for some time more and more creeping upon us. We called the attraction of gravity a force without any reference to motion. A body resting on a shelf is as much pulled by gravity as when, after having been pushed off the shelf, it falls towards the earth. We applied the term force also to that molecular attraction which we called chemical affinity. When, however, we spoke of the conservation of force in the case of elastic collision, we meant neither a pull nor a push, which as just indicated, might be exerted upon inert matter, but we meant the moving force, if I may use the term, of the colliding masses.

What I have called moving force has a definite mechanical measure in the amount of work that it can perform. The simplest form of work is the raising of a weight. A man walking up-hill or upstairs with a pound weight in his hand, to an elevation (say) of 16ft., performs a certain amount of work over and above the lifting of his own body. If he ascend to a height of 32ft. he does twice the work; if to a height of 48ft. he does three times the work; if to 64ft. he does four times the work, and so on. If, moreover, he carries up 2lb. instead of 1lb., other things being equal, he does twice the work; if 3lb., 4lb., or 5lb., he does three, four, or five times the work. In fact, it is plain that the work performed depends on two factors, the weight raised and the height to which it is raised. It is expressed by the product of these two factors.

But a body may be caused to reach a certain elevation in opposition to the force of gravity without being actually carried up to the elevation. If a hodman, for example, wished to land a brick at an elevation of 16ft. above the place where he stands, he would probably pitch it up to the bricklayer. He would thus impart, by a sudden effort, a velocity to the brick sufficient to raise it to the required height; the work accomplished by that effort being precisely the same as if he had slowly carried up the brick. The initial velocity which must be imparted in the case here assumed is well known. To reach a height of 16ft., the brick must quit the man's hand with a velocity of 32ft. a second. It is needless to say that a body starting with any velocity would, if wholly unopposed or unaided, continue to move for ever with the same velocity. But when, in the case before us, the body is thrown upwards, it moves in opposition to gravity, which incessantly retards its motion, and finally brings it to rest at an elevation of 16ft. If not here caught by the bricklayer, it would return to the hodman with an accelerated motion, and reach his hand with the precise velocity it possessed on quitting it.

Supposing the man competent to impart to the brick, at starting, a speed of 64ft. a second, or twice its former speed, would the amount of work performed in this effort be only twice what it was in the first instance? No; it would be four times that quantity. A body starting with twice the velocity of another, will rise to four times the height; in like manner, a three-fold velocity will give a nine-fold elevation, a four-fold velocity will give a sixteen-fold elevation, and so on. The height attained then, or the work done, is not proportional to the velocity, but to the square of the velocity. As before, the work is also proportional to the weight elevated. Hence, the work which any moving masses whatever are competent to perform, by the motion which they at any moment possess, is jointly proportional to the weight and square of the velocity. Here, then, we have a second measure of work in which we simply translate the idea of height into its equivalent idea of motion.

In mechanics, the product of the mass of a moving body into the square of its velocity expresses what is called the *vis viva*, or living force. It is also sometimes called the "mechanical effect." If, for example, we point a cannon upwards, and start a ball with twice the velocity imparted by a second cannon, the ball will rise to four times the height. The speedier ball, if directed against a target, will also do four times the execution. Hence the importance of imparting a high velocity to projectiles in war. Having thus cleared our way to a perfectly clear conception of the *vis viva* of moving masses, we are prepared for the announcement that the heat generated by the collision of a falling body against the earth is proportional to the *vis viva* annihilated. In point of fact, it is not an annihilation at all, but a transference of *vis viva* from the mass to its ultimate particles. This, as we now learn, is proportional to the square of the velocity. In the case, therefore, of two cannon balls of equal weight, if one strike a target with twice the velocity of the other, it will generate four times the heat; if with three times the velocity it will generate nine times the heat, and so on.

Dr. Joule has shown that in falling from a height of 772ft., a body will generate an amount of heat sufficient to raise its own weight of water 1° Fahr. in temperature. We have here the mechanical equivalent of heat. Now, a body falling from a height of 772ft. has, upon striking the earth, a velocity of 223ft. a second; and if this velocity were imparted to a body, by any other means, the quantity of heat generated by the stoppage of its motion would be that stated above. Six times that velocity, or 1,338ft., would be an inordinate one for a cannon ball as it quits the gun; but if animated by six times the velocity, thirty-six times the heat will be generated by the stoppage of its motion. Hence, a cannon ball moving with a velocity of 1,338ft. a second, would, by collision, generate an amount of heat competent to raise its own weight of water 36° Fahr. in temperature. If composed of iron, and if all the heat generated were concentrated in the ball itself, its temperature would be raised about 360° Fahr.; because 1° in the case of water is equivalent to about 10° in the case of iron. In artillery practice the heat generated is usually concentrated upon the front of the bolt, and on the portion of the target first struck. By this concentration the heat developed may become sufficiently intense to raise the dust of the metal to incandescence, a flash of light often accompanying collision with the target.

Let us now fix our attention for a moment on the gunpowder which urges the cannon ball. This is composed of combustible matter, which if burnt in the open air would yield a certain amount of heat. It will not yield this amount if it performs the work of urging a ball. The heat then generated by the gunpowder will fall short of that produced in the open air, by an amount equivalent to the *vis viva* of the ball; and this exact amount is restored by the ball on its collision with the target. In this perfect way are heat and mechanical motion connected.

Broadly enunciated, the principle of the conservation of force asserts that the quantity of force in the universe is as unalterable as the quantity of matter; that it is impossible to create force and to annihilate it. But in what sense are we to understand this assertion? It would be manifestly inapplicable to the force of gravity as Newton defined it; for this is a force varying inversely as the square of the distance, and to affirm the constancy of a varying force would be self-contradictory. Yet, when the question is properly understood, gravity forms no exception to the law of conservation. Following the method pursued by Helmholtz, I will here attempt an elementary exposition of this law, which, though destined in its applications to produce momentous changes in human thought, is not difficult of comprehension.

For the sake of simplicity, we will consider a particle of matter, which we may call F, and a second movable particle, D, placed at a distance from F. We will assume that these two particles attract each other according to the Newtonian law. At a certain distance the attraction is of a certain definite amount, which might be determined by means of a spring balance. At half this distance this attraction would be augmented four times; a third of the distance it would be augmented nine times; at one-fourth of the distance sixteen times, and so on. In every case the attraction might be measured by determining, with the spring balance, the amount of tension which is just sufficient to prevent D from moving towards F. Thus far we have nothing whatever to do with motion; we deal with statics, not with dynamics. We simply take into account the distance of D from F, and the pull exerted by gravity at that distance.

It is customary in mechanics to represent th[e] magnitude of a force by a line of a certain l[ength], a force of double magnitude being represent[ed by a] line of double length, and so on. Placing, t[...]

* By Professor TYNDALL.

particle D at a distance from F, we can in the imagination draw a straight line from D to F, and at D erect a perpendicular to this line, which shall represent the amount of the attraction exerted on D in this position. If D be at a very great distance from F the attraction will be very small, and the perpendicular consequently very short. Let us now suppose that at every point in the line joining F and D a perpendicular is erected proportional in length to the attraction exerted at that point; we should thus obtain an infinite number of perpendiculars of gradually increasing length as D approaches F. Uniting the ends of all these perpendiculars, we should obtain a curve, and between this curve and the straight line joining F and D we should have an area containing all the perpendiculars placed side by side. Each one of this infinite series of perpendiculars representing an attraction, or tension, as it is sometimes called, the area just referred to represents the total effort capable of being exerted by the tensions upon the particle D, during its passage from its first position up to F.

(*To be continued.*)

ACOUSTIC ILLUSTRATIONS OF THE METHOD BY WHICH STELLAR MOTIONS ARE DETERMINED WITH THE SPECTROSCOPE.*

THE fourth of the series of lectures known as the Mechanics' Course was recently delivered in the large hall of the Sheffield Scientific School, upon the above subject, the lecturer being Prof. A. M. Mayer, of the Stevens Institute of Technology, United States.

Prof. Mayer began by calling the attention of his audience to the character of vibrations, instancing the pendulum as one of the best examples of visible mass-vibration, and saying that the curve representing its motion was that representing all other vibratory motions of whatever kind. This curve he had obtained experimentally by means of an ingenious apparatus which he described. Besides these, there are molecular vibrations, due to elasticity, the action of which was very clearly illustrated upon the black-board. A water-wave is a mass-vibration, as is shown admirably by Prof. Lyman's wave apparatus. The progressive character of a wave was then exhibited by means of a long wire coil, along which an impulse was transmitted as a visible undulation or wave. As an example of a molecular vibration due to elasticity, the vibration of a Brown and Sharp's straight-edge, fastened firmly at one end, was given, and a series of beautiful curves drawn upon smoked glass by a wire attached to such a vibrating rod, were thrown on the screen.

The lecturer then passed to the theories of light, describing the emission theory and the undulatory theory. Certain phenomena, such as reflection, refraction, and dispersion could be equally well accounted for by either; but certain others, such as those of interference, could be explained only by a wave or undulatory theory. This latter theory supposes a trembling of the particles either of air or of the matter filling space, which trembling, so far as interference goes, may be lateral, or longitudinal, but the phenomena of polarisation of light indicate that these vibrations are transverse to the direction of propagation of the ray. In sound, the vibration is longitudinal; in heat and light, lateral. Hence, sound-waves may interfere and produce silence; light-waves may interfere and produce darkness; heat waves may interfere and produce cold. The ear is so constituted that it takes cognisance only of the longitudinal vibrations of the air, though the air vibrates in all directions; the eye takes notice only of lateral ether-vibrations, though the ether-vibrates in all directions. Interference was then described and illustrated on the board, and the phenomena of fringes shown to result from the overlapping of waves in unequal phases, which could be a consequence only of undulations. The practical use of such knowledge as this was illustrated by a description of Newton's rings, and the method by means of which these rings may be made to indicate a distance as small as a millionth of an inch. Another instance of the practical application of these facts is Arago's Differential Refractometer, which will show a difference of density in the air of one-eight thousandth part, and by which the refraction of the air has been measured, and tables constructed, by whose use the mariner may find the true altitude of the sun.

The effect of lengthening and of shortening a wave was then explained. In the case of a sound-wave—moving 1,100ft. a second whatever the wave-length—if the length be diminished more vibrations enter the ear in the same time, and the pitch rises; if it be increased, less vibrations enter, and the pitch lowers. Light-waves are strictly analogous; whenever any one of the coloured waves which form white light is lengthened, its colour changes towards the red end of the spectrum; when it is shortened, towards the violet. Hence change of pitch in the case of sound, or of colour in the case of light, is evidence of motion, either to or from the observer; which it is, depends on whether the wave is lengthened or shortened. Now, while the motion of a star at right angles to the line of sight is easily detected and measured by the telescope, motion in the direction of this line is capable of measurement only by the spectroscope; if the motion be diagonal, then by both of these instruments together. Hence the motion of a fixed star in space, or of a whirlwind on the sun, may be measured by the change in refrangibility which certain lines in the spectrum undergo.

To illustrate this point by means of sound-waves was the object of the evening. With the lantern the image of a tuning-fork beating 256 times a second—and giving the note Ut_3—was thrown on the screen. By the side of one of the prongs, and just touching it, was a carefully rounded and varnished cork ball, suspended by a filament of silk. On sounding a second fork placed on its case and tuned in accurate unison with the first (by an ingenious method devised by Prof. Mayer) anywhere in the room, even 30ft. distant, the first was thrown into vibration and the image of the cork ball was projected a foot or two away from the prong. When, however, the second fork was sounded, and the lecturer walked rapidly—at the rate of 8ft. a second—towards or from the first, touching the case only when in motion, no motion of the cork was observed; the wave being in this way shortened or lengthened by an amount sufficient to throw it out of unison with the lantern-fork. Again, a third fork, vibrating 254 times a second, produced no effect on the ball; but when sounded and placed on its case, as this was swung rapidly towards the first fork, the wave-length was thereby so shortened as to bring it into unison with this, and the ball promptly responded. A fourth fork, vibrating 258 times, showed the same phenomenon, when placed on its case as this was swung away from the first fork, the wave thus being shortened into unison. The demonstration was most complete and satisfactory. Prof. Mayer stated that he purposed making some quantitative experiments with the apparatus, which will be of the highest value to science.

The lecturer closed with an application of this sound demonstration to the phenomena of light. It was an exceedingly interesting lecture throughout, and was listened to with the closest attention.

* From the *College Courant.*

HISTORICAL NOTES ON POISONING.

THE following remarks formed a portion of the introductory lecture to the course of Forensic Medicine delivered at King's College by Dr. David Ferrier, and are abstracted from the report in the *British Medical Journal*:—

I have chosen, said Dr. Ferrier, to illustrate the development of Forensic Medicine in one of its branches more particularly, by bringing before you the results—possibly more curious than valuable—of an inquiry into the uses of poisons, and the notions that have prevailed at different periods in the history of medicine on the subject of poisoning. This has always been a matter of curiosity and interest, not more to the medical profession than to people generally; and, on account of the ideas associated with the word poison, it has always proved an attractive theme to writers of fiction.

The earliest use of poisons seems to have been for the purpose of anointing arrows; and the word which is used to denote poison (*toxikon*) derives its origin from the word signifying bow (*toxon*). This custom dates from the most remote antiquity—from the time when men earned their means of subsistence (*bíos*) by the bow (*biós*). It is almost universally prevalent at the present day among the most primitive and savage tribes; and to this custom we owe our knowledge of one of the most powerful poisons that exists. We find frequent allusions to it in the classical writers. Homer represents Ulysses as sending to Ephyra for poison wherewith to anoint his arrows. The story of Hercules dipping his arrows in the venom of the Lernæan hydra, their deadly effects, and the dreadful accidents which befel Chiron and Philoctetes, are familiar to you all. This story is an indication of the nature of the poison employed; and we have it on the authority of numerous writers that snake-poison was frequently used for this purpose. Such was the custom of the ancient Scythians, who likewise mixed the venom with human blood, of itself regarded as a virulent poison, in order to intensify the effects. Even at that early period, they had discovered the fact, though its explanation by the physiological relation between absorption and excretion is only of recent date, that, when taken naturally, the poison was innocuous, and was only fatal when directly introduced into the blood by means of a wound.

Another very ancient use of poisons was for the purpose of the ordeal—a method of judicial investigation which also obtains among many tribes at the present day. With this custom we generally associate the physostigma or ordeal bean of Old Calabar. It is supposed that it was a poison of some kind which constituted the maar, or bitter water, of which we read in the book of Numbers, and which was used as a judicial test of the honour of wives accused of infidelity by jealous husbands. Harmless to one who was innocent, the effects in the case of a guilty woman were dire enough, causing the belly to swell, and the thigh to rot. It is very doubtful whether this were really a poison. It is more likely that the dreadful invocations of the imposing preliminary ceremony were sufficient to deter any but an innocent woman from draining the contents of the cup.

One of the most curious chapters in the literature of poisoning is that which relates to the use of poisonous substances in the preparation of *philtres*, or love-potions, which were administered under the idea that the affections of the person so practised on would be gained by the individual who employed them. Though the means adopted were often ridiculous enough, and partook more of the character of sorcery and incantation, yet in many cases they were not of the same harmless nature, and the evil effects which frequently resulted assumed such an importance in the eve of the law, that, even at an early period, the administration of such philtres was looked upon in the same light as more serious attempts at poisoning, and was punished as a capital offence.

Among the Greeks and Romans, Medea was universally regarded as the greatest adept in the art of preparing philtres; and hence the term *Medeides herbæ* was used by Horace and Ovid to designate such substances generally. Next in reputation stand the Thessalian women, who may be supposed to have learnt the art from Medea, and who attained great celebrity in all that related to poisoning, sorcery, and incantation. Hence "Thessalian arts" and "Thessalian poisons" are frequently employed by the classical writers as generic terms, applicable to all forms of poisoning. Philtres are described by Ovid and others as affecting the reason and causing a phrensy which sometimes terminated fatally. Lucretius, the great philosophical poet of the Ciceronian era, is said to have written his poem "On the Nature of Things" in the intervals of delirium occasioned by a philtre or love-potion secretly administered to him by his wife or mistress, Lucilia; and Lucullus, the Roman general, is stated to have died in a state of delirium from a similar cause. The laws of the Twelve Tables contained special provisions against this form of poisoning. Though it would appear, therefore, both from the accounts we have received and from the necessity of special enactments against it, that the administration of philtres often led to results far more serious than were contemplated by those who used them, we can hardly regard otherwise than as a subject of amusement the credulity which prevailed even up to a very late period with respect to many substances held in high repute, and supposed to be possessed of marvellous properties. Most of these substances would hardly come under the head of poisons, or even noxious substances, as we understand them; but yet in most countries their administration was forbidden, as coming under the head of sorcery and witchcraft.

It is a curious circumstance, and one which we find great difficulty in accounting for, that not merely human blood, but the blood of animals in general, was universally looked upon as a poison in ancient times; and that this belief should have been shared by medical writers up to a comparatively recent period. We read in Herodotus that Psammenitus, King of Egypt, was put to death by Cambyses by being made to drink bullock's blood. Such also, according to the popular belief, was the mode in which Themistocles committed suicide. Unwilling to fight against his own countrymen, he drank a goblet of the blood of a sacrificial ox, and expired almost immediately. Even up to the time of Blumenbach, in the middle of the last century, the belief that blood was poisonous was general, and it was treated of as such in many learned works on poisons and legal medicine. Zacutus Lusitanus, writing in 1657, relates many instances of dreadful effects resulting from the drinking of blood. It is worth while quoting one of these. A student, animated by the spirit of practical joking, gave to another, instead of wine, 2oz. of the blood of a red-haired woman mixed with sugar. The victim of this joke did not experience any immediate bad effects, but after a day or two he passed into a raving state, and became ultimately a confirmed idiot. One is tempted to remark that the individual in question cannot at best have been far removed from this state, if he could mistake for wine the nauseous mixture offered to him. And, in the opinion of Andreas Cæsalpinus, who nearly anticipated Harvey in the discovery of the circulation, it is to human blood that we owe the origin of one of the most virulent contagious diseases. He traces the origin of syphilis to the fact that the Spaniards, in abandoning the small town of Somma, at the foot of Mount Vesuvius, mixed all the wine of the place with the blood of the patients in the hospital of St. Lazarus.

Blumenbach, in his lectures, recommended his students to make experiments in order to clear up all doubts as to the poisonous qualities of blood. One student experimented on himself, and drank seven ounces of warm bullock's blood without experiencing any evil effects. Another preferred to experiment on a dog, which likewise survived the experiment.

Returning from this digression on blood once more to the subject of philtres, we find that the belief in them was strong even as late as the time of Van Helmont, in the middle of the seventeenth century. Van Helmont himself was fully persuaded of their efficacy, and perhaps the most remarkable statement in regard to them occurs in one of his writings. Here is a translation of it: "I know a plant of common occurrence, which, if you rub and cherish in the hand till it becomes warm, and then take the hand of another and hold it till it also becomes warm, that person will forthwith be stimulated with love for you, and continue so for several days." There were not a few, however, even in ancient times, who were sceptical as to philtres. Ovid, who speaks so much in them, had his doubts; and, in a letter to a young lady, he recommends, as by far the most preferable prescription, "ut ameris, amabilis esto." From these and similar truths, the influence of philtres gradually ceased to be believed in, and disappeared from medical literature by the middle of the eighteenth century. Closely connected with the practice of brewing love-drinks was the still more pernicious and dangerous one of dealing in abortifacients. What we now call the crime of abortion was not in early times regarded as such. False political and social doctrines had much to do with the prevalence of the practice before the dawn of Christianity, and it was not till the time of the early Christian emperors that legislative measures were enacted to check it. The agents who pandered to the licentiousness and vice of this period [the Roman Empire] were numerous, and well skilled in the knowledge of almost all the mechanical and oxytoxic means of procuring abortion with which we are at the present day acquainted. Then, as now, the attempts were frequently followed by fatal consequences.

It is, however, with the use of poisons for the express purpose of taking away life that we more particularly associate the term poisoning and it is on this that so much has been written, and, at the same time, so much has been fabled. It was but natural that men should turn to some account the knowledge of the deadly effects of many substances with which they could not help becoming acquainted, and to employ them for ridding themselves of objects of jealousy, hate, envy, or revenge, especially as this could so often be done secretly and securely; and it was also natural that the same means should recommend themselves as a rapid and pleasant mode of suicide. Poisons were also employed for state purposes, as a means of execution. The most celebrated instance of this is the koneion or state poison of the Athenians, which has derived its chief interest in connection with the death of Socrates. The description given by Plato of its mode of action has given rise to considerable discussion as to its nature. Apart from its name, which would be no satisfactory guide, it has been generally identified with the *Conium maculatum* or hemlock. Some have doubted whether it were only a simple infusion of hemlock, and think that it must have had other ingredients. Whatever it was, it does not appear to have been very powerful or rapid in its action; for we are told that mental excitement was apt greatly to interfere with its effect, and sometimes more than a single dose was necessary. The carrying out of the sentence of capital punishment by means of poison was not, however, confined to the Athenians, and we have numerous instances in other countries where the same method was adopted. It was allowed as a special mark of favour in some cases; and in later days, when scientific men were eager to study the effects of poisons in an exact manner, it was permitted by the State, and criminals were quite willing to submit themselves to be experimented on with poisons, rather than undergo the horrors of a public execution. The mode of execution by poison was strongly advocated by many medical writers of the last century. Celtes, a German writer, thought it was a mark of very great simplicity and stupidity in his countrymen not to have adopted it; and Gruner, in a very eloquent and feeling manner, extols the comfort and tranquillity of being quietly put out of the way, without becoming, under the hands of the executioner, a horrible and bloody spectacle in the eyes of a cruel mob.

It was a strange custom that prevailed among the inhabitants of the island of Ceos. The old men, when they found that they were no longer of service to the State, and felt themselves a burden to their children, assembled together at a banquet of death, and, with their heads crowned with chaplets, joyfully drank a happy despatch in cups of hemlock. A more sensible custom obtained among the ancient inhabitants of Marseilles—one which might with advantage be revived at the present day, if only those most interested would subscribe to its provisions. Valerius Maximus relates that the inhabitants of that town kept a public poison, intended for the special use of those who wished to commit suicide. Before, however, the applicant was supplied he had to go before a jury of six hundred—the Timarchi—and satisfy them that he was miserable enough to be allowed to put an end to his troubles by poison. The kings of Persia were also in possession of a poison which caused a speedy and painless death, which they carefully preserved for their own special use against an evil day.

In times of trouble, and in ages of barbarous cruelty, men who took an important part in public affairs, and thus exposed themselves to the machinations of numerous enemies, often carried on their persons a sufficient quantity of some deadly poison, to which they resorted as a means of escape from tortures worse than death. I might cite numerous instances of this practice in various ages, but one or two well-known examples will suffice. I have already alluded to the death of Themistocles, which was popularly set down to the effects of blood, but which, in all probability, was due to some poison which he carried on his person. Demosthenes, when all hopes of escape from his enemies, the Macedonians, were gone, committed suicide by taking a dose of poison, which he is said always to have carried about with him in a quill. The story of Hannibal is likewise familiar to you all. After being hunted about from place to place by his relentless enemies, the Romans, he was obliged to sacrifice himself, in order to save his protector, Prusias. He is said to have carried the means of death in a ring which he constantly wore. Though we can admit the possibility of this, we have no means of ascertaining the nature of the poison, nor the method in which it was introduced into the system. Perhaps the most celebrated instance is the case of Mithridates, King of Pontus, who was, according to accounts, quite an adept in toxicology, and left behind him a work on that subject, which, however, has unfortunately been lost. Mithridates, like some oriental monarchs of the present day, lived in constant fear of being poisoned. To guard against this, he invented an antidote, which became so famous that the name Mithridatium was applied to antidotes generally. Of this, however, we shall have to speak by-and-by. By the use of this antidote, but more probably by the habitual use, in small doses, of the poison which he feared, he is said to have rendered his system insusceptible to the action of poison; so that, when he came to require its aid, it proved faithless to him, and he was obliged to have recourse to his sword. The story of Mithridates would seem to show that it was one poison only, or at most very few, which were known, or at least had recourse to, by poisoners of that time.

It is, however, to the secret crime of poisoning that we attach the chief interest, both in a popular and medico-legal sense. It is often difficult to arrive at the real truth in many of the narrated accounts, surrounded as it is, and mixed up with, so much that is evidently mythical. It is remarkable that this crime should have prevailed in some countries to a much greater extent than in others, and that so many women should have acquired a notoriety in this art. A great many of the accounts, however, which we have received regarding the proficiency which so many women are said to have attained, especially in the art of preparing slow and secret poisons, must be estimated at the same value as the similar tales of sorcery and witchcraft. As women were supposed to be specially addicted to these black arts, so they got a similar amount of credit for the art of secret poisoning; and, in ancient statutes, the word which signified witch was also used to signify poisoner. Most of the old statutes regardeded sorcery as a *veneficium*, and punished it with the same penalties. In the laws of the Twelve Tables already alluded to, persons who administered poisons, or uttered an incantation against the life of another, were punished with death; and, in the Institutes of Justinian, capital punishment was inflicted on those who by odious arts, whether by poison or by "magical whispers," took away the life of another.

The crime of poisoning does not appear to have been common among the ancient Egyptians or Jews, judging from the absence of any special legislation against it. The existence and character of the law against this crime afford a fair indication of its frequency, for in ancient times it was those who made the laws that had often the most reason to fear. The crime was very common among the Persians. This we have on the direct testimony of Xenophon; and certainly the punishment was such as might be expected to deter evil-doers. Those who were found guilty of poisoning were laid with their heads on a flat stone, and then beaten about the head and face with another stone till the skull was smashed in pieces. And, judging from the story of Statira, the Persians must have arrived at considerable dexterity in the art of preparing and administering secret poisons. It is related that Parysatis, wife of Darius, wishing to get rid of Statira, the wife of Artaxerxes, smeared with poison one side of the knife with which she carved a fowl. She sent the poisoned side to Statira, while she ate the other herself; so that Statira died apparently from causes which left no room for suspicion.

The crime was not common among the Greeks. When it did occur, the malefactors were condemned to death by the Areopagus. The Romans are said to have learnt the art of poisoning from the Persians. In this they soon excelled their masters, and indeed almost every other nation. The first great outbreak of the crime is reported by Livy, which occurred about the year B.C. 330. At this period, the morals of the upper classes of society had become so scandalous that the more virtuous and honourable members of the Senate set themselves to stem the torrent of vice. Soon afterwards, the frequent occurrence of sudden death among the illustrious senators filled the city with alarm, and led to an investigation. By the evidence of a slave, who had been privy to their councils, a secret society of patrician women was discovered, whose avowed object was to get rid of the obnoxious senators by means of poison. They vehemently denied the charge; asserting that their preparations, which were found, were only medicines for the poor. As a test, they were compelled to drink their medicines, which proved fatal to them all. Their accomplices, to the number of one hundred and seventy, were thrown into prison, where they perished. Two hundred years after this occurrence, secret poisoning again became extremely frequent, and led to the passing of the famous law "de veneficiis et sicariis" by the dictator L. Cornelius Sulla. This law is still preserved in the Institutes of Justinian. By it the crime of poisoning is held as more heinous than any other form of homicide, and was punished with corresponding severity. Under the Roman emperors, particularly about the time of Nero, poisoning was so frightfully common that few of any note were safe. The chief instrument in the perpetration of the numerous villanies which characterised the life and times of Nero was the famous Locusta. So necessary did this woman appear to the success of the schemes of Nero, that she was maintained by him as an *instrumentum regni*, and had pupils intrusted to her, that the valuable art should not become lost. It was Locusta who prepared the poison by which Agrippina despatched her husband, the Emperor Claudius, and by which, among others, Nero despatched his brother Britannicus. In the writings of Tacitus, Suetonius, and other writers of that epoch, there is much curious and interesting information regarding the experiments of Locusta, the nature of the poisons used, and what were considered at that time as the symptoms and signs of their administration. The poisons were chiefly derived from the vegetable and animal world, mineral poisons not having become known till a later period. Aconite seems to have been frequently employed.

It is also probable that aconite or some equally powerful poison formed the really active ingredient in many of the compounds which were by popular rumour supposed to owe their deadliness to substances which we now know to be wholly or almost wholly inactive. It was the popular belief that the poison which carried off Claudius was prepared from and administered to him in a dish of mushrooms. We could more readily credit the account, if it had been stated that he was poisoned by toadstools, the poisonous properties of which were well known. It has, however, long been a vulgar belief that toads are poisonous—an idea probably originating from their repulsive appearance, and from the fact that they do secrete an acrid fluid in their cutaneous glands. Modern research has not, however, confirmed this notion; and there is reason to believe that as many toads as frogs are eaten by epicures. That toads are poisonous, will in all likelihood continue to be believed as long as Shakespeare is read. Probably the same method of reasoning led to the belief in the poisonous nature of the *aplysia*, or sea-hare. Further than having a disgusting appearance and fetid odour, and having the power of emitting a coloured liquid when irritated, it does not seem to possess any specially poisonous qualities, though the subject might perhaps be worthy of further investigation. Nero is said to have frequently used this as a poison, and it is with this that Domitian is said to have poisoned his brother Titus.

(*To be concluded.*)

A Valuable Telescope.—An equatorial telescope was sold by auction, by Mr. J. C. Stevens, on Friday, and realised £745 10s., Mr. Henley being the purchaser. It is thus described in the catalogue: Equatorial telescope, complete, by T. Cooke and Sons, York; object-glass, 10in. clear aperture, and about 12ft. focal length; finder, with object-glass 2¼in. aperture; nine Huyghenian eyepieces, powers from 55 to 800; four sunshades, neutral tint; first surface reflecting prism, for viewing the sun; transit eyepiece; double parallel wire micrometer, with six eyepieces and four sunshades, in polished mahogany box; new prismatic illuminating apparatus, with Iris diaphragm for regulating the intensity of the light, and discs of coloured glass for changing its colour; sensitive level, swinging on pivots attached to the telescope tube, for determining the horizontal of the declination axis, in order that the line of collimation may sweep the plane of the meridian, enabling transits to be taken; large position circle at the eye-end of the tube, graduated upon silver, and read with two verniers and microscopes; large declination circle on the axis, graduated upon silver, and read with two verniers and microscopes; also a small supplementary declination circle, with levels, at the eye-end of the tube for quick setting; hour circle graduated upon silver, having two sets of divisions and verniers, and reading microscopes; equatorial motion communicated by clockwork, and additional tangent screw motions in right ascension and declination by means of rods and handles brought down the tube and axis.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

AXIS OF VENUS.

[4535.]—I QUITE share the opinion of "F.R.A.S." (let. 4491, p. 480) that no alleged determination of the precise inclination of Venus's axis can be accepted with confidence. But it seemed to me that his use of the word "imagined" might mislead, as not suggesting that De Vico's estimate was in any way based on observation. Before throwing out my suggestion, I looked up Webb, and though I noticed the passage quoted by "F.R.A.S." *from* p. 50, it did not seem to invalidate Webb's remarks at p. 49, that Bianchini "did his work *well*," but that "the *most effective* results" were those obtained by De Vico. (The italics are mine. Better than well seems at least not bad. The note quoted by "F.R.A.S." appears to refer to De Vico's style of writing, and to inexperience about other matters; for surely Webb knew his own mind when he was writing, and did not contradict flatly on p. 50 what he said on p. 49. I lay no stress on this point, however.

"F. R. A. S." will, I know, excuse my raising the question, since our common wish is to get as near the truth in these matters as may be. What seems pretty fairly established is a rotation period of about 23¼ hours and a great axial tilt. As to believing in De Vico's minutes and seconds of tilt, I can as well believe in his seconds, tenths of seconds, and hundredths of seconds of rotation-period, which imply that he was sure of every rotation since Bianchini's time, and that Bianchini's *observations* and De Vico's *timed* the arrival of the spots in certain positions, within a few minutes—which is absurd.

Can any one give me De Vico's estimate of the position of Venus's vernal equinox? The way in which our text-books neglect such points is simply discreditable. So far as observation is concerned, to give the axial tilt without the place of vernal equinox is as reasonable as it would be to give a planet's diameter without mentioning its distance. RICHARD A. PROCTOR.

AXES OF THE PLANETS.

[4536.]—IN answer to Mr Proctor (letter 4449, p. 406), Schröter estimated the angle which the equator of Mercury makes with the plane of his orbit at about 20°. W. T. R.

SPINNING-TOPS AND GYROSCOPES.

[4537.]—I AM quite unable to spare the time necessary for the proper discussion of this subject. I wrote only to point out the undoubted fact that mathematical analysis affords a complete account of all the phenomena of the gyroscope. What I remarked further on the subject of popular explanation was said altogether *en passant*, and should be taken in connection with what I said on the insufficiency of such explanation. But though I wrote *currente calamo*, I did not think it was in the power of any reader so thoroughly to misapprehend my remarks as J. M. Taylor and "E. H." (let. 4510 and 4511, p. 435) have done, each in his particular way. The possibilities of misapprehension are not easily gauged, however.

As to "E. H.," I shall be very brief. His remark that *whatever I may say* my ideas are extremely like "A.'s," is, of course, very ill-mannered; but he probably thinks it justified by facts: therefore, I take no exception to it. I should have thought he could perceive, however, that whereas "A." applied a mistaken idea about the bullet to illustrate the motion of a top, I applied a known fact to illustrate the same matter, the fact, namely, that the direction of motion of a swiftly moving body changes slowly under the influence of gravity. "E. H." asserts very confidently that "the question most certainly is *not*, at what rate?" It is particularly kind of him to tell me what question I was considering, but I must repeat that I *had* the rate in view. It is an undoubted fact that the shift of pose of an inclined top takes place more or less quickly according as the rotation is less or more rapid.

"E. H." proposes to give a popular explanation of gyroscope motions with several explanatory diagrams, when you, Mr. Editor, think fit. My advice to him is even as the advice of Mr. Punch to persons about to marry—*don't*. We had enough on the subject, and a good deal to spare (especially in the way of explanatory diagrams), some two or three years ago, from a gentleman anxious to enlighten the world with new ideas about the gyroscope; ideas, unfortunately, rather more new than true. If my recollection serves me aright, that gentleman used the initials "E. H.," but I am not sure. Perhaps the "E. H." of letter 4411 can tell us whether he ever favoured these columns with letters about the gyroscope.

"E. H." is obviously in labour, or eager to be in labour, with a new theory about nutation. I fear our wishes for a "safe delivery" should be limited to ourselves.

J. M. Taylor's supposition that "the centrifugal force lifts the body of the top itself," would hardly have resulted from his discussion of centrifugal motions, if he had not been *quite* so careful to avoid "entering into the mechanical analysis of the resolution and composition of the forces." The rising of a governor ball, or of a weight swinging as a conical pendulum when the velocity is increased, is in perfect accordance with those accepted laws of motion which Mr. Taylor seems so eager to invalidate (mistaking his failure to understand them, I imagine, for new lights). He would do well to remember the law (though it labours under the disadvantage of being an accepted one) that "action and reaction are equal and opposite."

Mr. Taylor "could hardly credit his senses," when he found me broadly stating that the weight of the top is insufficient to change the direction in a brief interval. Passing over the fact that his reference to his senses is not particularly polite, let me be permitted to point out that the weight of the top is the weight of its particles; that its particles are moving in different directions; that the time during which a particle moves in a given direction is a very brief interval indeed, being "no time at all;" that if one considers the motion of a given particle at any moment, one must not forget that that particle is not the whole top, *nor free to move without the top;* and that though the motion of this particle under the action of gravity would tend (*if the particle were free*) to shift the plane of the particle's rotation in one particular way, the motion of the particle directly opposite (*i.e.*, the particle so placed that the line joining the two is bisected by and perpendicular to the axis of rotation) would tend to shift the same plane of rotation in precisely the opposite way. The consideration of a few such facts as these, combined with a recollection of the circumstance that I was professedly only sketching out a certain method of reasoning, may perhaps enable Mr. Taylor to recover the reliance which he has been accustomed to place in his senses.

"Puzzled" (query 12377) may be satisfied that the height of the tower has nothing to do with the fact which puzzles him. RICHARD A. PROCTOR.

[4538.]—I THINK the suggestion of "F.R.A.S." as to the advisability of certain of our correspondents studying "fourpenny catechisms" is a good one. "A." (let. 4487) cannot understand how a cannon ball, fired horizontally, should strike the ground at the same time as if it had been dropped perpendicularly from the muzzle of the gun. He seems to imagine that the ball would travel for some distance in a horizontal direction. This is where he is in error. The ball would not travel in a strictly horizontal direction for the space of a single inch. The moment it leaves the mouth of the gun gravity begins to act, and draws it downwards. I would advise "A." to procure an elementary treatise on mechanics, and study the "parallelogram of forces." He will then see that a body acted on by two forces, represented by two sides of a parallelogram, will take a direction answering to the diagonal of the parallelogram, and that it will arrive at the end of the diag. in precisely the same time as it would have arrived at the extremity of either of the sides, if acted on only by the corresponding single force. Example.—If a cannon be trained horizontally, with the muzzle 16ft. from the ground, and a shot be fired from it—say, at the rate of 1,400ft. per second, then, leaving out the resistance of the air, the sides of the parallelogram will be 16ft. and 1,400ft. respectively, and the ball will strike the ground at the end of one second, and at the distance of 1,400ft. from the vertical line to the mouth of the gun. Owing, however, to the fact that gravity is a continuously acting force, the ball will not pass in a straight line over the diagonal of the parallelogram, its course will be a curve; but it will arrive at the other extremity in the same time as if it had described the diagonal. "A." is right in saying that a swiftly moving body offers resistance to any force seeking to change the direction of its motion. The faster the ball is propelled from the mouth of the gun, the greater resistance it offers to the deflecting force of gravity, consequently the angle which is formed at the mouth of the cannon by the line of fire, and the direction the ball takes, is less in the case of the more swiftly moving ball. In other words, the ball goes farther before striking the ground, but the time of flight is the same. If "A." cannot understand this, I hope he will follow the advice given above.

The case of "A." differs from that in which "F.R.A.S." recommended the "fourpenny," inasmuch as the querist in the latter case merely asked for information on a certain point, while "A." makes assertions which show his extreme ignorance of the subjects about which he writes, and at the same time declines to receive the information given him by better-informed correspondents.

Looe. G. M.

[4539.]—I WOULD suggest to "A." (let. 4487, p. 412), to prove the incorrectness of my assertions and correctness of his own, rather than ask me to stop stating obvious and recognised truths. I did not misrepresent him about "particles rotating in a plane, and unable to get out of it." My letter referred to other correspondents besides him, and if he will read the other letters carefully, he will perhaps see what I alluded to. He assumes it to be admitted that the ball travels for some portion of its flight in a horizontal direction, but that is just what is not admitted, for the ball begins to deviate from the horizontal the instant it is free for gravity to act on it. It is quite clear that if gravity does not act the first instant, it is not any more likely to do so at any subsequent instant. Whatever can "A." mean by such expressions as "turned in a direction contrary to the plane of its motion," or "moved in any direction contrary to a straight line"? The expression so commonly used, "resistance to change in direction of motion," is inaccurate. Such a resistance is erroneously imagined to exist, because, from want of consideration, a wrong expectation is formed of the effect of an impulse, tending to produce change of direction. In the case of rectilinear motions or moving forces, it is well known that we must apply the "parallelogram of forces" to obtain the new direction a body will move in when two forces, acting in different directions, are combined. The body offers no resistance whatever to motion in the new direction, any more than it does to moving in a straight line under the influence of a single force. And it is just the same with a rotating body like a top or gyroscope. The "parallelogram of forces" applies equally to this case, and in a more direct and simple manner than is commonly supposed.

"Epsilon" (let. 4488, p. 412) seems to be unaware that a top will gyrate without falling and without wobbling, even when its axis has a considerable inclination; when, in fact, his proposed process of cutting the peg level would not apply. He seems also to be unaware in what sense the term gyrating is applied to a top or gyroscope. A top has a motion of rotation about its own axis, but if not perfectly vertical its axis has also a motion called gyration, when, its point of support being stationary, its outer end moves in a circle. "Epsilon" introduces an entirely new view into the matter when he says "the top ceases to gyrate, and consequently falls, but not through gravitation"!

Glasgow, July 6. E. H.

THE NEGRO.

[4540.]—THE darkness of Jews long settled in certain countries, as India, China, Abyssinia, and Waregla, is as "H. J. C." notes (let. 4528), our chief warrant for any effect of climate on human colour; but a far more curious and less accountable fact, if true, is that noted by the late Dr. Wolff (himself a Jew), that all his brethren in the Levant, including Syria, were fair, light-haired and blue-eyed, or the most frequently so of any race in those regions, while here, in western Europe, a light-haired Jew is hardly known. As for the resemblance of the eastern "black Jews" to Negroes, it can be no nearer in colour than that Hindoos, and in form not at all, the latter being far nearer to ourselves in every respect than to the Negro. "Fiddler" (let. 4529) repeats his very gratuitous puzzles about Josephus, as if the latter were the most ancient authority on these matters, or as if we had not the chief documents used by him (which is not the case with any other ancient). Those documents uniformly throughout the Old Testament, name Cushites (or in Greek, Ethiopians) as remarkable for dark skin. "Can the Cushite change his skin, or the leopard his spots?" And they enumerate Cush as one of the sons of Cham, whose name, according to most Orientalists, meant black, being the root of one old name of Egypt as the land of black soil, and of our words *alchemy* and *chemistry*, as "black art," or Egyptian art. It is incorrect then to say with "Fiddler," we have no suggestion of there being any Negro in Noah's Ark. It is nearly as much implied as so brief a narrative could imply, that Ham, or his son Cush, or both (and if so, then his wife and other children) were nearly black, and yet not necessarily of the darkest race known even to the Hebrews. For while Cush and two other sons are declared to have become notoriously dark races (and one, Cush, geographically, bordering on Negroland), a fourth son, Phut, is never again named, he or his posterity, after the genealogy, until, I believe, that single verse of Nahum, where they appear only in connection with the southernmost city, and nearest to Negroland of any ever named in the Bible, and which is itself named but that once. As for the antediluvian Nephilim, there was no reason to describe their colours more than any other of their qualities, and not a word to imply they were all (or any of them) white; nor that Adam or Noah were as white as Japhet, Shem, or ourselves; but in Adam's case rather the reverse. As for Adam's son Seth (who is nowise implied to be his "third son" rather than his thirtieth) he is clearly made an ancestor through Noah, not merely of Negroes, but of all the modern world. None of us can claim less or more de cent from *this* Seth. The name, of course, as Sethos, Sethi, Sesostris, &c., became common, but the confusion of him with any Egyptian is absurd. Moreover, of all Africans, the ancient Egyptians were the least like Negroes, either in colour or anything else, though, doubtless, nearer than any Asiatic or European, but not so near as Melanesians and Australians. There is not a trace of any one "palming off Seth" (*any* Seth that I can hear of) as "father of the black race," or any wise black himself. There is this connection of the name with Cham or Khem, that both became names of an obscene idol, the same as Baal-Peor, Peor-Apis, or Priapus; and this is the "Sheth" named in Balaam's prophecy, whose worship the Messiah was to annihilate.

As for the proofs "Fiddler" asks for, "of the great antiquity of man (one hundred thousand years)", he will find, by searching Lyell's "Antiquity of Man," that there is no shadow of ground, as yet, for any such estimate. The only valid geo-chronometers are those furnished by delta deposition, peat-growth, waterfall recession, and débris of precipices, all discovered by De Luc (the first coiner, by the way, of the term "geology"); but he added, mistakenly, one from the growth of glaciers and mountain snow, which has been proved unsound, as these advance and recede for some years, even half a century at a time, advancing in wet years, and receding in dry ones. One more chronometer than his, however, occurs in such caves as that of Settle, described (p. 323), where the chips, detached by frost from the roof, had made a 2ft. covering in 12½ centuries, over the Roman Welchmen's relics, and just thrice as much between the flint folk's time and theirs, thus carrying back the sudden end of the flint workers to exactly the recorded century of Noah. So it is with all these independent chronometers, in every continent alike, the 50 centuries, neither more nor less, are uniformly attested since the great change; and men had been before it, on the whole globe, with the mammoth and mastodon; but whether for one, or two, or three thousand years, there is nothing as yet to show. The deltas of the Ganges and Mississippi seem far older, perhaps ten times; but they each have a gravel stratum at the exact depth, according to Lyell's data, corresponding to the Noachian interruption, and the sudden extinction of great animals and inferior men everywhere attested. As for his new-fangled and utterly fallacious pretence of a chronometer, the *only* one ever mentioned in his "Antiquity of Man," based on the idea that land rises so many inches in so many centuries, one really cannot stoop to refute it seriously when all readers have his own accounts before them, if not in the very same volumes, of Chili and New Zealand being thrust up 10ft. with a jerk, and the new Aleutian Isle rising 3,000ft. in a year. All writers and publishers of big books must necessarily make for their market. What they themselves believe may be nowadays a very different matter. E. L. G.

[4541.]—I HAVE read "E. L. G.'s" letter (4456, p. 407) with great attention, but has he not overlooked the almost conclusive evidence in Gen. vi. 1, 2, that the descendants of Adam were negroes, and the daughters of men children of a white race; for if the reverse, surely a white man would not consider a negress as *fair?* Then, again, with reference to the genealogy of the patriarchs in chap. v, what period of time is there described as a year? Considering their ignorance of astronomy, I think the patriarchs would reckon time by the day and lunar month, which gives seventy-eight as the age of Methuselah, a more probable length of life than nine hundred and sixty-nine of our years. As to the genealogy of Shem in chap. xi., I consider here is evidence of a change in the mode of reckoning; probably, instead of lunar, seasonal changes, such as seed-time and harvest, are the periods there given. It will be understood that the first argument in this letter is founded upon "E. L. G.'s" supposition that the Adamite and Nephilim races are of different origin.

T. A.

CONDENSATION OF STEAM IN PIPES.

[4542.]—As I have had practical experience in a similar case to that of "A. W. E." (let. 4467, p. 410), I think that perhaps the most satisfactory way of answering his seven queries relative to the condensation of steam, &c., will be to state what I have already accomplished.

About fifteen years ago I took steam down a pit through a total length of pipe of 310 yards. The boiler pressure was 45lb. per square inch, and the total loss of pressure, as near as I could ascertain, about 1lb. per square inch merely. The pipes were 2in., and were well covered with two wraps of hay-band through their entire length, and this plastered with cement, and then covered with tarpaulin to keep out the wet, as the pit was damp and continually dripping. The engine had an 8½in. cylinder, 260ft. per minute piston speed, and ran for four minutes at a time with intervals between. Close to the engine I placed a steam reservoir, also well lagged, of ten times the cubic capacity of the cylinder, and all the system of pipes was made to slope towards it in order to separate the condensed water. This vessel had a cock at the bottom to draw off the water when required, and I found that leaving the steam in the pipes for ten hours, with the engine standing still, only produced half a bucket of condensed water, showing the great value of well clothing the pipes, and the great economy resulting therefrom. What the difference would have been with naked pipes I do not know, but they would have formed a huge condenser; and seeing how cheaply and easily they may be protected, it can never be worth while to neglect doing so. By treating the exhaust pipes in the same way for a certain distance, the mine will not be appreciably heated. There is no doubt that this system presents great advantages for draining purposes, avoiding heavy cranks, spear-rods, &c., providing the pumps are properly designed to maintain a uniform flow, so as not to have to stop and start a heavy column of water at each stroke. With respect to the employment of compressed air for conveying power, I may add that all methods hitherto employed are expensive, both in first cost and in subsequent working, the only exception being in those cases where there is sufficient water-power available for driving the pumps. The problem is to convert high pressure steam into high pressure air with the least possible loss by friction of machinery, and the least possible complication of parts. An ordinary compression pump does next to nothing for at least half its stroke, and this defect is inherent in every form.

It has occurred to me lately that possibly the principle of the injector might solve the difficulty satisfactorily, and I will endeavour to explain how without the aid of a diagram. Suppose we have a large boiler, or air reservoir, under water to keep it cool, and a high pressure steam boiler near to, would not a jet of steam blowing into a long trumpet-shaped pipe, whose small end communicated with the reservoir, sweep a quantity of air along with it into the reservoir, which air would accumulate till it nearly, if not quite, equalled the pressure of the steam itself? The steam would, of course, condense on the sides, and leave only air, and this separation of the two could also be facilitated by taking off the air wherever it is required through a coil of pipes under water, such pipes to slope towards the reservoir, which would have to be blown off occasionally from the bottom. This experiment is very easily tried, and the results, if favourable, are so important and applicable to "A. W. E.'s" requirements that I suggest it may be worth his while to construct a small apparatus to test the principle, some existing steam boiler being used. A 9in. pipe closed at each end, and pressure gauge attached, would do for the air vessel, and care should be taken after the index has moved as far as it will go to shut a cock to keep in the air, as the gauge might deceive as to the real quantity of air present while the steam was actually blowing in. There is nothing contrary to mechanical law in one force resolving itself into another of equal degree, and theoretically any given number of cubic feet of steam should produce precisely the same number of cubic feet of air at the same pressure. It should be remembered that the principle of expansion in a cylinder can be utilised to a far greater extent with compressed air than with steam, even when it is superheated, and this circumstance will no doubt compensate to a great degree for any little extra expenditure of steam necessary to obtain it.

If "A. W. E." should experiment in this direction, I hope he will communicate full particulars to the ENGLISH MECHANIC.

Bath, July 9. HENRY TURTON, Engineer.

"OUR" LIFEBOAT.

[4543.]—I BEG leave to propose for discussion what ought to be the principle of construction of the vessel which is to be called "The ENGLISH MECHANIC Lifeboat," which we all, of course, wish to be a model of excellence, and I commence it by offering my guinea towards its completion, whatever the final decision as to its form may be. This is, I submit, a far more useful question to settle rightly than that of the Deluge, which has lately occupied so large a portion of your pages, and I trust it will be conducted with as much ability and animation; but without resort to insulting expressions, which, however suitable to quasi-theological disputation, would be quite out of place when seeking to learn the best mode of saving life in dire peril.

A good vessel for saving life in storm must possess in a high degree several qualities not easy to combine. She should draw very little water, and be very steady under sail; she should be very light, but very strong; she should have all the speed of a very narrow boat, and all the roominess and safety of a wide one: so must be as tight as a bottle, and as easy to enter as a barge; she must be impossible to sink or upset or break; quick to sail; easy to row; handy to steer. It is easy enough to get a vessel that will fulfil one or two of these conditions; but to contrive one that will combine them all is very difficult, and unless all of them be fulfilled to a very considerable degree "our" boat will not be one to be proud of. The most promising attempt I have heard of was made by a Mr. Richardson, of Manchester, who, about twenty years ago, patented a lifeboat he called the *Challenger*, because he challenged any other lifeboat to beat her. This boat was, perhaps, not strictly speaking an invention; it seems rather an adaptation of the principle of the double canoe, which has been in immemorial use in the Pacific, but was far more strongly constructed. It consisted of two long air-tight iron pontoons (divided and strengthened by plates into air-tight compartments) floating parallel to each other, and supporting above and between them a deck protected by a gunwale for the crew, a very ample grating being provided for the immediate escape of any water shipped. It is evident that such a vessel need draw very little water, and if provided with a dropping keel would make but little lee way; that if the tubes were constructed with fine waterlines, each in form like the half of a long vessel, she would make nearly as good headway as one such vessel would, while the two halves being held a considerable distance apart would be very steady, just as a man standing on two feet is more steady than he who stands on one. It is also clear that such a vessel would need no ballast, and could hardly capsize. Neither could she sink, for no water can enter her closed tubes, and if one were damaged, it would only slightly derange her trim, for each tube being divided into water-tight compartments a part of it only could fill. I do not know either the weight or the size of Mr Richardson's boat (or raft, as some may prefer to call it), but think it might be made very light in proportion to its size and strength, especially if made of steel, with trussed beams for thwarts to hold the tubes in position and support the gunwales. It may be rowed and steered and sailed like another boat, except that she could safely carry far more sail than one of her weight of common build.

I do not know Mr. Richardson, or whether he be still alive; but his patent, which was taken out in or before 1852, has, I presume, expired. Indeed, a means for saving life is hardly fit for a monopoly; but we cannot justly blame an inventor for resorting to the only means for obtaining repayment of the costs he must incur in experiments and construction, but must regret that no other way of repaying and rewarding such benefactors is provided. PHILO.

MONOLITHIC BUILDINGS.—To "KHODA BUX."

[4544.]—THERE is no novelty in employing the tensile strength of metal (say iron or steel) for supporting floors and roofs. We do it when we use an iron tie to truss a beam. Many years ago I had the pleasure of hearing that amiable musical enthusiast, Mr. J. Hullah, lecture on his plan for supporting the roof of a monster music hall, I don't know how many feet long and wide, without internal pillars. Not being acquainted with monolithic building, Mr. Hullah proposed to build it with bricks and mortar, and attach the tie-rods, which supported the great weight of its vast roof, to the corners of its walls. This is, no doubt, the way to avail ourselves of their greatest power to resist a horizontal pull; but being only an ignorant blacksmith, and not at all a scientific person, I failed to perceive any advantage Mr. Hullah's method of supporting a roof had over allowing it to rest on the walls, which would, if the beams of the roof be completely trussed by tie-rods, then act as columns without interstices, supporting only its weight, for no horizontal thrust could then exist.

I believe Mr. Brannan—whose address is 8, Bouverie-street, E C.—will send "Khoda Bux," or any other person who desires information, full particulars of his patent wire concrete on application. Of course, like all inventors—we are a sanguine race—Mr. Brannan considers it the preferable material for all buildings, from labourers' cottages to mansions, breakwaters, piers, and even military fortifications. It certainly does seem to possess the advantages of a maximum of strength with a minimum of incombustible material. If not exactly papier-mâché, seeing it contains nothing of which paper could be made; it is eminently "fibrous." Practically, it would seem of little importance whether the "fibre" be round or flat, and at present rolled iron or steel ribands, alias hoop iron, may be cheaper than wire; but considering that cold-drawing imparts wonderful tenacity to steel, I can't help thinking a much less weight of wire than of hoop iron would suffice to afford the required power of resistance; besides, hard drawn steel wire is much less capable of permanent extension than hoop iron, consequently floors strengthened by it would be much less liable to "sag"—*i.e.*, sink in the middle. Which of the two may be found to be cheapest is only to be determined by trial.

THE HARMONIOUS BLACKSMITH.

[4545.]—THANKS to "Khoda Bux" for his letter (4461). I trust the subject will have full discussion in your pages I am interested in. Would like to adopt the method by the process referred to. Would "Khoda Bux" permit inspection of his buildings, if they are within reach, and give details of working?

J. T. HOLEHOUSE.

"J. C." AND DARWIN.

[4546.]—THE ordinary idea of creation, is existence produced by the sole will of the creator, and is entirely distinct from the idea of origination from development. If "E. L. G." means us to suppose that Darwin insists that the oceanic islands are ancient enough to have allowed of mammalia being developed upon them, I should like to know where he does so. The more ancient lands, indeed, according as they are more or less separated by barriers, are inhabited by their peculiar races of animals and plants, and to judge by the remains found in the earth, predecessors to these can frequently be traced, having a similarity of conformation. Islands of comparatively recent date, on the contrary, according as their communication with other land is cut off, are found deficient, sufficient time not having elapsed to allow of independent development to have taken place. H.

THE ROBIN HOOD SEWING MACHINE.

[4547.]—IN answer to R. Tansley (let. 4378, p. 355), allow me to inform him that ten years since, when skirt quilting was all the rage, I made a machine that would work with from one to twelve needles, at any distance apart, and, so far as the machine went, it worked most satisfactorily at either quilting or tucking, making a lockstitch. I have the machine by me now; but there are several reasons for not using a machine with so many needles which make it answer better to use the ordinary machines, that present themselves in practice, and are not noticed in theory. My machine would feed either at right angle or diagonal to the needles. Will R. Tansley describe his machine more fully? if so, I will answer any question put to me.

"G. W. K. L.," (let. 4471, p. 410) knows little about this subject, or he would not make such remarks as are contained in his letter. He should know that the feed would not be in a line with the needles, as no good could arise from it; therefore, it must be at right angle or diagonal to the needles, and if he knows anything about sewing-machines he will know that such a machine would not be of any use in the domestic circle, but in the manufactory. H. J. S.

DOUBLE STARS.

[4548.]—On July 5th from 10h. to 12h. p.m., the air being pretty good, I examined the following stars:—1. μ^2 Boötis was at once separated with power 550, and on increasing the power up to about 700 with a Barlow lens, it was well open, but the sight less pleasing, on account of the loss of light, and the defects of the atmosphere, which, of course, were more visible. I estimated the position of the companion to be between 170° and 180°. Doubtless, this double is beyond the reach of Mr. Knott's instrument, but perhaps Mr. Key may have obtained some recent measures, and if so, I would feel much obliged if he would give them. 2. ζ Hercules. The companion of this double was well seen with power 350. I find it bulges about two-thirds of its diameter outside the first ring of the primary. 3. δ Cygni. I found this double more definite even than μ^2 Boötis. I could not see the companion steadily, but only now and then, when the rays of the primary, in moving about, were leaving it for an instant. Then it was quite clean and beautiful. 4. η Coronæ. This was seen with no difficulty at all. It is certainly the most easy of the four.

Allow me to correct the last seven lines of the postscript of my letter (4450) on Gassendi, as I see, in reading it now, that it is worded in such way as to lead to the supposition that the only means we have of knowing the revolution of a star is to count the number of years that elapse between two periastrons. If so, how could we know anything about the revolution of those stars which require hundreds and thousands of years to accomplish? Every one knows that three measures taken in three different parts of the orbit are sufficient to calculate that orbit.

Jumet-Hainaut, July 6. C. GAUDIBERT.

NEW DOUBLE STARS.

[4549.]—I have found a considerable number of new double stars recently with my 6in. refractor, and select the following, to which I would call attention:—

WEISSE XVI., 785. 16h. 41m. 48s., N. 2° 58'; mags. 8, 8½. This is a rather close pair, ⅘° s, a little f 19 Ophiuchi (Σ 2096). The distance is about 1".

WEISSE XX., 1744. 20h. 56m. 48s., N. 21° 7'. About 1° from Vulpeculæ s f. A pair of 8 mag. stars will be seen in the finder; the f star is the double. The distance is about 2", and magnitudes 8 and 9½, or 10.

SCORPIO, 15h. 54m. 39s., S. 24° 18'. A moderately difficult pair, p a 7m. star (B.A.C. 5317); distance, 2"; mags., 8½, 10. Another double, a little s of this, is Lalande 29136, 15h. 55m. 8s., S. 24° 39'; easier than last; mags., 7, 11; distance, 4".

I have already called attention to the duplicity of other stars in Scorpio, found last season, among which are 2 and 12 Scorpii, the former an exquisitely beautiful pair, the components being separated about 3". There is still another pair, nearly 1° n of 12 Scorpii, the distance of which is about the same, 4". The place of this is: 16h. 3m. 51s., S. 27° 18'. Some of these southern objects may have been observed before, as none of them are difficult with the aperture used. If any one is aware of earlier observations, I should be glad to have it noted.

I am sorry that among the numerous astronomical correspondents of the MECHANIC there is so little interest taken in this department of practical astronomy. It is quite common to hear telescopes (more particularly reflecting) spoken of from seven or eight to twelve inches aperture, and upwards. I have never seen an instrument of this kind, but understand that it is claimed their dividing power is equal to that of a refractor of the same aperture, and the illuminating power only a little less. If this is so, no one with an aperture of 7in. or more (if the instrument is good for anything) is likely to fail in finding at least one new double on every good night, and a much smaller glass will answer for very many objects. Notwithstanding Mr. Bird's large experience in this matter, I cannot agree with him in thinking that there is very little left to be done in the discovery of new objects. The field seems about as good as it ever was, and in one respect better, because the objects hitherto unnoticed are, for the most part, sufficiently difficult to make their detection much more interesting to the observer than finding and cataloguing the easy doubles, of which fully three-fourths of the lists are composed. I have met with but very few, in any of the catalogues, too difficult for my 6in. Alvan-Clark refractor, and some hundreds of the most difficult in the catalogues of the Struves I have re-discovered in searching for new pairs, the distance of a great many of them being less than 0·5". One found the other night was given as 0·3" by Otto Struve. I had expected to receive the advantage, to a greater extent, of the observations and notes of other observers in reference more particularly to the supposed new doubles, that being the only reason, and the only excuse, for occupying so much space with this subject. I trust this will sufficiently explain the rather numerous communications heretofore published.

Chicago, June 25. S. W. BURNHAM.

NEW DOUBLE STAR 11 SCORPII.

[4550.]—A night or two since I noticed a small companion to 11 Scorpii, which seems to have been missed by the Struves, and by other observers, so far as I can learn. The companion is, perhaps, 10½ or 11 mag., and precedes 4" or 5". This is an easy object for a 6in. aperture, and it is difficult to account for its omission from lists of double stars, if it has ever been examined with anything above 4in. This is readily found, as it is the nearest naked-eye star to the well-known triple, ξ Scorpii. The new pair is 1⅜° s, a little f ξ. Its place for 1870 is: 16h. 0m. 28s., S. 12° 24'. I should be glad to have Mr. Knott measure this pair, and particularly a closer and more difficult one, found recently, 6 Serpentis. This last is a very beautiful double.

Chicago, June 25. S. W. BURNHAM.

A CHEAP SUPER FOR COTTAGE HIVES.

[4551.]—R. SYMINGTON (letter 4501. p. 483), describes a common flower-pot, with plate of glass, as a cheap super. In a bee book I have read, we are warned not to use putty about a hive, as it is said bees are apt to eat it. Is this true? Two of these books tell us that queen bees will not pass through a narrow opening, but one says it should not exceed three-sixteenths, the other says one third, of an inch in width. Which is the right width to admit the working bees and to exclude the queen and the drones from the honey-storing place? PHILO.

ROTARY ENGINE.

[4552.]—I inclose a section, external and internal, of a rotary engine, which, from its simplicity and compactness, cannot but give satisfaction to many of your readers. It has been said that it is equal to 4 horse-power, if it is not above, and yet the cylinder is little more in size than an ordinary hat-box. No. 1 is an interior section; the steam enters through the pipe A, and is turned by the slide valve B alternately into the

FIG. 1

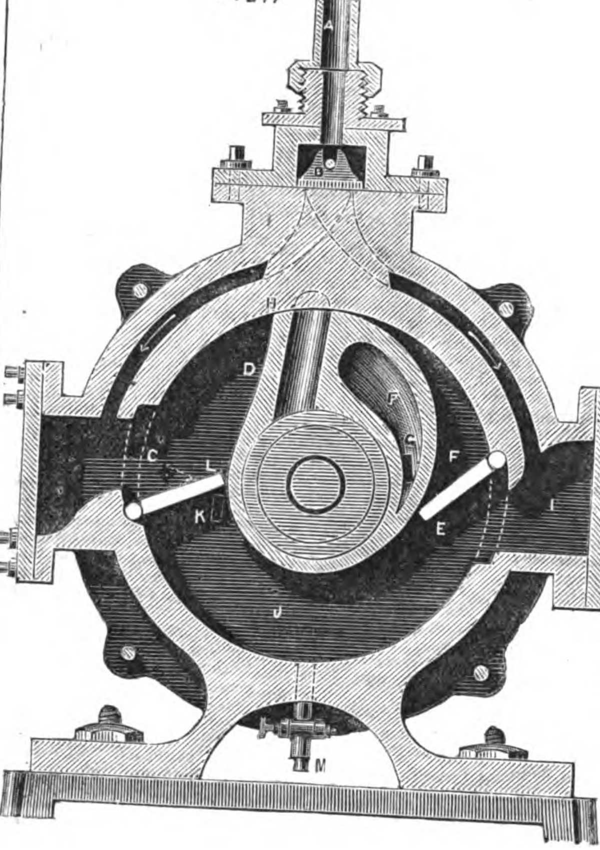
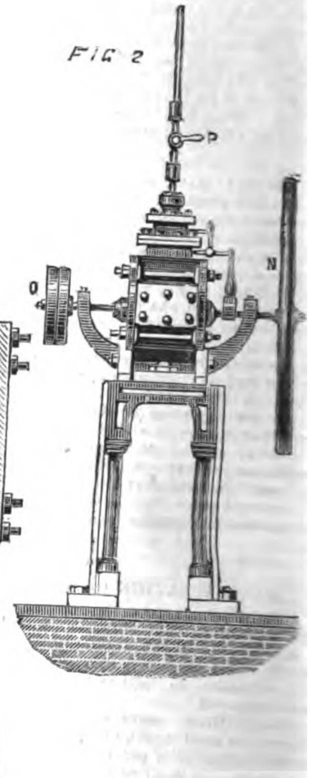


FIG. 2



courses right and left in the direction of the arrows. We will suppose the steam to be now admitted into the chamber C; it would act upon the arm of the piston D, and force it round in the direction of the valve, at the same time the exhaustion is going on in the chamber F F, through the aperture G, but when the point of the piston H has reached the end of the valve E, that valve is closed, as shown by the dotted lines, but the instant it has passed the point of the valve E, this valve slides up the face of the piston D, and the steam being then admitted at I, renews the pressure on the surface D, at the same time the exhaustion of the chamber J is going on through the opening K, and the piston is urged on in the direction of the valve L, where the steam is again admitted. This process is repeated at either side at every revolution of the fly-wheel. The waste steam passes off through a pipe on opposite side of fly-wheel. No. 2 is a small side view showing the fly-wheel and eccentric for working slide-valve, the eccentric being between the plummer block and cylinder; N, the fly-wheel; O, driving pulleys for machinery; P, the stop cock for turning off or on the steam; M, in section No. 1, cock for draining cylinder of water or steam. JOSEPH WILLIAM FENNELL.

THE BEARING-REIN AND BLINKERS.

[4553.]—I hope the excellent and humane letter (4493) of an "Old Ploughman," at p. 384, may help to quicken the disuse of this useless and cruel contrivance, which is, I think, almost confined to what are called the educated and refined classes. I counted the other day, out of 100 horses in vehicles of various sorts, 30 only that had bearing-reins, most of them on the horses of gentlemen's carriages; but a few, I regret to say, on cart-horses, cab-drivers, costermongers, and omnibuses. Coachmen are too well educated (about horses) to use bearing-reins, which are, at the best, useless; and, if so tight as to produce any effect, hurtful and dangerous.

Every one knows, who knows anything, that he should ride or drive with a light hand, and allow his horse freedom to change the position of his head according to changing action. When a horse is pulling hard he lowers his head, when running fast he throws it forward, to get greater freedom for breathing, and when going gently he moves his head from side to side to see and, I suppose, enjoy the scenery; at least my horse looks as if he did, and I hope he does; but how can he do any of these things if his chin is pulled up nearly to his breast? As to the smart look it gives him, a horse's natural attitude both is and looks the best; it is as bad taste to alter it as it is to alter a woman's beautiful figure by squeezing up her waist till she looks like a wasp. Of course, some horses, like many men, get into loose going ways, and want training to carry themselves naturally; but this, as "F.R.A.S." properly says, may be done by the judicious use of reins, without torturing. It is not only the merciful but the wise man who is merciful to his beast.

Blinkers for horses are, I am glad to see, being given up. It is said a horse without them will be frightened by seeing the wheels following him. We do not ride horses with blinkers, and they are not frightened by the wheels they pass alongside. A horse is seldom frightened by anything he sees distinctly; it is unexpected things that startle him, and he is less likely to be startled if he has no blinkers to prevent him seeing distinctly. The only use of blinkers to a horse is to save his eyes from the whip, but a well-trained and well-used horse does not need the whip at all, or, at most, only to make him understand who is to be master, and it is generally better to conquer by gentleness than force, horses as well as men. PHILO.

TO "OUR" ENTOMOLOGICAL READERS.—NEW AND EXCELLENT FIXATIVE FOR THE DOWN OF *LEPIDOPTERA*.

[4554.]—I have some good news for all our entomologists. No doubt the majority of "our" readers have heard of the much-prized preparation for fixing drawings, known as Rouget's Fixative; for the benefit of those who have not I will describe it. A small glass flask is supplied with a miniature blowpipe, so adjusted that when the solution is poured into the vessel it can be blown out in the form of spray. The drawing is held at a distance of 12in. from the flask, and a puff or two through the latter covers it with a jet of vapour, on the almost instantaneous drying of which the drawing is perfectly fixed.

Well, it was only the other day some one—I believe a lady entomologist—had the happy thought of bathing a butterfly in the spray blown from the flask I have described. The insect looked for a few minutes drowned and spoiled. After two or three minutes in the sun the appearance of vapour had disappeared. No: so the virtue of the process. Actually the wings would bear rubbing between the thumb and finger without losing a portion of their scales. One very important advantage is at once apparent. The large space, to say nothing of expense, occupied by glass cases for the preservation of *Lepidoptera* may be saved by this process. I do not, of course, speak of cases mounted for display, but of the preservation of specimens for reference. This may readily be done with books, the leaves of which are made of cork, with slips of rather thicker cork cemented or sewn to the edges and at the back, in which the insects can be arranged directly they are captured, like artificial flies in a fisherman's pocket-book.

The value of this simplification in the mode of keeping specimens, especially abroad, to the scientific entomologist, cannot be overrated. I venture to state that there is no branch of natural history so popular, so interesting, and so accessible as entomology; none that is so generally, patiently, silently, and so enjoyably pursued. Those who take no interest in the subject are not aware of the world-spread dominance of this laudable passion. No doubt this new discovery is already widely known, and will carry joy to many collectors and many humble homes; so that it will be the means of enriching our museums with thousands of specimens of these aërial plume-bearers, so difficult to preserve in the original freshness of their rainbow hues. In offering so valuable a boon to the draughtsman M. Rouget little thought how far he was superseding the labours of the entomologist, by giving permanence to the down of *Lepidoptera*. H. B. E.

P.S.—I take this opportunity of thanking "Ento" for his interesting bits on the subject.—H. B. E.

FIDDLES.—To "FIDDLER."

[4555.]—HOMER says Jove occasionally nods. If the father of gods and men, in the elegant words of the late lamented James Crow, Esq., does "just so," we need not be "very much surprised" to find that a "Fiddler" is occasionally not quite "wide awake." When I read the statement of my friend (who has so long been accustomed to "bowing and scraping" that he has become the very pink of politeness) that Paganini produced tones "equal to a piano," I did indeed wonder, even as "Wondering Willie" once wondered what manner of man the "Blacksmith" might be. Shades of Correlli, Paganini, Sivori, and Co., to think a fiddler, a manipulator of the king of musical instruments, only producing sounds equal to those of that comparatively poor affair the piano—an instrument which all genuine fiddlers abhor for its untunableness, at least its necessity for that fiddler's horror, temperament. Of course violinists were never yet heard to play out of tune, no, not even one "comma," however many "stops" they employ.

"Fiddler" says the bow remains on the string. If he uses the word remains in the sense of continuous contact, very little tone indeed would remain. If the string never departed from the bow, how could the string vibrate "at all, at all." It would, indeed, be very "melancholy remains," for then the string would be constantly pulled in only one direction—a condition quite incompatible with vibration. I "rather guess" our bows—or rather the particles of rosin on their hairs—act just as plectra do on the string; that is to say, they communicate to the string not a continuous impulse in one direction, but a rapid succession of such impulses, just as the teeth of a saw or those of a revolving cogged wheel do, or as my rather odd fiddle-stick (which had a long row of quill plectra inserted in it) did. I feel very confident the bow no more remains in contact with the string than the hammer of a piano does which don't "block," or the repeating hammers of that very pleasing instrument, the melopiano, do. In every case of the prolonging of the vibrations of strings—whether effected by a bow applied directly to them, by a rubber which rubs some elastic material, such as silk or hair, which communicates the impulses it received to the strings, as in the case of Mott's sostinente pianoforte, and its modern rival the tetrachordon, or the melopiano, which has hammers which strike its strings at intervals of time too minute for the ear to detect, just as the eye fails to distinguish the individual spokes of a rapidly revolving carriage-wheel —the one thing needful is a rapid succession of impulses, for a really continuous impulse would produce exactly the same result as pulling your fiddle-string on one side with the finger, under which circumstances there cannot be much vibration and very little tone. Such violin practice could not offend the most refined ear, and would be more gratifying to our friends than that "bowing and scraping" abominably out of tune which, however polite, don't exactly cause the "harmonious one" to become a yet more

HARMONIOUS BLACKSMITH.

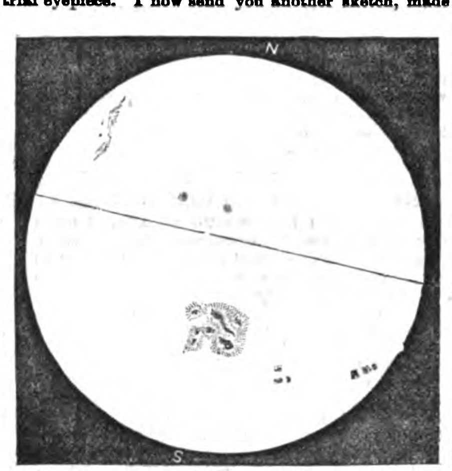
P.S.—There is nothing occult in the cause of a violin, a voice, or a piano sounding louder in an empty (of furniture) room. It is not the larger flat surfaces of the wall, floor, and ceiling (which, by the way, don't usually become much augmented by removing our "sticks"), but because the aërial waves generated by our "sweet" voices, and by the soundboards of our fiddles, &c., are not so much broken up and partially destroyed as they were by the aforesaid "sticks," which greatly obstruct their transmission. I don't think reflection from the walls, &c., can have any influence, because reflecting a sound can no more increase its intensity—unless it be reflected from a concave surface to a focus, when the increase of intensity becomes merely local, like that of light or heat—than the reflection, or rather deflection, of a billiard ball from the side of the table can increase the velocity of its motion. No doubt effects (which are not furniture) can be produced by the reflection of sounds—echoes, to wit—either in the orchestra or elsewhere (we do it in churches to the voice of the preacher), and that some of those "effects" are very surprising to those persons who are not familiar therewith, but I can conceive no pleasing musical "effect" sound reflectors behind an orchestra could produce; on the contrary, I fear we should hear a very disagreeable "echo" (not worth the halfpenny the clever newspaper of that name costs me) if the reflecting surface be distant, as it is in some concert rooms in which the concave roof acts very effectually, if not very pleasingly, as a sound reflector. The roof of the Albert Hall did so until General Scott prevented it from "publishing its reflections," which he did without infringing "the liberty of the press"—I mean the press for admittance to the People's Concerts.

ECONOMY IN USING COALS.

[4556.]—SEEING the present great advance in the price of coals, especially in London, and the probability of a still further advance, will you allow me to ask my fellow subscribers if they can (any of them) describe the methods in use on the continent and in our country places for economising coal for domestic use? I have been told that in some parts of France people use coal-dust or slack mixed with wet clay into lumps and dried in the sun or near the fire, and that the mixture burns well. I have also heard of something like this in Staffordshire. Will any of the artificial fuels do for open fireplaces? I can highly recommend the use of a wire shovel, which sifts the cinders beautifully. I burn all mine in the parlour. Of course, servants can't be made to do the same in the kitchen. W. BROWNE.

SUN SPOTS.

[4557.]—LAST week I sent you sketch of the sun as viewed through telescope, with low power and terrestrial eyepiece. I now send you another sketch, made



at 7.30 on Friday evening, July 5, with astronomical eyepiece, and power about 120. Object-glass 4in.

JAMES H. WHISTLE.

THE "ENGLISH MECHANIC" IN THE COLONIES.

[4558.]—ALLOW me to express the great pleasure I enjoy on each arrival of the Overland Mail, in perusing the monthly parts of your admirable journal, to which my son is a subscriber. It is indeed a wonder of information and instruction to all readers who feel any interest in mechanics or in science. The wide circulation of so instructive a periodical throughout distant parts of the empire must be productive in due time of valuable results.

326, George-street, Sydney. W. MACDONNELL.

THE HARP.

[4559.]—"FIDDLER" is evidently a most enthusiastic admirer of the harp, and in sounding its praises he seems altogether to overlook its imperfections. He wonders why the ancient Irish harp has gone out of fashion, and in the same breath answers himself, and gives us a very conclusive reason, viz.—that it can only be played in two keys, both of which are major, consequently, the absence of semitones precludes the possibility of producing those rich and telling harmonies which are to a melody what flesh is to a skeleton. The ballads and tunes which it can render are, though good enough in their way, of the slightest and most unscientific description, and he who plays nothing better can hardly be said to deserve the name of a musician. Even among these ballads are there not many wild and beautiful melodies in a minor key which could not be rendered at all on such an instrument as this harp? Depend upon it, no instrument goes out of fashion without good reason, for in the long run the world's verdict is always just.

I quite agree with "Fiddler" in wishing that music were more attended to in the education of youth, but I do not think with him that everybody ought to learn to sing and to play on two instruments, for if so, we should have to endure more in the way of bad music than even we do now, which is saying a great deal Let those learn that manifest a taste for the art, but for goodness sake let unmusical people alone. Playing without expression, taste or touch, singing without time, tune, or feeling:—such are the results of trying to teach music to those who are not born with a natural love for it. VERTUMNUS.

PIANOFORTE CONSTRUCTION.

[4560.]—THE "Harmonious Blacksmith" (let. 4415, p. 382) honours me by asking for my opinion on or experiments respecting corrugated soundboards. Finding, years ago, as he has done, the extension of the soundboard impracticable, and to some extent a question whether we have power enough to set it in vibration effectually if we extended it, my thoughts were naturally directed to corrugate it—*i.e.*, to construct it so as to contain a greater surface in the usual limited space. But I must confess I could never see the smallest advantage in doing so, and, therefore, made only the experiments described further on. When we depart from a straight line we gain just as much more stiffness in proportion to the greater surface so gained. This will be seen even if we make the experiment with a sheet of paper. Then we require more power in proportion to the greater surface, just as much, or more, as if the soundboard had been extended in a straight line. But, having made no experiments in that direction, I am bound to say that I do not feel inclined to throw the smallest stone at the idea. Thinking that most likely the hard grain in the pine wood is sonorous, and the soft grain between them acting partly as dampers, I did not scratch it out (as I now see some one has the patent for), but constructed two soundboards, one of beech wood and one of glass strips quarter of an inch wide, and the thirty-second part of an inch thick. These strips I glued edgeways on to pieces of wood with their extreme ends, so that they were exactly like a soundboard made of Swiss pine quarter of an inch thick, the soft grain taken out and the hard grain left only. I glued the bars behind and the bridge on the front as usual. The advantage I expected to derive from this arrangement was that the vibration should run along the hard grain more freely, not being checked by the soft grain, and having nearly double the surface (32ft. instead of 16ft.), causing the production of nearly double the quantity of tone compared with the ordinary soundboard. Well, I can put the tuning-fork almost anywhere and a certain amount of tone is always heard, but on these two soundboards I heard none. Now, I am just before my invention for which we took the patent, and without going into details I will only say this, the hard grain with nothing but the air between, produced no tone; the hard grain with material equally hard between, which would be a solid beech board, produces no tone. I conclude thus, taking the solidity of air as 0, the solidity of the hard grain = 1,000, the material between must be solidity = 500. Then I took strips of beech-wood, s. 1,000, and poplar, s. 500, glued them together alternately, and found the soundboard perfect as far as the material is concerned. By taking a piece of best Swiss pine, which it is difficult to find even one inch wide in a whole soundboard, because it grows so irregular in many respects, and the proportion of the solidity of the hard and soft grain is seldom 500 to 1,000, I found my conclusion was right, at least I gained the same practical result. I have the opinion, and it is included in the patent, that two different materials of different hardness or rigidity, specific gravity, and elasticity, may vibrate rather abruptly against each other; and I am now preparing a violin breast of three different materials, rosewood, mahogany, and Virginia pine, and will report the result. Perhaps my last experiment belongs in some respects to corrugated soundboards. I took the inside of the soundboard out, leaving only the two faces a full sixteenth of an inch thick, and supported them by glueing small strips of wood, 3in. apart, between them, but find it no good, which I expected.

J. H. SCHUCHT.

ON TUNING PIANOFORTES AND OTHER STRINGED MUSICAL INSTRUMENTS.—I.

[4561.]—PROBABLY the very earliest method of altering the tension of the strings of musical instruments for the purpose of altering their pitches, or what is termed "tuning" them, is that employed in the Nango or negro harp, a specimen of which is in South Kensington Museum, and is figured on page 13 of the illustrated catalogue of musical instruments. If I am not mistaken the Egyptian lyre in the Florence Museum, the Egyptian harp in the Museum at Berlin, and also the two Egyptian harps (copied from paintings in tombs) figured in Sir Gardener Wilkinson's great work on the "Ancient Egyptians," are all tuned by this means, as is also, perhaps, the tako goto or koto (see page 21 in catalogue). I mean by sliding the loop to which one end of each string is attached up or down an inclined bar, and thereby increasing or diminishing its tension.

Another probably very ancient method of tuning is to vary the vibrating length of a string by shifting one of its supports or bridges instead of altering the tensile force to which it is subjected. I suspect the strings of the tako goto are tuned thus, although they are so arranged that the former method also seems possible. Those of the santir or Oriental dulcimer, figured on page 32, are also examples of this method of tuning, the practice of which was probably suggested by "stopping" the strings of instruments of the lute, guitar, and viol class for producing sounds of various pitches, all such instruments being provided with a neck, and its fingerboard usually divided by transverse low bridges, technically termed "frets," which determine the length of the vibrating part of the string. (N.B.—These "pets" are exceedingly useful for determining the intonation, and the writer has often been compelled to "fret," or rather to lament, that the fiddle was deprived of them, for, if properly placed, they insure a much closer approximation to just intonation than many fiddlers' fingers—which are not invariably placed on the fingerboard—do, in practice, afford the hearer.) Sooth to say, very few fiddlers can play the diatonic scale with so near an approach to correct intonation as it is rendered by a well-tuned pianoforte, however much the aforesaid fiddlers may choose, habitually, to elevate their nasal organs at temperament notwithstanding. By the way, the varieties of stringed musical instruments provided with necks are very numerous—the Japanese biva, the Chinese pepa, the rebab, *alias* rebeck, the ujuk, the Indian tambura, the Italian chitarrone, or theorbo, the mandoline, lute, pandurina, the ancient banjo, and the modern guitar, also the whole family of viols and violins included, are examples of this class; yea, even that king of modern musical instruments, ye fiddle, which—I trust my clever friend "Fiddler" and his fellow-fiddlers won't be offended—is, after all, but a lute or guitar with its soundboard "bellied," or arched, to resist that downward pressure of its strings which necessarily results from the employment of a high arched bridge, needful for facilitating the bowing of single strings, also deprived of its frets, a deprivation occasionally to be lamented by those blessed—or cursed—with musical ears, and whose strings are bowed, *alias* "sawed," with horse-hair, instead of being "plucked" like the unsuccessful candidates are at competitive examinations by the Hon. Bob Lowe and other kind and benevolent *gentlemen* who sorrow—not as those without hope—for the customary *in*-efficiency of the said candidates.

It seems probable the simple method of altering the tension of a string by winding it round a peg must have been in use very early. I have heard the specimen of ancient Egyptian harp—not the lute—is tuned by this means, which has been employed from time immemorial by the Chinese and other eastern peoples, often in a very primitive form indeed, compared with the neatly-turned and well-finished box-wood pegs of a modern violin, or the yet more refined steel wrest-pins of a modern harp, which are turned conical in a slide lathe, probably the very highest examples of the wrest-pin family in ordinary use. I have often wished those of the pianoforte were subjected to the same process—those of some of Erard's grands made about thirty years ago, and the wrest-pins of Mr. Nosworthy's very peculiar pianos were—for then we might hope to be free from the annoyance of "jumpers." Perhaps, however, the wrest-plank and bad boring are often as much in fault as the pins.

As the weight of musical strings became increased the resisting power of their wrest-pins had to be augmented in proportion to enable them to resist the additional strain. If the reader will compare the wrest-pins of ye ancient clarichordis, ye virginals, ye spinetts, and ye harpischordis, &c., in South Kensington Museum, and elsewhere, with those of a modern concert grand piano, he will be enabled to form some idea of the change time has brought about in this matter. Large and powerful as the wrest-pins of a modern grand piano are, the writer found them insufficient to resist the strain of the strings of his experimental instrument, and was compelled to resort to the means described and figured in No. 211, p. 64 of the ENGLISH MECHANIC, to enable its wrest-pins to resist the pull of the strings, some of which (of No. 40 wire) require a straining force of nearly seven hundred pounds each.

Tuning by wrest-pins with a simple cross handle—whether that handle be the flat head of a fiddle peg, or the more powerful tuning hammer of the harp or pianoforte—is after all but a rough and primitive contrivance, whose results are unsatisfactory unless great practical skill has been acquired by long practice; it is very rapid and cheap, also nasty. Many attempts at improvement have been made, and probably the machine heads of the guitar and contrabass are among the most successful of them. Contrivances for applying the principle of the machine head to the ordinary pianoforte tuning hammer have not yet come into general use, probably more from their running counter to the prejudices of that remarkably intellectual class, ycelpt pianoforte tuners, who are remarkably conservative of evil ways, than from any inherent defect in them. I must admit every such contrivance which I have seen necessitates either the employment of two hands to the apparatus—one to hold and the other to work it—which is very inconvenient, unless you have an assistant to hold it or to strike the keys, or some contrivance, an adjustable cranked arm, for instance, which affords a fixed stop and prevents the useless rotation of the handle (see the patents of Newton, A.D. 1854, and Johnson, 1855), I have sometimes thought I could get over this difficulty by employing an endless screw on the stem of the handle at a right angle to and gearing into an oblique-toothed wheel on the pipe, in which case the stem of the handle would become at once the stop and transmitter of force. This has not, that I am aware of, been carried out, so I invite the designs of my clever fellow-readers for doing what would be a real blessing to amateur tuners.

Of course, the thicker the plank the longer the pin may be that is inserted in it; but in grand pianos, whose strings are above their wrest-planks, it would be very objectionable to increase the thickness of the latter because every such increase must compel the lowering of the hammer centres, and the further they are below the strings the more "out of the square" with the latter must the hammer's path become, at the instant it strikes them. It was probably a sense of this evil (which is of considerable practical importance, especially for obtaining clear sounds in the treble) which induced some of the earlier piano-makers to place thin strings under the wrest-plank, doing which completely gets over it, and others (Schwieso, for example—see his patent, No. 6069—who preferred continuing the usual position of the strings), to construct their wrest-planks of metal. Now it is obvious an iron wrest-plank only half-an-inch thick could not retain a wrest-pin subjected to the force of (say) three hundred pounds tending to turn it backwards, unless, indeed, it was driven into its hole much too tight to be turned with any nicety—tuning requires nicety—by any ordinary tuning hammer. A little reflection will teach us that good hard wood, probably beech, is the best kind in use—is, from its capacity of resisting compression, its elasticity, which enables it to hold the pin firmly without the necessity of driving it into its hole objectionably tight, and its non-liability to adhere dangerously to the metal pin—far preferable to metal for a wrest-plank, so long as the pins are only held by the adhesion of the surrounding material. When anything like a wrest-pin is employed in conjunction with a metal wrest-plank, some contrivance, such as the introduction of suitable elastic material between their surfaces, becomes an absolute necessity, besides which, as the metal surfaces which would be in contact with the pin in so thin a wrest-plank would be too small to resist the strain without risk of destructive adhesion, some means of increasing the surface of the parts in contact is also a practical necessity. Probably that patented by Mr. Schwieso, A.D. 1831, No. 6069, price 6d., is as good as any. As a matter of course, "in that case made and provided," as our legal friends express it, the very same thing, or at least something hardly distinguishable from it, except perhaps that it is inferior, was patented over again in A.D. 1870. Another arrangement of the metal wrest-plank was patented by Mr. Nosworthy, A.D. 1860, in which the surfaces which retain the pin are divided just as they are in the violin, but the strings, instead of being between those surfaces, as they are in the fiddle, are above both, which renders putting them on more convenient. His arrangement, however, seems open to the same objections as a moderately thick wooden wrest-plank for grands, in which the hammers strike upward, and have their strings above their wrest-planks, for the external surfaces of the two metal plates which form his wrest-plank are about as distant from each other as those of an ordinary wooden wrest-plank. I will say more on this subject next week.

THE HARMONIOUS BLACKSMITH.

EARTHQUAKES AND VOLCANOES.

[4562.]—I KNOW I have not the pleasure of being one of your most respected correspondents, but I think your love of fact and philosophy is sufficiently great to find an excuse for my drawing your attention to some little matters which are of vital importance.

You may remember that some time ago I drew the attention of your readers to a (by me) presumed connection between the attraction of planetary position (with respect to the earth) and earth disturbances—earthquakes, volcanoes, mining explosions, &c. This I did more particularly in a letter on "Astrono-Meteorology and Magnetism," in No. 215, p. 151, of the ENGLISH MECHANIC, of May 7, 1869, with several facts illustrative of such presumed influence. Like most new ideas, the principle was ridiculed, and I got a pretty good share of abuse for my pains. But there were no facts or arguments to the contrary. Lately I have been reading an article in "ours" on "Earthquakes and Volcanoes," by A. Le Plongeon, M.D., and amongst the "conclusions" he has arrived at (p. 348, June 21, 1872) I find the following nearly similar hypothesis as my own:—"4. That the sun's immense reservoir of electro-magnetism, and the other celestial bodies, which are likewise reservoirs of the same agent, increases the action of the electro-magnetic currents that traverse the earth, according to their respective positions with regard to this, and hasten the effect of the chemical operations," &c. On reading this, I think you will say the agreement in principle between us is as near as possible perfect. The only departure is, that I went beyond the learned author, and gave the exact "positions" for such disturbances. For instance, in the last MECHANIC (p. 374, June 28), he devotes his article to a long description of the "Cataclysms of the 13th and 16th August, 1868," giving most valuable and copious details of the great South American earthquakes of that period. Now, as both I and the learned author seem to agree that the positions of the other celestial bodies are the causes, it may be useful to test this period. Taking the positions from Raphael's "Ephemeris," I find them as follows:—

J	H	V	N	(×)	S	×	(Mv)
6	7	8	9	16	23	26	28

Letting the line represent the orbit of the earth during August, 1868, it will be seen that the earth was exposed, in four days, to the influence of as many planets in the same degrees of different signs, including the irregular position of the planet Venus—one so remarkable as the cause of earthquakes, shocks, inundations, &c. From the details of M. Le Plongeon, it will be seen that within three days the effects of this compound influence were in operation, though at "Jacna, for several days previously to the 13th, subterranean noises were heard, and some light shocks felt." It is also worthy of remark that this disturbance should again intensify and cease on the 14th day, when the earth came under the attractive influence of a fresh position—of Saturn. The month closed with another position of great intensity—that of Mercury in conjunction with the sun—the commencement of the period being marked by a shock at Pau, in France, on the 26th: succeeded by an "alarming shock" at Jasbereny, in Hungary, on the 28th.

Connected with rainfall, M. Le Plongeon states that shortly after the shock at Jacna, on the 13th, "it began to rain (a strange phenomenon in a country where it never rains)." In coincidence, I may add that at Bombay, on the 9th, the fall was 12in. in the twenty-four hours. In England, on the 11th, we had an excessive and general downfall, the greatest for many months previous. On the 12th, the fall at Aberdeen registered 2·58in.; Ardrossan, 2·22in.; Greenwich, 1·40in.; Nairn, 1·36in. On the 16th, fearful thunderstorms swept over France, and Italy was visited by an extraordinary whirlwind. The 28th was also the occasion of a fearful downpour of hail and rain at Natal, in Africa, which lasted two days, destroying an immense amount of property, including seven bridges, one costing £150,000.

In confirmation of the theory, I may give another singular instance of April, 1863, of intensity of influence denoted by the following diagram:—

Ma	H	[J.]	V	(Mv)	S	N
4	7	12	15	20	21	24

By this it will be seen that there were positions of Mars and Herschel on the 4—7th, followed by the earth's passage between the sun and Jupiter on the 12th, the positions of Venus, on the 15th, and, finally, the solar conjunction of Mercury on the 20th, with close positions of Saturn and Neptune. It was thus a month of extraordinary intensity of position, and was attended with remarkable phenomena, including the great earthquake of Rhodes, on the 22nd. In France, on the 11th, "a deluge of rain, mixed with hailstones of an extraordinary size, laid waste the district of Maury (E. Pyrenees), over a surface of 9,000 acres. The ground was covered with hailstones to the depth of 6in., and in some places to the depth of 18in." On the 14th a premonitory shock was felt at Rhodes; but on the 22nd, about 10.30 p.m., "a series of short undulatory movements took place, followed by a continuous shock, which quivered throughout the island for nearly a minute." One thousand houses were damaged in Rhodes, 400 nearly destroyed, 240 persons were killed, and a great many wounded, 12 out of 44 villages were utterly destroyed, and the others greatly injured. Slight shocks were repeatedly felt on the 23rd. On the 26th a violent storm of wind, hail, and rain threw down more of the partially-ruined houses, and on the 30th a further strong shock took place at noon, followed by another in an hour and a half.

Such was the fatal experience of the island of Rhodes. In England there were violent storms, and much magnetic disturbance generating, on the 23rd, one of the most remarkable and perfect appearances of "daylight aurorae" ever witnessed, thus realising another of M. Le Plongeon's "conclusions" (MECHANIC, p. 348, col. 3): "Electro-magnetic disturbances in the atmosphere suddenly taking place, and without any apparent causes, manifested by the loss of power of magnets."

I cannot follow all the numerous shocks given by M. Le Plongeon, because most of them are of too remote occurrence to get the data for the positions of the time. There is, however, quite enough for study in the details of the one of August, 1868, given. I could add such facts by dozens.

But I am glad to see the principle growing, and much more so to see so many offshoots striking out in the columns of the MECHANIC. It is satisfactory to me to know that I was not one of the least valuable of your correspondents. We shall conquer some day, and it may then, perhaps—as now—be a satisfaction to you to know that your space was not wasted and abused so much as was supposed.

July 6. FREDERIC PRATT.

[4563.]—TO-DAY'S paper furnishes me with another of these facts, of so remarkable a character in reference to what I have just written, that I am sure you will pardon my troubling you by adding it. The positions of the period—April 14, 1872—are these:—

		conj. sun.			conj. sun.
×	J. S.	(N)	×	H	(Mv)
1	11	18	15	17	24

This terrible twin-event, as you see, is the result of the combined influences of Neptune with the sun, on the 18th, falling out on the transition point. The 24th night was the sudden eruption of Vesuvius (Mercury in conjunction with the sun).

As a remarkable fact, I may state that on the 19th of March, 1861, a similar earthquake calamity fell upon the city of Mendozon, in Chili, which, in six seconds, reduced a flourishing city of 20,000 inhabitants to a heap of ruins not 6ft. high, destroying 12,000 persons. The positions then were:—

	conj. sun.	conj. sun.		
J	(Mv)	(N)	S	H
9	16	19	24	20

This is marked by two solar conjunctions within three days, and hence the greater magnetic, &c., disturbance. The storms of Europe at the time were of the greatest intensity, and were the history of the period.

You will, perhaps, tell me the immense distance of Neptune would preclude the notion of any such influence. Well, some months ago, in the ENGLISH MECHANIC, Professor Zerffi, writing on the table-turning phenomena, in answer to a similar supposed objection, was quoted as saying that a billion of Uranus distances would diminish in no wise the force of magnetic attraction.

As the utterances of a scientific man, I noticed it as a singular opposition to the negatives of "F. R. A. S.," who denied any such influence or action. "Who shall decide when doctors disagree?" When I find my opinion reiterated in the MECHANIC, can you wonder I am still obstinate enough to be a co-holder with the Professor of the doctrine?—and to apply it!

FREDERICK PRATT.

P.S.—We have some meteorology this month. The following are the positions:—

	conj. sun.		conj. sun.			conj. sun.	
×	(S)	×	(V)	N	×	(H)	×
2	10	13	16	18	21	24	28

We have three solar conjunctions, a somewhat singular and rare occurrence. I think the events will be equally so. I think you will probably hear of some severe earthquakes, &c., at the major points. At present we certainly feel that the sun has borrowed some intensity somewhere. I registered 90° in the shade yesterday, and they have it equally hot in New York, having over 200 deaths from sunstroke in the week.

Studied by planets and periods, this month ought to teach something of weather science, if its professors were not too scared by the cuckoo cry of Astro-Meteorology, and too ignorant of the true workings of Nature. F. P.

A MORNING SUNSET.

[4564.]—(Let. 4519, p. 436.)—THIS is an appearance infrequent in England, but not uncommon in the East, being caused, perhaps, in the same way as the Pillar of Fire at sunset. I once saw an evening sunrise at Wimbledon. In my "Meteorological Notes" I find the following taken from Dr. Hooker's travels in India:—"In the clear dry mornings of these regions (the Kymore Hills) a curious optical phenomenon may be observed of a sunrise in the west, and sunset in the east. In either case bright and well-defined beams rise to the zenith, often crossing to the opposite horizon. It is a beautiful feature in the firmament, and equally visible whether the horizon be cloudy or clear, the white beams being projected indifferently against a dark vapour or the blue (sky?)." In the "sunrise" I witnessed the rays crossed from west to east. It must be remembered that a glow in the East at sunset is a very common occurrence. M. PARIS.

ARTIFICIAL MANURES.

[4565.]—IN answer to "Saul Rymea" (let. 4414, p. 381), stone-coal is the popular name for the variety of coal known to scientific men as anthracite. It is generally considered as the ultimate product of the peculiar change which vegetable matter undergoes under the influence of moisture, heat, and pressure. It is pretty nearly pure carbon, containing over 90 per cent. of that element. It is very difficult of combustion, and burns without flame. It has no tendency to coke or to soil the fingers. It is worked largely in South Wales and Pennsylvania. How it could prove valuable as a manure I am at a loss to imagine, and should have been inclined to fancy with "Saul Rymea" that it was a misprint for bone-coal.

With regard to the recent invention of a manure consisting of a mixture of stone-coal and sulphate of iron, I think it was unnecessary to patent the composition, for no one would be likely to use it, at least, not a second time.

I know a district in the West of Ireland where the soil is impregnated with a small quantity of sulphate of iron (doubtless derived from the oxidation of pyrites), and the land is perfectly barren. Before "Saul Rymea" tries the effect of the proposed manure on any considerable scale, let him make a small experiment on some weed he is anxious to get rid of.

If vegetables in the open do not require more nitrogen than they can obtain from the atmospheric ammonia, how is it that manuring a crop with a nitrogeneous substance is found so greatly to increase the produce. That it does so, is a matter of fact which no farmer would think of disputing.

The cause of the present high price of ammoniacal compounds is, that they meet with such an extensive application as manures. There is no fact better authenticated than that combined nitrogen is a most valuable manurial agent. Most elaborate and accurate experiments have been made upon this subject, both in the laboratory and in the field.

As to the comparative manurial value of sulphate of ammonia and nitrate of soda, it must be remembered that 66lb. of the former contains as much nitrogen, and therefore can do as much work as 85lb. of the latter substance. This is considering both as pure, but as the sulphate of ammonia of commerce is often practically pure, while commercial nitrate of soda often contains 15 per cent. of water and impurities, it would be fairer in practice to say that 66lb. of sulphate of ammonia have the same fertilising power as 100lb. of nitrate of soda, that is, that two of the former do as much work as three of the latter. Consequently, it will be practically as cheap to use sulphate of ammonia at £24 a ton, as nitrate of soda at £16, and cheaper, if the latter manure cost £17, as assumed by "Saul Rymea."

In addition to being richer in nitrogen than nitrate of soda, the sulphate of ammonia supplies sulphate, a necessary constituent of plants, while soda is only found in very exceptional cases.

When the farmer pays £16 for a ton of the best guano, he does not give a fancy price, but merely pays the market value for the contained phosphates and nitrogen. ALFRED H. ALLEN.

M. PARIS AND PERSPECTIVE.

[4566.]—M. PARIS (let. 4427) has not quite mastered his perspective, although Mr. Proctor and other correspondents have given him very good information. Now, M. Paris says, "Why should all books upon perspective teach that the drawing should be similar to what would be seen by tracing on a sheet of glass?" Just so. In fact, the drawing ought to be the same as that seen on the sheet of glass, provided the drawing is within the cone of vision. As the cone of vision was explained by former contributors, we will not say any more about it. Now, as all books on perspective teach that the drawing ought to be the same as that on, or passing through, the glass plate, why do our artists and draughtsmen, who draw architecture, not use the glass plate under all circumstances? The answer is simple; the glass plate cannot be used in five cases out of six. When, for instance, the subject is a large or high building, the glass plate must be removed so far that the arm and hand could not reach it, in other cases it is impossible to fix a glass plate. How, then, can an artist accomplish his object? How can he draw a correct representation of his building or landscape? The only way is to learn the science of perspective, which demonstrates that all lines passing from buildings, &c., through the glass plate, can be produced upon paper, without the glass plate, by certain mathematical rules. Those rules are the deductions from the observations made upon the glass plate. All outlines of architecture and inanimate subjects ought to be drawn by mathematical rules only, otherwise they are not correct representations. One of the first rules is this: All horizontal and vertical lines behind and parallel to the glass plate remain the same in the drawing. Secondly, all other lines not parallel to the glass plate must converge to the same point, which point can be found by demonstration. M. Paris must have seen some of the latter lines, or he saw lines outside the cone of vision. We have been investigating the linear portion of perspective, but now let us go a step further and look at the aërial perspective relating to colour.

"M. A." (letter 4428) is "rather inclined to agree with M. Paris that pictures are, as to perspective, a compromise;" he also thinks, "it is agreed that the the colour need not be the same." Allow me to say "M. A." is mistaken; in fact, nothing is perhaps more difficult than to represent truthfully those objects which we see before us. It requires practice and great study to portray upon a flat surface that which is spread out in space before our eyes. The more true the artist is to nature, the less he thinks of compromise, the more perfect will be his pictures, the more they will be a source of pleasure to every one. There is an immense difference between a true pictorial representation of a landscape and a caricature; "M.A.'s" mountains "drawn two or three times their perspective height" belong to the latter class. The best advice one can give to "M. A." is simply this: Master the rudiments of linear and aërial perspective, and you will see nature to better advantage."

THE WELSH SHEPHERD.

"FIDDLER'S" VIOLIN REFLECTOR.

[4567.]—"FIDDLER," in letter 4226, p. 274, asks for my opinion respecting what he terms a sound reflector, which he thinks might be advantageously applied to a violin. I do not suppose that he means a sound reflector similar to a light reflector, which would only keep the sound out of one place and throw it into another, and, as a matter of fact, nothing can be reflected without a loss of the original quantity. I, therefore come to the conclusion that he means that when the strings vibrate the breast is set in excessive vibration to produce the fullest amount of tone possible, and over and above that a small quantity of power would still be lost. Then he wants to put a board or breast on to take up that small quantity of power and produce tone. Now, if we take it as a fact that some violins are in existence which produce the full amount of tone possible, and above that have some small power to spare, which might be transferred to another board or breast, where could we fasten it on the violin? According to a law of which I have spoken before, if we put a piece on the instrument on one place or other, it will add to the specific gravity, its centre of gravity is shifted, and, in fact, the violin vibrates in entirely new proportions, and I venture to say in most cases not for the better. J. H. SCHUCHT.

SEWING MACHINES.

[4568.]—THE Wheeler and Wilson has the defect mentioned by "G. W. K. L." in 4471, p. 410, but that is only a grievance to a learner. I do sympathise with his strictures on "A Practical Man," but surely he has never seen a practical woman driving the Wheeler and Wilson. I have one at work in my own house at present, and I beg to tell him the operator has not to leave go of the work with either hand in order to start the machine, but, employing both hands with the threads and fabric, starts the machine entirely with the feet. IRISH MECHANIC.

FRUIT PUDDINGS.

[4569.]—I WOULD like to tell you and your readers how to make a black currant or any other fruit pudding, and to have it turned out of its basin and brought to table a real success, and not a miserable afterthought, as many an ill-made heavy pudding proves itself to be. This is from experience, and I would like those wives and mothers who do not feel sure of theirs to try mine. First, gather your fruit fresh from the garden, say enough for a pint basin, take flour enough to fill that basin three parts full, use no baking powder or suet, as I believe suet to be the indigestible part of a pudding, but use instead a teacupful of the fat from the top of Australian mutton. Break this loosely into the flour, not rubbing it fine upon any account. Add just enough cold water to mix into a moderately stiff paste. Grease the basin, and lay in the paste, then the fruit, with a little sugar, cut round the basin and fit a cover. Tie a dry, clean, and floured cloth rather loose over the top, but whatever you do, do quickly. Boil in a good-sized pan with only sufficient water to rise one-third the height of the basin, keeping the water to that height. Boil one hour and a half, and see that the pan has a tight-fitting lid. The crust of the pudding will then be light and dry, with plenty of the fruit syrup inside. SARAH.

CO-OPERATIVE STORES.

[4570.]—IF "E. L. G." will go with me through the following everyday transaction in a retail store such as we have been considering (either co-operative or not), perhaps, if not himself, yet other readers of the ENGLISH MECHANIC may see a reason for the retail store charging an advance of 10 per cent. upon the wholesale price. The store buys tobacco at 3s. 8d. per pound, and the attendant, when he has time, weighs the pound of tobacco into 32 half-ounces—i.e., if he can make it hold out, which it will not do, and the last half-ounce has probably to be obtained from a fresh supply. To the first cost has now to be added the cost of a sheet of paper cut into thirty-two pieces, and the value of the half-hour's labour in weighing, and to supply the working man with his weekly half-ounce another half-hour is consumed in selling and receiving payment of the thirty-two parcels. The case now stands thus:—

	s.	d.
1 pound of tobacco cost	3	8
1 sheet of paper................................	0	0¼
1 hour's labour	0	3
Loss in weighing	0	0¾
Total cost..	4	0
Retail price at 3d. per ounce	4	0

Now each of these parcels is in the regular way of trade sold for less than half a farthing upon the first cost. With what sort of coinage would "E. L. G." pay the storekeeper for his labour upon each parcel instead of allowing him to charge an advance of 10 or 12 per cent. upon the cost price? The whole subject lies in a very small compass. The excessive competition between traders for custom has enabled the public to demand and obtain so much accommodation in the form of credit and expense in selling and delivering goods that the trader could not afford to sell at a reasonable rate of profit. The co-operative store refused to give credit, and would not incur the heavy expenses traders had submitted to in the delivery of goods, the result was that in many instances the trader was supplanted.

R. R. SMITH.

REVOLVING BRUSHES.

[4571.]—A STUDY of the woodcuts of "Allen's Patent Governor" (page 373, June 28), has given me the idea that something like the top part of Fig. 7 (only very light and portable) could be cheaply contrived to propel hairdressers' revolving brushes, if suspended from the ceiling by an indiarubber band to let it rise and fall and unhook when not in use. We see the weight, drum A, and arm W (on which the brush could be placed), and I should be thankful to be shown the best way of obtaining or fitting either spring cogwheels or bands and weight to obtain sufficient speed inside the drum. The whole need not be of any great weight, the smaller the better, and the two or three wheels multiplying each other would give plenty of speed. R. A. H.

Dugong Oil.—Attention has been recalled, by the contents of the Queensland Annexe at the International Exhibition to the medical uses of dugong oil. They have been declared by more than one medical practitioner, following Dr. Holt of Brisbane, to possess all the nutritive qualities of cod-liver oil, and to be equally useful in all the forms of tuberculous and wasting diseases which are benefited by the administration of cod-liver oil: it is alleged to possess an actually agreeable flavour, to be pleasant as an article of food, and to be acceptable to those whose stomachs reject cod-liver oil. At a recent meeting in the Annexe, the pastry was made with dugong oil, and pronounced excellent.

Temperature of the Sun.—Great difference of opinion exists as to the temperature of the sun. As an instance of this it may be said that Father Secchi maintains this temperature to be about ten million degrees Centigrade. At a recent *séance* of the French Academy, in defending his estimate against the much lower figures of Ericsson, Zöllner, and Faye, St. Claire Deville asserted that he was engaged in investigating the subject, and that his results fixed the temperature at about three or four times the melting temperature of platinum, about 6,000° to 8,000° C. Mr. Vaulle also announced an ingenious theory upon the same subject, fixing the debated figure at 10,000° C. Finally M. Fizeau stated that, having compared the solar light with that of the carbon points of the electric light, he had been able to estimate that the former was about three times as intense as the latter, and hence, assuming the relative calorific intensity to be in proportion to the luminous intensity, he had arrived at the figure of 8,000° C. as the correct one.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[10478.]—**Pork Diet.**—Mr. Newman, at p. 413, has correctly stated some of the objectionable qualities of pork as an article of diet. He might have added others, indeed several others. Among these I may mention the following:—Persons who eat much pork are particularly liable to skin diseases, often of the most disgusting and obstinate character. Scrofula is more than usually common among them, and is generally of a very bad type. Consumption (tuberculosis) is sometimes traceable to it, and in all cases is greatly aggravated by it. Intestinal worms (round and thread) are also more than usually common among pork-eaters, besides tænia (tape-worm), mentioned by Mr. Newman. I might lengthen the list if space were no object, but the "defects" noticed by Mr. Newman, and supplemented by me (above), I regard, after a long life of professional observation, to be absolute facts. I think the prohibition of pork as an article of diet by the great Jewish and Mohammedan lawgivers shows that they were philanthropists possessing profound knowledge and wisdom. The ravages caused by a pork diet among the British troops in the Crimea a few years since will probably be remembered by many of our readers. In warm and hot weather pork is more objectionable as food than in temperate and cold weather.—ABOTES.

[11554.]—**Pedestrian Tour.** — "Avon" (p. 48) need be under no anxiety as to shoes made of No. 8 canvas standing a reasonable amount of wear; indeed, I think No. 8 canvas thicker than necessary, though it should be stout enough to carry the thick soles, well supplied with nails, needed for comfort and safety for climbing slippery mountain slopes. As the canvas wears most just above the welt, a strip of well-greased leather or of indiarubber may be fixed, reaching an inch above the sole, and over the toe. Above all things take care that the sole is cut a little longer and wider than the foot—the shoemaker will make it less if you let him. Make him understand that you want the shoes to wear, not to look fashionable. If "Avon" does not object, as I do, to the bother of lacing shoes (which should be made high), he need not have elastics, but if those are made to fit easy they cause no inconvenience. There must be no compression or confining of the foot or ankle for those who wish to walk with comfort. Remember, canvas shrinks when wet. There is much to be said in favour of "Avon's" proposal to give up any attempt to keep dry, and rely solely on the power of changing any clothes that get wet. Wet does no harm, and causes but slight discomfort to those who keep warm with exercise. If this course be decided on, instead of a repellant cloth cloak or poncho, a change of clothes must be carried, unless the pedestrian can return at night to the place from which he starts, as in the lake district he often may do without difficulty. A change of clothes need be no great weight—a pair of thin jean trowsers and an alpaca coat or a blouse are all that need be added, and they will be but little heavier than the cloak that may be left behind. Let me most earnestly warn the inexperienced never to sit so long as to get chilled in damp clothes. A severe, perhaps fatal, cold, or an attack of rheumatism, is the not unfrequent penalty of such imprudence. Let them beware also of damp sheets, not uncommon in the moist lake district, especially when the inns have more visitors than the servants can properly attend to. If the sheets feel in the slightest degree damp, take them off and sleep on the blanket. A grand protection against cold-catching is washing all over with cold water. Every bedroom of a decent inn should have its shower bath, and easily might have, and certainly would, if common-sense were not so extremely uncommon. "Avon" is quite right in preferring a satchel to a haversack, which is a terrible plague to those not used to it. I prefer a shooting jacket with capacious pockets, and if I must carry more than I can stow away in them (*e. g.*, coat and trowsers) to wrap my traps up in a large sheet of thin waterproof cloth as a pack, which can be carried in various ways as a satchel. The cloth is useful to lie down upon when the grass is not quite dry; and laid on the floor with the corners tied up it makes a capital sponge bath to be used before and after sleep. By the way, do not forget to include a large sponge amongst a pedestrian's outfit, though a towel soaked in water is a tolerably good substitute. Do not be sparing of the water. Let the inexperienced avoid hard work during the heat of the day. Start early, when the day is young, and enjoy the cool air; see the mists on the brae and the sun clearing them off, with touch as wonderful, and to many as strange, as if by magician's wand. Rest during the heat of the day, and reserve your strength and spirits for the cool of the evening. I find two good meals a day amply sufficient, not counting a bit of bread with a cup of milk on first getting up. Get a walk of six to ten miles before turning in for breakfast, with chops, or lunch, whichever you like to call it, at ten or eleven o'clock, then rest and read till the fierce heat of the day is past, and be ready for another walk, bringing you to your resting-place early in the evening. Be careful to get there early, unless you have secured a bed, as, perchance, you may have to go further than you intend. Avoid, if possible, any hard walking after your second meal, which may be dinner, tea, or supper, as you please. I prefer cocoa and chops, especially of such mutton as you get in mountain districts. I like to finish off with a glass of ale, just before going early to bed, but think it would be wiser to do without. When among lovely lakes and mountains no alcoholic stimulus is needed. A white cover over the umbrella greatly increases the protection it gives against heat, and adds very little to its weight. I have tried a great many different kinds of head-coverings, and find the common black hat the worst, and an Indian felt hat the best, of any I have tried. This is made of hard felt, is about an inch more in each diameter than the head, which is encircled by a soft band attached to strips of cork. The hat is lined with cork. It never in this climate gets hot inside. There is a passage for air between the hat and its lining, which escapes through holes at the top. I have the protection of a hard and thick hat, with the comfort of a soft one. It cost 16s., and seems, after three summers' wear, as good as new, except the band and the lining. I am told that a straw hat with a white linen cover protects sufficiently from the sun, but I have not tried one. A white handkerchief tied over the hat, and hanging down behind the neck, is good when an umbrella is not used, or when that is wanted for a stick. I do not fancy gaiters, but some like them to protect their legs from thorns, and to enable them to wear the trousers knickerbocker fashion, which they say relieves the knees. It is worth trying, but I have not tried it, though I have often wished furze, gorse, or whin thorns were not quite so sharp, or that I was better protected from them.—PHILO.

[11554.]—**Pedestrian Tour.**—"G. W. K. L." would probably find advantage in a dodge of which I have had many years' favourable experience. Since I adopted it I have never had the slightest blister or soreness of the feet. It is simply to ventilate the boot by boring two, or (say) three holes about a quarter of an inch in diameter in the upper leather—by preference in the raised parts of the wrinkles between the toe and instep. Any water that may get into the boot is then rather a comfort than otherwise, as it is soon evaporated. On coming in the stockings will usually be found dry, not soaked with condensed perspiration, and the boots may be kept comfortably soft by a daily greasing. Canvas shoes would doubtless do well for road tramping; but if "G. W. K. L." is in the habit of making the most of his trips by finding his own way over the hills with an ordnance map, he may often find himself in places where his feet would suffer without better protection than canvas, say, for instance, amongst stones overgrown with heather. To obtain the full advantage from the holes the boots should be of strong leather, an easy fit at first, with plenty of width for the toes, the more the better. A fair sprinkling of projecting nails in the soles is a great comfort on a hill side.—P. S. T.

[11589.]—**Dry Steam.**—I wish "E. L. G." would explain why he thinks that when high pressure steam escapes into the air it expands immediately, so as to fill much more space than low pressure steam does. Why should it expand instantly sixtyfold? What experiment proves that it does so expand instantly? That it would do so nearly immediately if it escaped into vacuum, and that it does gradually if it escapes into air, is no doubt true; but so far as I at present see, the pressure of the air must prevent the immediate expansion of high pressure steam beyond that of low pressure steam; and if so, its reduction of temperature by expansion alone will be the same whether it expand in air or in a cylinder so enlarged as to allow its expansion from (say) the pressure of four atmospheres at 296° to that of one at 212°. I have frequently seen in England, on a dry and warm day, the vapour of a locomotive steam jet dissolve almost immediately. The quickness of such disappearance of visible steam is a familiar indication of a coming fine day; it shows a low dew point. I expect the disappearance is still more rapid on the Suez Railway, but it is often very quick here. I believe the utility of superheating steam is to secure a reserve of heat to prevent condensation of water when part of the heat is transformed into force, and for the same reason it is advantageous to keep the cylinders of a locomotive hot, to prevent condensation in them. I do not agree with "A., Liverpool," that if a vessel be filled with steam at 1lb. and at 100lb. pressure, more water will be condensed from that at 1lb.; it will be just the reverse. But perhaps "A." has not expressed his meaning quite fully. Possibly he means steam at 1lb. increased by heat only to 100lb., if that be possible. In that case, however, the quantity of water condensed would be equal. I do not perceive what connection the rate of evaporation from an open or a closed boiler has with the question, though it is no doubt faster from an open vessel with equal fire and heated surface, the reason of which is easy to understand without supposing that each cubic foot of low pressure steam contains more or as much water as an equal bulk of that at high pressure, the quantity of water being really in proportion to the pressure if heated in contact with water. If steam be heated out of contact with water, its elasticity is increased just as that of air or gas is.—PHILO.

[11632.]—**Debility.**—To E. PARKER.—A friend in London tried to procure the bean you recommended, but dealers refuse to give it without the permit of a doctor. Can E. Parker kindly state the reason?—CORDWAINER.

[11787.]—**Electric Signal Bell.**—Allow me to correct my assertion that your magnet is incurable. I had forgotten for the moment the fact that when the armature of an electro-magnet touches its poles, a portion of its magnetism is retained for a short time. This contact may be avoided, however, by pasting a piece of paper on the side of the armature which is next to the magnet.—GLATTON.

[11792.]—**Compound Engine.**—Whilst I am much indebted to C. E. Stewart for his information on the compound engine, I must still consider my query unanswered. I wish to know the proportion the high pressure cylinder bears to the low pressure cylinder. Mr. Stewart tells me that depends on the pressure and distribution of steam. Perhaps Mr. Stewart or some other of our correspondents will be good enough to give us some more information on the subject. I should also like to see the merits and demerits of the compound engine freely discussed in these columns.—FALSTAFF.

[11874.]—**Bryant and May's Matches.**—I can assure "Saul Rymea" that my statement concerning Bryant and May's matches contains no error. Let "Saul Rymea" find a piece of hard, well-worn linoleum, then let him take hold of the match close to the head and rub it briskly, and I think he will have no difficulty in getting it to ignite. I have just succeeded in lighting six matches in succession upon a piece of linoleum which had been well warmed in the sun. Very new linoleum is too soft for the purpose. The matches I have used are obtained direct from Bryant and May's.—HIPPARCHUS.

[11874.]—**Bryant and May's Matches.**—Two days ago I tried four of Bryant and May's safety matches in succession on linoleum; all of them ignited. The linoleum was old and worn, about one foot square. I don't think it had ever formed part of a safety-box.—FREDERIC H. WARD, Surgeon.

[We have tried and failed. The linoleum, however, was comparatively new.—ED.]

[11940.]—**Waterglass as a Preservative of Natural History Subjects (U.Q.).**—Although I never tried waterglass for the above purpose, it is impossible that it will answer; it must destroy such things as wings of butterflies, and would by degrees form a white film over beetles and other subjects.—THE WELSH SHEPHERD.

[11959.]—**Vandyke Brown(U.Q.).**—This pigment is an earth found on the Continent; there it is called Cologne's earth, found near Cologne. The darker sort, Cassel earth, is found near Cassel in large quantities; it is ground in water and washed. There is also a very light and bright sort prepared by calcining green earth (terre vert). The two first sorts were formerly sold in England under their respective names, but now they are only known by the one name, vandyke brown.—THE WELSH SHEPHERD.

[11962.]—**Telegraphy in the United States (U.Q.).**—The Western Union Telegraph Company is the largest company in the United States, and most successful; offices, 145, Broadway, New York.—S. M. B.

[11970.]—**Water Regulator.**—The water regulator consists of a tube of glass, ⅜in. bore, brass-capped at both ends. The bottom cap is solid, the upper one has a hole in it into which is fitted exactly a brass rod sliding up and down. The tube should be about 8in. long, and filled with water to within about 2in. of the top. This regulator is interposed in the circuit, connections being made with the brass caps.—ALEPH.

[11973.]—**Magnetic Engine.**—In reply to "L.C.," p. 413, I have a pair of electro magnets with which I wish to make an electric engine.—GLATTON.

[12056.]—**Echo.**—Concavity is the cause of echo. Remove the cause, convert it into convexity, and the result will be the reverse—perfect freedom from echo or recurrent sound. It is lamentable what amounts are lavished on ornamentation, regardless of acoustics. If an acquaintance with science were but as appreciated and rewarded as is ornamentation skill, it would vastly more contribute to usefulness and comfort. If quite practicable, I would suggest the concavity of the vaulted roof being screened over by perforated zinc, somewhat in the form of a convex lens at front. This would divergingly disperse the sound-waves, and thus, by widening the area of dispersion, destroy all tendency to their recurrent pulsation. It might be fitted up so as to be removable for thorough cleansing of the chapel. The perforation is to aid ventilation, and would be useless without some one or more outlets to the open air above the zinc. (See "Tyndall on Sound.")—J. BARWICK.

[12070.]—**Electric Kite.**—"Ardtannes" will find, in Francis's "Electrical Experiments," p. 83, full particulars for an electric kite (from which I have succeeded several times), and full cautions, too. The last I flew some years ago so awed me (by a summer storm-cloud passing over and causing flashes, any one of which, if it accidentally had passed through the bodies of myself or friends, must have caused instant death) that I do not advise tyros to meddle with this subject.—X. M. S.

[12102.]—**Lightning.**—Fergusson says that the electric discharge—*i.e.*, lightning—travels at the rate of 288,000 miles per second; greater than the velocity of light, which is only 194,000 miles per second.—GLATTON.

[12111.]—**Hothouse Boiler.**—If "W. F." has convenience to raise his supply cistern (say) 12ft. or 14ft. above his boiler top, he may raise the boiler until the bottom of the boiler is level with his pipes; but I would warn him the safety of his apparatus depends entirely on keeping his cistern well supplied with water, as his pipes would not form a reserve in case his cistern got empty, as they would if the boiler was below the pipes.—AN ENGINEER.

[12151.]—**Concrete Engine Beds.**—I have put several concrete engine beds down, and in my opinion nothing can answer better. They are superior to any ashlar pillar that ever was made. And if your material is good you can start with safety when it is seven days old. I use a cast-iron plate for bottom, holed to receive holding down bolts. I prefer the plate in one piece; but if it is inconvenient, you can put them in separately, but mind and have one plate to take two bolts.—LUFFRA.

[12160.]—**Size of Iron Tool, &c.**—At Mr. Purkiss' request, I send you a few lines on this subject. I agree with him in all he says, with one exception—viz., the use of a duplicate speculum, or concave tool, for figuring the pitch polishing tool. This I have found to be by no means necessary, indeed I doubt if it be actually practicable. When the glass speculum is ready for polishing (having a good spherical figure), nothing more is necessary to give the pitch tool the right curve than slightly to soften it by heat, place the speculum, moistened with rouge and water, upon it, and move it about gently by hand, until each of the pitch facets is observed (looking through the glass) to be in actual, not rolling, contact with the surface of the speculum. When this is found to be the case the work may proceed, but not before. It is always well, when work is to be resumed the following day, to warm the pitch slightly before placing the speculum upon it; though I must confess I have often proceeded myself without this precaution, and with no bad consequences. I need scarcely remark that perfect contact on the polisher before work is commenced is absolutely essential to a good result. I have never found any additional refinement on the above-mentioned simple directions to be necessary in practice.—H. C. KEY.

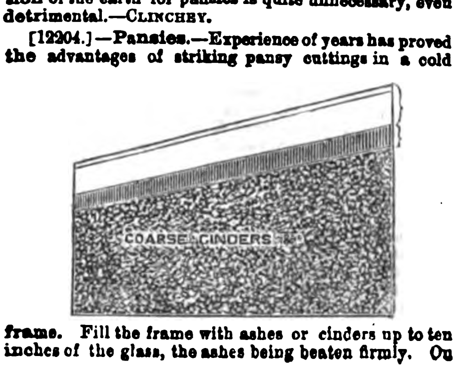
[12172.] — **Constipation.** — The communication from "J. W." (reply 12172, p. 390) is interesting and valuable, and many, I am sure, would be glad if he would give a few particulars regarding his method of curing constipation. Will he kindly state (1) if he used and still continues to use the enema daily? If not, how often should it be used, and must it always be continued after once beginning its use? (2) Has it entirely cured him of his "old friend" who returned six months after the operation? (3) What quantity of water should be injected, and does he recommend pure cold water, or would it not be better tepid and medicated? Lastly, will he kindly state the best form of apparatus for self-application, and where it can be purchased?—SAXUM.

[12192.]—**Concrete.**—To describe the whole process of concreting would be taking up more of your space than I am justified in doing; besides, it is a thing that almost any builder knows all about; at the same time I can inform "J. W. F." that I have done several stables with concrete all except the stalls, which are paved with firebrick (I was afraid it would be too slippery for the horse to get up on); the mangers were concrete too, and a more efficient and cheaper job I never saw done. They are kept sweet with little or no trouble, and they are a thing that no crib-sucker can possibly injure.—LUFFRA.

[12199.] — **Speeding Pulleys for Gut.** — E. Williams had better not make his pulleys according to the dimensions given him by "E. S. S." or "P. W. H. J." If he does he will have to alter his gut about 4in. to change fr m quickest to slowest speeds. The different angles made by the gut when running in the different gro ves have not been taken into account by "E. S. S." and "P. W. H. J." Cone pulleys to work well should be calculated and made for the distance between centres they have to work at. The following are dimensions for a pair of pulleys for a foot lathe in which the distance between centres of treadle shaft and lathe spindle is 2ft. The diameters of pulley on spindle are 10in., 8in., 6in., 4in., and the diameters on large pulley are 2ft. 6in., 2ft. 4 15/16in., 2ft. 3⅞in., 2ft. 2⅜in. The pulleys should be turned so that they measure the given diameters at the centre of the gut when tight in its place. The value of the ENGLISH MECHANIC would be very much increased if every one would be careful to see that he sends right answers or send none at all.—G. M.

[12204.]—**Pansies.** — The sifting in the preparation of the earth for pansies is quite unnecessary, even detrimental.—CLINCHEY.

[12204.]—**Pansies.**—Experience of years has proved the advantages of striking pansy cuttings in a cold



frame. Fill the frame with ashes or cinders up to ten inches of the glass, the ashes being beaten firmly. On the ashes lay four inches of carefully-sifted and worm-free turf, mixed with a little sand. In this plant the strongest ripest cuttings you can obtain, and leave six inches above for the plants to grow in. Do not let the soil be more than six inches from the glass. Keep the plants hardy, covering only with the glass, and letting in plenty of air in fine weather, water to be given occasionally and moderately. In April transfer the plants to your border, preferring a position shaded from the south and west, so far as the roots are concerned, the soil being well rotted manure mixed with loam below; and light rich soil the upper three inches. —GERARD SMITH.

[12206.] — **Geraniums and Fuchsias.** — "Phœnix" and S. Bettone in their replies seem to have overlooked the following points in the query. The geraniums were to be scarlet, the fuschias beautiful foliage, and cheap varieties produced within the last few years. In my reply I kept strictly to single scarlet zonales and variegated fuchsias. I have appended a list of good growing, free flowering, moderate-priced varieties, embracing the principal shades of colour, from which an amateur may make a fine selection without the trouble and expense it has cost me to arrive at my present stock. I may here add I should not be inclined to give a beginner the advice lately tendered in the MECHANIC—viz., to leave the selection to a nurseryman. It is not a nurseryman's interest to push the prettiest varieties, but rather those that are easily raised; and although such catalogues as those of H. Cannell, Woolwich, and G. Poulton, Edmonton, (both of whom send rooted cuttings by post—a great boon to growers far from London), are generally pretty reliable, I often find the descriptions overcoloured, and am induced to purchase new varieties indistinguishable from old ones. My plan is to obtain Hibberd's "Garden Oracle," and the catalogues of some of the best nurseries annually, and having carefully gone over these, to send to the nurseries for young plants of the best sorts. When these are in bloom I know what to retain, and what to sell, give away, or throw out. Besides the selection I now append, I shall be able in a few weeks, when new stock is better tested, to give your readers, if desired, further lists of desirable kinds. List:—Single zonales, from crimson-scarlet through the shades of salmon and rose to pure white: James Crutt, Richard Headley, Monster, Shakespeare, Mrs. Spencer, Rosamond, Beauté de Suresnes, Rose of Alandale, Purity. Doubles: Victoire de Lyon, Gloire de Nancy, Triomphe, Madame Lemoine. Golden tricolors: Sophia Dumaresque, Florence, Lady Cullum. Silver tricolors: Italia Unita or Mabel Morris. Bicolors (dark): Model, Countess of Kelli. White-edged: Silver Chain. Ivy-leaf (variegated): L'Elegate. Fuchsias (dark): Try me O! Light: Arabella. Light (very dwarf): Merry Maid. White corolla (double): Vauquer de Puebla; (single) Puritani. Double (dark): Lord of the Manor, Hercules. Not to trespass, I abridge the list of fuchsias.—IRISH MECHANIC.

[12213.]—**Coffee.**—The best machine for making good coffee is a common jug. It must be very clean, and perfectly dry. Buy the best coffee, grinding at home, and if possible just before making. Measure five teaspoonfuls to a quart of water. Let the jug stand before the fire to get hot, and be sure that the water be actually boiling before pouring over the coffee. Begin by pouring slowly; when full, slightly stir the surface, and let stand a few minutes to settle. That the water must be boiling and the jug hot is important, as this keeps the aroma from taking flight. Why this is, I cannot tell. Perhaps Mr. Bottone can. Everybody knows how essential to the enjoyment of a cup of coffee is the presence of its aroma. If the well-known fragrance is wanting (and one wonders whether it ever existed at all in some varieties of the decoction) take the railway refreshment-room kind—dark, sweet, and flabby. The highly chicorised and the weak solution—a sort of coffee broth made in a hurry without care.—SARAH.

[12217.]—**Violin Tuning.**—ERRATA (No. 380, p. 416).—The first string should be tuned to E, not C. —JOE.

[12217.]—**Violin Tuning.** — I notice several answers on violin tuning, but none of them mention the fact that in solo playing the fourth or G string is sometimes tuned to A, and even to B flat, by this means making otherwise difficult passages comparatively easy, the rest of the strings remaining perfect fifths as usual.—HONE KO TO.

[12221.]—**Brass Screws.** — The article which "J. C. L." speaks of in No. 335, p. 555, seems to me to relate to malleable iron screws, tables of which can be got in almost any mechanical book. It is universally known that there are always more threads in a brass screw than in one of malleable iron. I have never yet seen a table for brass screws, and would like very much if some of our readers could supply one.—FALSTAFF.

[12249.]—**High Pressure Fire-Box Boiler.**—I am extremely obliged to "P. W. H. J." for the information received from him through your valuable journal, and if I may trouble him further I should be pleased to know the thickness of plates for the shell and ends of boiler, and whether it would be advisable to have some of Galloway's conical tubes in each flue, and how many? As to the safety-valve, nothing but Hopkinson's patent seems to go down in this district.—495.

[12255.]—**Hair.**—"H. P. H." suggests a lotion of 1 ounce flowers of sulphur and 1 quart of water, but I cannot make the sulphur mix with the water—it floats on the top. I think he must have omitted something in the directions.—C. WATSON.

[12258.]—**Old Violin.**—No such maker as that mentioned by "A. J. L." ever attained any eminence in violin-making. I am of opinion that the label is an awkward and blundering counterfeit of the inscriptions used by the Amati family, as the date corresponds with the time at which several of the most eminent of those makers flourished. The label, however, is but a matter of minor importance, as "A. J. L." will find some of the vilest productions bearing forged labels of the finest makers. He ought to send the instrument in question to an experienced connoisseur, who would be able to inform him of its value.—P. DAVIDSON, author of "The Violin."

[12263.]—**Circular Saw Driving.**—If James Davis wishes to have 700 revolutions of saw, he will require a larger driving-wheel than 42in. The formula for such cases is this: Let A be diameter of driving-pulley in inches; B, diameter of driven pulley in inches; S, speed of driver; and V, speed of driven pulley, each in revolutions per minute. Then $A\,S = B\,V$. Thus the finding of any component with the other three given is a mere matter of substitution. In this instance A is unknown, and $B = 9$, $S = 40$, $V = 700$; $\therefore A \times 4 = 9 \times 70$; $\therefore A = \frac{630}{4}$ in., or $\frac{630}{4 \times 12}$ ft. = 13⅛ft. With the diameter of driver given the speed of driven pulley would only be 195 5-9ths per minute. If there is some insurmountable reason to prevent the driving pulley being made of greater diameter than stated, it would be advisable to use a countershaft. A good combination to effect desired purpose would be to have 44in. wheel on first driver, the belt going to 9in. wheel on countershaft. On countershaft there is to be a 32in. wheel belted to 9in. wheel on saw spindle. This would give about 700 revolutions. It would have been better if possible to have put larger than 9in. wheel on countershaft, but I have taken 44in. as the maximum for the drivers. I think that with heavy work on, with so small diameter of driven wheels, that the belt will be liable to slip.—P. W. H. J.

[12268.]—**Strength of Shafts.**—The strength of any material is estimated by the strength of its weakest part, so that in "Ixion's" example there is no need to take into consideration the diameters 2½ and 2¼, but only have to calculate for a plain shaft of 2in. diameter. It would not be any stronger if the whole of the shaft (excepting the 2in. part) were 12in. diameter. The following is the formula, in using it take the smallest diameter of the shaft out of bearings as the diameter: Let D = diameter of shaft in inches, H, the indicated horse-power, and N, the number of revolutions per minute. Then $D = \sqrt[3]{\frac{83\,H}{N}}$ in crank-shafts and prime movers, and $D = \sqrt[3]{\frac{65\,H}{N}}$ in ordinary shafting. Applying it to this case, $D = 2$in., $N = 170$; $\therefore (2)^3 = \frac{65\,H}{170}$; $\therefore 13\,H = 272$; $\therefore$ H.-P. $= 20\frac{12}{13}$ or (say) 20 horse-power.—P. W. H. J.

[12270.]—**Charcoal Furnace for Model Boiler.**—I think that three jets of the size mentioned will hardly be enough. To obtain the full power there ought to be a light every 1½in. or 2in. It would be best to have the lamp 12in. long, with six jets of diameter mentioned. Of course, without knowing what is required of the boiler, it would be impossible to determine the requisite number of jets, but I believe that this would develop the full power. The diameter of boiler is rather too small for a charcoal fire to be employed conveniently. There will be a difficulty in stoking the fire, and it will be liable to go out unless it has a good draught. The grate is to be 7in. long, supported at the back end by a bit of firebrick. It is to be 2½in. from bottom of boiler. The fire-bars are to be made of bits of ⅛in. boiler plate, and about ⅜in. wide, with three-sixteenths of an inch space between them. The boiler is to be set in a frame made of ⅛in. plate, with the chimney going up one end of boiler. The chimney is to be 3ft. long and 2in. diameter, made in 1ft. lengths for convenience of packing. In some models the chimney is square, and removed to some distance from boiler on base-board, and the smoke conducted to it beneath the bed plate through a rectangular tube. This looks well when the chimney is painted white and red in imitation of brickwork.—P. W. H. J.

[12273.]—**Water Power.** — Supposing that the length of pipe is one-tenth more than the fall, there would be 5·73 gallons supplied per minute = ·9168 cube feet. The power to be obtained by this is (.001892 × ·9168 × 80 × ·7) = ·085 horse-power = 255½lb. raised one foot high per minute. This would drive a moderate-sized machine, one that could be worked by a boy. For so small a turbine it is hardly worth while to give details, so I shall only give a few particulars. The best diameter would be (of casing inside) from 8in. to 9in. The diameter of the central wheel from outside to outside of buckets to be about 7in. The number of buckets in larger examples is 36, but I think 20 would do here, as a large number would be only useless complexity. In the manufacture, brass should be used as largely as possible to avoid being clogged up with rust.—P. W. H. J.

[12279.]—**Diminished Action of Battery.**—The nitric acid is soonest affected. Its change is a real destruction and deoxydation of the acid by the hydrogen, which in its absence would be evolved at the surface of the platinum. It cannot be purified or restored. The sulphuric acid undergoes a gradual change, being ultimately converted into sulphate of zinc.—ALFRED H. ALLEN.

[12283.]—**Food Analysis.**—Dr. Hassall's "Food and its Adulterations" is the most complete work on the subject; but, unfortunately, is out of print. If James C. Harker will wait a few weeks, he will find the information he requires in the ENGLISH MECHANIC.—ALFRED H. ALLEN.

[12285.]—**Logarithms.**—"C. P. E." has made a mistake in his query. He says that he finds log. 6·102 = ·78547 in the table. Now, he will never find the number with a decimal point to it in the table, because tables are not made with them. The points are left to be put in by the person using the tables. For instance, in a table without points, the log. of 6102 applies either to 6·102, 61·02, or 610·2, with the alteration of the characteristic. For instance, log. 6102 = 3·78547, log. 6·102 = ·78547, log. 61·02 = 1·78547, log. 610·2 = 2·78547. To find log. 6102·5 we must know log. 6102 and log. 6103. Now, log. 6102 = 3·78547, log. 6103 = 3·78554. Then the matter becomes just a matter of simple proportion, thus:

log. 6103 = 3·78554
log. 6102 = 3·78547

diff. of 1 = ·00007
∴ „ ·5 = ·00003

log. 6102 = 3·78547
∴ log. 6102·5 = 3·78547 + ·0000·3 = 3·78550

—P. W. H. J.

[12299.]—**Tar Pavement.**—I had occasion some years since to inquire as to the expediency of using gas tar in making footpaths which, as they have to be used in all weathers, should be in good condition whether it be wet or not. I was informed that when carefully made, such footpaths do not get soft either by the sun or the rain, and, if well looked after, can be kept in good condition for a very long time at very small cost. The foundation must be firm and dry, and, if not naturally, artificially drained. It is best, though not essential, to boil the tar to drive off its more volatile parts, and to thicken it with pitch; the broken stone, cinders, or gravel, must be mixed with as much tar as will just cover the surfaces of the hard material. If there is not tar enough the so-called asphalt will not bind well, and if there is too much, it will become soft in hot weather. The proper mixing of the materials is a matter of some nicety, requiring both attention and trouble, and is often badly done. When well done, the material is spread 2in. or 3in. thick upon the pathway, and rolled with a heavy roller kept wet to prevent it sticking. It improves the appearance of the work to sprinkle small fragments of sparkling spar which, imbedded in the surface of the nearly black asphalt, make it look like granite. Great care must be taken to avoid forming any hollows in which water can lodge, and every spring any hollows that may have formed must be carefully filled up. Unless this be done, and unless the foundation be good and dry, the asphalt will soon break up.—PHILO.

[12301.]—**Unequal Sizes of Cone Pulleys.**—To "JONATHAN."—I have no recollection of giving any formula for finding length of band; I don't like formulæ, as the book with them in is always left at home, like the Dutchman's anchor, just when you want it. "Derf Errac" gave one without any trigonometry on 29th October, 1869, and in Vol. IV., No. 103, there is a geomtrical calculation, both of which seem correct on trial. In Vol. VIII., No. 203, p. 460, I gave a way of making a set of pulleys to suit the band which has already been fitted to one pair of the set, and from that plan may be deduced a very easy way of calculating the length of band in this manner. The point d, which all the bands pass through, of course suits two equal as well as two unequal pulleys; therefore, if we draw a line through d parallel to A B, as is done in the diagram on p. 460, Vol. VIII., that gives you the diameter of the pulleys when equal. Now, the calculation of the band for these is simple enough, as it is only twice the length A B added to twice the half-circumference, or once the whole circumference of the pulley, which is got by multiplying the diameter by 3·1415. Now, having obtained the length of the band for equal pulleys, which also suits the pair of unequal ones first laid down, we can go on and draw other lines through d, which will give us any number of unequal ones that may be desired, all fitting the same band. If the belt has to be crossed you have only to make the sum of diameter of every pair alike, as e.g., 20 and 6, 16 and 10, 13 and 13, all equal to 26 when added together, and this holds good whatever the distance of the centres from one another. I see two answers to a query on the same subject (No. 12199, on p. 415), which show that "E. S. S." and "P. W. H. J." either don't understand the query or forgot what it was before they sat down to answer. Gut bands are never crossed, unless the pulleys are placed "in winding," as they would wear themselves out in a very short time, and it is only in the case of crossed bands that the sum of diameter remains the same as above. In my lathe a drop on the fly-wheel of 1ft. 1/16in. corresponds with a drop of 1ft. ⅞in. on the pulley, which proportion will be found to hold good for any ordinary foot-lathe, and is very different from what the above-mentioned answers put forward.—J. K. P.

[12304.]—**Phrenology.**—"Sigma" (p. 418) says that no greater mistake was ever made than to suppose, as some of our great writers do, that the mind is a blank sheet of paper on which we can write what we please, but he is as completely mistaken as it turned out he was about the electric sparks, as to what John Locke and other great writers who have followed him taught. They taught (does "Sigma" deny?) that a new-born child knows nothing, and that all it ever knows it has to learn, and that in that sense the mind is like a sheet of paper. But different minds, like different papers, are of various quality, and neither Locke nor any other great writer ever taught that we can write equally well upon any mind any more than that we can write equally easily and equally clearly upon any sort of paper. Upon some minds as upon some paper, every impression is distinct and permanent, while upon other minds every impression is like writing on blotting-paper, blurred, confused, and as uncertain as "Sigma" said my knowledge about electric sparks was, and his turned out to be. The phrenologists tell us that few minds are of equal quality throughout, that some receive and retain certain sorts of impressions better than others, and other different impressions better; that one artist, for example, will excel in drawing form, another in depicting colour, and they profess to be able to foretell in which each will most excel with equal cultivation, by observing the relative size of certain portions of the brain as indicated by the width between the eyes for form, and by a fulness over part of the eyebrow for colour, and they further allege that the size of such portions of the brain will be increased if the faculty be unusually cultivated. Whether these allegations are established by sufficient evidence is one question, but that the notion is *per se* absurd can hardly be maintained.—PHILO.

[12304.]—**Phrenology.**—In proof of the statement made in the latter part of "Sigma's" answer, I wish to state the following particulars. A friend of mine during his university career had his head examined by an eminent phrenologist. Shortly afterwards he began to read for a mathematical scholarship, and after a few months of this a marked change was visible in the shape of his forehead, and this afterwards increased by little and little till he ceased reading that particular subject.—E. JOHNSON.

[12304.]—**Phrenology.**—Phrenology may be and has been pushed too far, still there is some truth in it, but each case must be modified by the relative size of the organs, as well as by temperament, nervous, sanguine, billous, and so on, and again by early training, or inherited tendencies, all which must be taken into account. When phrenology was more in vogue it became for a time a favourite hobby, and was ridden to death. In estimating any novel doctrine or facts, it is usually well to remember that they must be taken with the counteracting weight of other facts which seem opposed; we then discover that the truth lies not in the effect of one, but in the result of both: so that if phrenology lands you in the place where men are not responsible, I shall be glad to hear when you come back how they manage matters there.—AFTERNOON.

[12309.]—**Boiled Oil.**—"G. W. C. H." should place in a glass jar some *bonâ fide* new linseed (from the oil pressing works, not the shops), pressed from fine Eastern seed, in the sunlight on the top of the house, with a piece of sheet lead scraped bright, inserted part in the oil and part in the atmosphere of the jar. Cover over with glass the mouth, so as to admit air and light freely to circulate, but not the rain to enter. In a few weeks the oil bleaches, and to the lead between wind and water a mass of mucus attaches itself, which is withdrawn by gently taking out the lead, rescraping, and again inserting until the oil becomes of the lightest sherry tint. By November it should be water white nearly, if the proportion of surface of lead has been enough in proportion to the oil used. He will find that this oil carries a power of what is called drying (to a non-cracking or blistering power, with even a dry oxide tint) without any further addition, which he is not, perhaps, aware of, though the action of the oil is not a "drying one" at all in that pure sense, but one of oxidation, which proceeds in a peculiarly increasing ratio at its finish in the constitution of the tough glass-like varnish of its complete state. He will, by this manipulation, get over the slower and primary portions of this oxidation in his jar by the help of the sunshine, leaving the latter portions to occur in his pigment under his brush by extended surface, without any addition of caustic chemicals or cooking to heat (*i.e.*, boiling), which an Italian painter of some note assured me a few years back, while travelling in that country (and being inquisitive enough to inquire into his jars of what to me looked like creatures preserved in spirits on the top of his studio), was the true secret of the staying power of the pictures of the old masters, and the cracking of modern pictures, to which, if so, "G. W. C. H." and your readers are quite welcome. If he cannot succeed, let him advertise his address, and thus obtain communication with me direct, as I have had vessels set one hard lump of transparent resin, which I dissolve in turps, and make a splendid varnish of to resist rusting on iron for experimental work.—X. M. S.

[12310.]—**Professors.**—"P. D." asks a somewhat ticklish query: "Who has the right to call himself 'Professor?'" Like the controversy about the definition of "engineer" which raged some time ago, the title can't be fixed within definite limits, or at least those who claim it as a sort of appendage to their names. We have college professors of languages, music, science, as Tyndall and Huxley, gymnasts, and a thousand other things too numerous to mention. Professor originally meant one who had gone to college or public institute and taken out certain honorary degrees; now any man may prefix or append it to his name who excels in any profession. The public, however, looks to the man who adopts it for competency to perform what he professes, and his disassociation with charlatanry.—RAT-TAT.

[12312.]—**Brick Vaulted Arches.**—Brick vaulted arches will be strongest built with the wedge-shaped brick made to follow the centre, and worked all headers. (Proved.)—W. HILL.

[12312.] — **Brick Vaulted Arches.** — Nothing can be more vicious in construction, or more sadly illustrate the vanity, for practical purposes, of any "scientific progress," while our whole industrial system is rotten and in galloping decline, than this wretched expedient for making thick arches by successive thin layers, begun in the hurry of the first railway works. It is true the Romans had occasionally made an arch in two "rings," but they were each a foot deep or more, and in large thin bricks, about equal in bulk to the mortar. It is disgraceful that, since the removal of the excise restrictions, no wedge bricks for bonded arches are to be had but by special order. All that need be wanted are about three stretchers, and four to six headers (I mean by the former those having their length wedged, and by headers those wedged in breadth). If those of each kind formed a radial layer or slice through an arch of the greatest thickness and smallest inner radius ever likely to occur, say a foot inner radius and three bricks thick, they would serve for all arches whatever, by variously alternating such a slice, or part thereof, with another part, or with a radial course of common bricks, or with two or three such courses to one wedged course. Arches of practically any inner radius, from one foot to twelve, might thus be turned, with no joint of perceptibly unequal thickness. Again, such wedges might have about half their weight saved by proper perforations in the direction of the centre battens. Only the faces of the arch (where either may be exposed) need be of solid bricks; and the key course, if perforated throughout and having its lowest stretchers not quite in contact, end to end, would receive and convey away all the foul or hot air rising to any part of the vault (of course into a kitchen chimney if at hand, or some chimney, or, what is better, a special flue inclosed between chimney-flues), and then such a vault would always be a far healthier ceiling than any flat one, or any now in use. If "Building Acts" had any reference to sanitary and public benefit instead of only to regulate risks for the promotion of the insurance trade, (the most anti-national interest possible), no stack of chimneys would be allowed to be built without one extra flue, besides those required for fireplaces, this foul-air flue extending from below the first-floor to a termination like that of all the smoke-flues, and being placed between the two warmest or most used smoke-flues; but its area need hardly, in any dwelling, exceed that of a brick at the bottom, increasing upwards by half a brick more at each story.—E. L. G.

[12315.]—**Dubroni's Photographic Apparatus.**—The great drawback in the use of Dubroni's apparatus is that after having focussed your object you have to remove the camera from the stand and go through certain manipulations before replacing it on the stand previous to exposure of the plate. In the meanwhile a hundred things may have happened to disturb your sitter or whatever you may be about to photograph, in which case you have to go all over your work again, and you may have to do this many times ere you are successful. There are other objections to this apparatus, but the one I have mentioned is insurmountable.—QUERCUS.

[12316.]—**Scale.**—The first scale described is of hundredths of a foot, ten of which are obviously = 1·2in. The ten horizontal lines crossed by nine oblique ones near each end, afford an old and good way of taking with compasses (supposing the lines very accurate, more so than they are usually on wood), any number of 200th's of an inch, up to 1,000; or of 400th's, up to 2,000, without having lines nearer together than a 20th or a 40th inch. On the other side, the scale of unequal divisions marked C means chords, and will serve to mark off any number of degrees on an arc you have struck with the chord of 60°, or distance from the 0 to 60 of the scale, as radius. Or, if you take double that length for a radius, you may regard them as sines of the corresponding numbers of half degrees, and so mark off by one step any half degree up to 45°.—E. L. G.

[12317.]—**Red Prussiate of Potash.**—Dissolve the yellow prussiate of potash in water, then pass chlorine gas through it slowly, shaking or agitating in some manner the whole time, till the liquid acquires a greenish brown colour. The end of the process may be known by taking out a few drops of the solution from time to time, and testing it with a solution of perchloride of iron, the chlorine being passed till the solution fails to produce a precipitate with this reagent. According to the equation $K_4 Fe C_6N_6 + 3Aq + Cl = K_3 Fe C_6N_6 + 3Aq + KCl$, a pound weight of the yellow prussiate would require 1·35oz. of chlorine to convert it into the red prussiate, and this weight might be obtained from either 7oz. of commercial hydrochloric acid or from 2¼oz. of common salt, nearly.—J. W. G.

[12318.]—**Artificial Oils.**—By saying that the oils of terebinth, bergamot, cloves, &c., are isomers is not meant that they can be changed absolutely into each other, so that oil of cloves shall become (say) oil of bergamot, but that on analysis each of these oils is found to contain exactly the same elements united in the same proportions—namely, $C_{10}H_{16}$, the different characters of each oil being produced by a different arrangement of the atoms of C and H in each specimen. In order to prepare oil of winter green artificially "Bob" must first procure salicine, then change this into salycylol by distilling with bichromate of potash and sulphuric acid, or he might obtain salicylic acid at once by passing carbonic acid into phenol containing small pieces of sodium, and now by distilling the salicylic acid with wood spirit and sulphuric acid he would obtain the oil of winter green or methyl salicylate. Phenol or carbolic acid may itself be made synthetically from its elements in the following way:—Pass a powerful electrical current through an atmosphere of hydrogen by means of carbon poles, acetylene is thus produced; heat this acetylene to a temperature below redness, and benzine is formed, treat benzine with nitric acid and you procure nitrobenzine; this, again, by distillation with iron filings and acetic acid produces aniline, and by treating this with nitrous acid it is possible to produce phenol or carbolic acid, so that we see the steps in the production of oil of winter green synthetically to be: Production of acetylene, C_2H_2; benzine, C_6H_6; nitro-benzine, $C_6H_5No_2$; aniline, C_6H_7N; carbolic acid, C_6HO_6; salicylic acid, $C_7H_6O_3$; oil of winter green, $C_8H_8O_3$.—J. W. G.

[12318.]—**Artificial Oils.**—"Bob" will not find the isomeric components of terebinth, bergamot, lavender, &c., to possess the saleable qualities of "taste," "appearance," or "smell," of the natural products from these sources. That (on his part) idea is "flam," but not their atomic components or chemical atoms as demonstrated by analysis. Exact isomerism of physical and chemical component never can be hoped to be arrived at except by the interposition of the process of vegetable life in the plant's cell. Though some isomerics are very near.—X. M. S.

[12319.]—**Dyeing Pulp for Sugar Paper.**—"A Paper Maker" might try a little French slate or glass blue to produce the desired colour.—RAT-TAT.

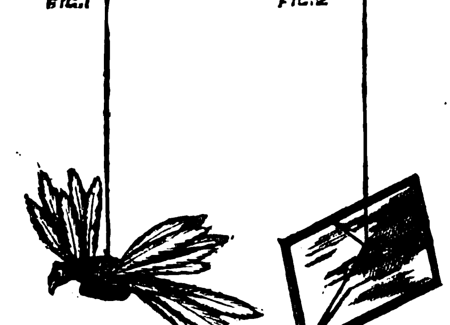
[12321.]—**Chess Player.**—The automaton chess-player is still exhibited at the Crystal Palace. There is a full description of the method of working in Brewster's "Natural Magic." "Willie Scorer" must not suppose that the visible mechanism is the source of the intelligent action.—ALFRED ALLEN.

[12321.]—**Chess Player.**—This subject is treated of at length and most fully in "Letters on Natural Magic," by the late Sir David Brewster, LL.D., F.R.S.—W. M. COLLES.

[12321.]—**Chess Player.**—I can further inform "Willie Scorer" that he will find an interesting account of the "Automaton Chess Player" in the April and May numbers of the *Chess World* for 1868.—J. W. ABBOTT.

[12323.]—**Scarecrow.**—The best scarecrow I ever made for small birds was formed of the pinion of a goose and a potato. Pull all the long pen feathers out of the pinion, and tie the remainder on to the upper side of a large potato, leaving a long string attached to suspend it; then stick the long feathers into the potato, so as to form a terrible-looking bird of prey, as shown at Fig. 1. When suspended from a high bough, or the end of a long rod, it dashes about in the wind, sweeping over or near the crops in a most threatening way, and presents such varied aspect that

FIG. 1 FIG. 2



even wingless bipeds wonder. No. 2 is a small looking-glass hung angling, and is an excellent thing for a cornfield. It flashes forth lightning all over the shop, and even rooks will not face it. When the sun does not shine, it shows everything reflected "on the move;" but the sun's rays reflected from it are a caution. Birds coming within one of its lightning flashes dodge and detour as if a ball had whistled past them. One great feature of it is that its field of refraction is always changing, so that itself seems endued with life. Its flashes may be distinctly seen for a mile.—C. N. ABBOTT.

[12325.]—**Brazing Fine Saws.**—Get a pair of tongs made with very heavy jaws. Fix the saw carefully to a board so that the ends may lie correctly and securely together, cutting away a piece of the board where the join of the saw comes, or in any other convenient manner, and prepare the place for brazing in the usual way. Have the tongs at a white heat and pinch the prepared splice with them, the brazing will be done well and neatly in a moment.—Q. YORKE.

[12328.]—**Terra Metallic Tiles.**—"Puzzled" may again renew the brightness of the tiles by dissolving alum in the water used, or hand-brush the floor, using the brush for black-leading the grates, or one formed of cut steel wires.—RAT-TAT.

[12329.]—**Practical Mechanics.**—I do not think there is any thoroughly good work which completely embraces the subject. I have often been in sore want of one myself, and have had many useful works on the subject pass through my hands but have never yet seen one that does full justice to the science of applied mechanics. If "An Irish Subscriber" has not done so, I would strongly recommend his reading the Cantor Lectures on Applied Mechanics, delivered by John Anderson, C.E., before the Society of Arts, in 1869. They appeared in the ENGLISH MECHANIC, and are also to be had in a separate form on application to the Secretary, Society of Arts, London. I beg to indorse "An Irish Subscriber's" suggestion, and think that a series of papers on applied mechanics would be gladly read by many of our subscribers, especially if they were written, as no doubt they would be, by one who is thoroughly acquainted with this interesting and pre-eminently useful subject.—CABE GLOU.

[12329.]—**Practical Mechanics.**—The three following are the best on the subject:—Goodeve's "Applied Mechanics," Rankine's "Applied Mechanics," Willis's "Principles of Mechanics."—S. M. B.

[12330.]—**Re Slide-Rests.**—In reply to "H. E.," let me ask him if he expects me to sit down and spend a whole day in writing drawings of the rests he wants. I have none by me, and they would take quite that time to make, particularly as one of them is some distance off at a friend's house. I have lately been too busy even to read the ENGLISH MECHANIC. I explained long ago why the drawings "H. E." wants had not been sent, and I will now give another reason. Some time ago a drawing of a certain instrument was requested, and I went to the trouble of making it, having previously been assured by the person asking for it that he actually wanted such an instrument and intended to fit it up for himself. A sight of the drawing choked him off at once: all he did was to return it, having carefully taken a tracing of it for himself. I don't get served so again if I know it.—J. K. P.

[12332.]—**Chemical.**—If the acid be weak, both it and the water suffer decomposition. With an acid of specific gravity 1·11 no decomposition of the water occurs, the gases consisting (when the action has continued some time) of equal measures of hydrogen and chlorine, which will slowly but completely recombine on exposure to diffuse daylight, or instantaneously if exposed to strong sunlight or burning magnesium.—ALFRED H. ALLEN.

[12332.]—**Chemical.**—The acid only will be decomposed by the action of the current; chlorine being given off at the anode or positive pole, and an equal volume of hydrogen at the cathode. In the case of sulphuric acid and water, the water is decomposed by a secondary action, owing to the liberated radical SO_4 not being able to exist in a free state, but this does not apply in the case of chlorine.—SIRIUS.

[12333.]—**Purifying Mercury.**—Your mercury must be distilled in an iron retort, at a low red heat.—DAVID W. BRAID.

[12333.]—**Purifying Mercury.**—Shake up well in a bottle with finely-powdered lump sugar. The bottle should not be more than one-quarter full. Blow air into the bottle with a pair of bellows, and shake up again, repeating the operation a few times. Then filter through a cone of smooth writing-paper with a pinhole in the apex. If this process should not remove all the impurities, redistil after having squeezed the mercury through wash-leather, and then digest in cold dilute nitric acid in a shallow dish for a day or two, stirring from time to time. The nitric acid will act but slightly on the mercury if foreign metals be present.—ALEPH.

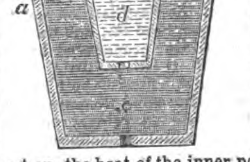
[12333.]—**Purifying Mercury.**—The mercury requires to be evaporated and condensed in distilled water.—RAT-TAT.

[12333.]—**Purifying Mercury.**—Treat the mercury with very dilute nitric acid, and then dry it; if this does not free it from the matters which "Barometer" complains of, he must redistil it, which can be readily done in an iron tube fitted with iron cap and tube screwed on, the tube from cap passing into a larger one closed at bottom, and immersed in a pail of water in order to condense the mercury.—J. W. G.

[12334.]—**Eye Query.**—When the eye loses the power of accommodating itself to near objects, such as small print at from 10in. to 12in. distance, the person is called longsighted. This change, which generally shows itself by a difficulty in reading small print by gas or candle light, commonly takes place between the ages of 30 to 50, which is called longsightness, because objects are best seen at a distance, and arises from a change in the state of the crystalline lens by which its density and refractive power, as well as its form, is altered. It frequently begins at the margin of the lens, and takes months to complete its circle, and it is often accompanied with a partial separation of the lamina, and even of the fibres of the lens. The variation of density takes place most frequently at a particular point in the margin of the lens, and at its commencement vision is considerably injured, if the human eye is not managed with peculiar care at this period. The change in the condition of the lens often runs into cataracts, or terminates in a derangement of fibres which, though not indicated with white opacity, occasions imperfections of vision that are often mistaken for amaurosis and other diseases. When the change has become symmetrical round the margin of the lens, the symmetrical action of a convex lens enables the eye to see as distinctly as before by converging upon the retina rays flowing from near objects, which the unassisted eye refracted in such a manner that they would meet at points beyond the retina. And the best advice I can give our querist will be this: Avoid excessive tea drinking, and as much as possible drinking liquors or spirits. If a smoker, give up tobacco at once, as there is nothing but regular and moderate living without excesses that will do any good. Wash the eyes in clean cold water two or three times a day, placing the face in the water with eyes open, persevere, and I have no doubt but "Spectroscope" will find great relief. If 24in. is the point at which querist can read small print, he will require a pair of convex spectacles to read in of 16in. focus, to enable him to read at the proper distance; and I would advise him to get them of smoke colour, the kind called bluish smoke, which will produce a natural effect, and they will be better to be peroscopic eyes. They may cost 10s. to 12s., and will do good service.—WILLIAM OLDFIELD, Sheffield.

[12336.]—**Vine.**—You can do both, and now is the time, heat and water both required.—OLD BOOTS.

[12337.]—**Seed.**—Some years ago, when I could not afford the luxury of a frame, or a hot-house, I raised the seeds of passion flower, canna, and some other difficult seeds in the following manner. I took a large pot a, and a smaller one b; between the two I stuffed newly-cut grass c as light as I could pack it. I sowed



the seeds in the pot d, covering it with a small piece of glass e, on the upper side of which was pasted a piece of blue tissue paper. (I had no blue glass at hand.) Then I watered and covered the larger pot with glass. I plunged the large pot in the ground. The seeds were up in no time. On removing the glasses to see how they got on, the heat of the inner pot has been so great as to be unbearable to the hand. I believe any tropical seeds might be so raised. As soon as they are up, air should be given, and when forward enough they should be planted out as wanted.—OLD BOOTS.

[12338.]—**Hyacinth Roots.**—When they have flowered let the pots be placed in a cool, dry situation, or the bulbs taken up and planted in sand, and so placed. When the leaves have withered away take up the bulbs, cut off the old roots and rootstock, loose scales and offsets (the offsets should be planted by themselves, to grow up into the flowering state), and leave the bulb in a cool dry place for a week, to harden. Then plant it in the border where it is to bloom the next year. If bulbs are purchased, plant them as soon as you obtain them, and not later than September. They will not bloom earlier for early planting, but the plant and blossoms will be much larger. The soil that answers best is composed of rotted turf mould, leaf mould, and sand, one third each, the two first ingredients being prepared long before planting time. Give six inches below and three inches of the soil above each bulb.—GERARD SMITH.

[12340.]—**Flour Paste.**—When your paste is nearly cold, add a solution of about two drachms of water in which has been dissolved 10 grs. of corrosive sublimate to each pound of paste, also about 10 drops of essential oil of lavender. Stir it well up and keep covered. You will find it a good plan to dry the paste in an oven till it is like horn, take out as much as you want at a time, and work it up with warm water.—OLD BOOTS.

[12340.]—**Flour Paste.**—All paste will get mouldy; make it in smaller quantities; it keeps best in a vessel of wood, not painted, covered over in a cool, dry place.—PAPERHANGER.

[12340.]—**Flour Paste.**—Add a little brown sugar and a few grains of corrosive sublimate to the paste; it will keep much longer, or add to it a few drops of carbolic acid.—J. W. G.

[12340.]—**Flour Paste.**—A little corrosive sublimate, or camphor, dissolved in it may keep it fresh for some time.—RAT-TAT.

[12341.]—**Moths.**—Try sprinkling the infested places with a mixture of powdered arsenic and camphor, or mix sugar with arsenic and set it in convenient places. Cover the floors and furniture with damp grass for one night, remove and thoroughly clean next morning.—RAT-TAT.

[12341.]—**Moths.**—The evil is in your sofa; your best plan is to sell it for anything you can; cure your carpet by thorough brushing and beating. If you buy another sofa keep it in constant use, and the surface well brushed, especially the parts least seen. If you only want the sofa to look at let the cover be cotton or linen, not woollen—better still, not to buy what you are afraid to use.—UPHOLSTERER.

[12343.]—**Dresser Top.**—If your sycamore top had not gone "winding" the worm would soon eat it up. There is no remedy but to have a new top of clean pine.—CABINET-MAKER.

[12343.]—**Dresser Top.**—Remove the sycamore top, steam it, and leave it under weights until it straightens and seasons. Damp cloths would not be of much use, unless at the same time constant pressure for a few hours could be applied.—RAT-TAT.

[12344.]—**Disappearance of Art.**—Ancient art, both mechanical and fine, depended mainly upon idolatry, which was by no means a cheap religion. We can hardly conceive the intense hatred of the earliest Christians to everything tainted in the least degree with idolatry—and everything was tainted with it—hence, as one prevailed the other declined, and in a few centuries Mahomedanism finished what Christianity began. I can readily believe that Christians for at least 300 years, carefully shunned for their children all that we call "art education."—E. G.

[12346.]—**Gearing Waggon Wheels.**—Bring the rule of three to bear on it thus: If dish of wheel be 2in., half the diameter 25in., length of arm or axle 10in.,

Then 25 : : 2 : 10 (arm
2

25) 200 (8in. out of straight line.
200

Bear in mind I am working from centre of arm or axle. Another way—and by far the best—is to make a full-sized drawing of wheels in their right position. Make the face of spokes in bottom part of wheels parallel to each other.—LUFFRA.

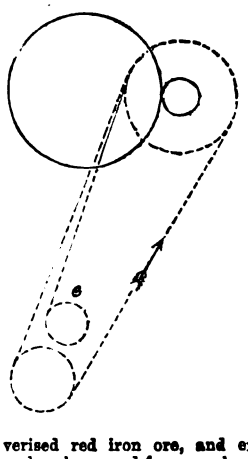
[12347.]—**Stroke.**—The stroke of an engine varies according to circumstances, which the designer must take into consideration, but the general rule is to make the stroke about twice the diameter of the cylinder. The diameter of the fly-wheel should be about four times the stroke of the engine, and the rim should weigh about 3 cwt. per horse-power.—FALSTAFF.

[12348.]—**Spanish Pronunciation.**—In answer to our learned contributor "E. L. G.," I beg to say that all good speakers of the Castilian tongue pronounce the final *z* as *theta* (the hard *th*); and the words he quotes *vez*, *paz*, *cruz*, are pronounced by good speakers *bayth*, *päth*, *crooth*, there is little, if any, difference between the Spanish *b* and *v*—both are pronounced with very nearly the same pressure of the lips as our English *b*; they write *vino* (wine) pronounced *bēno*, and they say *blancho* (white) pronounced as we should do. The final *d*, which is erroneously classed as *d* mute, is a much more difficult sound to get, it is our soft *th* very slightly. At Madrid its sound is precisely that of the *th* in our word *the* or *then*; but in Old Castile it is so nearly silent that many foreigners completely neglect it, and the words quoted by our friend "E. L. G." are pronounced by them very nearly *Berdā* and *Madri* (spelt *Verdad* and *Madrid*). The true sound, however, shows the faint presence of a final soft *th*, when heard from the mouth of a native of Old Castile. For the benefit of "Cast Steel" I wish to say that *g* before *e* and *i*, and *j*, whether initial, medial, or final, have the invariable sound of the hard guttural German *ch*. "Cast Steel," after he has mastered the verbs, will find Castilian one of the easiest of modern languages. If he will write to me privately I shall be happy to lend him for a time my "Estudios Filológicos," by Morentin, 1857. This contains a full examination of, and settles all knotty points in, the Castilian tongue, besides giving examples from the best Spanish authors.—WILLIAM WRAY, 1, Clifton-villas, Highgate Hill.

[12351.]—**Underground Telegraph Wires in Cities.**—Perhaps the following information from the "Electric Telegraph," by Bright, may be of service to "Dynam." "The wires are carried in iron pipes under the foot pavements, along the sides of the streets, and are thus conducted to the terminal stations of the various railways. Provisions, called testing posts, are made at intervals of a quarter of a mile along the street, by which any failure or accidental irregularity in the buried wires can be ascertained, and the place of such defect always known within a quarter of a mile. Some of the wires of the British and Irish Magnetic Telegraph Company were at first laid and protected in the following manner. Ten conducting wires are enveloped in a covering of guttapercha, so as to be completely separated from one another. Thus prepared, they are deposited in a square creosoted wooden trough, measuring three inches in the side, so that nearly a square inch of its cross section is allowed for each of the wires. This trough is deposited on the bottom of a trench cut two feet deep along the side of the common coach road. A galvanised iron lid, of about an eighth of an inch thick, is then fastened on by clamps or small tenter hooks, and the trench filled in. The method of laying the wires in the streets adopted by this company is a little different. In this case iron pipes are laid, but they are split longitudinally. The under halves are laid down in the trench, and the guttapercha covered wires being deposited, the upper halves of the pipes are laid on and secured in their places by means of screws through flanges left outside for the purpose. To deposit the rope of guttapercha covered wires in the trough, it is at first coiled upon a large drum, which being rolled along slowly and uniformly over the trench, the rope of wires is paid off easily and evenly into its bed."—C. N. W.

[12351.]—**Underground Telegraph Wires in Cities.**—In answer to "Dynam, Chicago," I beg to give him a short résumé of the best system used by telegraph engineers in running underground or "cable" wires through large cities or great centres of traffic. The wires through Cheapside, the Strand, Oxford-street, &c., are all laid on this plan. The first thing necessary is to obtain the consent of the Local Board to open up the ground. This is seldom refused, although it is sometimes obtained with great difficulty. (It is much to be regretted that the Government are so completely at the mercy of Local and Highway Board Surveyors in this respect.) Through busy streets the outside edge of the foot pavement is usually selected. Iron pipes with an inside diameter of 3in., of the same kind as used for gas or water, are laid about 18in. deep; as each pipe is put down a stout iron wire, No. 8 gauge, is threaded through it, and at distances of about 100 yards an iron flush or test-box is placed. This box is simply an oblong cast-iron box, 2ft. long, 10in. wide, 18in. deep, with movable stone lid laid flush with the pavement; the pipes are brought into each end of the box, and the iron wire terminated at each box and the ends secured. The pipes are then rammed with yarn and run in with lead to prevent gas or water leaking in, and the ground filled in as you go on. All is now ready for drawing in the cable. The wire most used is "No. 8 prepared guttapercha wire." This is a copper conductor of about No. 18 gauge, thickly covered with a coating of guttapercha, and that again covered with two coats of tape soaked in Stockholm tar (gas tar must be specially avoided for this purpose, as it injures the guttapercha). The wire and coating is now about the thickness of an ordinary lead pencil. The 3in. pipes will conveniently hold about thirty-five wires. The wires are wound side by side round a "drum barrow" and conveyed to the first flush box, the end of each wire is stripped of its guttapercha covering for about a foot, and the copper conductor carefully and firmly attached to the iron wire, the end of which is looped up and twisted round itself. Great care should be taken that each individual wire is firmly attached to the iron wire; the joint is then well wrapped with hemp or yarn made as smooth as possible, and well greased. Three or four men now go to the next box and steadily pull the iron wire (with cable attached) through. Of course, a man or two is left at the drum to see that the cable pays out properly and without kinking. About 6ft. should be left slack in each box to allow for testing purposes in case of faults. A box must always be put in at every set of joints or any sharp curves. The wire is usually supplied in lengths of 300 or 400 yards. If good supervision has been exercised, steady workmen employed, and every pipe thoroughly examined to see that no rough jagged pieces of iron are sticking up inside, the wires should all test as perfect when laid as before. If there is any incline in the level of the pipes it is a good plan to pour in a pail or two of water when drawing the cable through. As repairs to wires laid by this system are very difficult it is usual to run in several spare wires; if twenty-five wires are wanted thirty to thirty-five should be laid. The most fruitful causes of faults are—gas or water men smashing the pipes with a pickaxe when digging in the neighbourhood, and so cutting into the wires; rough pipes not being rejected, and careless drawing through, and bad joints. The inductive embarassment from one current flowing into another is *nil*, or at any rate so small that no account need be taken of it. I shall be happy to give "Dynam" any further information he may wish.—TEL. ENG., Oxford.

[12352.]—**Centrifugal Pump.**—There seems to be a little complication in "Teachable's" diagram of gearing wheels: *b* in the drawing is, I presume, the pinion wheel. Why not make it smaller, or place it, with another pinion wheel between the spur-wheel and disc, so as to do away with driving chain or band? By putting the large pulley and pinion on the right side of spur wheel a longer belt is necessary, and the question is whether any belt is strong enough for a 16 horse-power engine, except one longitudinally interlaced with copper wire, a dear sort of belt, though very lasting and not liable to breakage. By the arrangement alluded to the small wheel or friction roller *e* might be removed, as the belt from the greater distance of the pulley on disc and pinion pulley would work better without. Would "Teachable" try this idea, which I think is in part original? Avoid wheels and mechanism altogether, and when steam is generated to sufficient pressure in the boiler, let it be conducted at once into pump with small feed-pipe and cut-off valve. The upper portion of the pump where the steam enters may be made of larger diameter than the lower or water portion and left uncovered. The feed pipe is to be bent and pointed upwards. This arrangement is similar to the blast pipe in locomotive, and by it water could be raised through the pump-pipe and to any reasonable height, as smoke is inducted through the boiler tubes and into the smoke box, and driven out through the chimney.—RAT-TAT.



[12352.] — **Centrifugal Pump.** — If "Teachable" has his strap driving in the direction of arrow, he will not require the pulley *e* (left-hand side of strap downwards). As he does not state what kind of centrifugal pump (that is, pitch) I cannot tell him speed required. From the data he gives, his disc-shaft will travel 126 $\times \frac{72}{30} = 302\frac{1}{15}$, instead of 375 revolutions.—G. W. S.

[12356.] — **Small Malleable Castings.** —These must be made from a hard, white, crystalline iron. They must be packed in pulverised red iron ore, and exposed to a heat rather under cherry red for a week, when they will be found to be malleable. The red ore may be used over again, mixed with one-eighth part of fresh ore.—ALEPH.

[12357.]—**Stretching Vulcanised Rubber.**—Not by any process known at present. It might be spread out in a fluid state to the required dimensions, but the rubber would remain viscid.—RAT-TAT.

[12362.]—**Formula.**—See No. 295, p. 203, first formula. The last formula (for ullage) is wrong, and corrected in No. 298, p. 283.—E. L. G.

[12363.]—**Recovering Indigo.**—Treat the mixture with a weak solution of green copperas (3 per cent.), let it boil for an hour, filter, or strain through flannel bags. After standing some time, the yellowish solution will deposit the indigo nearly pure.—S. BOTTONE.

[12373.]—**Softening Spring Water.**—The hardness of water derives from the presence either of calcic carbonate, or calcic sulphate. This latter form of hardness is irremediable. That caused by the carbonate may be removed by adding a given amount of lime to the water. But it would be useless to put it in the well. The mode of procedure to be adopted would be the following:—Having found by experiment the amount of calcic carbonate contained in the gallon of water, place the quantity of water required for daily consumption in a tank. For every part, per gallon, of carbonate, which the water contains, add three-quarters of a part of fresh slaked lime. Allow the whole to stand some time before using. The tank will require cleansing from time to time to remove the deposit of chalk which will form.—S. BOTTONE.

[12380.]—**Light.**—That outside the room will be kept out, that inside the room will be dissipated and become heat. The querist must not forget that light is not an entity but a mere "mode of motion."—H. P. H.

[12380.]—**Light.**—Light is caused by rapid vibrations; anything which lessens the rapidity of the vibrations, or stops them altogether, lowers the intensity of the light, or produces total darkness. As an exemplification, let us suppose that two adjoining tanks, full of water, communicate with one another by means of an aperture. Let the water in one tank be kept in agitation by stirring &c. The water in the other tank will also participate in the motion. Let us now close the aperture. The motion of the water in the second tank soon ceases. The same is the case with light, though, of course, as the light waves are inconceiveably shorter, so the duration of the light, after the communication has been cut off, is almost inappreciable. Still, the undulations do continue, as may be proved by the fact that on exposing a scarlet geranium to the full glare of the sun, and suddenly placing it in total darkness, it is still visible for a short space of time; id est, it still communicates vibrations to the eye.—S. BOTTONE.

[12380.]—**Light.**—If the stopper of the rays be black or dark it absorbs them, so that they become heat. If white or pale, it reflects the greater portion, and if dull or glittering, turns them in all directions, to fall on every object outside, and a proportionate quantity to the sky (if there be any clear sky) so as to pass out of our atmosphere and away for ever. Now if the stopper has a face of brilliant silver, the whole (except the little that it absorbs) will be thus sent out of our world, which will, on the whole, be so much the cooler than if these rays had fallen on any other material. See my reply to query 11809, p. 337.—E. L. G.

[12381.]—**Education.**—Let "Paterfamilias" write to the Provost, S. Nicolas College, Lancing, Sussex, for a prospectus of the schools in his scheme. I think one of them will suit him.—SACRISTAN.

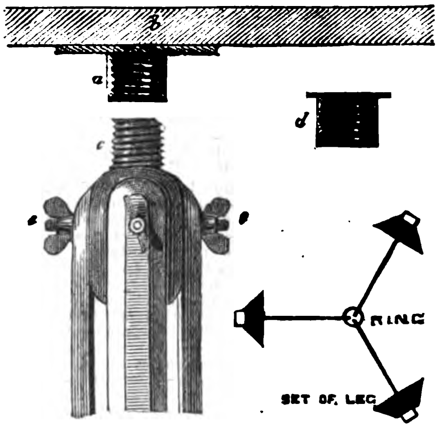
[12385.]—**Sulphur in Wall Papers.**—Ultramarine contains a considerable quantity of sulphur, hence is not adapted to colouring such papers as are to be used by jewellers, &c.—S. BOTTONE.

[12389.]—**Dirty Mercury.**—Tie the mercury into a piece of wash-leather, and force it through the pores by pressure between two boards. If the impurities come also, distil the mercury in an earthenware retort, and condense same in a flask. Pure mercury will not stain a barometer tube; a foul tube can generally be cleaned with warm hydrochloric acid.—PRIAM.

[12390.] — **Chemical.** — Roscoe's "Lessons on Elementary Chemistry" will meet "Home Student's" requirements. 1871 edition.—S. BOTTONE.

[12392.]—**Bee Management.**—The only safe way I can recommend "W. T. L." is to take the bees by stupefying them as he would do at "taking-up" time, but as the bees and not the honey seem to be the object "W. T. L." is desirous of saving, I should advise him to try chloroform and not brimstone, as the latter generally destroys life. "W. T. L." will find full instructions how to proceed with chloroform in No. 375 (answers to query 11762). After being placed in the box-hive, I should recommend constant feeding whenever it is dull or wet, as the season is getting on, and it is doubtful if they would get enough to keep them through the winter. If they are pretty strong, I should wait till end of this month, and then move about half or (say) 10lb. of comb into the box-hive with them for a winter supply; the combs may be suspended in the box by passing a stout bit of wire or small rod of iron through the middle of the box, unless it is a bar frame hive. This should, of course, be done while the bees are in a stupefied state.—BERKS FARMER.

[12393.]—**To Steady a Sketching Board.**—In answer to "Poloski," I presume that portability is the first thing to be desired. It is quite possible to get firmness if the supports to the drawing board are stout enough, such as a heavy tripod stand, like those used for levels, which, when closed, is about the thickness of a scaffold pole. Having been in a similar difficulty, I gave up the idea of perfect steadiness out-of-doors, portability being the first thing to be attained. I will describe the stand I made. It consisted of an ordinary tripod camera stand; the top portion above the leg junctions was fixed with a screw *c*, which acted with another *a*, fitted on the centre of under side of drawing-board *b*. This screw arrangement, if nicely fitted, will give all the needed firmness, supposing the board is not too large. Mine is 12in. by 16in. Then concerning the legs: the thumbscrews *e e* will, if screwed tightly before using, with the spikes at bottom, give firmness enough for all ordinary purposes. The other security that occurs to me is to have light iron wire stays to connect the legs at lower portion by screws and nuts, to take out and double up when not wanted (see small diagram), or the same purpose would be served by connecting supports by stout string.



Either of these contrivances will prevent the outward slipping. I do not believe that the camera lucida could be used with any kind of stand with much wind. An arrangement like this could be made more portable by doubling up at centre of legs by hinges, made firm for use by rings similar to those made for parasol handles.—A WORKING B.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "The Welsh Shepherd" has answered 11940, 11259; "S. M. B." 11962.

12057 Defective Sewing Machine, p. 313
12059 Watch Conversion, 313
12063 Tambour Frame, 313
12064 Diameter of Screw, 313
12067 Portable Force-pump, 313
12071 American Drill Chucks, 313
12074 Hollis Observatory Seat, 313
12075 Fruit Syrups, 313
12076 Polishing Slate Clocks, 313
12082 Turning Tools used for Metals, 313
12083 Polishing the Edges of Glass, 313
12084 Tools with Swiss Mandril, 313
12085 Cricket Bats, 313
12087 Violin, 313
12091 Plums, p. 314
12093 Budding or Grafting, 314
12095 Hardening Steel Shafts, 314
12103 Staining Glass, 314
12104 Spring Curves, 314
12107 Recipe for Greasy Strapping, 314
12117 Restoring Colour of Watch-plate, 314
12119 Pump for Colliery, 314
12121 Chemical Preparation of Fruit Essences, 314

QUERIES.

[12430.]—**Automaton Chess Player.**—Will Mr. Meyer be good enough to send a copy of the article he put in the *Gentleman's Journal*, as it cannot fail to interest all "our" readers who are chess players?—WILLIE SCORER.

[12431.]—**Bees.**—Would some one be kind enough to tell me the best way to take a hive without destroying the bees? as I have, in former years, been in the habit of burning sulphur in the hive, which not only killed the bees, but gave the honey a bad taste. Also, whether I must take all the honey out of the hive, and whether a second or third swarm would be likely to live over winter?—WILLIE SCORER.

[12432.]—**Testing Beer and Spirits.**—Will some correspondent inform me how to test the strength of spirits and beers properly; and the price of the cheapest apparatus used for that purpose?—J. W. F.

[12433.]—**Pie Heater.**—I have got a tin case to make same as those used in the London pie shops. Will some kindly reader give me such instructions as will assist me, say if hot water is used, and how the steam escapes, and if the water is kept hot with a gas jet, &c.?—A COPPERSMITH.

[12434.]—**Castings.**—Has there been a heavier casting cast at Bolton than at Sheffield or Newcastle? or can some one say where the heaviest casting was cast, and where the next heaviest was cast, and what purpose they were for?—J. WATSON.

[12435.]—**The Dragon-fly.**—A few particulars concerning the natural history of the dragon-fly, in a microscopical point of view, would be of interest to the subscriber, and no doubt to many other readers. I have lately been working upon the ovipositor, which makes a beautiful object for the microscope. Besides other features worthy of notice, there are two pairs of saws, somewhat resembling those of the saw-fly, and which show very beautifully when carefully prepared and mounted in balsam. What I should like to know is, the use of these saws, seeing that the insect deposits its eggs on the surface of water. The structure of the end of the male dragon-fly's body is also very curious. Any information or reference to authors who have written on the dragon-fly would be acceptable.—J. FORD, Stamford.

[12436.]—**Chromo-Lithography.**—Can any one give the entire process, and confer a great favour on a great many subscribers?—H. B. E.

[12437.]—**Brickmaking Machine.**—In No 289 of "ours," there was an extract from an American paper describing a newly invented brickmaking machine. Will some one kindly say if the machine has been introduced to this country, and if it has come up to the merits claimed for it in the above mentioned article?—ANGLO CELT.

[12438.]—**Chess.**—Would some reader kindly give me a solution of the knight's move over the whole chessboard, beginning on one of the four centre squares?—MANTISSA.

[12439.]—**Working Plane Surfaces.**—Will some reader describe the method for grinding and polishing perfect plane surfaces? I want to construct an instrument that requires perfect surfaces for reflection. I have succeeded only partially. A reply will greatly oblige—R. ROBERTS.

[12440.]—**A New Oil Light.**—I noticed about five weeks since that a new compound oil light of intense brilliancy was introduced by a German gentleman at the Inventors' Society, London, being only inferior to the electric light. Can any of "our" readers enlighten me on the subject?—P. K. S.

[12441.]—**Ants.**—Can any of your readers inform me how I can destroy ants, which have taken up their abode under the ground floor of my house, and, like the children, they get to cupboards where any sweets are kept?—THOS. LETCHFORD.

[12442.]—**Indigestion.**—I am troubled with indigestion and, like "Aroma," I tried the Susquehanna remedy but did not derive much benefit. I also, by the advice of a doctor, tried quinine. Could any of "our" correspondents give me a remedy?—PUPIL TEACHER.

[12443.]—**The Tremolo.**—I am much obliged to "Fiddler" for his answer to query 12297 as to the tremolo on the violin; but I think he has misapprehended my question, as it was not the shake or trill I wanted information about, but the tremolo, marked by Spohr with a wavy line. It is produced by the trembling or quivering of the single finger which stops the note, not by beats of the next finger. It is, in effect, something like the "vibrato" in singing. What I want to know is how to get the finger to tremble or quiver on the note, as my fingers obstinately refuse to move in the required way.—CORELLI.

[12444.]—**Day and Night Telescope.**—What is there special in the construction of a day and night telescope, and what advantage has it over an ordinary telescope?—VIDEO.

[12445.]—**Rotten Silk.**—Being a silk smallware manufacturer, and having had a strike in the trade, I have had some looms standing some time with a little silk in. Now we begin to work them the silk is quite rotten and breaks badly, and my foreman tells me it is the dust that rots the silk, he has seen such cases before. Could you inform me if that is the case through your paper, so that in future I can guard against it. The silk is black, and was never covered, and, of course, got quite covered with dust.—ANXIOUS.

[12446.]—**Manganese Battery.**—I should feel obliged if your esteemed correspondents "Sigma" or Mr. Tonkes would give me some information as to the following:—A three cell manganese battery, which has been in action since March, 1871, suddenly stopped on Monday last. On examining the battery, I found that the binding screw attached to the carbon of the middle cell was wholly covered with a very dark green crust, which I had to file off; the others were comparatively clean; it was doubtless this which stopped the current, as when the connections were cleaned the battery tested well. Now, would the fact of the battery being put to earth at each end cause the connections to corrode in this way, as until I added another circuit to the battery (from the house to the stable in which I used the earth for the return wire) I had no trouble at all, the battery being in a dry place the connections were kept clean. The connections are made as follows:—A stout copper wire is soldered to the zincs, coated with sealing-wax varnish to within an inch of the end; the binding screw is let into a lead casting at the top of the carbon stick, and coated about an inch all round with melted rosin.—EDWARD HENRY.

[12447.]—**Employment for a Retired Tradesman.**—Having acquired about as much of the "filthy lucre" as will keep me out of the workhouse, I want something to do. Can any of your correspondents or readers assist me? The change from an active business life to one of idleness won't do, and to frustrate his satanic majesty from finding me a job, I should like a few suggestions as to what is best to amuse, instruct, and interest. My taste is just a bit scientific. Mechanics might develop by practice if I got a lathe. As I know nothing about one, which is the best? One adapted (if any) for polishing stones as well as ordinary turning, and about what should I give for one? A few joiners' tools, &c., which are most in use, in fact, if I dedicate one little room in my house as a workshop, how should I furnish it? This query will perhaps fit other poor devils in a similar plight to myself, or who may be some time—A RETIRED TRADESMAN.

[12448.]—**Wall Papers.**—In "ours" of 28th ult., there is an excellent article on poisonous wall papers, in which, I think, all colours are condemned. I should feel very greatly obliged if some one or other of our contributors would kindly let us know with what we should decorate our walls, and if all papers be poisonous what colours are the least dangerous. I am sure that many besides myself would be thankful for information on the above point.—JIGGER.

[12449.]—**Gnats.**—Any of your able correspondents will greatly oblige me by informing me through your columns what is the best remedy for gnat-bites. Also, the best preventative to being bitten at all by those noxious creatures.—CONSTANT SUBSCRIBER.

[12450.]—**Beehives.**—I think all who are interested in the management of bees are certainly very much indebted to Mr. Abbott for the timely advice and general good information he gives in your valuable columns about bees. There is a diagram of a hive in No. 350, p. 306, I want just to ask a question or two about. (1) Is this the kind of hive Mr. Abbott now uses in preference to all others, as he says he sells his old hives for a mere song? (2) Do the blocks or distance-pieces between the inner and outer case reach from bottom to top of hive, or only a block at the bottom and another at the top? (3) Are the notches at the top for the reception of the ends of bar frames cut out through both cases, or only the inner one? (4) How does he manage when he takes off the top of the hive to prevent the bees getting down between the inner and outer case?—S. R. S. B. G

[12451.]—**English Concertina.**—I have an English concertina by Prouse, brass vibrators, and screwed; three notes are gone flat. Will some clever correspondent of "ours" kindly tell me how to put it in tune? and how can I get at the inside screws?—T. W.

[12452.]—**Building on Sand.**—I should be glad to receive a suggestion as to the best mode of securing a good foundation for a house I intend building, the site on which it is to be erected being composed entirely of a bed of sand? Would it be safe to build upon the sand, or should some provision be made in the way of concrete foundation?—INQUIRER.

[12453.]—**Manganese Cell.**—I have made a manganese battery, making connections with the carbon by soldering a piece of platinum foil on the end of a piece of copper wire, and soldering the whole into a hole in the carbon, and well covering with wax, both the top of the carbon and about ½in. of the wire. I find (after four weeks) that the wire is now eaten in two. How can I remedy this? Will electro-plating a copper wire and soldering it into the carbon be sufficient as in a series solid platinum wire would be too expensive, as also would binding screws. I should be obliged by a description of a joint that could be made by an amateur, and is not too expensive? The battery is the best I have ever used? How does it answer for plating?—D. J.

[12454.]—**Southern States of America.**—Will any subscriber give me some information regarding the climate, mode, and cost of living in seaport towns of the Southern States—say in Savannah, Pensacola, or New Orleans—or name any work giving reliable information on the subject?—JAMES LARGON.

[12455.]—**Water Supply.**—Where can I find the chartered terms on which the East London Water Company supply water to consumers, if through meter to private houses as well as manufactories, price for quantities, pressure of supply, what control they (the company) may have over their water after it has passed the minute ferules they place in their street main, where the tenement branch leads out and there is no meter, and if there is any statement of uses to which such tenement's water may be applied while paying the usual household rates?—X. M. S.

[12456.]—**Fuel for Steam Engine.**—Will some reader of the ENGLISH MECHANIC inform me if the ordinary gas house coke saturated with coal tar would increase in value for heating purposes sufficiently to replace coal? It is required for a 4 horse-power steam engine. Would it be superior to equal proportions of small coal and coke? Ordinary house coals are selling here at 30s. per ton, which makes working a steam-engine rather expensive.—HORTI.

[12457.]—**Geometry.**—In a given triangle inscribe a rhombus which shall have one of its angular points coincident with a point in the base, and a side on that base.—W. M. COLLES.

[12458.]—**Blowing Apparatus.**—Wanted an apparatus for blowing air (similar to the "Bessemer" process) into a vessel 3ft. deep, and about 20in. diameter. Material, hot syrup. If any of our readers would kindly advise what is suitable, whether fan or air-pump, and what size, they will confer a very great favour upon—SIMPLEX.

[12459.]—**Bending Laths.**—Would "Jack of All Trades" or any other gentleman be kind enough to tell me the best and simplest way to bend laths 1½in. to 2in. wide × ⅛in. thick?—R. M.

[12460.]—**Four-valved Cornet.**—Will some correspondent be so kind as to give me a scale for a cornet or flugelhorn with four keys?—H.

[12461.]—**Threads in Gas-pipe.**—Will any of your correspondents inform me of the "number of threads" contained in an inch of gas-pipe from ⅛in. to 2in. diameter, and the same particulars respecting the "brass thread?"—A SUBSCRIBER.

[12462.]—**Electrotyping.**—I have several plaster-of-Paris casts, taken from medals, about a quarter of an inch thick. Will some one kindly tell me how to make guttapercha or wax moulds from them for electrotyping? They have no rim to prevent the melted wax from running off. Should the plaster be oiled before pouring the wax on? Also, I should be glad to know how to lay the blacklead on my wax and guttapercha moulds. I generally use a soft camel's-hair brush for the purpose, but it makes the blacklead stick in some places and not in others.—GLATTON.

[12463.]—**Vision.**—Can "M.R.C.S." or some other correspondent explain to me the most probable cause of the inversion of the images depicted on the retina? It is clear that after the rays pass through the crystalline an inverted image is thrown on the retina, and yet we see objects in their right position. I know of two reasons —(1), that it is by a regular education of the eye, the visual impression being corrected by touch, &c.; (2), that as we see everything inverted, nothing appears inverted, as there are no terms of comparison. I should like to know which of these theories is the best, or if there is any other.—H. SCIENCE.

[12464.]—**Aquarium.**—Can any friend say what is the cause of the water becoming white in a glass globe in which I have a goldfish? One day the water is nearly white; the next day whiter still, but just the same as if I had put water in a dirty milk-jug; on the third day I can't see the fish through the glass and water, and then I find the fish dead.—E. FOWLER.

[12465.]—**Compound Eyepieces.**—I return many thanks to "A Fellow of the Royal Astronomical Society," Mr. Proctor, Robert Thomas, and William Oldfield, for their kindness in replying to my queries. If I might trespass a little mere on their good nature, I should like to know the way to ascertain the magnifying power of compound eyepieces. I know that with a single lens eyepiece the power is as many times as the object-glass exceeds the eyepiece in focus, thus a 1in. eyepiece with a 48in. object-glass will magnify 48 times. But I do not know how to tell the power with a compound, such as the Huygenian or Ramsden that has a field-glass and eye-glass, or a terrestrial with four lenses, by what rule is their power computed?—C. B.

[12466.]—**The Harp.**—Would "Ixion" (letter 4468) through "our" journal send the length of pole and each octave string; diagram of string plate, and description of soundboard, of his wire-strung harp?—EAST-END MECHANIC.

[12467.]—**Nitrate of Soda.**—Will "Soda" be kind enough to inform me the cheapest way and best time to buy a large quantity of nitrate of soda, say a small cargo? Would now be a good time to do so? The retail price has been this season as high as 17s. 6d. per cwt., and yet at that price it is the cheapest manure which a farmer can buy.—S. BROWN.

[12468.]—**Exhibited Inventions.**—I have heard somewhere that inventions about to be exhibited for the first time at one of the International Exhibitions can, on payment of a registration fee of a few shillings, be protected for the period the exhibition lasts. Will any brother reader oblige by giving some reliable information about this?—ZURICH.

[12469.]—**Bees.—How to Get a Swarm.**—Is there any means of making bees swarm, or of separating a swarm? My bees swarmed 2nd May, and have hung out for this last month, but do not cast a second swarm. One of our friends some time ago told us (through the MECHANIC) to turn up the stock hive and place another over it and drum them up. I should like to hear Mr. Abbott's opinion on this plan before I try it, as I can't understand how the new stock thus formed gets on for a queen.—F. J. GODDEN.

[12470.]—**Separating Salts Produced from Kelp.**—Will "Analyst," Mr. S. Bottone, or any of your correspondents, inform me how I can separate the various salts produced from kelp? The salts I wish to separate are chloride of potassium, carbonate of soda, and sulphate of soda, which are produced in the first evaporisation of the kelp liquor. I believe that the sulphate of soda could be crystallised out in the cold. If caustic lime were added to the liquor, would chloride of lime be precipated, caustic potash and bicarbonate of soda be produced, and if so, could they be separated? Any information relating to the above will oblige—A TYRO.

[12471.]—**Wheels.**—Could any one of "our" readers tell me which are called the "face arms" and which the "back arms" of a wheel?—FALSTAFF.

[12472.]—**Electrical.**—Would some kind reader answer the following queries?—1. What is the reason that an ordinary "shocking coil" does not deflect a galvanometer? 2. What coil is the best to use for medical purposes, and how do they differ from the "shocking coil"? Are the "magneto-electric machines" of greater medical value than the various coils in use? 3. What kind of battery is the best to use for coils where they are required to be left for some days without alteration or pulling to pieces, that is, always ready for action?—MEDICAL.

[12473.]—**Printers' Rollers.**—I shall feel extremely obliged to any member of the printing profession who will be kind enough to inform me the best mode of casting rollers.—A TYRO.

[12474.]—**Machine for Making Aerated Drinks.**—In letter 4406, p. 380, "H. B. E." submits a sketch of a machine for making aërated drinks. I like the plan very much—the bottling and corking machine attached, also the little space which is required for its working, and the generator which is attached to it. "H. B. E." will oblige by answering the following questions:—(1) How is the machine worked—can it be worked by steam? (2) Is the water and gas pumped into the condenser together by one pump or plunge? (3) What will be the cost of the machine to make 1,500 bottles per day.—E. L. P. G.

[12475.]—**Removing Whitewash.**—Will some reader of your columns kindly inform me how to remove whitewash from the *face* of stonework and woodwork without scraping or reducing the surfaces, portions of which are carved?—S., Colombo, Ceylon.

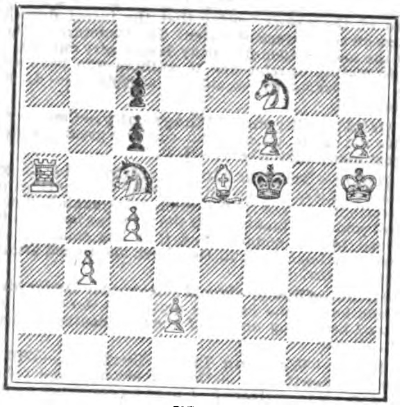
CHESS.

ALL communications intended for this department to to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The feudal age appears to have been the high and palmy era of chess, which, with music, was then considered as indispensable to the formation of an accomplished knight as skill in arms. In later times, the loftiest minds of their day, including kings, statesmen, and philosophers, have not disdained to resort to it as a relaxation from grave cares. The scroll of history, rich as it is in instances, can point out no stronger or more eloquent moral to that sin by "which fell the angels," than the stern Corsican bound to his desolate rock, and playing chess for the dear life, to stun the gnawings of his twin devouring vultures—fallen pride and blasted ambition. The genius of chess, moreover, is essentially catholic and universal, taking no account of religion, politics, or country. Mankind from India to the far North—the swarthy Hindoo and the pale-faced Scandinavian—alike practise it with the same keen relish and enthusiasm. Its resources, indeed, seem to be inexhaustible; custom cannot "stale their infinite variety." Like the kaleidoscope, it continually gives out fresh forms of changing beauty; the veteran amateur, who has grown gray in the exercise of its stratagems, experiencing as much interest in the pursuit as the novice who is acquainted with barely the moves.—*Captain Kennedy.*

PROBLEM VII.—BY J. PIERCE.

Black.



White.

White to play and mate in three moves.

SOLUTION TO PROBLEM VI.

White.	*Black.*
1. Q to K 4	1. Anything
2. Mates, acc.	

TO CORRESPONDENTS.

T. J. MILLER (Faversham.)—In a problem the mate must be effected in the stipulated number of moves against the best defence Black has at his command. If it admits of a solution in a fewer number of moves, the problem is clearly faulty.

E. T. (Grays.)—Philidor's "Legacy" is a well-known position, but hardly of sufficient interest for reproduction in our columns.

R. A. PROCTOR.—The problem, as amended, is considerably improved, both in design and construction. It shall shortly appear.

G. SLATER.—In order to prevent any further mistakes, have the goodness to submit the problems with which you have favoured us on diagrams.

A. W. COOPER.—We have mislaid your address. Please forward it again, as we wish to communicate with you.

J. KLING.—The problem in four moves is an elegant composition. The remaining two we have not yet examined, but doubtless they are equally good.

ARGO (Yarmouth.)—Problem I. can be solved by 1 R to R 8, &c. Problem III. is also wrong—

$$(1)\ \frac{\text{Q to Q sq.}}{\text{P R 4}}\ (2)\ \frac{\text{Q takes P}}{\text{P Q 3}}\ (3)\ \frac{\text{P Q 3}}{\text{anything}}\ (4)\ \text{mates.}$$

Problem II. is seemingly correct, and rather a neat idea. In order that it may be further examined, forward it afresh on a diagram.

G. WHITFIELD.—A report next week.

J. NEVILLE and S. N. BARKER.—Compare the published solution.

CORRECT solutions to Problem V. (continued).—M. L. Marks (Swansea); J. H. A. H. (Chester); Wiseaf (Dulwich); S. H. H. (York).

CORRECT solutions to Problem VI. have been received from E. T. (Grays); R. A. Proctor; G. Slater; J. E. (Lincoln); Rorie; G. Keller (Warrington); W. Airey (Worsley); C. Yeo (Paignton); A. Cunnington (Devizes); B. T. G. (Accrington); Wiseaf (Dulwich); C. J. L. (Portsmouth); J. H. A. H. (Chester); Theodore Fawsett (London); William Cook (Penge); A. W. Cooper. All others are wrong.

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ANSWERS TO CORRESPONDENTS.

**** All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, July 16, and unacknowledged elsewhere:—

G. L. R.—F. R. Leyden.—H. Hicks.—Alex. M'Kinley.—Dr. J. H. Wheatley.—J. H. Biggs.—A Tolhausen.—E. Hassall.—Francis Land.—U. P.—R. O. Berry.—R. Barlow.—O. B. M.—G. W. Royle.—R. A. Proctor.—W. Waghorne.—I. Whitesmith.—Rev. F. D. Soyers.—Edward Anderson.—P. H. Holland.—A. Ironside.—Wm. Grosvenor.—Wm. Lobley.—March and Patteson.—J. W. Hogg.—G. H. Hurst.—T. C. Ebdy.—E. R. B.—J. Estobb.—Underwriter.—A Brickmaker.—Janus Snell.—J. R. Symons.—Wiseacre.—A Builder.—Khoda Bux.—Edward Rockville.—H. Hird.—Henry Jackson.—Thomas Fletcher.—A. W. Pashley.—H. Neal.—Lieut. Col. Cotton.—W. H. Cook.—T. C. Ebdy.—John Ramsay.—H. J. Nash.—Alfred H. Allen.—Hyrab Scen.—The Harmonious Blacksmith.—Rat-Tat.—E. H.—Photo.—Mechanical Publican.—H. D. E.—W. S. E.—Vulcanite.—Toivo.—Hone Ko Io.—W. H. H. C.—J. E. P.—New Trowel.—C. Gaudibert.—W. E.—Charles Lennox.—Young Hopeful.—Gy.—J. S.—Conversion.—E. B. H.—Xenophon.—G. Pennington.—Whitesmith.—E. D.—Sarah.—Cottager.—Aberdeen Watch Jobber.—F. G. E.—R. P.—H. Meyer.—Excelsior.—R. A.—F. F. C.—F. A. R.—Anxious.—H. O'B.—Old Woman Doctor.—Seconds' Practical Watchmaker.—J. W. S.—Kaye.—T. G.—T. P. Barkas.—T. R. S.—Veritas.—Sufferer.—Wm. Meek.—Irwell.—W. E.—M. Paris.—Thomas Buchanan.—W. B. Winkle.—Epsilon.—Science and Art.—M. P.—Criterion.—Q. Yorke.—O. P.—W. S. B.—L. W. L.—T. A.—A Countryman.—A Carpenter.—Novice.—W. H.—W. Bird.—G. W. C. H.—E. W.—F. H. T.—Censor.—Aleph.—W. F. Fennell.—J. C. Buckmaster.—F. S. M. W.—O. M.—John Hopkins.—L'Ouvrier.—C. J. B.—Frederick Pratt.—Mechanical Equivalent.—A B. W.—J. Broadhurst.—John Cleek.—Fitness.—J. S. Whitaker.—Tnetap.—Upsilon.—Tyro.—Neaniscos.—Albert Stone.—Linum.—Fred. Hamilton.—Query.—Alf.—Carl.—H. Highton.—Philanthropist.—M.A.—W. Hatfield.—Putty.—A, Liverpool.—E. L. G.—C. B. H.—Near-sighted.—Humming Bee.—Wm. Black.—F. R. A. S.—Spinning Top.—Ed. M. Marshal.—H. Weldon.—Saul Rymea.—E. M.—O. P. Q.—Five Years' Subscriber.—R. A. Proctor.—Clinchey.—Book-Keeper.—J. T. Routh.—Mostyn.—P. H. Stacey.—Communicator.—W. H. H. Cooper.

A READER, Tonbridge, and "Lollipop."—Advertise.

VERTUMNUS.—Your letter on Noah, his predecessors, and successors, would lead us slap into a Biblical controversy. Its insertion would give "E. L. G." a reason for writing more than one letter.

O. B. M.—Rather too fantastical.

JOHN MITCHELL AND SON.—We have no terms for inserting illustrations and descriptions of patented inventions. We never made and never intend to make any charge for anything that goes into the body of the paper.

J. W. DAWSON.—Consult a physician.

CHARLES COLLINS AND G. E. L.—Your communications are advertisements.

J. SNELLGROVE expresses a hope that some papers on elementary mechanics will soon appear in the ENGLISH MECHANIC. Is J. Snellgrove aware that a series of papers on this subject appeared in the ENGLISH MECHANIC—by the Rev. E. Kernan—about eighteen months since?

J. M. B.—You advance too far on forbidden ground for our columns. Should be glad to hear from you on some more practical subject.

AMATEUR PHOTOGRAPHER, L. Newton, J. W. E., W. L. Warren, A Jones, A. S. Lewes, Orlando Hank, T. M'Gregor, Geo. Earnshaw, Johan, R. Owen, Zakynthos, and Subscriber are referred to indices to back volumes.

R. TANSLEY.—Another correspondent satisfactorily disposes of "G. W. K. D.'s" remarks, so there is no need to insert your sketch. We should be glad to receive sketch and description of the other machine you refer to.

Communications which can only appear as advertisements to hand from Private Student, T. H. (Camberwell), Zinc, A. A. F., W. Ward.

INQUIRER.—Consult a surgeon.

A PATTERNMAKER.—Wash them daily.

A MEMBER.—Both matters for a medical man.

J. W. (Leeds).—For your first query try carbolic acid soap.

S. I. G.—Thanks. See "Hints to Correspondents."

JOHN GAVIN.—Recipes for making blacking have been frequently given. The only way of competing with the large manufacturers is to be contented with less "profit," unless indeed, you discover a new process by which you can make blacking cheaper than they can. It stands to reason that its manufacture on the large scale, where all the ingredients are bought at first hand, must cost less than it would in a "moderate way." It would be useless to insert the query as you put it.

AB INITIO.—For "silk solvents" see p. 286, Vol. XI.

H. W. F.—You will find information on electro-gilding, silvering, and plating generally in Vol. XIII., pp. 342, 369, 393, 471, 496, 498, 549, &c.

PHILO.—Your letter headed "Rude Personalities" would add fuel to the fire. You accuse several well-known and highly valued correspondents of "rudeness" and "cowardice." Can you not see that if such a letter were inserted it would inevitably call up stinging retorts? You complain that we do not insert your several replies to personal attacks. If we did, the evil you complain of would be materially aggravated. You say "I have no objection to being attacked *if allowed to reply*, and would far rather be laughed at than have no laughing at all, but prefer laughing at others." Is it not best to go to the root of the matter, and, if possible, say what you have to say in such a manner as to give no one an opportunity of attacking you or laughing at you at all?

READER, Tip. O., R. A., and James White.—Your queries, &c., are advertisements.

G. W. BACON AND CO.—We have already described the Beckwith Sewing Machine, and have no more space to spare for the purpose at present. All suggestions as to being "permanent advertisers" are respectfully repudiated.

ERRATUM.—In the article on Chemical Physiology, "lymphatics" (p. 422), by a slip of the pen, was written for "lacteals."

A. W. J. C.—You will find your query about an electric kite answered on p. 364—so recently as June 21!

SPINNING TOP.—J. M. Taylor says: "The explanation I gave in the latter part of letter 4510 needs correction. The theory presented itself to me but a few hours before I noted down the reasonings in that letter. These are therefore but crudely stated, and with your permission I will forward a concise and corrected statement for next week's issue."

PLATO.—J. W. Durrad says: "In my drawing (let. 4474, p. 411) your engraver has inserted a spot in the inner shadow. I do not think I put one in my sketch, and certainly did not see one. Neither is the shading on the floor shown. I thank 'F.R.A.S.' for his excellent tests. I will examine them on the earliest opportunity, and (with your permission) send results."

JACK OF ALL TRADES.—Yours next week.

E. J. T.—Your letter is too dialectical. Why not discuss in moderate space the essence of things, and not use so many words about words.

JOHN BAYNES.—See "Notices to Correspondents," No. 6.

M. P. STUDDY.—You had better put the matter in the hands of the police, as we are constantly receiving such complaints as yours. We will not let the person you complain of advertise in our columns, but we cannot prevent him answering advertisers. Correspondents and advertisers should be more particular in parting with goods or money. We have repeatedly cautioned them.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JULY 26, 1872.

ARTICLES.

OCEANIC CIRCULATION.

In Two Parts.

BY RICHARD A. PROCTOR, B.A., HON. SEC. R. A. S.
Author of "The Sun," "Light Science," "Essays on Astronomy," &c.

PART I.

THERE are some questions, seemingly innocent enough, which yet appear fated to rouse to unusual warmth all who take part in their discussion. One cannot, for instance, find anything obviously tending to warmth of temper in the telescopic study of a planet; yet the elder Cassini was moved to passionate invective by certain observations of Mars not perfectly according with his own; and Sir W. Herschel, usually so philosophic, was roused by Schröter's recognition of mountains in Venus to deliver himself of a criticism justly described by Arago as "fort vive, et, en apparence du moins, quelque peu passionnée." The question, again, whether the 'Eozoon Canadense" is a true "Rhizopod," though not altogether removed from the region of hard words, might appear to be unlikely to excite war-like emotions; yet there has been some very pretty fighting over it. The solar corona has in like manner given occasion for rather strong writing; and if, on the one hand, the supporters of a lately-abandoned theory said of their opponents that "they made themselves ridiculous," these, in their turn, at times used a tone reminding one of the scholar who said of a rival, "May God confound him for his theory of the Irregular Verbs:" yet the corona seems at a first view rather calculated to produce a sedative effect than to excite unphilosophic wrath. The subject of oceanic circulation would appear to belong to the class of questions here considered. The very name of the Gulf Stream is to some physical geographers as a red cloth is to a bull. Even Sir John Herschel, usually placidity itself, was moved when he spoke on this point. But, though he and Maury grew warm enough in its discussion, their warmth was ice-cold compared with the fire of more recent disputants. We have before us the latest contribution to the subject, a rather ponderous essay in one of our leading quarterlies; and herein we find pleasing references to the "stupidities" of one set of opponents, the "shallow nonsense" of a second, "the wrong-headedness" of a third, with other similar amenities. More than once during the progress of this controversy the gentle public has been reminded of Bret Harte's remarks

> . . . . . about the row
> That broke up the Society upon the Stanislow;

and has been inclined to urge with "Truthful James," that they

> Hold it is not decent for a scientific gent
> To say another is an ass,—at least to all intent;
> Nor should the individual who happens to be meant,
> Reply by heaving rocks at him to any great extent.

The controversy has not, indeed, reached this last stage of development, and we trust it never will; but it has gone so near to it as to suggest that the disputants have wished to demonstrate, by example, the justice of Darwin's theory about the human "snarling muscles." *

*"He who rejects with scorn the belief that the shape of his own canine teeth, and their occasional great development in other men, are due to our early progenitors having been provided with these formidable weapons, will probably reveal by sneering the line of his own descent. For though he no longer intends, nor has the power, to use these teeth as weapons, he will unconsciously retract his 'snarling muscles' (thus named by Sir Charles Bell), so as to expose them ready for action, like a dog prepared to fight."—Darwin's "Descent of Man," Vol. I., p. 176. We may mention, by the way, that an instance has recently occurred, in which the human teeth were used to some purpose against one of the recognised masters in the art of biting. A man, proceeding in company with several others through a wood, was attacked by a hyena (usually one of the most cowardly of beasts). His companions fled, and having no weapon he was reduced to the necessity of showing tooth for tooth, and taking a good grip of the hyena's nose, he compelled that gentleman to howl with anguish. On this, the man's companions returned, and presently beat the hyena to death.

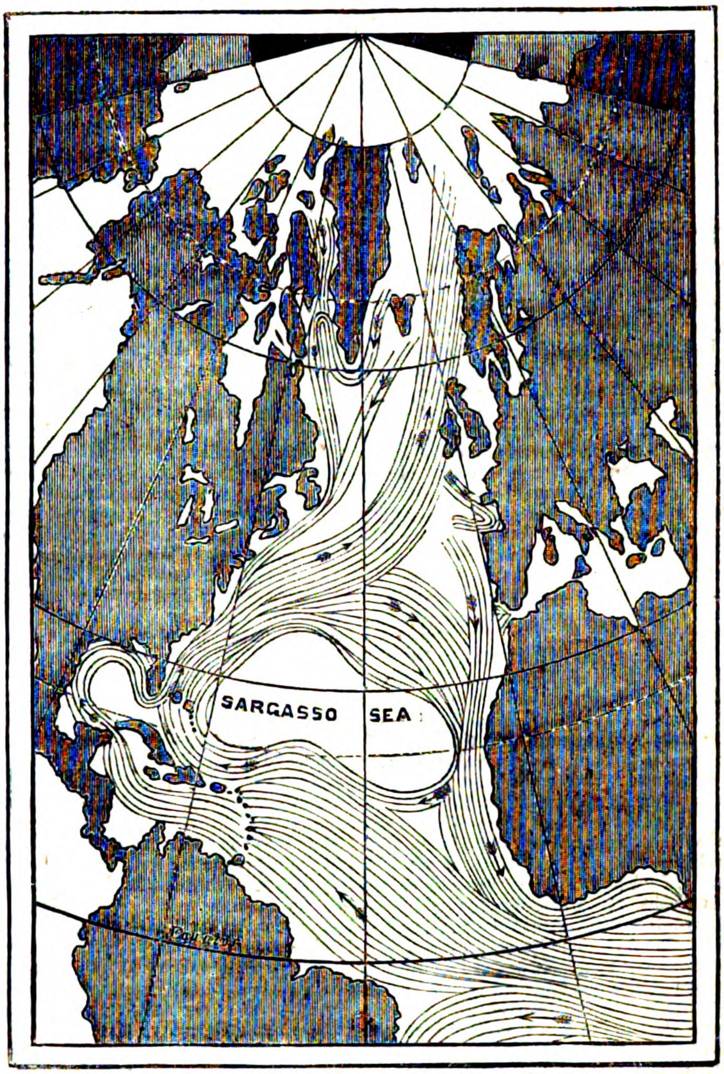
I propose to inquire into the subject which has been thus warmly discussed, trusting not to be myself inveigled by it into any warmth of expression. Indeed, but for the fate of others, I should feel no anxiety on this point, though I have myself a favourite theory to uphold respecting one branch of the subject. As it is, I share something of the feeling of the Red Cross Knight when he was approaching "Foul Error's den," and his monitress said to him "The perils of this place I better wot than thou; therefore I rede, Beware." I am not without hope, however, that I may be able to keep my snarling muscles quiescent.

I shall direct attention chiefly to the Atlantic currents, as being those whose real direction and extent are best known, and those, moreover, whose characteristics are most important to European nations.

Let us begin with the surface currents, and though the system of surface circulation can scarcely be said to have a real beginning, let us start with the great equatorial currents which flow westwards from the Gulf of Guinea,* or more correctly from the Bight of Biafra. We speak of the westwardly equatorial *currents*, because not unfrequently there is an equatorial eastward current running between two much more important *tropical* westward currents. Yet ordinarily there is one great westward current running in an unbroken stream from equatorial Africa to the shores of Brazil, and even when this great current is divided into two by an eastward current this last is only to be regarded as a sort of "backwater." The water moving westwards is relatively cold, more especially on the African side of the Atlantic.

The accompanying map exhibits the nature of the surface circulation of the North Atlantic. It is constructed on one of the forms of equal surface-projection described in my "Essays on Astronomy," and has the advantage over the ordinary Mercator's charts of exhibiting the true

* Along the *shores* of the Gulf of Guinea there flows an easterly current, several degrees warmer than the equatorial current.



dimensions of the various currents. I would, however, invite the student who wishes to familiarise himself with the true nature of the Atlantic currents to construct other maps; for instance, a polar map on the first method of equal-surface projection described in that essay, and a map of the whole Atlantic on the second plan, taking the meridian 40° west of Greenwich as the central one.

Of the water carried westwards by the great equatorial movement, the most important portion after reaching Brazil is carried northwards towards the West Indies. The reason of this is obviously to be found in the fact that Cape San Roque, forming the jutting angle of Brazil, lies several degrees south of the equator. The portion carried southward forms the Brazil Current, and after travelling along the shores of South America almost as far as the mouth of the La Plata, acquires gradually an eastwardly motion which eventually carries it back across the Atlantic towards the Cape of Good Hope, there to pass northwards and so again to traverse the Bight of Biafra. The surface-circulation in the south Atlantic is thus seen to be comparatively simple

The larger portion of the equatorial current is carried less quickly northwards, because the northern shore-line of Brazil and Guiana is inclined at a much smaller angle than the south-eastern to the westwardly course of the great equatorial currents. Thus the water which is carried towards the West Indies has time to acquire under the tropical sun a much higher temperature than it had possessed when traversing the Gulf of Guinea. It is divided into two parts by the *quasi*-barrier which the West Indian Islands (or rather the semi-submerged mountains of which they form the crests) oppose to its progress. A comparatively small portion finds its way into the Caribbean Sea, and making the circuit of the Gulf of Mexico, passes out eastwards round the peninsula of Florida. We may fairly assume that this portion *is* comparatively small; simply because this true gulf stream, passing between Cuba and Florida on an eastern course would continue so to move for at least some considerable distance, were it not in some way deflected. But it actually turns almost due northwards after passing through the Bahama Sea, traversing the Bemini narrows on this course, and so onwards towards Hatteras. This would seem to imply that the true Gulf Stream is pressed northwards by the arrival of a much larger body of water which has travelled outside the West Indies. It is true that the diversion of the Gulf Stream northwards may be really caused by the Great Bahama Bank. But this would equally establish our position; for if the Bahama Bank is thus effective in diverting the whole of this now swiftly moving current, the Windward Isles may be assumed to be correspondingly effective in diverting the greater portion of the sluggish equatorial current. Moreover, if we remember how shoals commonly take their origin, we may consider that the very existence of the Bahama Bank is probably due to the former encounter of the two important branches of the equatorial current—the part which had circled the Gulf of Mexico and the part which had travelled outside the West Indies. Thus, the northerly course finally taken by the Gulf Stream implies that the latter portion had prevailed over the former, and, therefore, that it is the most considerable portion. I must mention, however, that the Edinburgh Reviewer holds the part which enters the Caribbean Sea to be the larger.

Be this as it may, the Gulf Stream proper has acquired, during its circuit, characteristics perfectly distinct from those which it had had when entering the Caribbean Sea, or from those possessed by the remaining portion when approaching the Bahamas. In the first place, having traversed a much longer course under the same intense tropical heat, the Gulf Stream has become much warmer than the outer stream. In the second place (probably from having traversed the outlets of the Mississippi, and so carrying with it the finely-divided matter brought down by that river), the Gulf Stream has acquired a peculiar blue colour, somewhat resembling that recognised in most of the Swiss lakes.* Thirdly, its course having carried it into narrow channels, it has required a relatively rapid rate of outflow, insomuch that the surface flow of the current on its outward passage through the narrows of Bemini, takes place at a rate of from $2\frac{1}{2}$ to 4 miles per hour. Its width here is at the surface not more than about 25 miles, its maximum depth rather more than a quarter of a mile (about two-fifths of the channel's maximum depth), and its mean rate of flow probably about 3½ miles per day.

I shall not follow the Edinburgh Reviewer in considering the details of the progress of the Gulf Stream from the Narrows of Bemini to Cape Hatteras, because, though in themselves of the utmost interest and importance, these details throw no special light on the general subject of oceanic circulation. Suffice it that as far as Hatteras the Gulf Stream remains distinctly recognisable, and that even off Sandy Hook (New York) its surface temperature is little reduced, and its velocity still amounts to about one mile per hour. Off Nantucket the breadth of the current is about 410 miles, its winter surface temperature only 10° below that which it had in the Florida Channel, and its rate of flow still nearly one mile per hour. It has at this part of its course acquired a good deal of easting, a circumstance which must (unquestionably, we conceive) be ascribed to the fact that it brings from low latitudes the more rapid easterly rotation movement of the earth. The same would, of course, apply to the less characteristic but larger current which has arrived at the same latitudes *without* circuiting the Gulf of Mexico.

Now here we approach a critical part of our subject. It is admitted by all that off Newfoundland the Gulf Stream loses its special characteristics. As Dr. Hayes remarks, "its strength diminishes; the air of a higher latitude brings its temperature down to that of the North Atlantic generally" (not, however, without raising the temperature of the North Atlantic to some extent); "the water loses all its Gulf Stream character as to course, warmth, and flow (and as to colour also); and it dies away into the sluggish Atlantic drift which sets from a westerly to an easterly direction." It is not so generally noticed, but will scarcely, I suppose, be disputed, that the Gulf Stream water strengthens, and that appreciably, this sluggish Atlantic drift. Then it is reinforced by the portion which has travelled outside the West Indian Islands; and we may assume (without giving rise to objections) that the general prevalence of south-westerly winds will further strengthen the eastward motion of the combined mass. At any rate, let the causes be what they may (and presently we shall have a further cause to take into account), it is admitted by all physical geographers that a great, though slow current, or drift, *does* pass eastwards from the neighbourhood of Newfoundland. Moreover, it is admitted by all that the southern part of this current (which the Edinburgh Reviewer actually regards as identifiable with the Gulf Stream*) traverses the Atlantic until, nearing the Azores, it joins the southwardly Guinea current; while the northern part passes on a north-easterly course, which carries it between Britain and Iceland, between Sweden and Spitzbergen, onwards, even as far as the very neighbourhood of Nova Zembla. Lastly, it is admitted by all that, directly or indirectly, this great north-easterly current causes the climate of Great Britain, and of the north-western parts of Europe generally, to be milder than that of North American regions in corresponding latitudes.

It might appear, then, that all these things being admitted, no question of any importance remains so far as the actual facts of the oceanic surface-circulation are in question. We shall presently see that a question has arisen as to the *cause* of the observed facts; but as to their *nature* everything that seems worth discussing at all appears to be satisfactorily disposed of.

Let those readers who in their simplicity have adopted this notion hasten to dispossess themselves of it by reading some remarks by Dr. Hayes, the American explorer, quoted with approval by the Edinburgh Reviewer. The latter having repeated from "Lothair" "a sneer at the shallow nonsense which has been talked about the Gulf Stream, and at the exaggerated estimates of its potency which have been put forward by men (as well as women) who ought to have known better" (these are the reviewer's words, not Mr. Disraeli's) proceeds as follows: "As Dr. Hayes truly remarks, 'Weather predictors without end have launched upon it their stupidities; meteorologists have deluged the world (*sic*) with their assumptions respecting it; theorists of all kinds have floated their notions upon it. One whirls it away into the arctic regions, and opens a passage to the pole with it; another compels it to give a climate to countries where otherwise there would be no climate worth mentioning; while still another spins it round the Atlantic Ocean, and its wide-spread arms close upon a stagnant sea. . . . Through means such as these mankind has come to look upon the Gulf Stream with a certain degree of awe. It is a "breeder of storms;" the giver of heat; it might become the father of pestilence. Will it always continue to do its duty as hitherto? or will it start off suddenly with some new fancy, and, pursuing some new course, upset the physical and moral status of the world?'"

Now we have seen that the writer who thus indorses Dr. Hayes's diatribe, is among those who hold that a southern offset from the Gulf Stream circles round the Sargasso Sea to join the Guinea current. He says farther on that he "entirely accords" with the opinion of Buchan, the meteorologist, that the north-easterly current above referred to produces "an afflux of warmth brought to the British Isles by the water that laves our western coasts." He proceeds, "There is ample evidence that the cold of some parts of the north polar area is greatly mitigated by an afflux of water bringing with it the comparative warmth of temperate seas. It has long been known that cocoa-nuts, tropical seeds, trunks of tropical trees, timbers and spars of ships wrecked far to the south, and sometimes portions of their cargo, are found on the shores of the Western Hebrides, the Orkney, Shetland, and Faroe Islands, the north of Norway, and even Spitzbergen; and since their transport has taken place just in the course of the Gulf Stream if prolonged to the north-east, their arrival has been accepted almost without question as evidence of its agency. The evidence furnished by the surface-temperature of that north-eastern portion of the Atlantic Ocean which intervenes between Iceland and the North Cape, and then stretches away to the eastward between Spitzbergen and Nova Zembla, seems at first sight conclusive to the like effect. A large amount of additional thermometric evidence has been collected of late years; and this has been most ably digested by the eminent German geographer, Dr. Petermann, who has recently put forward a series of maps for different periods of the year, in which these observations are embodied, and their results made obvious to the eye by the course of the "lines of equal temperature," which in the summer pass between Iceland and the Shetland Islands, a little to the east of north towards Spitzbergen, and thence with more of an easterly bend even beyond the seventy-fifth degree of north latitude. The existence of a warm stream in this direction has been confirmed still more recently by two adventurous officers—Lieutenant Julius Payer, of the Austrian army, and Lieutenant Weyprecht, of the German army—who followed its path last summer in a small sailing vessel hired by themselves, and state that they found open water from east longitude 42° to east longitude 60°, even beyond the seventy-eighth parallel of north latitude, the highest point they reached being north latitude 79°, in east longitude 43°. A Russian expedition under Prince Alexis Alexandrovitch, of which the distinguished *savant*, Von Mildendorf, had the scientific charge, was about the same time exploring the Polar Sea between Nova Zembla and Iceland; and Von Mildendorf has stated to the Imperial Academy of St. Petersburg that "the corvette *Waja*... has proved the extension of the Gulf Stream to the west coast of Nova Zembla, and that we find it on the meridian of Banin Noss (in east longitude $43\frac{1}{2}$°) still of a width equal to two degrees of latitude, and of a temperature of fifty-four degrees Fahrenheit, cooling down only four or six degrees at depths of thirty and fifty fathoms."

As if to remove all question as to his real opinion the reviewer immediately adds that he fully accepts, not only the great body of facts so "industriously correlated by Dr. Petermann, but the inference Dr. Petermann draws from them that an attempt to penetrate the polar ice-wall to the north-east of Spitzbergen is more likely to be successful than the search for a passage in any other direction."

So that (1) Dr. Petermann, regarded by our reviewer as an eminent geographer; (2) Von Mildendorf, whom he regards as a distinguished savant; and (3) the reviewer himself, who no doubt does not regard himself as either shallow or stupid, seem all agreed as to the very points which the reviewer has spoken of as involving stupidities and shallow nonsense. Certainly they all agree as to the only points which seem in the least worthy of discussion.

What, then, the reader will ask, is the matter in dispute? Over what momentous question have the angry words quoted above been bandied?

After diligent search for the apple of discord, the student of the review will be led to the conclusion that it is neither more nor less than the *name* "Gulf Stream." We have seen that Von Mildendorf calls the warm current which passes by Nova Zembla the Gulf Stream. In this, it appears, he has shown shallowness and stupidity. Dr. Petermann has equally committed himself, or, rather, has committed a more serious offence. For Von Mildendorf might have used the offensive epithet only through inadvertence; but Dr. Petermann not only uses it, but has the hardihood (we might almost say the cruelty) to maintain that "it is a matter of no consequence." Moreover, as our reviewer sadly admits, "other physical geographers" agree with Dr. Petermann.

The reviewer is so grieved by the defection of the "distinguished savant," the "eminent geographer," and "the other physical geographers" that for a moment his confidence deserts him, and instead of applying afresh to them, directly, the lash which has indirectly reached them, he proceeds thus mildly: "In our *belief*, of which we shall presently explain the grounds, the *real* Gulf Stream has no more to do with the inflow into the polar area, than with the ripening of oranges at Naples, or the maintenance of Catholicism at Rome, so that, even if its current were to be

* This explanation of the colour of the Gulf Stream seems the best that has hitherto been offered. The *Edinburgh* reviewer thus states the matter:—"The remarkable blueness which distinguishes the water of the Gulf Stream from the oceanic water through which it flows may be due to its retaining in suspension the finest of the sedimentary particles brought down by that river, the coarser having been deposited near its [the river's] mouth; just as the intense blueness of the waters of Lake Geneva depends on its retention of the finest sedimentary particles brought down by the Rhone in the upper part of its course, while that of the waters of the Mediterranean is due to its pervasion by the like particles brought down by the Lower Rhone and other rivers, which discharge themselves into its western basin, and by the Nile in its eastern." It will be remembered that Prof. Tyndall, by researches carried on during the return of the *Urgent* from the eclipse expedition of 1870, was enabled to threw considerable light on the cause of the colour and shades of colour in water at greater or less depth. See also Dr. Carpenter's "Report of Researches in the Mediterranean," in the "Proceedings of the Royal Society," Vol. XIX., p. 200.

* He says that the great equatorial current is partly supplied "by the return of a portion of the Gulf Stream."

entirely diverted by the cutting of a wide channel through the Isthmus of Panama, not only would the climate of the British Islands suffer very little, but a north-easterly stream of warm water . . . would still mollify the severity of polar cold, and help to render Spitzbergen and Nova Zembla accessible to arctic voyagers." This belief, in which I cordially concur, would seem to afford excellent reason for rejecting the name Gulf Stream whenever the course of the stream shall thus have been diverted, but scarcely seems to justify the disuse of the name under the actual circumstances; still less would it appear to afford good grounds for using such hard words as "shallow nonsense" and "stupidity." If the course of the Danube were intercepted in Baden, it is tolerably certain that a mighty river would continue to flow past Vienna, Belgrade, and Ismail to the Black Sea; nor would the noble river which flows northward through Germany be much reduced though the Rhine were diverted in the Grisons: yet geographers are satisfied to call these rivers the Danube and the Rhine, not adopting new names at every stage where some new influx changes the size and character of either. And the title "Gulf Stream" has, in like manner, advantages in point of convenience, which are likely to prevent geographers from rejecting it yet awhile. It may mislead some few into supposing that the whole of the great north-easterly current has passed through the Gulf of Mexico, just as we can conceive that some few students of geography might imagine all the water which flows past Cologne, or Coblentz, to have come from the Grisons, or all that flows past Nikopolis to have come from Baden. Almost every convenient name however, is open to some such disadvantage; and the student of oceanic circulation who finds he has been to some degree misled by a name must not mistake the detection of his error for a great geographical discovery.

Majora canamus.

We have hitherto considered surface-currents only. We have not, indeed, considered all the surface-currents which traverse the North Atlantic; but the principal streams have been indicated. We must now direct our attention to submarine currents.

(*To be continued.*)

THE MUSEUMS OF LONDON.—I.

THE MUSEUM OF PRACTICAL GEOLOGY.

THIS institution is situated in Jermyn-street, S. James's; and incorporated with it in the same building are the Royal School of Mines, the Office of the Geological Survey, and the Mining Record Office. It originated in a suggestion made to the Government by Sir H. T. De La Beche, in 1835, that in the newly-instituted Geological Survey lay the means of collecting fossils, rock-specimens, &c., in illustration of the maps and publications of the Survey, and also the opportunity of bringing together practical illustrations of the arts and manufactures more or less connected with geology. The suggestion was adopted, and offices first set up at 6, Craig's-court, which, however, were speedily outgrown, and the present building was erected by Mr. J. Pennethorne, and opened in May, 1851, by H.R.H. the Prince Consort. The School and the Record Office are subsequent outgrowths of De La Beche's idea; it has lately been proposed by the Royal Science Commission to separate the School and Museum, but no further action has yet been taken. The institution, as well as the survey, was first placed under the direction of De La Beche, the founder, at whose death they passed to the late Sir R. Murchison. Professor Ramsay has succeeded Sir Roderick as Director General of the Geological Survey, and the post of director of this institution is attached to that office.

With regard to the School, the names of such men as Owen, Tyndall, Huxley, Frankland, Ramsay, Percy, &c., who are, or have been, professors, are sufficient proof of its high standard. The Museum aims at setting before the public the economic value of geological knowledge, the principles of obtaining and utilising those mineral productions which are so important to us, and also of affording to the student as complete an illustration as possible of the geology of the United Kingdom. Under these circumstances, it is surprising that the Museum is so little known, even among the people of London, while it is rarely found on the list of interesting places to be seen by country visitors. Many who hear of it regard it as a "dry" collection of old stones, and under this impression neglect the many objects of general interest which it contains. We recommend to all our readers who have the opportunity, and who have never yet visited it, to do so, and if useful, curious, or instructive natural objects have any interest for them they will not be disappointed. The Museum is opened gratuitously every day in the week except Sundays and Fridays; on Monday and Saturday from 10 a.m. to 10 p.m., on other days from 10 a.m. to 4 or 5 p.m., according to the season. It is also closed for a month from August 10th to September 10th.

The Museum itself may be described as consisting of one large oval room, lighted by means of a glass roof, and at night by gas-jets near the roof. The entrance leads first into a hall, connected with which is the lecture theatre, capable of seating about 600 persons. Having ascended to the principal floor, we see how the whole of the wall space is utilised by means of two narrow projecting galleries running round the greater part of the building, and having upright wall cases on the one hand and flat table-cases on the other. The palæontological specimens are, with one or two exceptions, confined to these galleries.

The building is a practical illustration of the application of geology to the arts, the materials being selected with a view to this end. The front in Piccadilly (being, however, without an entrance there) is of dolomite or magnesian limestone from Yorkshire, similar to that employed for the Houses of Parliament, but the difference in the state of preservation of the two buildings is very instructive. The front in Jermyn-street, where is the only entrance, is partly of the above stone and partly of red Suffolk bricks. The steps at the entrance are of granite, from Peterhead, and at the doorway is a slab of slate from Penrhyn. The pavement and steps leading into the hall is of Portland stone, the side walls of Derbyshire alabaster, while in the hall columns and slabs of serpentine are included in the walls. The floor in the centre of the hall is formed of a tesselated pavement surrounded by slabs of polished granite.

To the student of geology the Museum affords an opportunity (too often wanting to the town student) of seeing for himself specimens of the various rocks which form the crust of the earth, and of the fossils which they contain. Although the specimens exhibited are mainly such as are found in the British Islands, still they are so typical that they may well serve as specimens of universal geology. As a collection of British fossils this stands unrivalled, and as this department is in the hands of Professor Huxley, we may rest assured of its being arranged to the best educational advantage. The fossils are broadly classified in stratigraphical order, commencing with the Cambrian fossil in the end lower-gallery case on the left hand of the visitor as he enters the principal floor. On the floor of the room is a fine block of serpentinous limestone with remains of the Eozoön—the earliest known fossil—from the Laurentian district of Canada, and in a case near will be found a longitudinal section of the fossil, showing its arrangement in cell layers. There is a very fine collection of trilobites from the Silurian and Devonian rocks, and the carboniferous fossils (the vegetable remains being placed in the wall cases) are well represented. In each of the formational divisions there is a sub-classification into families and genera, and the majority of the specimens are marked not only with the generical and specific name, but also with the name of the bed and the locality where it occurs. In the recesses of the upper gallery will be found a fine collection of rock specimens, including an interesting collection of specimens exhibiting traces of glaciality, *e.g.*, striæ, &c., some of which, from the Permian beds, are adduced by Ramsay as proofs of the recurrence of glacial epochs. There is also a collection of volcanic products from Etna and Vesuvius, and a second collection of specimens (together with a model) from the district of the extinct volcanoes of Auvergne in France, affords an opportunity of convincing ourselves of the similarity of these products in (geologically) ancient and modern times. In this upper gallery is shown a small series of photographs of portions of the south coast of England, and we cannot but express our opinion as to the desirability of obtaining a complete series for the whole coast.

In the horseshoe series of cases on the principal floor is a splendid and showy collection of minerals arranged under the heads of the principal elements—carbon, sulphur, &c. This is, of course, not comparable for its completeness to the collection in the British Museum, but is probably, for that very reason, more likely to attract the attention of the general visitor. Extremely interesting in a metallurgical point of view is the very large collection of specimens of ores of the various metals, and in the table cases will be found numerous illustrations of the various processes connected with these, as well as the properties and uses of the products. Some articles, as swords, gun-barrels, &c., are shown in the different stages of manufacture, as are also cups and bottles in another portion of the building. One case is devoted to electrotype reproductions, including coatings of leaves, tubes of the pitcher plant, fossils, beetles, &c., with copper by this process.

But the economic value of the Museum is, perhaps, most strikingly displayed in the ceramic series. First of all there is a very complete collection of specimens of clay suitable for pottery from the various geological formations, and the manufacture in various stages of its progress is well illustrated. The series extends from the date of a Babylonish brick and Egyptian objects, through the Roman productions in our island, chiefly from Caistor, near Peterborough (where ancient kilns have been found), through the varieties of majolica and Palissy wares to the Staffordshire and Wedgwood productions of recent times. The institution is fortunate in possessing a good representative collection of Wedgwood's manufactures, including the copy of an antique vase. In two rooms at the opposite end of this floor will be found models of implements and machines used in mining and metallurgical operations.

On the floor of the hall are several cases containing cubical specimens (about 6in.) of the building stones found in this country, which were collected for the purposes of the committee appointed to select materials for the Houses of Parliament. A gigantic figure of Hercules is executed in stone from the same quarry whence was taken the stone for the Houses. Large polished pedestals of marble, and table inlaid with marbles, in various patterns are also placed here.

Such is a brief description of the main features of this Museum, and we think the aims of the projectors expressed in their address on the opening ceremony were not too high, that these collections might be made and "arranged with every reference to instruction, so that those interested might be enabled to judge how far our known mineral wealth might be rendered available for any undertaking they might be required to direct, or were anxious to promote, for the good or ornament of their country." W. H. W. T.

ASTRONOMICAL NOTES FOR AUGUST.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE right ascension of the Sun at Greenwich mean noon on August 1 is 8h. 47m. 37·3s., and his declination north 17° 53′ 50·7″. He will, therefore, be situated to the east-south-east of δ Cancri, and pretty near to the star in question. He rises in London on the 1st at 4h. 26m. a.m., and sets at 7h. 45m. p.m.; his rising and setting, in the same locality, taking place on the 31st at 5h. 12m. a.m. and 6h. 47m. p.m. respectively. The equation of time is additive (but rapidly diminishing) during the entire month. On the 1st, 6m. 1·14s. must be added to the time of apparent noon to obtain that which a properly regulated clock should show, and this, as we have said, decreases, so that on the 31st, mean noon is only 1·58s. in advance of apparent. The semi-diameter of the sun at the instant of his appulse to the Greenwich meridian on August 1st is 15′ 47·9″, and this will occupy 1m. 6·59s. of sidereal time (which is equivalent to 0·18s. less of mean time) in its transit. On the 31st the solar semi-diameter will have increased to 15′ 53·4″, but this will only occupy 1m. 4·42s. of sidereal time (convertible, as before, into mean time by the subtraction of 0·18s.) in its passage over the meridian. The sidereal time at Greenwich mean noon on the 1st is 8h. 41m. 36·14s.; and on the 31st, 10h. 39m. 52·79s.; the mean time at sidereal noon, or mean time of transit of the first point of Aries being 15h. 15m. 53·40s. and 13h. 17m. 56·18s. on those days respectively. Before dismissing this portion of our "Notes," we would invite attention to the curious fact that although Schwabe's period (for the present cycle) of maximum frequency of sun-spots has certainly passed, a supplementary maximum—if we may so speak—seems to be in progress just now; and groups of spots of great size, extent, and beauty reward the notice of the observer.

The Moon will be New at 9h. 45·6m. a.m. on the 4th; will enter her first quarter at 5h. 52·3m. a.m. on the 12th; be full at 8h. 53·3m. in the evening of the 18th; and enter her last quarter at 8h. 34·8m. on that of the 25th. She is 26·7 days old at Greenwich mean noon on the 1st, and 28·7 days old at the same hour on the 3rd. Then at noon on the 4th her age will be 0·1 day, and so on until the 31st, when it will, of course, be 27·1 days. At 2 o'clock in the afternoon of the 11th, Libration will bring an additional portion of her south-east quadrant into view, while at 8 in the evening of the 23rd the same cause will operate in the exhibition of more of her south-west limb. The Moon will be in conjunction with Mars at 10h. 36m. a.m. on the 2nd; with Uranus 10 minutes before noon on the 3rd; with Jupiter at 5h. 39m. a.m. the next day; with Venus at 7h. 15m. in the evening of the 4th; with Mercury at 2h. 10m. on the afternoon of the 6th; with Saturn at 3h. 50m. a.m. on the 16th; again with Uranus at 9h. 12m. on the night of the 30th; again, too, with Mars at 5h. 29m. on the early morning of the 31st; and, lastly, once more with Jupiter at 11h. 41m. the same night. Our notices of the separate planets will, however, show why these conjunctions will all be invisible.

Five actual occultations of, and four close approaches to, fixed stars by the Moon will occur during the month of August. Firstly, on the night of the 10th, at 9h. 43m., the Moon will pass quite close to 96 Virginis. Then, on that of the 12th, at 9h. 47m., λ Libræ will disappear at her dark limb, to reappear at her bright one (after the Moon has set) at 10h. 52m. On the evening of the 15th, at 7h. 50m., σ Sagittarii will disappear at the Moon's dark limb, reappearing at her bright limb at 8h. 53m. Again, on the 20th, just as 30 Piscium is rising, at 8h. 31m. p.m., it will be occulted by the bright limb of the Moon, reappearing afterwards at the dark limb at 9h. 28m. Subsequently, on the same night, at 10h. 8m., 33 Piscium will disappear at the bright limb; to reappear at the dark one at 11h. 11m. The Moon will pass quite close to B.A.C. 17 at 1h. 22m. in the early morning of the 21st. During that of the 22nd, at 2h. 5m., 26 Ceti will disappear at her bright limb, reappearing at the dark one at 3h. 1m. Lastly, at 2h. 43m. a.m. on the 24th, and 2h. 55m. a.m. on the 28th, she will be almost in contact (as viewed from Greenwich) with 38 Arietis and 5 Geminorum respectively.

Mercury is an evening star at the beginning of this month, setting on the 1st about 50 minutes after the Sun, from which he attains his greatest eastern elongation, 27° 19′, at 2h. 46m. a.m. on the 3rd, very evidently below our horizon. After this he of course approaches the Sun again, and sets sooner and sooner every evening, until he becomes invisible from his proximity to it. He will actually be in inferior conjunction with the Sun at 7h. 51m. in the evening of the 30th. His conjunction with the Moon at 2h. 10m. p.m. on the 6th has been already spoken of; and we may add that he will also be in conjunction with Venus at 2h. 53m. on the afternoon of the 23rd. His diameter will increase from about 7″ at the beginning of August, to nearly 10″ during the middle third of it; and during the commencement of the last half of the month he will be pretty favourably situated for observation in daylight. It is almost needless to add that an equatoreal is indispensable forfinding the planet under these circumstances.

Venus having (as stated last month) passed her superior conjunction on the 16th of July, is now travelling eastward, and is an evening star. She, however, only subtends an angle of some 10″, is very nearly round, and is, altogether, a very unsatisfactory telescopic object. She sets on 1st only 20 minutes after the Sun, and half an hour after him on the 31st. Her conjunction with the Moon at 7·15 p.m. on the 4th, and with Mercury at 2h. 53m. in the afternoon of the 23rd, have been noticed above.

Mars is a morning star. Rising on the 1st at about 2h. 27m. a.m., and on the 31st at 2h. 14m. He travels during August from a barren region to the north-east of δ Geminorum, to a point to the north-east of δ Cancri. His southing takes place on the 1st at 10h. 49m. a.m., and on the 31st at 10h. 3m. a.m.; and his setting, of course, in bright sunlight during the whole month. His diameter is still under 5″, and he is therefore absolutely destitute of any interest whatever for the observer with the telescope, merely presenting the aspect (of which we have spoken on former occasions) of a large red fixed star. We have noticed under another head his conjunction with the Moon at 10h. 36m. a.m. on the 2nd, and at 5h. 29m. a.m. on the 31st. He will also be in conjunction with Uranus 57 minutes after midnight on the 23rd.

Jupiter will be in conjunction with the Sun at 4h. 5m. a.m. on the 3rd, and will, consequently, be absolutely invisible during the earlier part of the month. He will, however, later, become a morning star, rising some two hours before the Sun at the end of August. He is travelling towards the east, through a particularly void region of the heavens, in the constellation Cancer. We have previously spoken of his conjunction with the Moon at 5h. 39m. a.m. on the 4th, and at 11h. 41m. on the last night of the month.

It is possible that the reappearance of satellite 4 from occultation at 3h. 17m. a.m. on the 30th, and the disappearance of satellite 1 in eclipse at 4h. 51m. 39s. a.m. on the 31st, may be caught; while at 4h. 18m. after midnight on the same day (*i.e.*, at 4h. 18m. in the early morning of September 1), the egress of the first satellite from Jupiter's face will be visible.

Saturn is now the leading object in the night sky, but is still too close to the horizon, even at its culmination, for satisfactory observation. It might be worth while, however, in observing Saturn at present, for the amateur to try the effect of the exceedingly ingenious eyepiece invented by the Astronomer Royal, for the correction of that chromatic aberration which tends, *inter alia*, to render a planet at so small an altitude indistinct. Saturn rises on the 1st of August, about half-past six o'clock in the evening, is on the meridian at 10h. 27·4m., and sets about 2h. 23m. the next morning; his rising, southing, and setting on the 31st taking place at 4h. 25m. in the afternoon, 8h. 23·4m. in the evening, and 21 minutes after midnight respectively. He remains in Sagittarius during the whole of August, and is travelling slowly towards (and a little to the south of) the star π in that constellation. The part of the sky through which he is passing is almost a blank. We have mentioned above his conjunction with the Moon at 3h. 50m. a.m. on the 16th; but this will obviously happen after he has set.

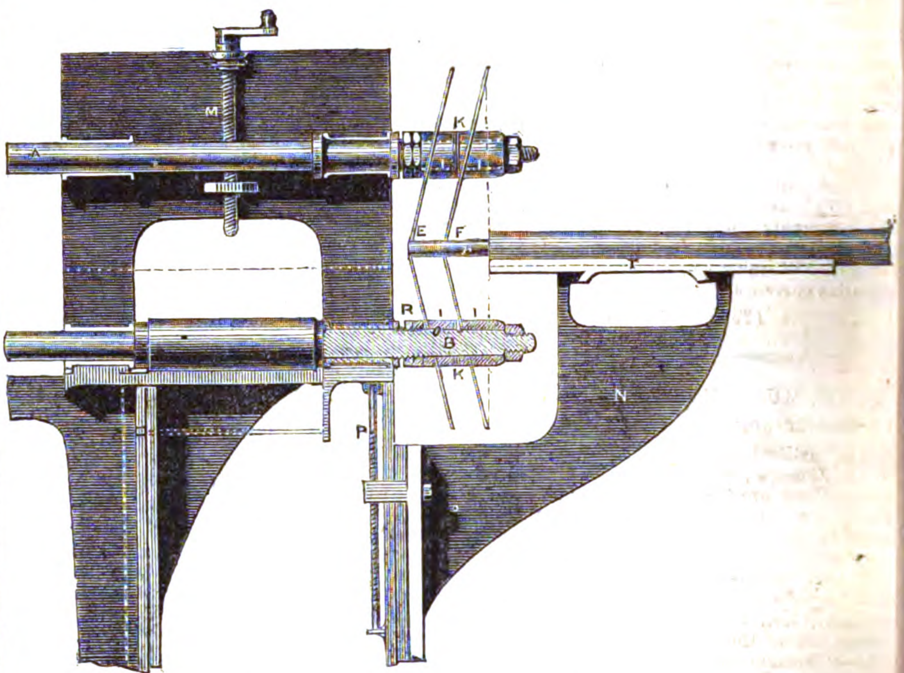
Uranus is a morning star, rising on the 1st about 3h. 39m. a.m.; and on the 31st 1h. 50m. after midnight. As he souths and sets in broad daylight during the earlier part of the month, and sets in strong twilight at the end of it, he must be looked for before sunrise. He is situated in a barren space in Cancer, and may be fished for on a line joining 20 and η in that constellation. This is, though, only a very rough direction for finding him; as, at the beginning of August, he will be slightly above such an imaginary line; and below it towards the end of it. The conjunctions of this planet with the Moon at 11h. 50m. a.m. on the 3rd, and at 9h. 12m. p.m. on the 30th; as also his conjunction with Mars at 12h. 57m. p.m. on the 23rd have been referred to under other heads.

Neptune is now coming into view in the night sky; rising on the 1st at 10h. 8m., southing the next morning about 4h. 59m., and setting, of course, in sunlight. At the end of the month he will rise a little after 8 o'clock in the evening, and be on the meridian about 3 in the early morning of the succeeding day. He may be fished for very slightly to the north-east of ο Piscium during the early part of August; just to the east of that star about the 16th; and, later in the month, to the south of east of it. It requires, as we have before intimated in these columns, a thoroughly good telescope to satisfy the young observer of the planetary nature of this distant member of our system.

The famous shower of shooting stars, annually visible on a night, or nights, from the 9th to the 11th of August (chiefly on that of the 10th, S. Lawrence's day), must be familiar to every observer who reads these lines. All, then, that is necessary is to remind the student to watch, on all three of the nights named, for a spectacle which must certainly well reward his vigils.

TENONING MACHINE.

A MACHINE for cutting tenons, by what is claimed to be an improved method, has been recently patented by Mr. C. M. Lloyd. The arrangement of the saws diagonally on the shaft is the principal peculiarity of the invention, which will be understood from the accompanying engraving. By this means the inventor claims that a clean and perfectly true tenon and shoulder is formed; that the saws are readily adjusted to cut any desire[d] thickness of tenon without loss of time, and tha[t] the saws can be sharpened whilst in position fo[r] working. Instead of placing the saws to run tru[e] on the shaft, they are attached to "run zig-zag," s[o] that their peripheries cut over the surface of th[e] tenon in widths of 3½in. more or less as may b[e] desired. The saws are kept in position by bevelle[d] collars, and are secured to the shafts by keys an[d] screw nuts. The inventor says that it is obviou[s] that a circular saw set at an angle on a shaft will [at] each revolution present all segments of its circum[-] ference to a different portion of the face of the woo[d,] and will travel the exact distance between the low[est] position of the saw, at any given moment, and a perpendicular line drawn from the uppermost edg[e] of the saw at such moment. Upon this principle the saws are applied to the shaft, fixed by coll[ars] and keys, and, according to the angle at which they are thus fixed, so will their proportionate trave[rse] for cutting the tenon be regulated.



In the figure, which is partly in section, A [B] ar[e] the upper and lower shafts set in gun metal journals, the shafts rotating at a very great speed, varying according to the character of the wood to be cu[t]. These shafts carry the four circular saws E, F, &c., set in diagonal grooves, in the collars I I, the[ir] angle being equal, although in reversed directions; the lower shaft being in section, the arrangement of fixing the saws is clearly shown, the key or feather O in dotted lines serving to keep the colla[r]s in a fi[rm] position. Provision is made for removing the collars and saws, and for substituting others as required by means of screw nuts, whereby the distance between the saws may be changed, the intermedi[ate] washers K K, or others maintaining such intervening space between them, and the position of the saws on the shafts may be altered in order to form the shoulder further from the edge of the wood or timber, or *vice versâ*, by means of the nuts seen in the engraving. The depth of tenon is regulated by shifting the position of the upper shaft A by the screw gear M, and by regulating the height of the table T corresponding.

For the feeding arrangement N is a bracket, capable of sliding vertically in guides, its elevation being regulated by the endless screw P; this bracket carries the transverse sliding table T, in the bed of which the wood is set and adjusted to the saws exactly as desired, and fixed by any means, the bed and table being made to travel in the bracket by manual or other power. The operation of the machine is as follows:—Let the part *r* of the wood be the tenon supposed to have been cut by the saws E, F, G, H, then the saw E will have cut from the point E, to the point F, and the saw F will have cut from F to the shoulder of the tenon; the teeth of the respective saws thus having travelled longitudinally along the tenon from those points exactly in accordance with the diagonals. The saws are, of course, run with great rapidity; the chief value of the machine, however, appears to be the facility with which it can be arranged to cut different sized tenons. It is not apparent on an inspection of the drawing how a "perfectly true shoulder" is obtained.

NOVEL METHOD OF DESTROYING VERMIN.

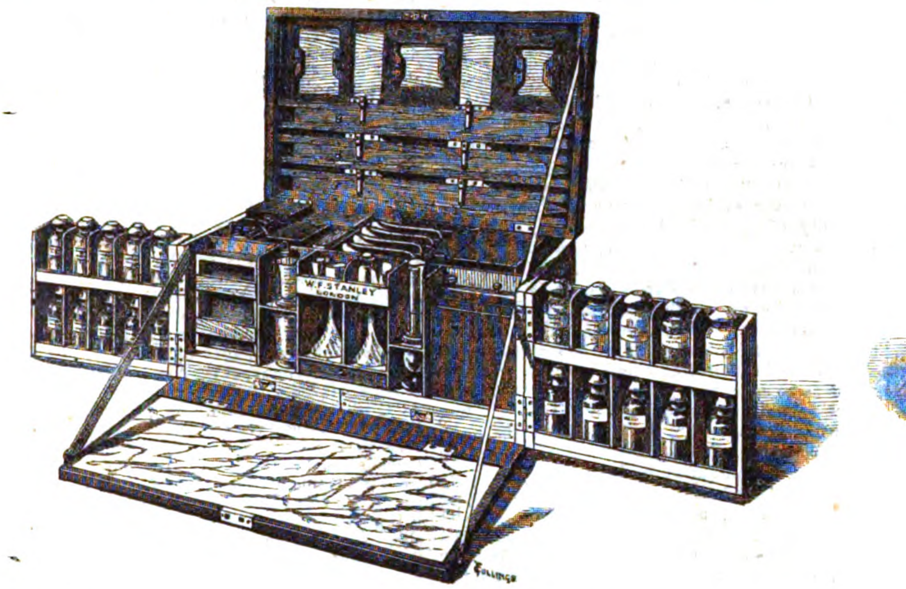
A MEETING of scientific gentlemen and others interested in farming and horticulture was recently held at South Kensington to witness some experiments with a patent vermin asphyxiator, which claims to be a disinfector, vaporiser, and universal fumigator as well. The experiments were conducted under the superintendence of Mr. Frank Buckland, who, in an introductory speech, pointed out the advantages of some reliable destroyer for the insects that infest our gardens and fields, and also the larger vermin, like rats and snakes, that in some countries are even greater pests than the insect world. The rabbit question, which Mr. Buckland jocosely stated had become a political claptrap, was shown to be effectually solved by this new machine. The process is simple, and though not new, either in its effects or means of application, is, however, so effectually concentrated and made practicable in this machine as to be to all intents a novel affair. By means of a fan, turned by hand, sulphurous acid gas can be driven through a nozzle into drains, rat, rabbit, and snake holes, and the gas either drives the vermin out, so that they can be killed outside, or it suffocates them in the holes. Some amusement was caused by a rat that was to be smoked out of a burrow made for the purpose, escaping and biting two of the bystanders who attempted to catch him. However, when caught and put into the burrow, the asphyxiator soon drove him out again. Some snakes were almost smoked and killed. A piece of stinking and maggotty meat was exposed to the action of the gas, and at once the maggots were killed, and the meat lost its bad odour. To people who have large granaries, maltsters, and others, the asphyxiator will be very valuable. An experiment with some weevils in a jar of corn killed them all in a few seconds. The pan attached to the fan can be filled either with the compound to produce sulphurous gas (merely pieces of brown paper dipped in hot sulphur), when it is required to fumigate thoroughly and destroy life, or ordinary smoke from grass can be used if it is required to drive out rabbits from their burrows. The deodorising effects of sulphurous acid gas are well known, and there is no doubt that this machine would be very valuable to disinfect houses after infectious diseases. Its application to shrubs in the open air can only be but partial, but in greenhouses it might be quite certain, and those shrubs subjected to the smoke were quickly cleared of their aphides.

PHOTOGRAPHIC LABORATORIES.

HITHERTO it is has been the custom for amateur photographers to purchase the various articles they require separately, and from time to time, or else to obtain in the first instance a box of apparatus and chemicals, neatly and closely packed in their case, but by no means conveniently arranged, if the containing box is afterwards to be used as a receptacle for the apparatus when in use.

Mr. Stanley's laboratories, as he calls them, are so arranged that every article has its place, and can be taken out or put back without displacing anything else; indeed, it is easier to return the article used to its proper compartment than to place it elsewhere. Another advantage is that when the operations are concluded, the whole affair can be closed in a minute.

Our illustration will give an idea of the general arrangement. When the lid is raised and the front turned down, the whole of the interior is exposed; the larger parts of the apparatus are contained in the back, each having its own division, while the chemicals and smaller articles appear in front, arranged just as they might be in a chemist's shop. The front, which has proper means of support when open, serves as a table to work upon.



In the larger sets of apparatus shown in the second illustration, there are two wings which turn outwards when the front is open, these contain the reserve stock of chemicals, the solutions in use for the time being occupying the central part of the case.

CONCRETE BUILDING.

THE following particulars of concrete building in Scotland, taken from the *Aberdeen Journal*, will interest several of our readers; the cottages referred to are in course of erection on the property of Mr. Lumsden of Pitcaple, a gentleman who is one of the directors of a concrete company in London:—

The whole process of building houses of concrete is so exceedingly simple that the employment of skilled labour is quite unnecessary, and indeed the four labourers who were employed in the construction of the cottages referred to had never seen anything of the kind before, and yet they performed their allotted work without the slightest difficulty. A foundation having been laid, a double framework of wood, or panelling, 9in. apart and 18in. high, is placed above the foundations round the entire building, forming a kind of box. This panelling consists of pieces of wood, varying in breadth from 3in. or 4in. to over 1ft., with a bead on the upper edge having an aperture by which the pieces are slid on to an iron rod. Being thus telescopic in construction, the pieces of wood can be lengthened or shortened according to the extent of the building. At intervals between the panels are placed upright bars, called separating posts, several feet high, through which the iron rods supporting the panels pass and are secured. At equal distances of 18in., ascending upwards, there are apertures in the posts for the insertion of the iron rods, and the panelling round the entire structure can be raised with great ease as the building advances. When operations are to be commenced, a quantity of packing, which may consist of rough stones of any shape, the more ragged the better, which forms the first layer of the building is thrown in, care being taken to keep the packing 1in. from the face of the work, so that it may not show through it. When the 18in. of packing are filled up, the concrete, which is in a semi-liquid state, like mud, is poured into the box, and percolates down through the stones, thoroughly filling all cavities, and binding the stones and rubble together so tightly that the whole forms one solid mass. For a day the portion of wall thus made lies encased within the panelling. By that time it has become quite dry, and the panelling or frame is taken off and lifted up other 18in., the bottom of the frame resting where the top was before. Thus another box is formed above the piece of finished wall, and identically the same process which we have described is repeated, stones and rubble being thrown in, and the liquid cement being poured over them. In this way 18in. of building are finished each day if the weather be good, so that in the course of a week the walls of a cottage 8ft. or 9ft. high are strongly and firmly built.

When the panelling is screwed together to the separating posts, it is so mathematically exact, owing to its careful structure, that the wall is built as straight as if tested with a plumb line. Indeed, it cannot fail to be so, and it is interesting to note that the whole building is finished without the aid of a plumb line, which is quite unnecessary.

A noteworthy feature in connection with the building of these concrete houses is that the usual cumbrous and often dangerous scaffoldings which are used in erecting ordinary buildings is superseded by a much better, more secure, and much less unwieldy arrangement, by which ropes are entirely dispensed with. Little hollow iron tubes, called cores, are placed in the walls, through which iron rods are inserted, connected with brackets, which are securely attached to the wall, being firmly screwed through the building with nuts. The brackets are just similar in form to supports used for shelving, and on the top of the brackets are laid the planks for the scaffolding, forming altogether a neat and strong support.

The two cottages, which are built as one, are 32ft., in length, by 22ft., and 8ft. high. In each cottage there are three rooms, those in the front being about 12ft. square, and the back rooms measuring about 7ft. by 12ft. The cottages are lighted by two windows in the front and four in the back. The flooring is of concrete, which, being thoroughly impervious to moisture, makes the apartments very dry and comfortable. It is intended to have the roof built in the ordinary way with rafters and slating, but it is not uncommon for concrete to be used as a roofing material, for which purpose it answers very well. The outside walls, when built, are finished with a coating of concrete, about a quarter of an inch thick, a little finer in the quality than that used for the ordinary building, which gives a smooth finished appearance to the structure. No supports are requisite for the lintels of the doors or windows, because after the concrete is hardened it is stronger than any support of wood or stone. When the building is in progress, spaces are left for the joists, and are temporarily filled with sand, which is easily removable at any time with a trowel. The spaces for the joists are made, alternately, 3in. and 6in. in depth on each side of the building, which diminishes the pressure on the walls considerably.

Houses finished in the way we have described are much cheaper than those built in the ordinary way, the saving being from 35 to 40 per cent. The buildings, at the same time, are more comfortable because being impervious to moisture and heat, they are warm and dry in winter, and cool during the summer. The rooms can be papered over the bare walls, no lath or plaster being required, though a coating of plaster in no way affects the concrete, if it is preferred.

THE "FOSSIL" MAN.

THE discovery of the so-called "fossil" man in one of the larger caverns near Mentone, on the Italian frontier, is likely to give rise to an animated discussion in scientific circles. The fossil man, or more correctly, perhaps, we should say the skeleton, was found buried several yards below the floor of a cavern overlooking the railway cutting from Mentone to Vintimille. Owing partly to the nature of the earth and partly to the dryness of the elevated cavern the skeleton is in very fine preservation, and with the exception of the ribs, probably broken by the weight of the overlying materials, is said to be complete. An illustration of the "Troglodite de Menton" was published in the *Courier* of that town in the month of April, shortly after the discovery, and has been reproduced in a recent issue of the *Geological Magazine.* It represents the skeleton as lying in a position which might have been expected if it had been known that the body had been interred in the ordinary way, the legs being crossed and bent at the knees, and the arms folded about the head, as if the man had died sleeping, and had been carefully covered over with earth. A number of shells similar to those found on living animals in the sea around the neighbourhood were discovered close to the skull, together with a quantity of deer's teeth, all of which were pierced with a hole, as if they had formed part of a necklace or head-dress. Stone implements, which appear to have been worked into shape by rubbing—such as chisels, axes, and scrapers—as well as bone needles, were found in abundance, together with the bones of animals, notable amongst which were the lower jawbones of several "herb-eating" species.

The discoverer of these remains, which may or may not be of much importance in forming a correct estimate of geological time, is a Dr. Rivière, a gentleman holding an appointment from the French Government to examine and report on the palæontology of the neighbourhood, in which he has brought to light a large collection of bones and teeth of various animals, principally of hyænas, rhinoceroses, bears, and gigantic stags, obtained chiefly from quarries. Having worked up the quarries tolerably completely he has now turned his attention to the caves, and a first result is the finding of this skeleton. We believe that Mr. Pengelly, who has had great experience in unravelling the secrets of caves, and who has for some years directed the explorations at Kent's Hole undertaken by the British Association for the Advancement of Science, has gone to the site of the discovery, and his report, together with that of Dr. Rivière, will be read by geologists with much interest. In the mean time, two gentlemen tolerably well known in the scientific world have furnished more detailed particulars, and expressed their opinions on the matter. From these we learn that the rock in which the cave is situated is Oolitic or Jurassic limestone, which is naturally full of caverns. The cave in question is narrow and lofty, as well as deep; the floor at the entrance being some 9ft. above the bottom, while in the interior the depth is considerably greater. No remains of extinct animals such as the cave bear (*Ursus spelæus*) were found *above* the skeleton; and the appearance of the place, taken with the surrounding characteristic facts, leads to the belief that it was a case of interment during the stone age, but not early in that period—the skeleton being, probably, that of a person of some position in those times. Mr. Nicholl, who has also examined the cavern, corroborates this opinion, and says that to him it appears to be a case of burial, the stones at the back and front of the skeleton clearly proving this, for they were evidently placed by design as if to mark the place of sepulture. M. Rivière, however, does not seem to have thought much of this fact, for he removed all the stones before the skeleton was photographed. If the man was buried, then, he might or might not have been co-existent with the extinct animals so many of whose bones were found in the cave-earth near the skeleton. Close by, in front of the cave, there was, Mr. Nicholl thinks, irresistible evidence that man lived in these caves at the same time that animals *now extinct* were living in the neighbourhood. For in front of the cave is a *talus*, formed of breccia fallen from the cliff above. The stones forming this breccia are as sharp and angular as when they fell from the cliff, and are cemented by lime and oxide of iron into a hard conglomerate. It appears that two years ago this conglomerate was cut into to some depth for the railway works, and numerous flint implements, such as knives, spear and arrow heads, and bones of extinct and existing animals, were brought to light. These facts, considering that the stones forming the conglomerate are so very sharp and angular, seem to Mr. Nicholl to afford very conclusive evidence that not only are the stones lying where they fell, but that the bones and flints are also just where they were thrown by inhabitants of the caves above.

It will be readily understood that discoveries of this kind, and the conclusions to be drawn from them, throw considerable light on a subject that has been matter of dispute for some years—viz., the antiquity of man. Formerly it was generally believed that man appeared on the face of the earth only after the disappearance of what are called the extinct mammalia, and consequently after those physical changes — catastrophes, cataclysms, or whatever else they may be termed, which, in times gone by, certainly affected the surface of our planet. In more recent days, however, the belief has gradually gained ground that man is a far more ancient inhabitant of the earth than was previously imagined, this belief having arisen from the discovery of his remains and works intimately associated with those of extinct animals. The presence of flint implements, which are believed to exhibit undoubted evidence of the handiwork of man, in heaps of bones of extinct animals is common enough, but the instances in which human remains have been found in similar deposits are far more rare: consequently, the finding of this "fossil" man is an important point, and whatever evidence it may afford as to the antiquity of man will be extensively discussed and severely criticised. So long back as 1824 Dr. Buckland discovered a large portion of the skeleton of a woman in the Paviland cave, Glamorgan, commonly known as the Red Lady of Paviland, but as it was only thinly covered, and ivory ornaments made from the tusks of the antediluvian elephant and rhinoceros, whose bones were found in the same cave, were discovered in contact with it, there could be little doubt that this lady was not contemporary with the hyæna and the bear, whose bones had also found a resting-place in the same spot. About one mile from this cave, however, is another known as Long Hole, in which flint implements, unquestionably fashioned by human hands, were found along with the fossil remains of the cave bear and hyæna, &c. Another instance of the antiquity of these implements was discovered by the Rev. W. S. Symonds in King Arthur's cave, near Whitchurch, Ross, and this would appear to afford indubitable evidence of the antiquity of the flint flakes and cores of chert found in connection with the bones of the usual cave mammals; for in one part of the cave beneath a thick layer of stalagmites which was itself covered by what is believed to be a portion of an old river-bed, flint implements were found mingled with the bones and teeth of the same species of extinct animals. Similar evidence has been obtained from caves in various parts of Belgium and France, as well as in America. Dr. Schmerling found in the Engi and Engihoul caves the bones of man, worked flints, and bone implements, indiscriminately mixed with the remains of the rhinoceros, horse, elephant, bear, and hyæna; while M. Lartet, who examined the celebrated Aurignac cave, concludes that not only was man contemporary with the mammoth, but that he actually used the rhinoceros as food.

We have said enough to show that the finding of this "fossil" man, from the bearing which it may have on received theories, is of some importance, and further discoveries in the same neighbourhood may be fairly anticipated, and will be doubtless eagerly expected. The evidence presented by the explorations of caves, however, requires the greatest circumspection in the unravelling of the rather tangled skein of facts, for the mere statement that bones of man have been found mingled with those of extinct animals does not necessarily require a belief in the contemporaneity of the living beings to whom the bones belonged—rather the contrary indeed, for man can hardly have been tenant of a cavern which was at the same time inhabited by the cave bear, hyæna, and lion—but the surrounding circumstances and the characteristic features of the earth in which they were buried are points which cannot be neglected in solving the problem. It is certain that very great changes have taken place in the climate of these islands since the cave-mammals lived and flourished in them, and these different periods are well marked in the deposits found in the caves; for, as Mr. Boyd Dawkins has shown, out of forty-eight well-ascertained species living in the Palæolithic or "ancient stone" period only thirty-one were enabled to live on into the Neolithic, "new stone," or Prehistoric period, while of these thirty-one all but six are still living in Britain; there can be no doubt, too, that the climate during the Neolithic period was certainly "less severe" than the Palæolithic. But all these considerations cannot be brought within the compass of one article, and must be postponed till the report of Dr. Rivière on his so-called "fossil" man is in the hands of geologists.

THE CONSTITUTION OF NATURE.*

(*Concluded from p. 458.*)

UP to the present point we have been dealing with tensions, and not with motion. Thus far *vis viva* has been entirely foreign to our contemplation of D and F. Let us now suppose D placed at a practically infinite distance from F; here the pull of gravity would be nothing, and the perpendicular representing it would dwindle to a point. In this position the sum of the tensions capable of being exerted on D would be a maximum. Let D now begin to move in obedience to the attraction exerted upon it. Motion being once set up, the idea of *vis viva* arises. In moving towards F the particle D consumes, as it were, the tensions. Let us fix our attention on D at any point of the path over which it is moving. Between that point and F there is a quantity of unused tensions; beyond that point the tensions have been all consumed, but we have in their place an equivalent quantity of *vis viva*. After D has passed any point, the tension previously in store at that point disappears, but not without having added, during the infinitely small duration of its action, a due amount of motion to that previously possessed by D. The nearer D approaches to F, the smaller is the sum of the tensions remaining, but the greater is the living force; the farther D is from F, the greater is the sum of the unconsumed tensions, and the less is the living force. Now the principle of conservation affirms not the constancy of the value of the tensions of gravity, nor yet the constancy of the *vis viva* taken separately, but the absolute constancy of the value of the sum of both. At the beginning the *vis viva* was zero and the tension area was a maximum; close to F the *vis viva* is a maximum, while the tension area is zero. At every other point the work-producing power of the particle D consists in part of *vis viva* and in part of tensions.

If gravity, instead of being attraction, were repulsion, when the particles are in contact, the sum of the tensions between two material particles D and F would be a maximum, and the *vis viva* zero. If D in obedience to the repulsion, moved away from F, *vis viva* would be generated; and the farther D retreated from F the greater would be its *vis viva*, and the less the amount of tension still available for producing motion. Taking repulsion into account as well as attraction, the principle of the conservation of force affirms that the mechanical value of the tensions and *vires vivæ* of the material universe is a constant quantity. The universe, in short, possesses two kinds of property which are mutually convertible at an unvarying rate. The diminution of either carries with it the enhancement of the other, the total value of the property remaining unchanged.

The considerations that we have here applied to gravity apply equally to chemical affinity. In a mixture of oxygen and hydrogen the atoms exist apart, but by the application of proper means they may be caused to rush together across the space that separates them. While this space exists, and as long as the atoms have not begun to move towards each other, we have tensions and nothing else. During their motion towards each other the tensions, as in the case of gravity, are converted into *vis viva*. After they clash we have still *vis viva*, but in another form. It was translation, it is vibration. It was molecular transfer, it is heat. The same considerations apply to a mixture of hydrogen and chlorine. When these gases are mingled in the dark they remain separate, but if a sunbeam fall upon the mixture the atoms rush together with detonation. Here also we have tension converted into molecular translation, and molecular translation into heat and sound.

It is possible to reverse these processes, to unlock the embrace of the atoms and replace them in their first positions. But to acomplish this as much heat

* By Prof. TYNDALL, reprinted from the *Journal* of the London Association of Foremen Engineers.

ald be required as was generated by their union. ch reversals occur daily and hourly in nature. the solar waves, the oxygen of water is divorced m its hydrogen in the leaves of plants. As lecular *vis viva* the waves disappear, but in so ng they re-endow the atoms of oxygen and hydro- ı with tension. The atoms are thus enabled to ombine, and when they do so they restore the ecise amount of heat consumed in their separation. e same remarks apply to the compound of carbon l oxygen, called carbonic acid, which is exhaled m our lungs, produced by our fires, and found ıringly diffused everywhere throughout the air. the leaves of plants the sunbeams also wrench ese atoms asunder, and sacrifice themselves in ı act: but when the plants are burnt the amount heat consumed in their production is restored.

This, then, is the rhythmic play of nature as gards her forces. Throughout all her regions she cillates from tension to *vis viva*, from *vis viva* to ısion. We have the same play in the planetary stem. The earth's orbit is an ellipse, one of the i of which is occupied by the sun. Imagine the rth at the most distant part of the orbit. Her tion, and consequently her *vis viva*, is then a nimum. The planet rounds the curve, and begins approach the sun. In front it has a store of ten- ons, which is gradually consumed, an equivalent ıount of *vis viva* being generated. When nearest the sun the motion, and consequently the *vis va*, is a maximum. But here the available tensions ve been used up. The earth rounds this portion the curve and retreats from the sun. Tensions e now stored up, but *vis viva* is lost, to be again stored at the expense of the complementary force the opposite side of the curve. Thus beats the art of the universe, but without increase or minution of its total stock of force.

I have thus far tried to steer clear amid confusion fixing the mind of the reader upon things rather an upon names. But good names are essential; d here, as yet, we are not provided with such. e have had the force of gravity and living force— o utterly distinct things. We have had pulls and nsions; and we might have had the force of heat, e force of light, the force of magnetism, or the rce of electricity—all of which terms have been nployed more or less loosely by writers on physics. is confusion is happily avoided by the introduc- on of the term "energy," embracing under it both nsion and *vis viva*. Energy is possessed by bodies ready in motion; it is then actual, and we agree call it actual or dynamic energy. It is our old *s viva*. On the other hand, energy is possible to odies not in motion, but which, in virtue of attrac- on or repulsion, possess a power of motion which ould realise itself if all hindrances were removed. ooking, for example, at gravity, a body on the rth's surface in a position from which it cannot ll to a lower one possesses no energy. It has either motion nor power of motion. But the same ody suspended at a height above the earth has a ower of motion though it may not have exercised . Energy is possible to such a body, and we agree call this potential energy. It embraces our old nsions. We, moreover, speak of the conservation energy instead of the conservation of force; and y that the sum of the potential and dynamic ergies of the material universe is a constant antity.

A body cast upwards consumes the actual energy projection, and lays up potential energy. When reaches its utmost height all its actual energy is nsumed, its potential energy being then a maxi- um. When it returns, there is a reconversion of e potential into the actual. A pendulum at the mit of its swing possesses potential energy; at the west point of its arc its energy is all actual. A atch of snow resting on a mountain slope has otential energy; loosened, and shooting down as avalanche, it possesses dynamic energy. The ne-trees growing on the Alps have potential ergy; but rushing down the Holzrinne of the oodcutters they possess actual energy. The same true of the mountains themselves. As long as e rocks which compose them can fall to a lower vel, they possess potential energy, which is con- erted into actual when the frost ruptures their hesion and hands them over to the action of avity. The hammer of the great bell of West- inster, when raised before striking, possesses otential energy; when it falls, the energy becomes ynamic; and after the stroke, we have the rhythmic play of potential and dynamic in the vibrations of the bell. The same holds good for the molecular oscillations of a heated body. An atom is pressed against its neighbour, and recoils. But the ultimate amplitude of the recoil is soon attained, the motion of the atom in that direction is checked, and for an instant its energy is all potential. It is then drawn towards its neighbour with accelerated speed, thus, by attraction, converting its potential into dynamic energy. Its motion in this direction is also finally checked, and, for an instant, again its energy is all potential. It again retreats, converting, by repul- sion, its potential into dynamic energy, till the latter attains a maximum, after which it is again changed into potential energy. Thus, what is true of the earth, as she swings to and fro in her yearly journey round the sun, is also true of her minutest atom. We have wheels within wheels, and rhythm within rhythm.

When a body is heated, a change of molecular arrangement always occurs, and to produce this change heat is consumed. Hence, a portion only of the heat communicated to the body remains as dynamic energy. Looking back on some of the statements made at the beginning of this article, now that our knowledge is more extensive, we see the necessity of qualifying them. When, for example, two bodies clash, heat is generated; but the heat, or molecular dynamic energy, developed at the moment of collision, is not the equivalent of the sensible dynamic energy destroyed. The true equivalent is this heat, plus the potential energy conferred upon the molecules by the placing of greater distances between them. This molecular potential energy is afterwards, on the cooling of the body, converted into heat.

Wherever two atoms capable of uniting together by their mutual attractions exist separately, they form a store of potential energy. Thus our woods, forests, and coal-fields on the one hand, and our atmospheric oxygen on the other, constitute a vast store of energy of this kind—vast, but far from infinite. We have, besides our coal-fields, bodies in the metallic condition more or less sparsely dis- tributed in the earth's crust. These bodies can be oxidised, and hence are, so far as they go, stores of potential energy. But the attractions of the great mass of the earth's crust are already satisfied, and from them no further energy can possibly be obtained. Ages ago the elementary constituents of our rocks clashed together and produced the motion of heat, which was taken up by the ether and carried away through stellar space. It is lost for ever as far as we are concerned. In those ages the hot conflict of carbon, oxygen, and calcium produced the chalk and limestone hills which are now cold; and from this carbon, oxygen, and calcium, no further energy can be derived. And so it is with almost all the other constituents of the earth's crust. They took their present form in obedience to mole- cular force; they turned their potential energy into dynamic, and gave it to the universe ages before man appeared upon this planet. For him a residue of potential energy remains, vast truly in relation to the life and wants of an individual, but exceedingly minute in comparison with the earth's primitive store.

To sum up. The whole stock of energy or work- ing-power in the world consists of attractions, repulsions, and motions. If the attractions and repulsions are so circumstanced as to be able to produce motion they are sources of working-power, but not otherwise. As stated a moment ago, the attraction exerted between the earth and a body at a distance from the earth's surface is a source of working-power; because the body can be moved by the attraction, and in falling to the earth can per- form work. When it rests upon the earth's surface it is not a source of power or energy, because it can fall no further. But though it has ceased to be a source of energy, the attraction of gravity still acts as a force, which holds the earth and weight together.

The same remarks apply to attracting atoms and molecules. As long as distance separates them, they can move across it in obedience to the attrac- tion, and the motion thus produced may, by proper appliances, be caused to perform mechanical work. When, for example, two atoms of hydrogen unite with one of oxygen to form water, the atoms are first drawn towards each other—they move, they clash, and then by virtue of their resiliency, they recoil and quiver. To this quivering motion we give the name of heat. Now this atomic vibration is merely the redistribution of the motion produced by the chemical affinity; and this is the only sense in which chemical affinity can be said to be con- verted into heat. We must not imagine the chemical attraction destroyed, or converted into anything else. For the atoms when mutually clasped to form a molecule of water, are held together by the very attraction which first drew them towards each other. That which has really been expended is the pull exerted through the space by which the distance between the atoms has been diminished.

If this be understood it will be at once seen that gravity may in this sense be said to be convertible into heat; that it is in reality no more an outstand- ing and inconvertible agent, as it is sometimes stated to be, than chemical affinity. By the exer- tion of a certain pull through a certain space a body is caused to clash with a certain definite velocity against the earth. Heat is thereby developed, and this is the only sense in which gravity can be said to be converted into heat. In no case is the force which produces the motion annihilated or changed into anything else. The mutual attraction of the earth and weight exists when they are in contact as when they were separate; but the ability of that attraction to em- ploy itself in the production of motion does not exist.

The transformation, in this case, is easily followed by the mind's eye. First, the weight as a whole is set in motion by the attraction of gravity. This motion of the mass is arrested by collision with the earth, being broken up into molecular tremors, to which we give the name of heat.

And when we reverse the process, and employ those tremors of heat to raise a weight, as is done through the intermediation of an elastic fluid in the steam-engine, a certain definite portion of the molecular motion is destroyed in raising the weight. In this sense, and this sense only, can the heat be said to be converted into gravity, or more correctly, into potential energy of gravity. It is not that the destruction of the heat has created any new attrac- tion, but simply that the old attraction has now a power conferred upon it, of exerting a certain definite pull in the interval between the starting- point of the falling weight and its collision with the earth.

When, therefore, writers on the conservation of energy speak of tensions being "consumed" and "generated," they do not mean thereby that old attractions have been annihilated, and new ones brought into existence, but that, in the one case, the power of the attraction to produce motion has been diminished by the shortening of the distance between the attracting bodies, and that in the other case the power of producing motion has been augmented by the increase of the distance. These remarks apply to all bodies, whether they be sensible masses or molecules.

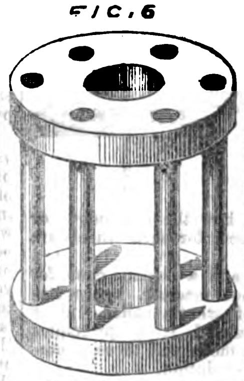
Of the inner quality that enables matter to attract matter we know nothing; and the law of conservation makes no statement regarding that quality. It takes the facts of attraction as they stand, and affirms only the constancy of working- power. That power may exist in the form of motion; or it may exist in the form of force, with distance to act through. The former is dynamic energy, the latter is potential energy, the con- stancy of the sum of both being affirmed by the law of conservation. The convertibility of natural forces consists solely in transformations of dynamic into potential, and of potential into dynamic energy, which are incessantly going on. In no other sense has the convertibility of force, at present, any scientific meaning.

MECHANISM.*

(Continued from p. 456.)

WE now return to the question of rolling curves. If one curve is to cause another to rotate, it is easy to see that the curves must have corresponding surfaces. Early mechanicians adopted a plan of which there is an example here—viz., driving pins round the edge of the wheel, and these pins worked between pins on the face of the other wheel, and thus continuous motion was obtained in shafts at right angles to each other. That motion was required because it was needful in early days to utilise the power of water for the purpose of grinding corn. The water fell vertically, and the water-wheel, therefore, moved vertically, but the millstones were required to rotate hori- zontally. The question, therefore, was, how can we with a vertical fall of water get a horizontal motion. It was got by pins driven into the face of the wheels; such wheels exist to this day in Dutch clocks. They were much increased, extended, and enlarged as machinery advanced. Ultimately they formed what are called trundle or lantern-wheels. Fig. 6 is an example of a trundle or lantern-wheel. In mill machinery the round staves are made of a tough hard wood, firmly fixed at each end. In light machinery the staves are of steel wire, and fixed only at one end.

FIG. 6

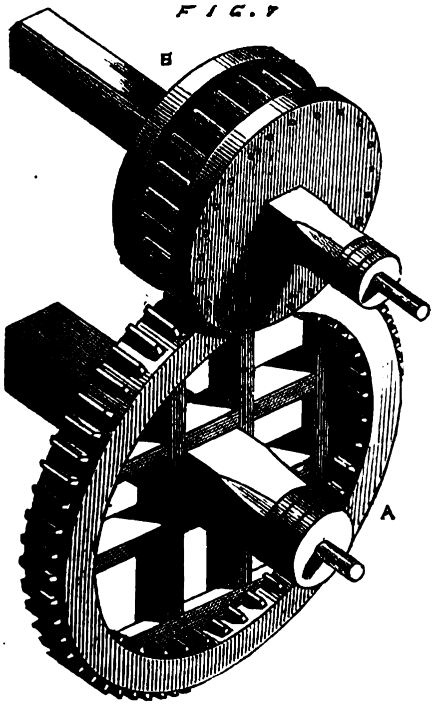


The reason why wheels in mill machinery were made so broad, in all respects so heavy, and to our eyes so inconvenient and clumsy, arose from the fact that the shafts were wooden ones, generally square—capped at the end with an iron hoop—an iron pin being driven into the wood for a bearing. Millwrights then had not means for completing these wooden shafts with that care which an Eng- lish development of the "tool-making" faculty has given us, and which we so successfully apply to iron shafts. There are drawings here of one of these earlier wheels, with its shaft and wedges, and of a modern wheel, with its turned wrought-iron shaft and key-way, from which you will at once see the difficulties which beset mechanics in the last century. It was needful that the wheels should re- volve truly with one another, but this was very diffi- cult with wooden wheels, wooden shafts, and wooden pin-teeth. Remember that it was not until Smea- ton's time (A.D. 1769) that cast-iron teeth were used for wheels.

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

Another difficulty with a square wooden shaft was to make the wheel "run" truly. About sixteen wedges were used, driven in on opposite sides, but, with all the driving, the wheel could not be made to run true. An inspection of Fig. 7 will satisfy

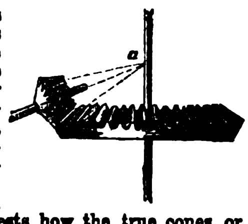
FIG. 7



any one of the difficulties alluded to. Now, however, with Mr. Whitworth's gauges for shafts, wheels can be fixed so as to run true. That was one of the earlier difficulties, and when removed there was no difficulty in disposing of these thick heavy lantern-wheels, and machinists began to adopt mathematically correct teeth, as well as true circular shafts and circular holes. There is no difficulty in making clear, without the aid of mathematics, the principles upon which these teeth should be constructed. There are diagrams on the wall intended for the purpose, but the subject belongs more properly to the next lecture.

But it was not only to shafts rotating at right angles to each other, as in the grinding of corn by water-wheels, that motion had to be communicated through rolling contact. As machinery extended, the directions of shafts to be thus driven became more and more varied. Hence for two shafts neither parallel nor at right-angles, but meeting, mechanicians were required to provide a contrivance. Fig. 8 will explain how they did this, and it also suggests how the true cones, or "bevels" as they are called, for such wheels are deduced.

FIG. 8



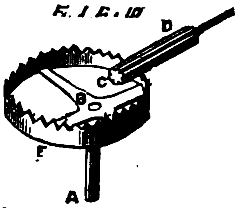
Much will have more, and a demand came for shafts not parallel and not meeting, hence has resulted a large class of wheels called "skew bevels." These are deduced from principles illustrated by this working mode and these photographs of hyperboloids of revolution.

The teeth, then, being correctly constructed, the question was, how can varying motions be communicated from one wheel to the other, or, rather, from one shaft to the other. It can be done by taking different curves, for it is the fact that, given one curve, another can always be found that will roll by a tooth arrangement in contact with it. Lobe wheels, and wheels formed upon the rims of squares, will work in gear with other lobe and square wheels. Here is an example, and it will be found that these wheels work as truly together as if they were circular. Here is another form, a heart, or cam, or lobe-shaped tooth-wheel, for which we are indebted to the authorities at South Kensington, and these rotate as truthfully as if the teeth were formed upon the rim of a circular wheel. A variable motion, therefore, has been obtained from a uniform one, for, although one of these shafts rotates uniformly, yet the velocity of the other shaft is not uniform. There are many cases in which such variable velocity is required, in none more than in arranging the velocities with which the tool or work travels in different machines. The mechanism for accomplishing that is devised in various ways. As an example of communication by rolling contact, it has been done by elliptical wheels.

FIG. 9

The history of elliptical wheels is very curious; and if there are any here who are interested in mechanism apart from mechanics, the thoughtful study of all that is written about what is called "planetary mechanism" in Rees's "Cyclopædia" will repay the time given to it. The wonders of those orreries, contrived at the latter part of the last century, are quite sufficient to excite the astonishment of mechanicians at the present day. Here is one of the plates in Rees's "Cyclopædia"—viz., one—under "Planetary Mechanism," showing an orrery moved by a small handle, but containing an immense number of wheels, probably more than 100. These orreries are very curious indeed, and we are indebted to them for two very important constructions, one being the elliptical wheel, the other the crown wheel. Astronomers wished very much to communicate a clear idea of the motions of the heavenly bodies, and they attempted to do it by machinery, not the machinery we have, but by contrivances, although, in our eyes, clumsy, yet in those days very beautiful. The orbit of the earth being elliptical, their object was to get an elliptical motion. About the year 1695 an attempt was made by Huyghens to form what we now call crown wheels. He then called them contrate wheels, because the teeth were in the contrary position to the usual one. He attempted to get at the requisite elliptical path by taking a contrate wheel, fixing its axis out of the centre, and putting a pinion to drive it; the wheel, therefore, went round with a variable velocity. Fig. 10 illustrates this arrangement. D C is a long pinion, F the contrate wheel, A B the axis placed out of the centre of the wheel F. If, now, the pinion C D moves uniformly, the axis A B will have a variable velocity, moving most rapidly when the distance from B to the driving portion of the pinion is the least. Roemer, about 1710, thought to accomplish the same object by a very ingenious contrivance, which is to be found in the cabinets of the mechanically curious to this day. He took a cone, and knowing that an ellipse is a section of a cone, he thought he could not do better than take two cones, making one grooved, and putting teeth round the elliptical section of the other, so as to fit into the grooves. Thus he got a velocity which he took to be the best representation of the path of the earth round the sun. There is a model of it here. Then a gentleman, Dr. Desauglier, who was the first to deliver public lectures on science in London, came forward about the year 1744. He attempted to accomplish the same thing by taking two wheels of a true elliptical form, nailing a string to each, so that one pulled the other round.

FIG. 10



Then Adam Walker tried to accomplish this variable motion by using epicycloidal inclined plane wheels, for a more particular description of which see the "Encyclopædia." Joseph Priestly, in 1801, accomplished the same by a contrivance which was very ingenious, and which may now be sometimes available. He did that which no mechanic who had a character to lose would venture to do—he made wheels of which the teeth were irregular, that is to say, he made a large wheel having more teeth on one half of it than on the other, and the teeth of both the wheel and the pinion being large, they worked together, though in a somewhat loose way, and thus one half of the wheel travelled more quickly than the other. By this means a pretty faithful representation of the path of the earth round the sun was obtained.

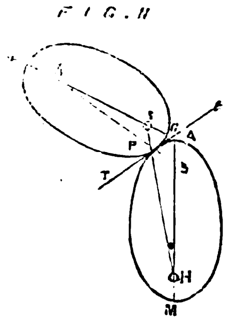
Then Pearson, about the year 1808, undertook to make, for the Royal Institution, one of the finest orreries, and one of the most extraordinary pieces of mechanism probably made in that day. He not only introduced wheels such as have been described, but attempted to get various velocities and varying distances by means of elliptical wheels; and he, for the first time, introduced an epicycloidal train, of which more in a future lecture.

Those of you who are curious in the matter of "rolling contacts" will look with interest at a clock now in the Patent Museum at South Kensington. It was made by a man named Harrison, about the year 1715, at Barrow, in Lincolnshire. It is going to this day, and keeping good time. It strikes the hour, indicates the day of the month, and with one exception, namely the escapement, all the wheels, all the teeth, and all the shafts are made of wood. The clock is well worth inspection. The same Harrison gained the reward of £20,000, which was offered by the Board of Longitude, for a nautical time-piece. The key of that clock is not a key—as we understand it—but is a pinion which drops into a wheel. The clock is made with a French-count wheel, and not a snail, such as is commonly used in modern English clocks.

Elliptical wheels are very good for rolling, so long as the driving wheel follows the driven one, but as soon as ever the reverse action takes place you will very soon see, by this specimen, that after a certain portion of the revolution is accomplished, they cease to roll in contact. Up to a certain point they roll very fairly, but as soon as the one ceases to gain on the other the rolling action ceases.

An inspection of Fig. 11 may explain this action, or what would give an experimental illustration might be more convincing. The latter may be had by cutting out two ellipses in card-board, and placing them on a drawing-board. Put pins through them at H and S, the foci. Let the ellipse A P M be the driver. It will be found that when the driven ellipse *a* P *m* is in the position in which A and (*a*) coincide, and therefore M H S and *a s h m* are in one straight line; then because the driving ellipse A P M is retiring from the driven ellipse, the rolling contact is not preserved.

FIG. 11



This difficulty was partially obviated by various devices until now, in ellipses as in the more complicated forms of cam and lobe-wheels, the rims are prepared with teeth, and the theoretical rolling action is attained.

Messrs. Muir, of Manchester, use these elliptical wheels to obtain a quick return motion in their planing machines, &c. They have kindly sent the model on which they made their calculations, and you will see from it what is the property of an elliptical wheel. Each rotates about its focus, and these axes are such that the distance from the one to the other is always the same. It is quite clear that the distance must be constant or the shafts could not be fixed. Two equal ellipses rotating as described satisfy this condition. Observe in connection with the rotation of these wheels that the driven ellipse travels with a varying velocity, although the rotation of the shaft of the driving one is constant. This varying velocity has been so arranged that when a machine is doing work the cutting instrument may be moved slowly. When the work is done, and the cutting instrument has to return in order to commence another cut, then the quick motion is imparted to it. Assume that in going forward it is doing its work, and in returning it is doing nothing. In the large model before you the cutting instrument comes back at three times the velocity with which it does its work, so that when there is nothing to do its industry is changed into running instead of labouring.

The class of rolling motions comprehended under the term "mangle wheels" must be noticed. This contrivance, illustrated in its most simple form in Fig. 12, is capable of preserving constant or variable velocity ratio with a varying directional relation. The principle alone can now be dealt with. The end of a shaft, on which is keyed a pinion, is guided in a groove, as shown in Fig. 12. It will be observed that this groove returns into the inner part of the wheel, and therefore, as the pinion is passed from the external to the internal teeth, the direction of motion of the wheel will be reversed. Now, as this groove may be of other than a true circular form, a varying velocity ratio can be communicated. These wheels sometimes fulfil very important offices in relation to the communication of motion by rolling contact.

FIG. 12

(*To be continued.*)

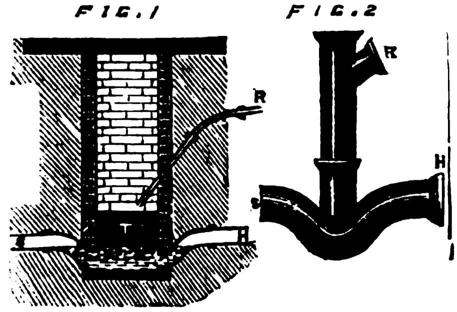
HOUSE DRAINS.*

THE literature of the sewage and drainage questions is gradually assuming gigantic proportions. Volumes have been written on the disposal and utilisation of sewage, and pamphlets innumerable have proclaimed the panaceas of their authors for all the ills of defective drains and drainage systems. The latest publication on the subject, which, however, is confined to the drainage of houses with the view of keeping gas out of them, is from the pen of Mr. Osborne Reynolds, the professor of engineering at Owen's College, Manchester, and, as might be expected, unlike the majority of the sewage brochures and letters to the dailies, contains

* Sewer Gas, and how to keep it out of Houses, by OSBORNE REYNOLDS, M.A., London: Macmillan.

a really sensible and certainly practicable plan for keeping out the sewer gas from our houses. This desirable object is not attained by employing any wonderfully constructed trap—a contrivance sundry species of which the inventors seem to think are capable of subverting the natural laws of fluids and gases, and of curing Nature of her abhorrence of a vacuum. On the contrary, Professor Reynolds abolishes all house traps, and simply places an ordinary siphon pipe between the house and the sewer, taking the precaution, however, to connect the bend in the siphon—the trap, in fact, with the external air. The object of this is, of course, to carry off any gas that may be forced through the trap before it can enter the house drains. He has applied this principle on the larger scale to his own house, and found it to answer perfectly; and in order that our readers may comprehend this simple and efficient plan, we copy the illustration of the man-hole and trap in vertical longitudinal section. All the drains in the house are connected with the pipe H, Fig. 1, which leads to a siphon trough T at the bottom of the man-hole, the latter being constructed as near the house as may be convenient. The floor of this man-hole is 2ft. above the bottom of the drain, which passes through it in the shape of an open trough T 2ft. deep and the width of the pipes, the sides being rendered in cement. This trough is so laid that the water stands half an inch above the orifice on the sewer side S, and an inch on the house side H, while to prevent scum forming on the surface, the pipe R brings rainwater from the roof and discharges it at the upper part of the trough T. Of course, in most cases a much simpler arrangement than this will suffice for the sanitary requirements of the house, for a siphon trap, Fig. 2, with a pipe communicating with the surface and connected with the rainwater pipe, will be found to prevent all influx of gas into the house. "In this way," says Professor Reynolds, "a trap is

FIG. 1 FIG. 2



formed which effectually closes both the house and the sewer from the man-hole, and *doubly closes* the house from the sewer; and if care is taken to arrange the orifices of the pipes in the man-hole as recommended, it will not be possible for the water to be sucked out of the trap [even] should the pipe run full." The little book also contains a clear exposition of some of the more common fallacies of drainage doctors together with the scientific principles which should govern this portion of the sanitary arrangements of our houses. It is a very useful book, with the contents of which every householder should make himself familiar.

THE IGNITING POINT OF EXPLOSIVES.

EXPERIMENTS have been recently made by Messrs. Leygue and Champion to ascertain the temperature at which certain explosives ignite. They used for this purpose a bar of copper, which was heated at one end only. It was provided with small grooves, placed 10 centimetres apart from each other, and provided with metallic alloys of different fusibility, so that the temperature of each part of the bar was easily ascertained. The substance under trial was then strewn upon the bar in small quantities, and the place where it ignited gave the temperature of ignition. Thus it was shown that to explode the different substances the following temperatures were required:—

	Deg. Cent.	Deg. Fahr.
Chassepot percussion-cap powder ...	191 ...	374
Fulminate of mercury....................	200 ...	392
Equal parts of sulphur and chlorate of potassium	200 ...	392
Gun-cotton..................................	220 ...	428
Nitro-glycerine..............................	257 ...	494·4
Chasse powder..............................	288 ...	550·2
Cannon powder..............................	295 ...	562·8
Picrates of mercury, lead and iron...	296 ...	564·6
Picrate powder for torpedoes	315 ...	598·8
" " musket	358 ...	676·2
" " cannon	380 ...	715·8

PROFESSOR AGASSIZ and party at last accounts were in Patagonia. They have found a "desert where even thistles will not grow," but as compensation, have also discovered "oysters a foot in diameter."

IMPROVED AUGERS.

THE improvement in augers and bits shown in the annexed illustration was patented by Mr. James Swan, of Connecticut, but the "letters" are void through neglect on his part to file a specification. He claims to have improved the well-known "Cook" bit, which was patented in this country in 1854, by a modification of the cutting edge. In that bit the cutting edge, commencing at the screw, falls back, so that the most advanced cutting point is at the extreme edge. The object of the modification is to cause the cut to commence at the centre and act as a shave from that point to the extreme edge, whereby the "tearing" often experienced in the use of the "Cook" bit is avoided. The improvement consists in starting the cut of the floor lip at nearly the opposite side of the screw point to that in which the floor lip terminates, and making the edge of a spiral form around the point to the opposite side, then reversing the curve, and carrying it forward up to the termination of the gouge lip.

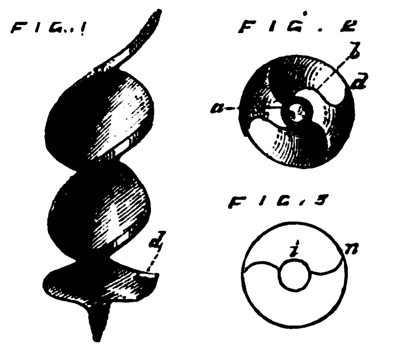


Fig. 1 is a side view of the improved bit; Fig. 2 an end view; and Fig. 3 is an end view of the "Cook" bit of the same size. The twist of the bit is formed in the usual manner. In the "Cook" bit the floor lip commences at the point *i*, on the same side and nearly in the same radial line as its termination *n*, whereby the cut is practically a square cut, the extreme edge being, if anything, a little in advance. In the Swan form the floor lip commences at the point *a*. From this point the cutter curves around to about the point *b*, or half-way from the centre to the edge, which last-named point is nearly opposite to the point of starting. From the point *b* the curve is reversed and made concave up to the completion of the gouge lip *d*, hence the cut acts as a shave to gradually cut from the point *a* towards the extreme edge, the centre being always in advance. As the letters patent are voided, it is open to any one to make augers on this plan, and test their advantages (if any) over the form in common use.

THE INCRUSTATION OF STEAM-BOILERS.*

ALL natural waters contain more or less mineral matter, consisting principally of carbonates of lime and magnesia, sulphate of lime, and chloride of sodium, in solution, and clay, sand, and vegetable matter, in suspension. The many other saline ingredients found in various waters exist in very small proportions, are generally very soluble, and have no relation to the utility of waters in boilers. Of the above-mentioned salts, the carbonates of lime and magnesia are only soluble when the water contains free carbonic acid—consequently the waters of rivers, lakes, &c., contain them in less quantities than those of wells, springs, and creeks, owing to the precipitation caused by the spontaneous evolution of the solvent on exposure to air, heat, and light. American rivers contain from 2 to 6 grains of saline matter in the gallon, in solution, and a varying quantity in suspension, generally exceeding 10 grains. Well and spring waters hold but little in suspension, but a quantity of the dissolved salts, varying from 10 to 650 grains in the gallon. When such water is boiled the carbonic acid is driven off, and the carbonates, deprived of their solvent, are rapidly precipitated in a finely crystallised form, tenaciously adherent to whatever they may first fall upon. Sulphate of lime requires 500 parts of water for its solution, and as the water evaporates supersaturation occurs, and the salt is precipitated in the same form and with the same adherent quality as the carbonates. Chloride of sodium and all the other more soluble salts are precipitated by the same process of supersaturation, but, owing to their greater solubility, much more evaporation is required. All suspended matter gradually tends to subside. This combined deposit, of which the carbonate of lime usually forms the greater part, remains adherent to the inner surface of the boiler. Gradually accumulating, it becomes harder and thicker, till it is as dense as porcelain, though tougher, and at length may obtain such a thickness as to prevent the proper heating of the water by any fire that can be placed in the

* Abstract of a paper read before the American Association for the Advancement of Science at Indianapolis, 1871, by Dr. J. G. ROGERS.

furnace. The high heats, sometimes necessary to heat water through thick scale, will sometimes convert the scale into absolute glass by combining the sand with the alkaline salts composing it; consequently more fuel is required to heat water in an incrusted boiler than in the same boiler if clean. A scale one-sixteenth of an inch thick will require the extra expenditure of 15 per cent. more fuel. This ratio increases as the scale is thicker. Thus, when it is ¼in., 60 per cent. more fuel is needed; ½in., 150 per cent., &c. To raise water in a boiler to any given heat, the fire-surface of that boiler must be heated to a temperature according with the thickness of the incrustation in an increasing ratio. Thus to raise steam to a pressure of 90lb., the water must be heated to about 320° Fahr. In a clean boiler of ¼in. iron this may be done by heating the external surface of the shell to about 325°. If ½in. of scale intervenes between the shell and the water, such is its non-conduction that it will be necessary to heat the fire-surface to about 700°, almost low red-heat. Now the higher the temperature at which iron is kept, the more rapidly it oxidises, and at any heat above 600° it very soon becomes granular and brittle, and is liable to bulge, crack, or otherwise give way to the internal pressure. This condition predisposes the boiler to explosions, and makes expensive repairs necessary. Again, it is readily seen that the presence of scale is extremely wasteful of fuel, and a hindrance to the proper working of the boiler.

Many methods have been devised to prevent and remove incrustation. Picking, scraping, cleaning, &c., are very generally resorted to. Such is its toughness and tenacity, however, that this only partially succeeds, and is moreover expensive both in time and money, since it is generally necessary to lose a working day in the operation. Various mechanical contrivances have been introduced, intended to intercept the precipitated saline matter from the supply water on its passage through the heating apparatus. They consist essentially of a series of obstructions to the flow of the water. After it has been heated almost to boiling by the exhaust steam, the carbonates are precipitated, and subside upon the shelves, straw, and other obstructions, over which the water flows. This plan, however, only partially fulfils the purpose, since it only intercepts a portion of the carbonates and suspended matter. The soluble salts all pass into the boiler, and a great portion of the dissolved carbonates also, which cannot be precipitated during the short passage through the heater. The scales, it is true, form more slowly, but as surely. It is impossible to make such contrivances completely efficacious; no merely mechanical arrangement will suffice. To chemistry alone must we look for the desired means. For a long time simple chemical means have been used in an empirical way with some success. The *modus operandi* of some of these I will notice. Starchy matters—such as Indian corn, potatoes, oil-cake, &c.—prevent scale only by enveloping the precipitates with gelatinous matter, thus lessening their weight, causing them to float, and obviating their agglutination into solid masses. This application, however, tends to cause foaming or frothing of the water, making it impossible to determine the quantity in the boiler, and hence is objectionable.

Molasses, fruits, cider, slops, vinegar, cane-juice, and a variety of other things, containing more or less acetic acid, placed in the boiler, convert the carbonates into soluble acetates. The sulphate of lime remains unaltered, however, and the iron being as much open to the attacks of the acid as the saline matter, the boiler is slowly, but, surely, damaged.

Oak, hemlock, and other barks and woods operate by means of the tannic acid therein. Various extracts, such as catechu, logwood, &c., very rich in tannin, are also used. Tannic acid decomposes the carbonates, but, unlike the acetates, the resulting tannates are insoluble. Their specific gravity, however, is low; they float in the currents of ebullition, and, having no tendency to adhere, do not agglutinate into a mass, and cannot form a scale. The sulphates and chlorides are not acted upon at all by the tannic acid, and will incrustate notwithstanding its presence. Tannin, as offered in the above-named agents, is left free to act upon the iron, and will, after a time, exhibit its damaging effects on the boiler.

The fixed alkalies are much used for this purpose, in the various forms of lye, ashes, carbonate of soda, caustic soda, potash, &c. These agents decompose the sulphate of lime, sulphate of soda or potash, and carbonate of lime being the results. The first is held in solution, the latter is precipitated, but in larger crystals, which do not form so refractory a scale as ordinarily. The carbonates of lime and magnesia are also precipitated by these agents, the free carbonic acid being taken to form carbonates or bicarbonates of soda or potash; the chlorides are not affected. This method simply modifies the form of the precipitate, and consequently the quality of the scale, without affording any means for its prevention, and therefore deserves but little attention. Ammonia and its carbonate have a precisely similar action, and the same objection stands against them. These alkalies have no chemical action on the boiler, but rather tend to preserve it, inasmuch as they prevent the free carbonic acid from combining with the insoluble crust of oxide of iron (formed by con tact with the water) to form a soluble carbonate of iron, which, being dissolved away from the iron, would leave a surface constantly exposed to fresh action. Chloride of ammonium is another means employed. This has its action only on the carbonates of lime and magnesia. The reaction produces carbonate of ammonia, which, being volatile, passes off with the steam, and chlorides of calcium and magnesium, both very soluble. This is an efficient way of removing old scale. Its only objection is the ammoniacal odour of the escaped steam.

The foregoing are methods in which a single agent is used. They are frequently combined with a view of obviating the mentioned objections. Starch, tannin, and soda, constitute the basis of most of these combinations. Crude petroleum is also used with reported partial success. The *rationale* of its action is not well understood, owing to the complexity of its chemical constitution. There are many proprietary compounds at present in use composed essentially of these elements, generally, however, with the addition of other things, introduced for the purpose of disguising their composition. Besides these, many other preparations are before the public which have been patented, all having a general resemblance, inasmuch as tannin, starch, and soda are the principal ingredients, in some form. Gum catechu is most generally the tannin-bearing body; sal soda, the alkali; and flax-seed, oil-seed cake, bran, or coarse flour the starchy element. In most of those which I have examined these very useful agents have been simply mixed empirically, without regard to chemical laws, and they generally contain more or less free tannic acid, and a considerable amount of inert, insoluble vegetable matter, which tends to produce foaming, besides being useless. Besides these methods, in which the chemical agents are introduced directly into the boiler, others have been devised, in which the waters are depurated, by chemical means, before entrance into the boiler. Clark's process consists in the precipitation of the carbonates with milk of lime, the free carbonic acid being taken up; the sulphate of lime remains in solution. Another method, proposed by myself, consists in converting the earthy carbonates into soluble chlorides by hydrochloric acid, and neutralising the excess of acid by filtration through carbonate of baryta (witherite) in coarse powder. The soluble chloride of barium thus formed decomposes the sulphate of lime, chloride of calcium being kept in solution, and the sulphate of baryta being deposited insoluble. This method recommends itself for railway water stations, on account of its cheapness and simplicity. Oxalic acid may be used very efficiently for the complete precipitation of all the lime salts as insoluble oxalates, but the expense might be a bar to its use. Tannic and acetic acids, the excess being properly neutralised by carbonate of soda, may also be used for tank depuration. These tank methods, however, cannot influence to any great extent the scale already formed; and as the removal of this is as needful as its prevention, it is palpable that that method is best for general application which secures the complete removal, as well as prevention, by chemical means operating inside the boiler.

Having this end in view, Dr. Rogers proposes two processes: one consists simply in the introduction into the boiler of a sufficient quantity of the oxalate of soda to cause the immediate decomposition of the scale-forming salts as they enter the boiler, converting them into insoluble oxalates, which are precipitated as a mushy sediment, which has no tendency to form scale, and which may be blown out from the mud-receiver, or otherwise voided. In the other process tannate of soda is the agent, kept constantly present in the boiler in solution; it decomposes the carbonates of lime and magnesia as they enter, tannates being precipitated in a light, flocculent, amorphous form, so that they do not subside at all in the boiler, but are retained in suspension by the boiling currents until they find their way into the same receiver, when they settle into a loose, mushy mass, which may be easily blown out from time to time. The carbonate of soda formed in the reaction is retained in solution, becoming a bicarbonate by appropriation of the free carbonic acid in the water. This decomposes the sulphate of lime, the resulting sulphate of soda being retained in solution, and the carbonate of lime being acted upon by fresh portions of the tannate of soda as above. The constant presence of the alkali protects the iron from all action, either of the carbonic or tannic acids. The same reactions take place between the tannate of soda and the already existing scale with like results, but more slowly, some weeks being generally required, in practice, in removing the deposit, if it exists in any considerable quantity.

Portions of scale are detached, from time to time, which may be removed at the usual cleanings, which should be made at short intervals, when possible, until the boiler is entirely clear of all incrustation, after which this will not be necessary. Extensive practical trial of this process for two years has demonstrated its utility for all varieties of boilers. It is economical, easy of application, and generally adaptable. It may be used in marine boilers as well as those using fresh water, since the marine scale is almost identical with that formed in boilers using ordinary waters, consisting almost entirely of the carbonates of lime and magnesia, and sulphate of lime. The chloride of sodium forms a mushy deposit, but is only incorporated in the scale to a slight extent.

USEFUL AND SCIENTIFIC NOTES.

A New Dryer.—M. Mène states that if 12 parts of best shellac and 4 of borax are dissolved in 100 parts of water by heat, and when cool, mingled with turpentine, an excellent and rapid dryer for oil paints will be produced. The solution may also, he says, be used as a varnish.

Testing Coffee.—Many adulterations in coffee can be easily detected, even if the taste is not a sure index. If a teaspoonful of genuine ground coffee be thrown into a tumblerful of cold water, it will float upon the surface. Some substances used in adulterating coffee will sink at once.

Spontaneous Combustion of Silk.—We learn from Dingler's *Journal* that it has been found that silk goods containing picrate of lead frequently catch fire in transit by railway. Experiments made in consequence show that a very slight amount of friction is sufficient to ignite samples of such silk fabrics.

Proposed Large Steamship.—It is stated that specifications are at present in the hands of several Clyde shipbuilders for a new vessel for the National Steamship Company. She is to run between Liverpool and New York, and is to be of gigantic proportions, second only to those of the Great Eastern. The dimensions are to be: length over all, 576ft.; breadth of beam, 50ft.; depth of hold, 35ft. It is expected that this great steamship will make the voyage from port to port in seven days.

Aluminium Coinage.—It has been a question in Paris of replacing the present bronze money by an alloy of aluminium. The adoption was supported by M. Sainte-Claire-Deville, but opposed by MM. de Marcotte de Quivières, the director of the Mint, and Peligand, chemist and assayer of coin. The reasons *pro* and *con.* are not yet made public, but the Government is recommended by the commission of the Mint to continue the experiments with aluminium.

Cleaning Greasy Wool.—A large number of manufacturers and scientific gentlemen assembled on Wednesday week at Clegg Hall Mills, near Rochdale, to witness a new process of cleansing wool by a cold method and without the use of alkali. The liquid employed is fusel oil, and a large bale of wool, greasy and dirty as possible, was submitted to experiment. We understand that the opinions expressed were favourable to the process, which is that of Messrs. Paul Toepler and Co.

Utilisation of a Waste Material.—It appears that large quantities of grease find their way into the sewers of Bermondsey. Seven years ago the Board of Works permitted its sewer men to explore the underground channels in the neighbourhood, and the result was the collection of grease or fat, which, when sold, and after paying liberally for expenses of collection, left a balance of £104. This sum is to be devoted to public improvements. This is another instance of the value of what are generally termed "waste products."

The Cholera.—Authentic numerical returns of the progress of cholera in Russia lie before us (*British Medical Journal*). They show that most imminent danger may be anticipated. In the Government of Ekaterinoslaw there had been, on June 12th, in the town of Ekaterinoslaw, 316 cases, with 195 recoveries and 109 deaths. In the Government of Kiew there had been, in the town of Kiew, on June 21st, 2105 cases, with 714 recoveries and 1001 deaths; and in Oumane, on June 10th, 196 cases, with 74 recoveries and 43 deaths. In Odessa, on June 23rd, there had been 173 cases, with 60 deaths; and in Kherson there had been, on June 21st, 301 cases, with 70 recoveries and 60 deaths. In Kamenets (Podolia) on June 10th, there had been 319 cases with 46 deaths. Cholera has also broken out in Moscow.

London Association of Foremen Engineers.—The meeting on Saturday, the 6th inst., Mr. Joseph Newton, President, in the chair, was a half-yearly meeting. The auditors' report showed the balance sheet correct, which left some cash and some not inconsiderable claims in the hands of the treasurer. The total value of ordinary funds amounts to £477 12s. 11d., the superannuation fund to £1,294 17s. 1d., stock (Three per Cents.); the widow and orphan fund also leaves a small sum in the hands of the treasurer. The report is signed by Messrs. W. H. Sissons and Robert Hedley, auditors; by Mr. Joseph Newton, president; and by Mr. Meredith Jones, treasurer. The association counts altogether 137 ordinary and 74 honorary members, 12 of the former and six of the latter class having been added to the list since January. At the last meeting Mr. Charles Leager was elected a member, and Mr. Alphonse Lafare an honorary member; Mr. James Halket was put into nomination. On the retiring of three senior members (Messrs. Reid, Coates, and Salmon), according to the statute three junior members (Messrs. Haughton, Gibbon, and Bulleugh) stepped into their places. The three new members of committee elected were, Messrs. Virtue, Carnaby, and Grantham. Mr. Scott was elected junior auditor. The meeting resolved to have a summer outing on the last Saturday in the month to Epping Forest, the detail arrangements to be left in the hands of the committee.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 81, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

AXES OF THE PLANETS.

[4572.]—I am obliged to "W. T. R." for his answer (let. 4356, p. 460) to my question on this subject. He does not, however, say whether he takes his information directly from Schröter. I have good reason for believing that "W. T. R.'s" information is correct; but if only taken from some work on astronomy it does not remove the doubts I expressed. In Klein's "Sonnensystem," the only German work I have which refers to the matter, it is stated plainly enough, "Nach Schröter soll der Æquator des Merkur mit der Ebene der Bahn einen Winkel von 20° bilden." But I have two text-books stating as plainly, "the axis of Mercury is inclined 20° to the plane of the ecliptic." That is why I ask for some information so definitely referred to Schröter's own account as to remove all doubt. I could, of course, hunt out the truth at the British Museum, or, probably, at the rooms of the Astronomical Society, but just now I am particularly busy.

Richard A. Proctor.

A GIANT PLANET.

[4573.]—I am glad to find that Mr. Proctor thinks me such a pleasing critic (let. 4446, p. 405). He thinks I acted unfairly in quoting only a part of a sentence of his, I can assure him I had no such intention, my only motive for the omission was the desire to save space. I used all the tangible part and sufficient to give the sense without alteration. He asks, have I never heard of a geometric mean? I have heard of such a thing, but did not see the most distant allusion to it in his article. May I ask him why, if he meant the geometric mean, he did not say so, instead of using the word "midway"? which, it now appears, makes him say something quite different to what he wanted to say. Midway means the part equally distant from the beginning and the end: 8,000 miles is the commencement in this case and 840,000 miles the end, and Jupiter's diameter of 82,000 miles when multiplied by five is then nearly equally distant from these two numbers. In his article he does not speak of the mean of any number, distance, size, or quantity, nor do I mention such a thing in my letter.* Also he asks "Do I need to be told that Jupiter's bulk is more than a thousand times greater than the earth's? or that it was the rough correspondence between this relation and the relation between the sun and Jupiter that he had in view?" I do not require the information he tenders me about the respective bulks, but I do wish he would tell me why he did not say Jupiter was as many times greater than the earth as the sun was times greater than Jupiter, if that was what he meant, instead of saying Jupiter was "midway" in size between the sun and earth? Jupiter to occupy a position "midway" between the sun and earth in size would require to be over six hundred thousand times as large as the earth, instead "of more than a thousand times." By no possible means can he make the ends of his argument meet, for if Jupiter was "midway" in diameter he could not be "midway" in bulk.

He tells us: "It is the very essence of his reasoning that the red-hot surface of the planet would be discernible, perhaps even through the cloud belts which seem to us the densest." Having given us his own definition of the pith of his argument, it is at last possible to grapple with him. Unfortunately, however, "the essence of his reasoning" consists of a supposition that an impossibility might occur. During several days past the sun has been invisible at noon day, the clouds having hid the bright summer sun from our sight. If our clouds can thus hide the almost vertical sun, which is thousands of times brighter than a red-hot body, what would the (to use his own words) "enormous masses of cloud suspended in the atmosphere of Jupiter" do with the visibility of a red-hot planet?

Mr. Proctor observes that his "theory presents the heat of Jupiter as (in the main) not obscure." In this particular, then, his theory is false, for the rays emitted by a red-hot body are chiefly obscure heat rays. On those occasions to which I have alluded, when the sun

* "Hyrab Sen's" attention is respectfully called to an answer to a note in answer to "E. T. J.," last page of last No. of English Mechanic.

was invisible, the aqueous vapour (need I say by absorption) so materially retarded the passage of his radiant heat that the temperature was fully one-third lower than it would have been had the air been free from vapour; and his heat is certainly not obscure.

If I have read his article he says, I know perfectly well that "he does not regard the cloud envelope as covering the whole of Jupiter." I am aware he does not view the whole of the planet as cloud covered; but judging from his own language, he certainly considers the red-hot portion to be in that condition. In that paragraph of his article wherein we are first introduced to his idea of a red-hot Jupiter he remarks, "Now, heat is the only form of force which could account for the enormous masses of cloud suspended in the atmosphere of Jupiter. And it seems difficult to conceive that the clouds could be maintained at a great height above the real surface of the planet, unless that surface were intensely hot, as hot, perhaps, as red-hot iron. If we supposed this to be the case, we should find at once an explanation of the ruddy aspect of the dark belts." Here, then, he says, the red-hot portion is covered by enormous masses of cloud, which require an intensely heated surface beneath them to maintain them at a great height; in fact, it is this great cloud mass and its behaviour that led him to the theory of a red-hot planet. The enormous clouds, and the peculiarity of their motions, prevent his viewing them as sun-raised—he thinks it must be the planet's own heat that has produced them—he sees portions of the planet look red, then he jumps to the conclusion that Jupiter is red hot. Unhappily he did not see that these enormous masses of cloud, the very existence of which compels him to believe Jupiter to be intensely heated, would prevent the planet being invisible however red-hot he might be. To have made his theory even slightly plausible he should have given Jupiter a bright white heat, and then he might have been visible through a very moderate thickness of cloud as a red-hot *looking* body, much the same as the sun when he first shows himself through a thick vapour screen with a red face.

Is it not clear Jupiter cannot be red hot, for if he were we should see no red belts, they would be hidden from our view by the "enormous masses of cloud"? In proof of this assertion I adduce the fact of the sun's disc being shut out by a far smaller mass of clouds. In my letter I said, "Now, if Jupiter is at a red heat [his clouds must be as dense and impervious as a Newfoundland fog bank; in fact, they must partake more of the nature of semi-condensed steam than of terrestrial clouds], *for if clouds are generated by the red-hot surface, rain must fall on it, and directly rain fell it would be sent hissing back in the form of steam.*" He gives only that part of the sentence which I have put in brackets, thus making me appear to say almost the reverse of what I actually said. I am represented by him as holding the opinion that Jupiter's clouds are like semi-condensed steam, and he managed to do this by omitting the words "if Jupiter is at a red heat," but as it is evident from my letter that I don't believe in a red-hot Jupiter, it is equally apparent I cannot believe his clouds to be of the very dense and steam-like nature I supposed they would be if he were red hot. The concluding portion of the sentence from which he quotes, and which I have now distinguished by italics, he ignores entirely; he does not even attempt to answer it; and as it is pertinent to the question at issue, I am driven to the conclusion that he was unable to refute this portion of my arguments, which is certainly directed to the intensely-heated planet part of his theory. Mr. Proctor wishes me to give an illustrative calculation in proof of my assertion that if Jupiter was as hot as red-hot iron—viz., 1,200° Fahr., his most distant satellite could only receive 2° from this source, and this statement astonishes him so greatly that he petulantly tells me I "count degrees Fahr. as a schoolboy counts marbles." If I do it as well as that I am satisfied, for schoolboys count marbles pretty correctly. The calculation he asks for I will give him with pleasure; but may I ask him if it would not have been better for him to have supplied a calculation, proving that the satellite in question could receive any considerable amount of heat from a red-hot Jupiter; and so refuting me instead of asking me so many questions. Forgetting that it is his theory which is on trial, he asks me to prove everything, whilst he hardly attempts to answer at all, and throughout the whole of his letter proves nothing. The method of calculation I employed is similar to that which Sir John Herschel used in estimating the actual heat of the sun. At the distance of his farthest moon (1,244,619 miles) Jupiter's rays are by radiation spread over a hollow sphere of the heavens, whose surface is, roughly speaking, 600 times as great as Jupiter's surface. Now, as his rays have, at that distance, to warm a surface 600 times as large as his own, their temperature will, from this cause, be reduced to the 600th part of what they had at Jupiter's surface; therefore, if Jupiter's heat is equal to red-hot iron, then $1200° \div 600 = 2°$ must be the amount of heat he would impart to his outer satellite. He is amazed at my assertion that Jupiter would be invisible to dwellers in his farthest moon, if he shone only as a red-hot body, and tells me I may take it for granted at that distance his "disc would appear just as bright as red-hot iron." Also, I am informed that I share in the common error that distance *per se* has an effect in diminishing the apparent brightness of a luminous object." With all due deference to so great an authority I decline taking his assertion for granted, and although I know it is the orthodox scientific view that distance does not diminish brilliancy, I shall still persist in believing it does. To support my views I will refer to the earth-shine on the moon which renders the darker part of the moon just visible, on a clear night, when the moon is a few days old. The earth, owing to greater size, sheds on the moon eleven times as much light as the moon sheds on us, therefore, earth-shine on the moon must be eleven times brighter than moonshine is here, and if distance does not diminish brilliancy the earth illumined part of the moon should appear to us very much brighter then the moonlit earth. Now, is this the case? I ask any of your readers if, on a clear moonlight night, a brick wall, which is not a very good reflector, does not appear many times brighter than the earth-lit moon? Of course, the depth of atmosphere through which we see the moon has considerable effect in dulling the brilliancy of the earthshine, but making all due allowance for this it is evident that distance is the cause of the great diminution of brightness we so plainly see. I should like to ask Mr. Proctor why, if distance does not reduce the apparent brightness of a luminous object, the stars—suns as bright as our own—do not appear so brilliant as the sun? there are no atmospheric effects to interfere in this case. I was afraid so great and potent an astronomer as Mr. Proctor would not be satisfied with petty terrestrial evidences, or I might have offered him many experimental proofs showing that distance does diminish brightness. He complains that I make him say, "Jupiter shines three or four times as brightly as a globe of his size should, if reflecting the sun's light only," and that I omitted the "important words" "if constituted like Mars or the moon." Then he goes on, "To remove all misapprehension, I actually added the words, 'Jupiter shines, in fact, very nearly as brightly as though he were constituted like one of our terrestrial clouds; This would, however, have ruined 'Hyrab Sen's' ingenious argument, and is, accordingly not admitted." To all this I reply: "If he will refer to my letter he will find it was Dr. Zöllner, and not him, whom I made say this; but I wrote on the assumption that he had adopted Dr. Zöllner's estimate of the planet's brilliancy, and as there is no reason for supposing Jupiter to be a better reflector of light than Mars, the words "if constituted like Mars" do not alter the case. If my ingenious (!) arguments would have been ruined by the fact of Jupiter's shining nearly as brightly as if constituted like one of our terrestrial clouds, why does he not show us how they would have been ruined? why does he not meet argument with argument instead of merely making an insidious assertion of no value? What do I mean, he asks, by saying that sunshine here is hundreds of times brighter than the light emitted from a body heated to redness? Unfortunately we have no means of accurately measuring light as we have of measuring heat—in fact, we cannot measure it at all, we can only estimate it by the impression it makes on our senses. I will give the method I used of estimating the li ht of a red-hot body and leave it to others to judge of its value. Let us take a page of printed matter (say of the same sized type as his article was printed in)—and hold it within a foot of a large red coke fire in a darkened room, we can then just see it sufficiently clear to read it, and the distance is so small there is hardly any loss by radiation; then let us take the same page into the open on a clear night when there is a full moon, and we shall find it as easy or easier to read it there than by the light of red-hot coke, however close we hold it. From this I infer that moonlight is as bright or brighter than the light emitted from a red-hot body, and sunlight is demonstrably thousands of times brighter than moonlight; therefore, if the light emitted by a red-hot body was even ten times as bright as moonlight, sunshine would still be hundreds of times as bright as the light emitted from a body heated to redness. HYRAB SEN.

THE NEPHILIM IN YORKSHIRE.

[4574.]—THE account of the Settle Cave discoveries, copied from the *Pall Mall Gazette* into p. 323 of the MECHANIC, had originally appeared in the former paper the very same day I noted, that your number of June 7 came forth, with the most contemptuous demands for *any evidence, either of the occurrence or period* of a universal flood (let. 4239, p. 303). I was about to notice the singular opportuneness of the answer, had you not saved me the trouble by reproducing it entire, and as Mr. Brookwood, the next week (let. 4356, p. 352) pointed out the diluvial bearing of the remarkable godsend, I should not write this, were there not a most unlucky misprint in your copy that puzzled me for a minute, and may therefore either puzzle or quite deprive some readers of the gist of the evidence. A little below the middle of last column (p. 323) a line begins, "But there were evidences of a very much older *Roman* occupation than this." The context would soon lead most readers to infer that "Roman" is a misprint for *human*, the argument being that as the two feet of frost chips, above the newer human relics have taken roundly 12 centuries to accumulate, the six feet of similar chips between the two classes of relics may probably have taken the previous 36 centuries. Having been almost driven, by this serious erratum, to revive the subject, I would further remark that the upper Romano-Celtic relics really date themselves more precisely than the *Pall Mall* writer ventured to fix them. He says, "there are two extremes between which the date of this occupation of the cave must [illegible] —the fifth century, as shown by the barbaric [illegible] and the first quarter of the seventh century, w[illegible]..us, kingdom of Stratholyde (or Cambria) was [illegible] n the by the Northumbrian Angles." Now coi[illegible] .quered circulated in such times (as they do now [illegible] constantly most civilised places) for a century or [illegible] in all but the were made; but surely these Rom[illegible] two after they Welshmen (the famous King Arth[illegible] .nised Britons or over-soft and falling race, wo[illegible]'s subjects), then an [illegible]ld not take to cave dwelling till their country was actually invaded by our ancestors the English, which was not the case in that very westerly part of modern Yorkshire (but ancient Cumbria) till well into the seventh century. The Angles, under Ida, had settled the eastern watershed in the middle of the sixth, but we read of no warfare by them west of the Penine chain till under Redwald A.D. 616, and Edwin of Northumbria, who, in 623, reduced Cumbria into permanent subjection; so that the quarter of that century is rightly fixed by the *Pall Mall Gazette* as the latest limit possible for the civilised Settle Cave relics, or 1250 years (rather than 1200) as their present least age. Supposing, then, the débris to be regular enough to admit so exact a measurement as stated of the ratio 1:3, between the upper and lower accumulation, and to be an accurate geo-chronometer, it gives us roundly $1250 + 3750 = 5000$; the exact "50 centuries," the "E. L. G.'s' 5000 years," about which so many of your correspondents have been making merry. Such, says the cave, is roundly the period since the "men of the drift" (or any older than Arthur's knights) occupied it; and such, say the elder versions of Genesis, the period since Nephilim were last in the earth, and "the earth was filled" (and consequently Yorkshire) "with violence through them." Of course those who read geological facts as they turn up, know that this is only the old story, a hundred times before and elsewhere, in divers ways meeting us. The comparison of the depths of peat, above and below the Roman causeway through the Peterborough fens; the depths of Nile mud, above and below the footings of dated Egyptian monuments; the pre-Roman and post-Roman deposits of Swiss lake deltas, and fifty other modes of testimony, as Cuvier, Buckland, and Mantell showed, all concur as closely as the above little sum. Neither in Europe, Asia, nor America, is there any clash of evidence. The Settle Cave brought no news; but the thing to note is, you having issued "Sigma's" call (p. 303) for "*any* evidence, either of occurrence or period," that morning of June 6, how singularly pat comes this issue of the *Pall Mall Gazette* the same afternoon. E. L. G.

EDDY'S GAS STOVE.

[4575.]—I AM at a loss to perceive the utility of this stove, unless it be so arranged as to bring fresh air into the room, not merely, as appears from the description, to warm that previously in, to be mingled with the products of combustion. The stove would warm a room more comfortably if the openings at the top were closed and the heated air made to escape at the bottom, for then the lower part of the room would be better warmed; moreover, the shell of the stove would become hotter, and therefore give off more radiant heat, which is the best and pleasantest form of heat for warming us. The total quantity of heat would be proportionate to the gas burned in either case. But it will be asked, "What, then, is the use of the rather complicated internal arrangements?" and that is exactly what I want to know. It seems that they will have no effect at all except to mix the products of combustion with air. If, indeed, those products were conveyed away out of the room altogether, those arrangements might be of some little use in providing a large surface for warming air; but the heat might be more usefully employed in warming a large surface, from which heat may be radiated, for radiant heat warms the bodies on which it shines above the temperature of the air surrounding them, and it is both pleasant and wholesome for us to be so warmed, when we need artificial warming at all; lately artificial cooling has been more needed. PHILO.

MONOLITHIC BUILDING.

[4576.]—To "W. G. C."—I am glad to see the subject of monolithic building brought forward in "ours," being myself a firm advocate of the system. Your letter (No. 4462) is a source of astonishment to me, as the statements you bring forward there are entirely at variance with facts which the "adverse critics" of the system can turn dead against you; the weak points of the "Polylithic" system (if you will accept the term) are not, as you seem to suppose, from thin mortar joints, nor yet from "smooth-tooled surfaces," being bad holders, but quite the reverse. Neither is the rough surface of the concrete the cause of better holding, and consequent strength in the monolithic system, but rather in the use of good cement newly prepared and used before the first intention of setting has taken place, together with being well compacted by ramming the material, which is thus brought into closer contact.

In all cementing processes the con[illegible]ditions of a good holding joint are close contact of the substances cemented and consequent thi[illegible]ness of the cementing material. The reason is se[illegible]f-evident, there being no after shrinkage, or comp[illegible]ratively none, whereas in the polylithic system the after shrinkage is very considerable, and when w[illegible]ndow and door frames intervene, as they must do in house building, and these cannot yield much [illegible] in the shrinkage, there is, I think, quite sufficient cause to account for ruptures and weakness. Furth[illegible]rmore, the practice of making beds of mortar th[illegible] lie for weeks before being used must be destruc[illegible]ve of its cementing properties. Another serious evil lies in the rapidly absorbing nature of dry brick. The water is absorbed before the chemical change has had time to complete itself, and though afterwards given up in part, still it can never restore it to good sound mortar; hence, in setting the arches of doors and windows the bricks are first wetted to counteract this tendency. Such parts are, therefore, invariably found to be the strongest in the building, the extreme thinness of the mortar joints notwithstanding.

EPSILON.

THE NEGRO.

[4577.]—THE pun of "T. A." (let. 4541, p. 461) upon the ambiguous English word "*fair*" in Gen. vi. 1, 2), ought really to be embalmed as a specimen of this generation's "biblical criticism"—the matter in which alone all may shine alike, even "T. A.," equally with a bishop. If he had happened to be a Greek or Russian, it might have been pointed out in his Septuagint, that in Solomon's Song, i. 5, a verse, where, *if anywhere* an actual negro (and that, a lady) is introduced, she gives herself this very same epithet! "I am *black*, but comely (καλὴ), O daughters." In Genesis, the Adamites "saw the daughters of men, that they were καλαί." But if "T. A." has the audacity to overrule Solomon, that no negroes can be καλὴ, this would not clash with my supposition that among the non-Adamite perished races was one black one. Has he not seen that I assume at least three distinct races, how many more is unknowable, but one race to afford the mother and the wife of Japhet, another those of Ham and the negroes, and a third those of Shem? I only said there *might be* reasons for Noah and his sons having no wife of their own race; without seeing that the story *does* plainly indicate a reason, that may in all probability have amounted to necessity. Consider the force of the statement that "all flesh (humanity) had corrupted his way upon the earth." In the remote savage tribes, whose relics alone we find, the "Flint-folk" or "Men of the Drift," the corruption consisted in mere "violence." In the civilised cities, and the Adamite race above all, it was more refined; and what do we now find in such races that have most corrupted their way? No guide but self-interest, hence infanticide, especially of female children (as in China), and it being no one's interest in particular to bring up daughters rather than kill them, imminent or actual dying out of the race for want of females to continue it. This then, happening now, must have happened when "*all* flesh had corrupted his way upon the earth." It would simply contradict this sentence to assume that after the Adamites had taken to marrying the inferior, short-lived "daughters of men" (as Gen. vi. implies) for some centuries; there remained any daughters of their own race unslaughtered. There could be no Adamitess brought up (especially as they were doubtless of slower growth) for Noah to marry, much less for his sons; and so, in all probability, the reduction of life was become inevitable whether any Deluge happened or not, and Noah would, in any case, had there been no Deluge, have ended the long-lived Adamites; or rather, as the same causes would have extinguished the mixed and short-lived races too, the Flood was necessary to *preserve* any human species on the earth at all! And so may future equally wide destructions (as prophesied) be, according to all present social appearances, equally necessary. Even if the females of the long-lived race were not extinct, this cause must have made them too scarce and precious to be within the means of Noah and his sons to purchase; for everything implies they were a poor and unknown family—that of a "just man," and "preacher of righteousness," in such times, could not be otherwise; and no wealthy or powerful man would have needed anything like a century for building and provisioning the Ark. A German fanatic of Luther's time, having persuaded himself of a new Deluge, built an ark of equal dimensions, we read, in a year or two, though so far from rich (or at least from well-advised in construction) that he saw it fall to pieces before the time anticipated for its use.

In connection with longevity, and especially whether, after the flood, it was as great in the women, it should be noted that the Bible gives but one female's age, Sarah's, and she lived barely two-thirds of her only *son's* life. Again, in Job (who was probably earlier), the death of a wife, mother of ten grown-up children, and taking of another, who bears ten more (as Abraham's last did six), appear matters of common course. But the facts that though Shem (and presumably his brothers) lived after marriage five centuries, his wife bore but five sons, Ham's but four, and Japhet's but seven, surely imply these women to have been of very different longevity from their husbands. If of the same race, why should they not have had (as tradition attributed to Eve and antediluvian women), fifty or more sons apiece, when they were so greatly needed?

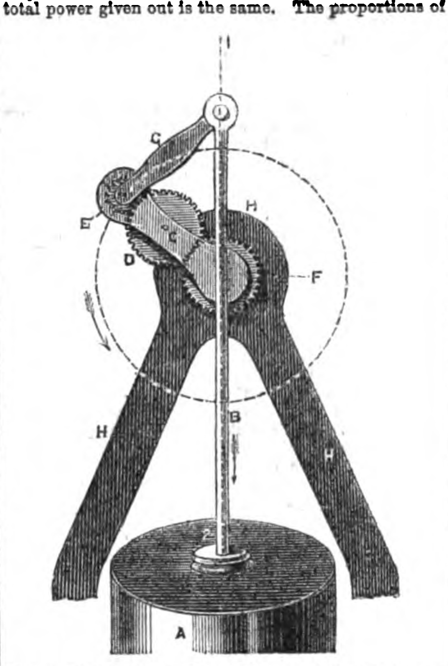
As for "T. A.'s" notion that men who, for ten generations, lived (by his own showing) the respectable age of above 900 months, never discovered the existence of a natural period *longer* than months! and called them "years" indifferently, it is really necessary he should fix distinctly *what* "change in the mode of reckoning" the genealogy of Shem gives "evidence of." At least, he or any reader equally hazy may be asked to take the small trouble (which I object to do unless forced) of copying out these verses, Gen. vii. 11, viii. 4, 5, 13, 14, 18, x. 1, xi. 10, 12, 13, 14, 15, giving to the "years" what he considers their modern meanings, and explaining at what later verse the "change in the mode" comes in. If the *longest* antediluvian life was 78 years, what does he consider the life of Abraham or Isaac to have been, longer or shorter, and for what reasons? I mean natural and admitted physiological reasons. And especially the "few and evil" years of Jacob, when he said they had not attained to those of his fathers, xlvii. 9; what were they?

The "T. A." sort of mind being commoner in this subject than in others, let me add for him that if Shem, Ham, and Japhet, or rather their three mothers and three wives, were, as I suppose, as distinct as the Mongol, Negro, and Gothic races, the angles of the triangle that includes all other modern ones, then the long-lived race, whose last pure specimen was Noah, were, of course, different from all these; and, *in colour*, may (or rather *must*) have approached what we find least like them separately at present—namely, the Red Indian—we need not suppose in any other respect than colour. Hence, Hebrew tradition would be no likelier to give them and their father any epithet than "*Adam*." We are not to suppose any of the patriarchs bore in life the names we know them by, or that Chinese, Phœnicians, Hindoos, or any nation has known them by. All these are *descriptive epithets*, made ages later; and in the Bible, rather *translations* of such epithets into the Canaanite tongue of Samuel's time. E. L. G.

A NEW METHOD OF CHANGING RECIPROCATING INTO ROTARY MOTION.

[4578.]—THE following slight sketch of a proposed means for effecting the above purpose will, I venture to think, interest some of your mechanical readers. Their opinions as to its practical utility are requested.

In the accompanying diagram A is a fixed cylinder, B the piston rod, C an arm attached to the shaft, this arm is double from E to C, and carries two toothed wheels E and D; F is a fixed tooth wheel either cast on or otherwise secured to support H H H., the shaft to which arm C is attached passes through the centre of F, and has its bearings in it and through into H; to the axle of small wheel E (indicated by dotted circles) is attached an arm G, which is connected with piston rod. The motion of piston rod is communicated by arm G to the wheel E, causing it to revolve; this sets the wheel D in motion, and this wheel being geared with the fixed one F travels round the same, carrying arm C round at same time, thus giving a rotary motion to the shaft to which C is attached The variations in power and speed at different parts of the stroke are very similar to those of the ordinary crank, and the total power given out is the same. The proportions of



the wheels are, D and F = 1, E = ½. The wheels can, of course, be used of any breadth, and sets carried on each side the piston rod, in order to distribute the work over a greater surface of teeth. This motion has been tried on a moderate scale (with two 6in. and one 3in. wheel, stroke 3ft. 6in.), and found to answer satisfactorily as regards the motion of the piston rod being maintained in a perfectly straight line, and as to the power given out equalling that given out by the ordinary crank, but it has not yet been tried in a steam-engine. It has the great disadvantage of being a combination of toothed wheels, but it has the following advantages, which may perhaps counterbalance the said disadvantage, viz.:—There is no tendency at all in this motion to throw any side thrust on the piston rod, and consequently the necessity for connecting rods, cross heads, parallel motions, slides, and guides, is done away with; it works in as little room as an oscillating engine and has a fixed cylinder. To sum up, it has none of the friction attending it usually caused in engines by machinery, used to counteract the side thrust on piston rod, which is always present in every engine turning an ordinary crank. If these advantages are sufficient to overcome the objection to the use of toothed wheels, practical men can judge. My own opinion, as a theorist, is, that for ships' use, with engines of long stroke, this motion with fixed cylinders would be preferable to either trunk, beam, or oscillating engines, and perhaps more especially for screw steam ships, as it will be observed the arm C is only one half the length of an ordinary crank for same length of stroke. I believe engines of long stroke are desiderated; if so, this motion is especially suited for them, and some of the disadvantages connected with the use of toothed wheels would be overcome by the fact that they are the parts that would be most affected by wear and tear, and are also the very parts which could be most readily renewed whenever occasion required. Drawbacks arising from weakness in the arms G and C (if any), as compared with the usual cranks and connections might be obviated by working, instead of the two cylinders as ordinarily used, four or more of the same aggregate area, and thus distributing the strain as required.

In order to take up as little space as possible the drawing is only contrived to give a general notion of the idea. If the subject should prove of sufficient interest I will gladly furnish more details in a future number, in the mean time soliciting the opinion of practical mechanics. G. PINNINGTON.

AN OPINION WANTED ON A NEW MATERIAL IN ORGAN BUILDING.

[4579.]—WILL "Harmonious Blacksmith," "J. D.," or other amateur builder kindly give their candid opinion on the adaptability of paper for organ pipes, I mean such as are circular. I do not consider myself even an amateur; but I do claim to be an enthusiast, having some slight acquaintance with the principles of organ building, and, therefore, willing to give to others the result of my thought whenever anything suggests itself. Suppose, for instance, a mandril or roller of wood, say, 2in. in diameter, and 2ft. in length, be turned perfectly straight, and a sheet of paper be coiled round it as tight as possible, putting glue or other cement all the way until the paper is of sufficient thickness, say five or six times round, being sure that glue is used first time round, so that the tube thus formed may be slipped off and put aside to set hard, after which it may have some suitably decorated paper put on the outside. Then take a piece of dry, hard wood, and turn a foot or boot in such a way as to admit of a round block or languid being put inside, and a round cap outside, leaving a passage for the speaking wind as usual. Now, take another piece of wood and turn it out so as to form a short tube of sufficient length to form that part of a pipe from the upper end of the boot to (say) two inches above the mouth, at which part a recess inside may be turned to receive the paper tube already made, and so complete the pipe. And now for what I consider the greatest difficulty, which I think may be easily overcome by those who are moderately handy at the lathe, and that is the upper lip or feather edge, which can be turned like all the rest, but in two pieces; this I will explain at another time, and, if possible, with rough drawings. My simple arguments in favour of paper are, that all the various particulars of pipe making are within the management of all amateurs, and not costly. And, again, the pipes being covered with fancy paper, may be arranged on the soundboard on the Schudamore plan, so as to have a very nice appearance, and so do without case. The largest rank may have its tallest pipe in the middle, the others decreasing to each side; the next rank smaller may have its tallest pipes at each side, the others decreasing to the middle, and so with the rest of the various stops. I believe it possible with one large and one small mandril to make all the pipes, however narrow, wide or long, increasing from one to the other with the greatest regularity needed for any scale. SUORAM.

THE BEARING REIN AND BLINKERS.

[4580.]—I INDORSE the remarks of "Philo" (let 4553) entirely, both as to bearing reins and blinkers for horses, but how are the latter to be put away when horses have been run in them for years? I use a pony without blinkers with much pleasure, but he was broken without, and the few times I ran him in blinkers gave me reason to think he would shy a good deal; without them he does not shy at all, and will bear an umbrella or parasol up behind him without taking any heed. I have a very fine mare, quiet, but high spirited, broken in blinkers, seven years old. I cannot say I should like to run the risk of now breaking her to run without; have others done so with success? While on the subject of horses, the above mare has a very flat foot and thin sole, easily hurt with sharp stones, and the sole grows very little. Will "Philo" or any of our friends advise me as to the management of her feet, the best mode of shoeing her, and whether Mr. Flemming's or the Goodenough plans of shoeing would be suitable in this case, and if so where can the *modus operandi* of these several plans be obtained? C. J. C.

SPINNING TOPS AND GYROSCOPES.

[4581.]—I HAVE always understood that when a top is spun the axis leans more and more from the perpendicular until it falls, however great the velocity; but that, at first, the increase of the inclination of the axis from the perpendicular is imperceptible, the inclination increasing more rapidly as the velocity of the top decreases. Is this so, or is the inclination of the axis constant when the velocity is great, supposing the axis to be inclined at first? Taking out of account friction and the resistance of the air, would the velocity of a top or gyroscope remain undiminished? GY.

HOPS AND SLOPS.

[4582.]—A FARMING friend, a hop grower, thinks favourably of the plan I suggested to him for getting rid of the fly from the bines—namely, syringing with soap and water. I use this remedy to get rid of the aphides from beans, &c., and it appears to me to be applicable to the hop fly. With respect to soda as a manure, he warmly recommends it for almost everything. Its *modus operandi* is, perhaps, not quite clear as manure; it is, however, a deadly enemy to wire-worm and the tribe of garden or farm plagues in general. M. PARIS.

SOUNDS OF THE MUSCLES AND THE EARS.

[4583.]—IN 1809 Dr. Wollaston called attention to the sound, or *susurrus*, produced by the muscles when in a state of contraction. The sound may be observed by putting the end of the finger gently into the ear, and bringing the muscles of the hand and forearm into strong contraction; or by applying a stethoscope to a contracted muscle. It is like that of carriages at a great distance, passing rapidly over a pavement, or, like the deep hum from a large foundry. Wollaston tried to estimate the pitch of the note by putting his thumb in his ear, while his elbow rested on a horizontal board, on which he had cut a number of equal notches, about ¼in. asunder. Against these notches he rubbed a pencil, more or less quickly, till the sound he thus produced seemed to coincide with that from the muscular contraction. Then he attempted roughly to estimate the number of notches passed in a second. They appeared to be in general between twenty and thirty in a second. Dr. Haughton has also experimented on this subject. He got a number of friends to say what they thought to be the pitch of their susurrus, by comparing this with notes in a piano. The result was that four of the observers (two of whom were ladies), found it CCC; and five (of whom three were ladies), found it DDD; these notes corresponding respectively to thirty-two and thirty-six vibrations per second. His own susurrus seemed to him to be CCC.

Considering the sound very like that of cab-wheels in London, heard in the silence of the night, when the streets being quiet, the cabmen are able to drive fast, Haughton measured the intervals of the Guernsey granite pavement, and found them to be about four inches, making therefore three knocks or impacts in a foot traversed by the cab-wheels. Supposing the cabs to drive eight miles an hour, the number of impacts per second will be

$$\frac{5280 \times 3 \times 8}{3600} = 35{\cdot}2$$

Considering the susurrus note as D D D, giving thirty-six vibrations per second, its resemblance to the sound of the cab-wheels ceases to be matter of surprise.

A phenomenon not unfrequently observed is the sudden production of sounds in the ears—sounds which cannot be attributed to an external cause, as they are generally perceived only in one ear, and, therefore, probably arise in some way from the state of the ear itself. In some parts of Germany and other countries an ethical meaning is attached to such sounds, which are interpreted as praising or accusing, according as they occur in the right or the left ear. The acoustical properties of these sounds are discussed by Mr. Oppel in a recent number of Poggendorff's *Annalen*. His own experience was that the sound began quite suddenly, was pretty strong, and of well-defined pitch, but gradually became weaker, and at last seemed very like the sound from the bell of a clock a little after the hammer has struck it. The intensity differs on different occasions. At one time the sound is very loud, at another it is soft and scarcely audible. It generally continues about from ten to twelve seconds, and is to be distinguished from a low humming sound that is sometimes perceived in illness, which is of longer continuance, and has periods of greater or less intensity.

"Having at one time," Mr. Oppel states, "perceived this tingling in the ears to recur more frequently than usual, and for several successive evenings, I found it giving, in the left ear, the note D⁴. It occurred to me to find out whether or not the note was always of the same pitch, and whether the note in the one ear was of the same pitch as that in the other." He then gives a list of 9 cases, in which the sound was in the right ear, and 18 in which it was in the left, with the pitch of the note in each case. From this, it appears that the pitch is not always the same. It ranges in these 27 examples from D^1 to B^3. In some cases two notes at the interval of an octave were perceived. In one instance (the note being G^4) he had difficulty in determining whether the sound was in the right or the left ear. It appeared to be in the middle of the head, continued an exceptionally long time (seven minutes), and was repeated about a quarter of an hour later, when it lasted five minutes. In one other case the pitch was extremely high, and he compares it to the hissing of a water drop when it falls on a heated stone.

There is another subjective phenomenon, Mr. Oppel remarks, to be distinguished from these. It is a kind of cracking in the ears, often perceived when one has cold in the head, and specially noticeable in sneezing at the beginning and end of the sneeze. It is a very high pizzicato kind of sound. Mr. Oppel observed seven cases in which it did not appear to vary much from C^5.

The above account of some of the sounds in the human body may furnish material for easy experiment to the curious. A. B. M.

THE STAR ANTARES OR ALPHA SCORPIONIS.

[4584.]—ALLOW me to call the attention of such of your readers as take an interest in matters astronomical to the present remarkable visibility of the green companion to Antares. Last night, at about 10 p.m., turning my 4¼in. achromatic (by Cooke) on this very splendid object, I saw, to my surprise, the comes as distinctly defined and brilliant as the principal star itself. With a magnifying power of 284 the discs, round and sharp, appeared to be almost in contact; whilst the colours of the two components, red and green, were positively gorgeous. Having had no previous expectation that an instrument of such very moderate aperture would be able to reveal this object at all, much less to show it with such distinctness and ease, I was quite delighted with the spectacle presented, and equal gratification, I feel assured, will be experienced by other amateurs who shall take the trouble to turn their telescopes on this most noble star.

July 21, 1872. J. L.

THE CENTRAL HILLS IN GASSENDI.

[4585.]—SEVERAL observers have of late contributed to "our" columns drawings of the great lunar walled-plain, Gassendi. On comparing these sketches with others in my possession, I was much struck by the great differences which existed between them, even with regard to the more conspicuous markings. Amongst these is the central group of hills, in which the Rev. T. Webb tells us Schröter noticed several changes. Of this group I have collected sketches from different sources, and send three, which, if placed alongside those contained in other numbers of the ENGLISH MECHANIC, will exhibit "the strange diversity of the drawings by different hands." These are such as forcibly to suggest extensive changes, even within late years; and with every allowance for differences in illumination, and for roughness or inaccuracy in sketching, I cannot but think that some great disturbing agency has recently been at work on this part of the moon's surface. The experience of the observers, and the class of instruments employed by them, appear to preclude all deception, whilst the object itself is too conspicuous to admit of mistakes, such as would serve to account for the great differences in published drawings.

The first drawing which I send is taken from the second volume of Ferguson's "Astronomy," into which it was copied from one of Schröter's plates. Ferguson remarks of it, "This mountain has three tops, one of which appears like a bright spot in the shadow of the other, when the sun is on its horizon." In this respect it agrees very well with Mr. Loder's drawings (letters 1924 and 3747), but the closeness and the relative sizes of the two western mountains (in Fig. 1) are at variance with both of Mr. Loder's figures, yet are borne out by Mr. Birmingham's sketch (let. 4241). Mädler's drawing (Fig. 2) made with the help of the Dorpat telescope, is fairly accordant with the others in these features, and all appear to agree in the situation of


FIG. 2
FIG. 1
FIG. 3

the easterly peak, which, in Schröter's drawing, is seen shining in the long black shadow thrown by its companions. It is B sigma 5, in Mr. Birt's drawing (let. 2786); Mr. Gaudibert represents it as bent in form, with the concavity facing the north (let. 4076). So much for positions.

When, however, we come to compare shapes, we find greater differences. Mädler's drawing (Fig. 2) which I have copied from plate 18 of Lardner's "Handbook of Astronomy," shows a long, slightly curved plateau, upon which three hills project. To the north of it, and below its level, is a promontory, to the east of which we see four hillocks connected together. Turning from this to Fig. 3, a marked contrast is presented to us. The drawing is copied from a beautiful sketch, made by Professor Phillips, and inserted in Vol. CLVIII. of the *Philosophical Transactions*. It was executed in 1858 with the aid of a 6¼in. refractor, by Messrs. Cooke and Sons, of York. Compared with Schmidt's plate of Gassendi, a satisfactory agreement was found to exist, amongst other points, between the two representations of the "digitated central mass." Thus, Mädler, using a superb telescope of 9⁶/₁₀in. aperture gives us a sketch totally devoid of fissures, whilst some years afterwards Professor Phillips, with the aid of a smaller instrument, was able to delineate an upheaved surface, riven and torn in an extraordinary manner, and in this he is supported by Schmidt. This, I think, points to changes which occurred between the periods at which the drawings were made.

The drawings by Messrs. Birmingham and Gaudibert next claim our attention. They represent the south central hill as penetrated by two deep fissures, and as concave at the north-west extremity. But it will be noticed that the rents occur on the western side, whilst the very reverse is shown by Professor Phillips's sketch. By what subversive process the vast heap could have been overturned so as to lie in the position given by Messrs. Birmingham and Gaudibert it is difficult to imagine. Such strange differences strongly suggest the idea of extensive volcanic action since the date of Professor Phillips's drawing. If such differences occurred merely in connection with the extent of a minute cleft, or the position of a craterlet, we could not reasonably have recourse to the alternative of "change" to account for them. But when, as in the present instance, sketches made at different epochs by experienced observers with the aid of powerful telescopes, vary as to the formation of a conspicuous group of hills, and to such an extent as to represent them in contrary ways, we cannot, I think, overcome the difficulty except on the supposition of a real change on the lunar surface. W. BROWN.

SPOTS ON THE SUN.

[4586.]—DURING the past few days I have observed the sun on several occasions with an old 4in. metallic mirror reflecting telescope, and have noticed the partial passage across the disc of a large scattered group of maculæ, which contained one spot of considerable dimensions. On July 12, at 2h., this group was situated in the north-eastern quadrant, and was constituted of twenty-seven individual spots, several of which were immersed in penumbræ. The largest spot, which was situated in the eastern portion of the group, contained three well-defined umbræ and a large irregular penumbra, which, on the east side, was very dark, and on the exterior edge pierced with a train of minute dark spots. In the other quadrants I noticed four groups, and one isolated spot surrounded with penumbra in the north-western quadrant. These groups, though small, were composed of twenty-one spots in all, so that, including the large cluster before referred to, there were forty-eight dark spots seen altogether. I should have obtained a pretty correct estimate as to the dimensions of the large spot, but clouds coming over effectually precluded the possibility of my doing so. I also observed several groups of faculæ; these were seen, as is usually the case, near or in the vicinity of the margin of the disc. At about the time of observation, cumulus clouds were continually passing over the solar surface, but it was only partially obscured.

I have thought it appropriate to forward you the foregoing particulars for publication, because much interest has, during recent years, been manifested in sun-spot observations, and many of the scientific readers of your excellent journal may be pleased to learn that the spots have again become numerous, the more especially so as we are now approaching the minimum degree of intensity of these phenomena. This appears evident from the fact that at the observatory of the British Association at Kew the number of groups (271) observed in 1871 was less than the number recorded in the preceding year, although in 1871 the sun's photosphere was considerably disturbed, and at times especially violent convulsions were noticeable.

The large and interesting group of spots to which I have called the attention of your readers will have disappeared from the western edge of the solar disc before these lines are printed, but it may be expected to reappear on the eastern side at the beginning of the ensuing month, if, indeed, it is not dissipated before that time. WILLIAM F. DENNING.

PLATO.

[4587.]—IN answer to Mr. Birt (let. 4499, p. 433, No. 381), I beg to inform him that I relied more on hearsay than on anything seen in print, that "a heap of débris was near the centre of the floor of Plato." With regard to the second part of his reply, I must say that I thought I perceived the two white spots in the hollow of the shadow, as very faint cloud-like specks, not nearly so distinct as in the sketch. But being such faint objects, I may have been mistaken, and promise Mr. Birt that for the future I will be more particular in recording what I really saw, and not what I thought I saw. And while on this subject I would ask Mr. Birt if he would kindly give me a few hints for sketching the lunar craters, &c. Because in a short time I hope to become the possessor of a larger instrument, and then intend to make the moon a special object of study. T. H. F.

TRIPLE STARS.

[4588.]—ON searching for the double star P. XVIII. 263 Aquilæ (which is designated by Smyth as a "handsome test-object"), on the data given in Webb's "Celestial Objects," p. 188, with a 4¼in. refractor, I was unable to identify it; but in the place there indicated as "following a third magnitude star, bat far south in a fine field," I found a triple star. Magnitudes of components about 9½, 10½, and 10; positions (say) 260°, 110°; distances about 6" and 14", all by estimation, as I have no micrometer; power used 185. The two closer components were difficult to observe from the strong twilight which existed, and almost as difficult as the double 9th magnitude of the triple star ψ Cassiopeia observed on the same evening —11th July. This object-glass also showed finely the closer components of P. II. 72 triple in Cassiopeia under the same atmospheric conditions. I may remark the object-glass allows the "debilissima of Herschel" between ϵ^1 and ϵ^2 Lyræ.

I would feel obliged by "our" "F.R.A.S." examining the first-named object with his 4¼in. Dallmeyer, and stating whether it is the one given by Mr. Webb as above. The position angle of the closer components does not agree with it. EPSILON.

DOUBLE STARS.

[4589.]—WILL some of our astronomical correspondents kindly say whether the following double stars have been recorded? I do not find them in Mr. Webb's "Celestial Objects, &c.," nor in Mr. Proctor's smaller atlas:—

SERPENS.—Preceding 5, about 50" of time, nearly same declination, and in the same field, with an eyepiece magnifying about 150. Seen only once, June 30, 1872, in bad weather.

OPHIUCHUS.—2° 30′ N. of E., a little following. Distance about 2″. Position about 170°, July 6, 1872.

LYRA.—About 18h. 25m. N., 28° 40′. Position between 310° to 300°. Distance about 3″, magnitude 8 or 9, and each star much about the same. Dusky yellow. There is a larger star in the same field, S. To find it, place Vega in the centre of the field and move the telescope west about 8′ and the three stars will be in the field. Seen only once, July 11, 1872.

Jumet-Hainaut. C. GAUDIBERT.

A MORNING SUNSET.

[4590.]—THE phenomenon that your two correspondents (pp. 436, 465) describe by this singular name is a mere effect of perspective, and therefore, of course, mysterious to M. Paris; but figured under the name "Converging Beams," in Brewster's "Optics" (Lardner's "Cabinet Cyclopædia") and other optical manuals. The beams, which are caused by clouds dividing the broad glare of sunlight, intercepting some and letting separate portions pass, are, of course, in fact parallel, as much so as the horizontal cornices or courses of the most regularly built street or cathedral nave. But standing in the middle of such a nave, and looking either way, M. Paris will see all these lines converge to a vanishing point or pole, eastward and also westward. So it is with the sunbeams, when they are long enough to be visible for some miles each way, towards the sun and away from him. One pole is necessarily the sun himself, and the other, being his nadir, or exact opposite, cannot be above the horizon unless he is below it, and never presents any notable appearance, the beams merely dying off towards it, like auroral streamers towards the zenith. Occasionally these beams are less visible where broadest, overhead or at 90° from the sun, than where perspective concentrates them towards his nadir; but I have commonly found the reverse the case. The phenomenon is so much commoner in morning than evening that I have only seen it by sunset once; but at perhaps a majority of the sunrises I ever watched, yet only in low latitudes. Approaching Barbadoes from the east, I have seen it on many successive mornings, and sometimes with no cloud visible, those that cast their shadows across our whole sky being below the east horizon. E. L. G.

[4591.]—NOTICING "W. W. M.'s" letter (4519, p. 488), "A Morning Sunset," forcibly brought to mind a very similar circumstance which happened to me whilst in New Zealand. One fine evening I was walking home from a neighbour's, some four miles away, and happened to reach the top of a hill just as the sun set, showing those splendid diverging rays so frequently seen in fine weather, when I noticed a precisely similar appearance in the eastern sky, and stood some time to watch it, and it had not disappeared when I reached a patch of dense bush, of a mile and a half, through which I had to pass, on emerging from which I was so low in a deep and narrow valley that I lost sight of the rays altogether.

I would also add that on the evening of Sunday, June 30, I saw the same appearance, though not nearly so bright, in the east, over the houses, as I walked down the Old Kent-road. I can't say the exact time, but people were just leaving church.

In the same hope that "W. W. M." expresses I have taken this somewhat long liberty, and but for a fear of being disbelieved should have asked for an explanation before. HONE KO IO.

THE GYROSCOPE, &c.

[4592.]—THERE is a phenomenon which I noticed some years ago which belongs to the order of things now under discussion, which ought to be considered. There is a little toy often seen and used for lottery purposes, in fact, an enlarged teetotum which spins in a central tube, and has its table divided and numbered. I found that if this is set spinning vigorously, the whole affair may be turned upside down, and the teetotum will not fall out until its motion is nearly ended. Here is something much more like gravity overcome than anything yet noticed, and the fact is one worthy of explanation. I confess I can give no satisfactory one, but I suspect friction within the central tube to have something to do with the matter.

Some of our correspondents seem to have very hazy notions of the laws of motion and of projectiles. "G. M." (let. 4538, p. 460) is right in his correction of some absurdities, but he overlooks one circumstance; a ball fired horizontally would not quite reach the ground at the same instant as it would if falling from the muzzle, because part of the force of the powder is employed in lifting the shot, for a ball fired horizontally would rise but for gravity, because its line of motion is on a tangent with the earth's surface, and therefore rises, and this prolongs the time of falling; of course. I am ignoring the resistance of the air, which is a separate element of the calculation, and by diminishing the horizontal velocity acts with the increasing vertical velocity due to gravity in converting the path of the shot into a parabolic curve. SIGMA.

[4593.]—AFTER some little consideration I fancy I have discovered the key to the curious contradictions in J. M. Taylor's letter (4510, p. 435). In criticising Mr. Proctor in his third to sixth paragraphs, inclusive, he writes for himself; whilst in other parts he must be writing for some friend with whom he is discussing the subject, and whose ideas he would rather leave to the tender mercies of others in preference to treating his friend to his own views on them. Not less amusing is the triangular combat between (or rather amongst) "A.," of Liverpool, Mr. Proctor, and myself.

To return to J. M. Taylor, let me assure him we are not "pulling down established ideas" when rejecting what "Philo" and others term the "ordinary explanation," for that explanation never was by any means "established." Is J. M. Taylor trying sarcasm, when in his second paragraph he speaks of the "impossibility of avoiding contact with the laws of mechanics and plain facts, with which it cannot harmonise?" The problem to be solved (which has been solved) is, of course, to find an explanation that does harmonise with the laws of mechanics.

Mr. J. M. Taylor is himself in criticising Mr. Proctor, and I have not much doubt Mr. Proctor will virtually admit its force and change his front to some other "one case or feature of that case," or, possibly, back to "the general features of spinning motion" (let. 4310).

As to J. M. Taylor's friend's "governor" theory, I would point out that the lifting action, in an ordinary steam-engine governor is not directly due to the centrifugal tendency. It is a secondary action, arising from the balls being connected to the vertical spindle by links or levers, which will not admit of any outward motion, excepting what is accompanied by some upward motion. A careful consideration of the conditions involved will also show that when the balls are in the act of rising the spindle must have an increased downward pressure. In the suggested explanation, it is first assumed that two particles are detached from their rigid connection, and are connected by links. Then, after describing what might happen under such circumstances, the conclusion is jumped to, that the same results must happen even with all the particles rigidly connected, and no attempt is made to show that the movable link arrangement is not essential. It is suggested that the pressure of the peg point on the table must always be positive, but it is assumed that it must vary with the velocity of the spinning motion. I really think the experiment I have more than once before referred to is conclusive on this point if fully studied. (See p. 411 of the MECHANIC for January 7, 1870.)

Many who attempt to explain the action of a top or gyroscope are not aware that the instrument can be arranged to act in many curious ways, which at first sight seem quite different from the ordinary experiment. I have formerly explained how the centre of gravity of the gyroscope may be made to trace a series of spherical epicycloids instead of a plain circle; and it is obvious that any complete theory must include these and other cases. Can "J. M. T." (or his friend), or "Philo," or "A.," show how their explanations can be rendered applicable to the case of the epicycloids?

Glasgow, June 15. E. H.

[4594.]—WITH the greatest respect for Mr. Proctor, (let. 4509), I must observe that in my opinion his answer is most unsatisfactory, and reminds one of the usual method of dealing with children when they ask us questions which we don't quite understand ourselves. Of course, he is not bound to answer any question unless agreeable to himself, and if I am to be forced to take anything for granted without having any proof shown, that would end the matter at once. The question is, "If a cannon ball be fired horizontally, how is the resistance to change of plane of motion so nullified that it becomes of no effect whatever, and the ball reaches the ground as quickly as if dropped freely from the same height?" Now surely this can be answered in language that all may understand if it is correct. As for the moon, it only strengthens my argument; she yields a certain amount to the attraction of the earth, but the superior impelling force prevents her from yielding altogether. Neither is the speed of paddle or screw sufficient to call this force into visible action. I would like an explanation of the following experiment. Take a weight and swing it round with sufficient speed and it will attain and maintain a rotatory motion in a horizontal plane as long as the power is kept up. Now, it is evident that if the cord were gradually let out and the power increased as well, this weight would not fall to the earth, but would maintain the same distance from the ground as at first; the cord has nothing to do with holding it up except that it restrains it from flying away. This can be tried by any one; whether the cord be short or long the weight maintains its position as long as the velocity is kept up, and pray how are the conditions changed, if any other force, say gunpowder, is substituted for the cord?

J. M. Taylor (let. 4510) is clearly in error when he says that "centrifugal force has not the power of retaining a particle in a horizontal plane, &c.," as he can easily prove for himself by swinging a weight attached to a cord round his head. Neither is it correct, in my opinion, to say that "centrifugal force has the power of raising," &c.; it is the lever attached to the ball which yields to its force, and in the case of the governor of an engine it necessarily raises the ball, but were the levers arranged horizontally, then they would fly out without any lifting of the balls, and it is quite fallacious to imagine that the vertical shaft would press less upon its bearing, or the top to weigh one particle lighter when in motion, because there is no tendency to move in any direction but at a tangent to the plane of motion, and were such the case then there would be a speed at which any rotating body would fly upwards. A., Liverpool.

ON TUNING PIANOFORTES AND OTHER STRINGED MUSICAL INSTRUMENTS.—II.

[4595.]—BESIDES the geared tuning-hammers before mentioned, many contrivances for tuning piano-strings with greater accuracy and convenience than it can be done by amateurs with the ordinary wrest-pin and tuning-hammer have been published. One of the earliest, applied to the strings of harpsichords, was a screw, employed a century ago by Wakefield, whose patent bears the date of 1771. I think this is the earliest employment of a screw for this purpose of which we have any record, unless, indeed, Plenius preceded him in this as he did in the employment of a separate weight to strain to the required extent each of the gut strings of his celebrated lyrichord, which in consequence (according to the handbill recently reprinted in this journal) never went of tune. In the employment of screws for tuning—I don't mean equine screws, they have been commonly employed in all ages for pulling their riders "out of tune"—Wakefield was followed by Hawkins (1800), Smith and Todd (1801), Thunder (1805), Deakin (1823), Pape (1845), Erard (1850), Gordon (1852), Greiner (1859), and others "until this day."

Hawkins, Loeschmann, Kirkman, and others applied the screw by attaching one end of the wire string to a pin or peg in a nut which travelled along the screw, just like the plate of a common slide-rest is made to travel by its screw, which is, of course, abutted endways. On the contrary, Kohlman attached his strings to hooks formed at one end of his screws, and applied the required force to them by a thick nut, which fitted the pipe of the tuning-hammer. So little muscular exertion was required that the latter, instead of the ordinary cross-handle, had only a round knob like that of the handle of a large bradawl. The same method was afterwards proposed by Moody, 1864. Not content with tuning one string at a time, some rather crotchetty folk have attempted to tune many strings at once. J. J. Hawkins, as early as 1800, proposed to make all the strings of the piano the same total length and thickness, and to vary their pitches, not only by making the lengths of their vibrating portions between the bridges differ, and after tuning them to vary the pitch of the instrument a whole octave at a time, by raising his tuning frames, one of which carried all the strings of twelve notes. Dietmar afterwards attempted the same thing in grand pianos which had Stodart's—or rather Thom and Allen's—patent tubular bracing, by means of screws at the ends of their tubes, but how he got over—if he ever did, which I greatly doubt—the difficulties which must have resulted from the total lengths of the strings of grand pianos differing I cannot conceive. Mr. F. Greener had an "exhibit" in 1851 of an odd-looking pianoforte, the sides of which had openings like the bell mouths of trumpets—probably to "let the sound out of the box." In this instrument the two strings of each note were provided with an ingenious contrivance for causing them to vibrate in unison, and they being attached to a single hitch-pin, which was fixed in a slide moved by a screw, the pitch of both might be raised or lowered simultaneously. This contrivance, however "awfully clever" it might have been, was anything but cheap, and therefore even if more useful than it appears, not very likely to come into general use. In truth, "Le jeu ne vaut pas la chandelle;" and the same may be said of Pope's contrivance for altering the pitch of six unisonous strings at once.

Probably the very best method of "fine" tuning is deflecting the string, either downwards or sideways. This was the method employed by Messrs. Wheatstone and Green for tuning the one or two flat strings of their patent musical instrument—see their patent, No. 7154, A.D. 1836—in which what I may denominate a "string reed" produces not only the ordinary reed tones of the harmonium, but also those derived from a sounding-board, with which it is connected, a very valuable contrivance, enormously augmenting the loudness and improving the timbre of the sounds. Tuning by deflection is at once the cheapest and most delicate method of fine tuning I have had experience of, and by employing it we can retain all the advantages of using wrest-pins—a practical pianoforte-maker and tuner would be sorry to part with those advantages—combined with the means of slightly, but for all practical purposes sufficiently, raising or lowering the pitch of a string without disturbing its wrest-pin or turning it backward, which is of great importance for avoiding injury to the string. Tuning by deflection was first employed in the pianoforte by Schwieso (A.D. 1826), afterwards by Stumpff (1839), Myers (1839), Pape, Burkingyoung, Brooman, and others.

I have found the cheapest and most convenient method of carrying out tuning by deflection in ordinary cottage and bichord grand pianos is to use screws which press on the wires between the wrest-plank bridge and the wrest-pins. If these screws be made with heads which fit ordinary tuning-hammers, they are most convenient in practice, because the same instrument serves for both them and the wrest-pins; but such screws are rather costly, although far from difficult to make. I have made them out of old wrest-pins, which were not drilled, by turning down the part to be screwed to about the diameter of a No. 12 wood-screw, and cutting a shallow coarse-threaded screw, about fourteen to the inch, on the reduced part. No doubt were such screws in demand, the patent wood-screw makers, or the wrest-pin makers, would make them very cheaply, considering the latter are manufactured by thousands for about half-a-crown per set of 170; but as the reader can only—if he don't make them himself—obtain them by having them made for him to special order, they will cost money. I need hardly add what is specially made must be specially paid for, yea, even through the nasal organ at times.

Although a screw with a moderately large head will serve without, it is preferable to put a metal, a hard leather, or an ebonite washer between the head of the screw and the string. This protects the latter from abrasion, especially if, when formed of metal (say brass, copper, or zinc), a groove close to, but not quite running into, its hole be formed in its under surface. This groove effectually prevents the washer from turning with the screw, and, if its ends be rounded off, also prevents any sudden bending of the wire.

As some of my very economical fellow-readers may object to the cost of a set of tuning-screws with heads to fit their tuning-hammers—N.B., that cost is by no means a "Meek" one—I can assure them a very tolerable substitute is the ordinary patent wood screw, about No. 10 or 12. Any kind of head will do if you employ a suitable washer under it; but I prefer either rose or cylindrical heads, especially the latter, technically termed "cheese" heads—probably because they are the "cheese" for our purpose; both of these heads have their under surfaces flat and square with their shanks, which is far preferable to a conical surface if the latter touches the string. Of course, if metal washers beneath the heads are employed they may be countersunk, in which case the conical form of the head becomes unimportant. It is, perhaps, preferable slightly to round the under edges of both rose and cheese heads, especially if used without washers, which I don't recommend; but when a very hard sole leather washer is interposed the wire forms a groove for itself, the ends of which are naturally rounded by the pressure, consequently no harm can ensue, even if the under edges of the screws be left quite sharp.

The greatest objection to the employment of common wood screws is the difficulty of turning them when an ordinary screwdriver is employed, without the liability of its slipping off and disfiguring the front of the wrest-plank, not to say injuring the wires. A screwdriver ⅛in. wider than the diameter of the head of the screw may have its centre filed away, leaving two prongs about one-tenth of an inch long, which receive the head between them, and greatly diminish the risk of its slipping off the screw. I find this answer admirably; but then I consider myself rather a careful person, and am apt to consider most other persons "arent," consequently something suited for the careless is almost a necessity. The best contrivance I have been able to devise is a sort of tuning-hammer with a short cross handle, or a handle like that of a graver. The pipe of this tuning-hammer is bored to receive easily—but not too loosely—the heads of the deflecting screws. It is sawn for about ⅛in. of its depth, and a steel plate, which fits the grooves in the heads of the screws, is rivetted therein. This plate does not extend within one-sixteenth of an inch of the end of pipe so that it cannot enter the grooves until almost the whole thickness of the cheese head of the screw is within the pipe. Of course, slipping off is rendered almost *impossible* with any ordinary amount of stupidity, and for anything beyond that I don't believe it to be my mission to provide, although I cannot deny such greater provision to be a great social want in this enlightened (?) age.

As the purpose of this contrivance is to slightly increase or diminish the tensions of strings, and thereby slightly alter their pitches without the necessity of turning the wrist-pin backward, which injures the wire when the latter is the thing required—provision must be made for doing both. In other words, the deflecting screws ought to be screwed in until they deflect the string about half the distance between its original position and the wrest-plank, before commencing to tune the instrument. This will enable ye tuner not only to sharpen, but also to flatten, the pitch of a string should he have the misfortune to "pull it up" too sharp with his tuning-hammer without being compelled to turn the wrest-pin back or "press the string down," by no means a desirable thing to do, although not so evil as the former. Of course, it is only us amateur tuners to which these cautions apply. It is quite notorious no professional tuner was ever known to "pull up" a string too sharp, unless, indeed, the wrest-pin was a "condemned" jumper, in which case both the act and its emphatic "condemnation" is quite excusable. The unpractical [?] blacksmith, to whom, perhaps, more than forty years' experience has taught nothing, humbly trusts professional tuners will not be offended by this attempt of his to enable amateurs to tune their pianos when they are "up the country" and out of the tuner's reach.

THE HARMONIOUS BLACKSMITH.

SOUNDBOARDS OF PIANOFORTES.—To "SCIOLIST."

[4596.]—"SCIOLIST" (let. 4419, p. 382) wishes to be informed if the removal of the long bridge and the belly-bars would improve or augment the sounds of a pianoforte, assuming its soundboard to remain equally under the influence of its strings as it is at present. I really cannot inform him, having had literally no experience of any instrument so constructed, but I will tell him what experience and observation has taught me anent this matter.

If the soundboard be very much too rigid for the strings to communicate sufficiently ample motions to it, the sounds produced are but weak. This error—which, by the way, is one on the safe side—is a very common one in pianos made by persons who very laudibly aim at great durability, and reasonably fear that deterioration of tone which almost invariably ensues when the soundboard sinks at an early period from its deficiency of strength to support the pressure caused by the down-bearings of its strings. In making their soundboards somewhat too rigid the intentions of manufacturers are honest, but like all good things—even telling the truth—it may in practice be carried further than produces pleasant results. This fault is, however, one on the right side—viz., that of safety, and may easily be remedied by removing a portion of the depth of each belly-bar with a chisel and a small thumb plane until you obtain the quality and degree of loudness of sound you want, especially in the tenor and bass, the soundboard being very seldom too rigid for the treble. N.B.—The loudness of the bass and tenor sounds of many modern pianofortes may be greatly increased by this means.

It seems very probable there must be some imperfectly ascertained proportion between the size and rigidity of a soundboard and the strings which move, and cause it to generate sounds, which induces the production of sounds of the greatest intensity combined with pleasing timbre. Perhaps some slight diminution of rigidity below this proportion increases the loudness at the cost of some deterioration of the quality of the sounds so produced; also, if the strings press on the bridge—*i.e.*, have what is termed down bearing—of durability. Whether it now is, or even will be by the employment of means superior to any now known, possible to obtain equally loud sounds by the vibrations of a soundboard whose strings do not press on it—which, by the way, was the plan proposed by the ingenious harpsichord-maker Plenius—but are simply clamped to what might then be a comparatively low and flexible bridge (either by side bearings or otherwise), I am quite unable to say, being "ignoramus." Not having any very distinct theory of the soundboard, I decline venturing to prophesy results, which, by the way, your confident theorist is usually much addicted to doing, far more so than those who possess the advantage of having had their very confident theoretical opinions corrected by many failures when they attempted to carry them out practically. I think, however, a carefully conducted course of experiments with such soundboards—which, as there would be no reason for bellying or arching them, might be made as "flat" as the writer—would be well worth the trouble of carrying out, for they seem to promise that desideratum more prolonged sounds, because the less rigid flat soundboard would probably be compelled by the strings to move sufficiently to generate audible aërial waves for a longer time than they can now move a rigid arched belly. Probably, however, this system, and most others, may have already been tried and judged by Messrs. Broadwood and other first-class old firms; for I often suspect the late "W. T." was not very far wrong when he said he believed more knowledge was hidden in their archives than he and myself would ever live to discover by experimental investigation. He added, in his sneering manner, "It would save us schemers much time, trouble, and money, if I could persuade those firms kindly to publish their failures as well as their successes," he also remarked that, as a rule, it was only those successes which afforded them pecuniary profit which they did make known by adopting them in the manufacture of their instruments.

"Sciolist" also inquires what is the reason pianofortes can't be made with both their bridges on their soundboards. I really was not aware of the fact that they could not, and, seeing that it has been done repeatedly, can't help doubting the alleged fact. As regards the bass, I know no reason why it is not commonly done, excepting that, as it is very easy to make the bass of all pianos whose strings are from 3½ft. to 4ft. long more than powerful enough for any trebles yet produced, it is not worth the small additional trouble of doing it. For very short bass strings I have already suggested its adoption. Both bridges of the piano were placed on its soundboard as early as A.D. 1827, by Dodd; but as he carried it out in the treble as well as in the bass, I "kalkalate" the tones produced must have greatly resembled the sentimental professions of some young persons "about to marry," inasmuch as it must have been "werry holler," yea, even like unto ye sounds generated in an empty tub when we drive in its bung.

THE HARMONIOUS BLACKSMITH.

ON FIDDLES, HARPS, AND MUSIC.

[4597.]—I FEEL an explanation necessary so that "our" musical readers may really know what I mean by a sound reflector. I am not certain that I have given it the right name, so it is open to any one to call it what they please; it is the result I am looking after. If you bow a violin, first under the chin, and afterwards with the back of the violin placed against a deal door with long panels, an increase of sound will be the result. Short panels show no result, but a piece of mahogany from three-quarters to an inch thick held underneath the violin while playing gives the best result. If I had never tried this, I should think it highly probable that the sound would be increased, for the same reason that a musical-box sounds much louder on a board. I agree with Mr. Schucht that it would not do to attach or fix permanently any additional weight to a violin; but I think it possible to play, with the reflector tied loosely against the back of the instrument, by its two ends if cut to fit the instrument. A piece of gut looped on the same nut as the tailpiece is on, and knotted through a hole in the reflector for one end, the other secured in like manner round the end of the neck, either end of the back may be made to touch, as a slight conjunction is all that is necessary. I am pleased to hear of the new soundboard or breast that Mr. Schucht is making, and long to hear the result. I hope he will remember the bass bar; but I would not recommend a bar between each section—perhaps, however, he will do without any bar at all after the experience he had with the supporting strips of wood. I think the centre of the breast should be at least one-eighth of an inch thick if the violin is to be strung in the usual way, as I am of opinion that the weight of the strings interferes with the tone even in the best made violins.

I can assure my friend "The Harmonious Blacksmith" that I never heard Paganini play; but I have heard that it was always an extraordinary performance, so much so that he was caricatured. Where is the fiddler that has so much notice taken of him nowadays? Where is the trumpet tone of Tartini, who composed the "Devil's Sonata" under the old gentleman's influence? But I have never heard a violin sound louder than a piano, but only as a distinct tone from it; and I have found in a general way of pleasing, that the harp and violin suit the ear of the listener best. Notice the splendid effect produced by the voice assisted by harp and violin; it is not loud, but inexpressibly charming. I wish I knew as much about the harp as "Vertumnus" infers (let. 4559); but I have never touched one, although the day may come when I shall add it to my orchestra. "We" have often asked after the construction of the soundboard of the harp with no effect: will "Ixion" oblige? I think wires would do for the short or treble end, but would be too twangy for the bass; but this depends entirely on the strength and proportion of the soundboard. Would it be able to bear the weight or pull? Perhaps Mr. Schucht's invention may do for the harp, as well as for piano or violin. With respect to the hints on musical education, I have seldom met with an ordinary amateur player who felt that music is a science. So long as they can rattle out a polka, or accompany a song in their way, that will do. Ask them to play one of Mozart's sonatas for the piano, or one of old father Hadyn's, and they will not, for they cannot. Yet there is more real music in these two alone than in all the so-called melodies of the present day. I have a word of advice to all who can play a little (as it is usually styled) on the piano. Buy Beethoven's sonatas, and learn them; especially study the masterly way in which a melody is changed or transposed from one key into another. This one principal study is lost sight of among our teachers of music, and yet once known, places the learner on the first round of that ladder that leads to perfection, as far as attainable by genius and patience. I beg leave to inform "Correlli" that if he will do as I desire, his wishes as to the tremolo will ultimately be gratified. Can he imitate the roll of a drum with five fingers (four one hand, one of the other) tattooing on a table? For this is a good exercise without a Jack Tar's assistance.

FIDDLER.

THE TREMOLO ON THE VIOLIN.—VIOLIN TUNING AND FIDDLEANA.

[4598.]—"FIDDLER" (p. 417) seems scarçely to have apprehended the scope of "Corelli's" question, and indeed, this is hardly to be wondered at, for I conceive the latter does not mean tremolo at all, this being that sort of agitation that occurs in the music accompanying the ghost scenes in the "Corsican Brothers," as performed at the Princess's Theatre, and is produced merely by very short and rapidly repeated strokes of the bow. But what is really required is, I think, the manner of producing a thrill (not trill) upon a particular note analogous to what is called expression upon the harmonium. This is not a very difficult affair, but still it requires a little attention to a few points. Firstly, the instrument must be properly held, with the neck of the fiddle resting on the left thumb, and on no account to be allowed to touch the bottom of the fork formed by the junction of the thumb with the first finger. Then the elbow must be well under the back of the violin, quite to its middle or rather beyond, th violin being, of course, held horizontally. All this wi enable the very tips of the fingers to fall perpendicularly on the strings, even on the fourth, at the top of the fingerboard if required. No more than one finger should be on a string at a time; when the second falls the first should be raised, and so on. This necessitates very firm stopping, and great dexterity of hand, and I may inform the uninitiated that the fingers do not fall at uniform distances in the production of succeeding notes, but that these distances are different for every note for the whole length of the fingerboard. Now, if "Corelli," having attended to these points, and standing upright, will stop a note with (say) the middle finger, and shake his wrist, he will find he can produce the effect he desires. The best way to tune a fiddle is to have an A tuning-fork which can be sounded on the belly of the instrument whilst the A string is plucked with the thumb, three or four inches from the nut, then the other strings can be tuned by fifths, in the usual manner. If the strings were to be tuned separately from the piano, the fiddle would be out of tune, but if the piano must be had recourse to, it is better to sound upon it a minor chord of A, rather than a single note. When a scale is played upon the piano, all the notes, relatively to each other, are out of tune, and on this account first-class singers, in practising, are guided by a violin, which, in competent hands, is always in tune, whatever may be the key. Unless very considerable improvements have been made in the organ since I devoted more attention to music than I do now, this latter instrument is still more lamentably deficient than the piano, for so little is, or was, done in the way of that shocking compromise called temperament, that it was, or is, in very few keys that it can, or could, be played without being positively and literally intolerable, in fact, excruciating. It has been mentioned in these pages that though the violin is spoken of as being in the key of G, there is no particular reason for this being so. This is an error. It is not alone in that key because the lowest note is a G, but because that scale is played in the natural first position of the hand, without any shift, when the F sharp on the first string falls naturally under the first finger, while the F natural requires either the half shift downwards on the first string, or the extension of the little finger on the second string. If "Corelli" is desirous of practising some difficult achievements on the fiddle, let him, for one, place his little finger lightly on the double high E on the first string, so as to produce a harmonic, then press the finger down in order to have the ordinary note, when he should run the little finger down the string so as to distinctly mark each note, till he arrives at the B, and finish the double octave with the remaining fingers and open string. With regard to the bow, he must begin at the point, and give it an impulse that shall make it hop so as to come down afresh on the string for each succeeding note, that it may be a staccato passage. When he can do this neatly and perfectly, say 30 or 40 times in a minute, he can begin it at the G above, and then proceed till he gets to D in the ledger lines, and proceed with the fingers on the successive strings till he comes to the end of three octaves on the open G on the fourth string. When perfect in all this he can try to do it with a drawing bow instead of a pushing one—that is to say, beginning at the heel instead of the point. Then there is another pretty exercise called Tartini's or the devil's shake. Stop a note on one of the three lower strings with the first finger, place the third finger on the next higher string on the note where it it would naturally fall, and then produce a double shake with the second and little fingers. And now a word anent the funny fiddle of our excellent "Harmonious Blacksmith," who is as felicitous in his selection of a pseudonym as he is in that of the subjects on which he writes. This instrument is of so simple a structure that it would surely have been best to have made one at once, and thus have saved us much speculation; but I cannot help remarking that I do not think it would succeed, and, to say the least, it is not wanted. Supposing all these seven soundboards to be effective, which I do not believe, where is the necessity to make so terrible a noise? No one can assert that a good violin, in proper hands, is weak or incapable of filling any reasonably sized building; and, moreover, we have here a combination of two instruments of which the fingering is essentially different, for in the violoncello it frequently becomes necessary to stop with the side of the thumb, which is brought to the front of the fingerboard for that purpose. Then there would be the very wide intervals between the fingers in stopping the notes on one part of the instrument, and the sudden transition in their great approximation on the other part; the bow requisite for the one would not do for the other. Then the manner in which this instrument would have to be held is against it, for although the fiddle can be played with the button resting on a table, nobody has ever heard anything performed in this way equal to the brilliancy that is obtainable from the old-fashioned manner of holding it, and where should we be when the thumb is brought to the front? Indeed, I am well persuaded that with all the efforts to invent a new, and improve upon the old, fiddle, we shall never hit upon anything better than we already possess; it is, as with painting and sculpture, we may, perhaps, rise to the level of the old masters, but we shall never transcend them. I have a fiddle, with a pedigree, made at Padua in 1704, by Anthony of Vicenza, that I should be very sorry to change for any modern instrument, M. Vullianme's imitations included. It is difficult to imagine what can be required when we have an instrument that admits of true legato as well as staccato playing, of the thrill above described, of gliding from one note to another without break for two octaves if necessary, of a swell and diminuendo, of the sustaining of notes to any length, of the production of chords, double notes, simultaneous octaves, and arpeggios, with a whole scale of harmonics, and a positive change of quality by means of the sourdine or damper, with a scale of a good three and a half octaves, and susceptible of being played in any key. What other instrument combines all these advantages? F.R.C.S.

THE VIOLIN.—To "SUFFOLK AMATEUR" AND "BEACON LOUGH."

[4599.]—HAVING invited criticism on my fiddle, I hail it, however unfavourable, and I thank "Suffolk Amateur" for his in letter 4421; but, with all due deference to his far greater authority, I beg to make a few remarks thereon.

"Suffolk Amateur" is quite correct in supposing I had no intention of inclosing my multitudinous soundboards in a box, the only effect of doing this with which I am acquainted being practically to reduce their number to one. The ordinary violin is said to have two soundboards—viz., its breast and back—but, if I am not greatly mistaken, only one of the surfaces of each can, in practice, generate audible aërial waves—to wit, the one surface of each which is exposed to the external atmosphere. It is quite true their inner surfaces are not quite "shut up," for apertures exist, yclept sound-holes—query holes to let out that odd kind of entity or noun substantive the sound—I suppose to establish communication between the partially inclosed and external air; but so long as these so-called sound-holes are very small, and they ordinarily have but a very minute area compared with the surfaces of the back and breast, it seems to the writer that the communication they establish must be very imperfect, so he once suggested making many sound-holes in the sides of the fiddle, for which suggestion he was duly snubbed by an expert.

My suggestion, however absurd it may seem to violinists, who usually entertain rather peculiar theories on the conditions necessary for the production of sound, was simply intended for rendering the inner surfaces of breast and back efficient for the generation of sound waves necessarily synchronous with those generated by their outer surfaces; in other words, for converting the ordinary violin into an instrument having four sound-generating surfaces instead of only two, which I then and yet believe to be, for all practical purposes, the limit of their number. I have been told there were French violins shown in the International Exhibition, A.D. 1862, which—as my Hibernian informant expressed the fact—"had no backs at all, at all, excepting their wooden back bones." I presume he meant not exactly a spinal column, but a wooden bar beneath the belly, which connected the tail-piece with the neck and resisted the tension of the strings. Such a wooden bar existed in the late Mr. J. J. Hawkins's violin without a back which I have described, also the demoralising effects thereof on one of the greatest violinists and lover of fiddles I ever knew. I really know no reason why these fiddles, although unsupported by backs, should not have been as loud as a "Strad" if, as I believe, their total areas of sound-wave generating surfaces were equally large, and for all practical purposes it would seem to be so, whether formed by outer surfaces of the lid and bottom of a box (I mean a fiddle, which, as usually constructed, is but a shallow box) or by the upper and lower surfaces of the lid of the box—in other words, the two surfaces of the fiddle's belly.

"Suffolk Amateur" thinks the resonance of a hollow box necessary to produce "power of tone." He is by no means singular in entertaining that faith in hollowness. I believe that formerly nearly all the makers of stringed musical instruments were of the sect I might take the liberty of designating "Hollowtonians." Until a comparatively recent time they, almost without exception, seemed to regard sound as a substantive, something like Jack, to be shut up, if not generated, in a box. Hence, it need not surprise us much that having, as Mrs. Glass advises, first caught their "air"—I mean their tune—in the box, that they should, if only for respiration, provide air, alias sound, holes, to let him out piecemeal. Letting him out all at once must manifestly have been impossible when we come to look at the small means of escape provided in the form of sound-holes in the soundboards of fiddles, lutes, guitars, and harpsichords. Nay, even the old grand pianoforte-makers tried hard to "box up" the sounds of that instrument, and the subsequent manufacturers of the earlier cabinet and cottage pianos made them with solid wooden back linings, until experience convinced the makers of both that a piano whose soundboard was exposed to the atmosphere on both its sides—like that of a fiddle without a back—yielded much louder sounds than it did when its soundboard formed the lid of a nearly close box. I "kalkalate" it would require a long search nowadays to find a piano, small or great, with a close back or bottom lining. Modern instruments are sometimes rather "tubby;" but their boxes or tubs are tubs with their bottoms out, consequently the box, alias tub theory, can't "hold water."

That a box is necessary to produce "power of tone" can hardly be believed when the notorious fact that the sounds of a harp are not only swelled by opening its back doors, but that those sounds generated during the whole time those doors remain open are much louder than when they are shut, is taken into consideration. Were a nearly close box necessary for the generation of loud sounds, we should indeed experience increase of loudness when the back doors of the harp are opened, but—as the box would then become one without a bottom or its equivalent—all the sounds produced after opening the swell would be weaker. Just the same thing might be expected when I open the Venetian swell of a harpsichord; but the very reverse happens.

"Suffolk Amateur" says, "Compare a tambourine with a drum." Now, tambourine is literally little tambour or drum. The French call it "tambourette," just as we call a small poker a "pokerette." Just as well might we compare a child with a man.

I am not quite sure that putting two membranes on one cylinder sensibly increases either the volume or intensity of the sound produced when one of them is struck. We don't use two membranes in a kettledrum, and yet its sounds are anything but deficient in loudness, nor can I think their power be caused by their being "boxed up." A. Saxe, who is generally supposed to know his trade "indifferent well," made them without the "kettle," and his bass drums without cylinders, alias "barrels," of any length to speak of. I am informed drums are now made with what my before-mentioned Hibernian friend terms "steel" membranes, each drum having but one. He says the quality of the tone is very fine and their power remarkably great—quite equal to sheepskin. If I am not very much mistaken, the leetle tambourette, about 7ft. diameter, which I both saw and heard at the late Alfred Mellon's promenade concerts, had but one—not sheep—skin, probably formerly the cuticular property of some distant African relative of the bereaved Mrs. 'Pottamus. Had it been born in this iron age it would have probably possessed an iron hide.

The help I requested of "Beacon Lough" was either records of the acoustic "facts"—which are found to obtain when the soundboards of musical instruments are corrugated—or the opinions of those who, like "Beacon Lough," are better acquainted than I am with theoretical acoustic science, on the probable consequences of forming them in the ways proposed by M. Pape and Mr. Robertson. I thought I made this clear when I wrote.

THE HARMONIOUS BLACKSMITH.

CTENODUS.

[4600.]—IN the ENGLISH MECHANIC, Vol. XII., No. 291, p. 112 (letter 620), I directed the attention of your readers to a curious form of bone which has been recognised as a sphenoid of *Ctenodus*. The sphenoid bones that are discovered in the Northumberland coal-measures vary very materially in size, ranging from 1in. to about 12in. in length. The average length of those discovered is about 5in., but a few days ago I had the pleasure of inspecting one of considerable magnitude. The specimen is a fragment, but the broad or anterior extremity is perfect. The length of the fragment is 7¾in., and the width of the rhomboidal extremity from angle to angle is 4in. The widths of the rhomboidal plates bear a somewhat uniform proportion to the lengths of the sphenoidal shafts, and one perfect sphenoid now before me has a plate 2in. wide, the length of the entire bone being 6¼in. I infer, therefore, that as the plate of the large sphenoid before referred to is 4in., the total length of the bone could not have been less than 12½in.

Some of the flat, ridged, palate teeth of the *Ctenodi* are 4in. long and 2in. broad, and many of the head-bones display considerable strength; it may, therefore, be fairly inferred that some of the *Ctenodi* were of great magnitude, and that their dental crushing powers were very great. Whether the carboniferous *Ctenodi*, like the modern Australian *Ceratodi*, described by Dr. Günther, were vegetable feeders has not yet been established; but whatever they fed upon, it appears to have been something not very hard and not difficult to crush, as the vast majority of the teeth found are as perfect as if they had not been used at all, or had been used only for crushing comparatively soft food.

Newcastle-on-Tyne. T. P. BARKAS, F.G.S.

THE INDUCTION COIL.

[4601.]—I HAVE met with certain difficulties in the construction of this instrument, and finding that several of my friends and some of your correspondents have met with no better success than myself, I thought I might venture to request you to insert the following, since the replies to it (if it is fortunate enough to elicit any) can hardly fail to be of use to any of your readers who may be engaged in constructing a similar machine. I have made my description as short as I could consistently with clearness:—Length between the discs, 7in., length of fasciculus 10in., diameter 1in., 22 B. W. G. Primary coil, about 50 yards of No. 18 copper wire, cotton covered and coated with a composition of pitch, resin, and guttapercha. The primary is insulated from the secondary by a thick coat of the same composition, and two or three thicknesses of paper well varnished with shellac. The secondary is divided into three spaces, of which only the central space is wound as yet. It consists of about 500 yards of No. 35 copper wire, covered with two layers of cotton (4 strands in each layer), wound on in opposite directions, and further insulated by being passed through melted paraffin, the diameter being increased by these processes to about ·06in. The layers are separated by two thicknesses of paper soaked in paraffin. The contact breaker is Ladd's improved form, placed vertically and playing on the central fasciculus. The tube on which the primary is wound is of paper, about one-sixteenth of an inch thick or a little more. The condenser consists of 18 sheets of tinfoil, 8¼in. × 10in., separated by sheets of paraffin-covered paper.

From a battery consisting of three pint Bunsens, a spark of scarcely more than one-eighth of an inch can be obtained with the condenser, and without it the sparks will scarcely pass over any appreciable interval.

The questions that I more particularly wish to ask respecting this coil, are:—1. Is there any chance of obtaining electricity of high tension without the use of silk covered wire? 2. What length of spark can I reasonably expect from a coil containing about a mile of secondary wire insulated as above described? 3. Is the wire of my primary coil (18 B. W. G.) much too fine?

I may add that I have carefully read the whole of "Sigma's" valuable papers on electricity, and I think that I have understood them pretty well. The following passage, however, puzzles me, and I cannot find any person or book that can clear up and explain the difficulty. "A current arising from the consumption of one unit of zinc will deposit exactly the same quantity of copper, viz., one unit, whether it passes directly to the coppering cell, or whether a long fine wire in which heat is developed is also interposed in the circuit; the only difference will be that it will take much longer about it." (Vol. XII., p. 77 No. 177.) It seems to me that this heated wire must radiate heat to surrounding substances and raise their temperature, thereby doing a certain number of foot pounds of work. Whence is this force derived, if the unit of zinc still deposits a unit of copper? I can understand that the mere heating of the wire would not diminish the force, provided none of the heat escaped by radiation or otherwise. I wish it, of course, to be understood that I ask this question entirely for the sake of information, and not to produce a discussion, or cast a doubt on the fact as stated by "Sigma." T. H.

REFLECTION.

[4602.]—IF we take a long belt of silvered metal, or cut a strip off a mirror, we can, by bending it, cause the reflected rays of impinging light to converge to a focus after the manner of an ordinary concave speculum. Under those circumstances a distorted image of an object will be formed at the point of convergence; is it possible so to fashion a second mirror, or grind a lens, which, receiving and transmitting the first image, will rectify its deformity, and afford a correct picture of the object? If this could be done probably we might purchase reflecting telescopes for as many pence as we now pay shillings, and for its scientific and pecuniary interest, I submit the query to the consideration of our readers. E. B. F.

PERSPECTIVE.

[4603.]—I CANNOT but think that the laws of perspective which are true for different objects in a picture apply also to the portions of individual objects, and that if what I term pictorial perspective requires a modification, for instance, in the linear perspective of distant objects, such as mountains, a good case is made out for a similar modification being requisite in the proportions of a single object. If "B. D. T." (let. 4532, will refer to my definition of perspective, he will find that the remarks I made were closely connected with the subject. "B. D. T." remarks if a picture be drawn out of (linear) perspective it will convey a false impression of its form; but in the next sentence we read, that when drawn in true perspective, mountains do not convey a correct impression of their magnitude—so that out of perspective or in perspective the mountains seem in bad case, and the only remedy proposed is the impossible one, so far as a picture is concerned, of viewing it stereoscopically. Now, it is just because a picture cannot be so viewed that pictorial perspective steps in and modifies the linear perspective, which avowedly fails in accomplishing that which it is the mission of perspective to effect.

At the risk of some repetition allow me to add: True linear perspective being the exact projection of the form of external objects on the plane of the picture cannot but place on the retina the same image that the natural object would do if its outlines were in one place parallel to that of the picture; but, as this is not the case, the images that are formed are diverse, and give rise to different impressions on the mind, one being of depth the other of flatness; the former being perceived by the stereoscopic power of binocular vision, while the latter can only be transmitted by the independent action of the eyes, and is equally well appreciated by one. It must be borne in mind that we do not see the images on the retina but by means of them; that vertical, horizontal, or parallel straight lines in a picture are not always, I might almost say seldom, vertical, horizontal, straight, or parallel in the corresponding image on the retina, though by means of these curved, divergent, &c., lines we judge with the greatest accuracy as to their straightness, parallelism, &c., so that we may readily conceive why an image, which is deficient in exact linear accuracy, may for certain "visual" reasons convey to the mind a true perception of the object to be delineated. M. A.

[4604.]—MR. PROCTOR (let. 4531, p. 439), *cum multis aliis*, seems unable to grapple with the real difficulty, which is this:—Given, a high tower of equal breadth, is the top farther from the sketcher than the base or not? If it is, it must be optically narrower, and therefore the lines defining the side viewed will not be parallel to a suspended plumb-line. Mr. Proctor, in his demonstration, simply begs the question. We are not dealing with vertical lines, and therefore the mathematical proof does not apply. The only vertical line is one exactly opposite the spectator; in the tower, therefore, one at least must incline, very little indeed, but I assert its inclination is capable of instrumental observation. M. PARIS.

[4605.]—MAY I be allowed to add yet one more letter to the copious correspondence on the subject of perspective, in answer to the "Welsh Shepherd's" last letter (4566, p. 465)? He states that the rule in perspective that all vertical lines should be drawn parallel is a deduction from observations made on the glass plate. This is not so—for if a sufficiently accurate outline could be made upon the glass plate it would give a result at variance to the rule, notwithstanding that the rule is practically correct. The real reason why artists draw all vertical objects with vertical and parallel lines, is that the convergence of vertical objects within the cone of vision is so slight as to be imperceptible, but the convergence does exist for all that. The fact being that all vertical lines do converge to a vanishing point, which is the zenith, and this convergence exists whether the object be within the cone of vision or not. But this convergence being so slight as not to be perceptible to the senses, the rule of artistic perspective which says that all vertical lines in nature are to be drawn vertical and parallel is a correct one. It appears to me that some of those writers who oppose convergency, imagine that the convergence spoken of is supposed to be equal in ratio to the convergence of horizontal lines, but the fact is, that the convergence of vertical lines within the cone of vision is only a fraction of the convergence of horizontal lines, and that fraction ever diminishing according to the increase of distance of the spectator. But that this convergence does exist even within the cone of vision can be proved as follows—Draw a horizontal line; at one end of this, and perpendicular to it, draw a shorter line; let this line represent the height of a parallel column; let A be its summit and B the base. Then on the horizontal line, fix on a spot for the spectator; let this point be sufficiently far away from the vertical line, so that a line drawn from the point to the summit will be at an angle fairly within the cone of vision. Let us call this point C; from C draw a line to A, set the compasses at C, and from the base B draw an arc cutting the line C A. The point at which the arc cuts the line gives the difference of distance from the eye of the spectator of the summit and the base; the summit is found to be slightly more distant, and must therefore optically speaking be smaller, although the senses may not be able to recognise the difference. BOBO.

[We are unable to devote any more space to this discussion.—ED.]

THE PENDULUM.

[4606.]—I HAVE recently been reading Sir J. Herschel's "Treatise on Astronomy." My attention was particularly struck with that part on geography, beginning on p. 107, where the equatorial and polar diameters of the earth are given, as the results of calculations, from meridional arcs previously measured.

Sir John says that the results, as given by him, were taken from a paper by Professor Airy, "On the Figure of the Earth." He would be considered a bold and presumptuous man to doubt or call in question the accuracy of such results, viz.:—Equatorial diameter at 7,925,648 miles; polar diameter at 7,899,170 miles. The only cause of doubt as to the accuracy of these values is the "uneven and mountainous surface of the earth." Does the measurement of meridional arcs include the uneven surface of the earth? If not, how is the case to be met? Answer, by the pendulum. Shakespeare asks the question, "How wags the time?" It is not necessary to erect a pendulum on some suitable place, such as the mouth of a coal-pit, and another some thousands of feet below the surface, and at each of those stations to watch and count the wags of the pendulum, for the purpose of ascertaining the difference of the force of gravity.

We have, by the industry, care, and precision of astronomers the exact values required—namely, the number of wags which the pendulum has made during the moon's motion round the earth, from one star to the same star again, which is termed the moon's sidereal motion, equal to logarithm 6·3730208

And 86400 s. in time log.	4·9365137
	11·3095345
5280 ÷ 16 = 330 = log. =	2·5185139
	√ 8·7910206
	4·39551030
0·4971499 ÷ 0·00072332 =	0·49642658
Equatorial diameter, 7926·54 miles =	3·89908372
	0·00144664
Polar diameter, 7900·18 miles =	3·89763708
Equatorial log. =	3·89908372
	√ 7·79672080
Mean diameter, 7913·35 miles =	3·8983604

By changing this method of calculation in the separation of the values, we shall obtain the same results. Thus:—

	4·9365137	6·3730208
	2	2
	9·8730274	12·7460416
	2·5185139	2·5185139
	√ 7·3545135	√ 10·2275277
		5·11376385
	3·67725675	3 67725675
		1·43650710
	$0·4971499^2$ =	0·9942998
		2·4308069
		10·2275277
		√ 7·7967208
	Mean diameter	3·8983604
		0·00072332
	Equatorial diameter	3·89908372
	Polar diameter	3·89763708

VERITAS.

SOUND (OR UNSOUND) THEORY.—To "F.R.A.S."

[4607.]—I FEEL highly flattered by the opinion "F.R.A.S." expresses that my acquaintance with the interior construction of some old and new stringed musical instruments may possibly be a trifle more familar than his own, also by the "handsom concession" he is pleased to make that his scientific acquirements may a *leetle* exceed my own. His opinion of the probable effect of corrugating a thick soundboard is exactly identical with my own, which, indeed, was (substantially) expressed in my letter, No. 4416, although it did not occur to me that the motion of such a soundboard's molecules might be developed in the form of heat. No doubt, corrugation is usually employed for increasing rigidity, and excess thereof can hardly conduce to the production of louder sounds; but that "theory is wholly opposed to this form of construction" does not seem to me quite self-evident, because a corrugated soundboard whose rigidity is a given quantity may be made of less weight than one whose surfaces are nearly parallel. Now the string will, *cæteris paribus*, move the lightest soundboard furthest, and thereby generate ampler aërial waves, just as it acts more powerfully on the thin soundboard of a piano whose needful amount of rigidity is obtained by gluing wooden bars on it, than it does on one whose thickness is sufficient to resist the downward pressure of the strings which rest on it. Although strongly opposed to making soundboards unnecessarily rigid, I must admit that in practice—at least in the piano—what would appear to be a very unnecessary amount of rigidity seems—so long as it is not obtained by excessive thickness of material—to be rather conducive to the production of sounds of fine timbre without sensibly diminishing their loudness when rigidity is not carried to an absurd extent. See my reply to "Sciolist."

One word about my unlucky first fiddle. Will "F.R.A.S." kindly communicate any fact which induces him to believe that aërial waves, generated by the vibrations of one or more soundboards, can have their amplitude increased, and affect us as sounds of greater loudness, when one or more of the surfaces of the said soundboards form the top and bottom of a box? So ignorant am I of theoretical acoustics that I can't even conceive how any thing in motion, or any form of energy—no, not even a sound-wave—can be made any bigger by being treated like "Jack," and "shut up" in a box any more than I can conceive the light waves, or undulations, transmitted by "F.R.A.S.'s" "aplanatic objective" can be augmented by being "shut up" within the tube of his telescope. See my reply to "Suffolk Amateur."

THE HARMONIOUS BLACKSMITH.

"ANOTHER LIQUID GLUE."

[4608.]—I HAVE tried the recipe given in p. 425 for "liquid ether glue" (No. 1: nitric ether glue and indiarubber), and if the nitric ether supplied by my chemist be the veritable article, I denounce the recipe as a delusion and a snare. As in "Another Liquid Glue" a similar solvent (?) is advised, permit me to ask some of "our" chemists to enlighten my ignorance by saying what is ether, nitric either, "ether free from alcohol," and whether either will dissolve gum (shellac), glue, and indiarubber? In the mean time these recipes will be confidently copied into newspapers as coming from a reliable source (I inclose a cutting from the *Weekly Dispatch*), and no doubt many persons, as in my case, will find their time and money thrown away in endeavouring to produce what would be a very handy article if the formula could be relied on. The circumstantiality of the details as to how this particular glue will resist hot and cold water, &c., adds to the mortification of having followed what appears to be a freak of imagination rather than the result of that experience which we expect always to find in the pages of the ENGLISH MECHANIC. F. F. C.

P.S.—My nitric ether rendered the glue and indiarubber rather more insoluble than before its application.

COPY OF CUTTING

ETHER GLUE.—An excellent liquid glue is made by dissolving glue in nitric ether. The ether will only dissolve a certain amount of glue, consequently, the solution cannot be made too thick. The glue thus made is about the thickness of treacle, and is doubly as tenacious as that made with hot water. If a few bits of indiarubber cut into scraps the size of a buckshot be added, and the solution be allowed to stand a few days, being stirred frequently, it will be all the better, and will resist the dampness twice as well as glue made with water.

WATCH REPAIRING.

[4609.]—IN the article on the above in No. 381, p. 421, by "Seconds' Practical Watchmaker," reference is made to the method of making wheels flat. Now, with the particular wheel in question—Geneva escape-wheel—"Seconds'" does not make it quite clear how to "bump it," so as to avoid a "smash."

I have found out, by experience, never to risk laying a Geneva escape-wheel entirely on to a hollow punch to bump it, but use instead an ordinary flat punch with a small hole drilled up to the centre, or a small steel-piped watch-key. Lay only the arm to be hammered across the hole in the punch, and hammer as lightly as possible, at the same time shifting the arm of the wheel a little after each blow.

If the wheel is tight, and resting equally on the shoulder of the pinion, I would certainly not advise "trueing" by the method "Seconds'" recommends, as it has a tendency to bulge the ends of the pinion leaves, which would interfere with the fourth wheel pitch. This would not happen if the pinion was hardened; but unfortunately by far the greater number of Geneva watches imported of late years have none of their pinions hard. I would suggest, with "Seconds'" kind permission, that if he would devote as much of the space in his articles as he conveniently can to "causes of stoppage" of the various "movements" upon which he treats, he will confer a boon possibly on many professionals as well as amateurs. I would also suggest that if "West Cornwall," "Yorkshire Pivot," and as many of our really able brother "pivots" as are willing, would contribute their experience as the subjects are being treated, I am sure, Mr. Editor, that subscribers would not have to complain again for some time to come—as one did a few weeks ago—that there was so little information to be derived from the ENGLISH MECHANIC in our particular branch of industry, but it would also tend very much to enlighten those who are "moving along in the dark," anent watch repairing. ABERDEEN WATCH JOBBER.

ON THE MEASUREMENTS OF THE ELECTRO-MOTIVE FORCE AND INTERNAL RESISTANCE OF A GALVANIC BATTERY.

[4610.]—(1.) THE ELECTRO-MOTIVE FORCE.—The process described by "O." (p. 411) is ingenious, capable of considerable accuracy, and, so far as I am aware, novel; but his reasoning in support of it is, I think, erroneous. His second and third equations are not generally true, but only in the particular case when the term $g\ i_3$ vanishes; and, as no *à priori* proof of their truth without that term is afforded, the whole argument fails. The general proof would be to take the equations connecting the intensities in the different portions of the conductors for each cell independently, and to equate the values of the two components of i_3. As this process is a little complicated, I offer the following simple proof. Since the resistances have, by "O.'s" hypothesis, been adjusted, so that no current flows through G, the value of g is immaterial, and may be anything, from zero to infinity, without in the least affecting the current flowing through the other parts of the arrangement. If $g = 0$, then—

$$i_1 = \frac{E_1}{x + R},$$

$$i_2 = \frac{E_2}{y + r}.$$

If $g = \infty$, $i_1 = i_2$; $\therefore$ whatever be the value of g, i_1 and i_2 are equal.

$$\therefore \frac{E_1}{x + R} = \frac{E_2}{y + r},$$

the result obtained by "O.," whose argument beyond this point is correct.

(2.) INTERNAL RESISTANCE.—With all due deference to "Sigma" (p. 301), I venture to prefer Mance's process to that of Fitzgerald for the following reasons: (*a*) The former requires only the ordinary apparatus which every electrician possesses—viz., a set of resistance coils with the bridge and multiple coils combined, a key, and a galvanometer, which last may be changed at pleasure, whereas the latter necessitates the use of a special shunt made for that purpose (and useless for any other) and always the very same galvanometer and conducting wires. (*b*) The employment of coils never less than 1 Ohm, as greater accuracy can be attained by getting a result 100 times too large, and marking off the decimal places, than by the use of fractions of an Ohm directly, and surely "Sigma" cannot consider the placing of a decimal point a "calculation," and, if not, there is none in either case. (*c*) It is far easier to see if a galvanometer is deflected when a key is depressed, than to adjust the needle to exactly the same amount of deflection in two experiments. (*d*) By the former process the result is accurate at the very moment when the reading is taken, and if a variation occurs from time to time, it can be at once measured, whereas a rapid comparison of the deflection with the two different arrangements in the latter process, even with an efficient system of switches, would, with a variable resistance, be at least very difficult. I cannot but think that "Sigma" has never tried Mance's method, because if he had he would, like myself, have been charmed with its simplicity and ease.

The plan suggested by "S. T. P." (p. 359) is a modification only of Mr. Fitzgerald's, and is open to the same objections (with the exception of the special shunt); but a new one is introduced, because the resistance of the external circuit, including the galvanometer, would not probably be expressed by whole numbers, and therefore it would be difficult to reduce the resistance by exactly one-half. Let me recommend "S. T. P." to try Mance's process, and with a proper arrangement of controlling magnets and other accessories which will doubtless suggest themselves to him, he will, I think, find it everything he can desire.

PI.

BLOWING EGGS OF SMALL BIRDS.

[4611.]—PERHAPS some of the readers of the ENGLISH MECHANIC have found it difficult to blow very small birds' eggs with a blowpipe. I always use, for wrens, titmice, and such sized eggs, a glass tube drawn to a fine point at one end, and blown about half way up its length into a bulb. I insert the fine end carefully into the hole in the egg, and, placing the larger end in my mouth, suck up the whole of the contents of the egg at once into the bulb of the tube, then inject water into the egg and suck up again with a fresh tube till all is clean. G. W. C. H.

REDUCTION OF DECLINATION.—RIGHT ASCENSION.—EQUATION OF TIME.

[4612.]—WHENEVER I have had occasion to reduce the declination, right ascension, or equation of time for required mean time I, like many observers, have resorted to the logarithm table, given in all nautical works, for the necessary aid, since they are stated to have been computed to "the nearest second." Recently, however, I have also computed these reductions according to the rule enunciated in the explanations in the *Nautical Almanac*, on its Ephemeris, in page 1, and I find their results differ by some seconds, both in time and in arc—greater when the hourly differences are large, and scarcely appreciable for ordinary requirements when the registered differences are simply decimals of a second.

To place this question clearly before your readers, I give my computations of the examples set out in pp. 539 and 540 of the *Nautical Almanac* for 1872, according to the *Nautical Almanac* rule, and by means of the logarithm table.

Required the sun's declination on January 16, 1872, at apparent noon, in longitude 60° West of Greenwich; the longitude in time is 4h.

January 16, 0h., the registered difference of declination for 1h. (increasing)	s. 28·30
January 17, 0h., the registered difference of declination for 1h.	29·29
Dividing this by $\frac{2h.}{24}$	12) 00·90
Proportion of the difference equivalent to midway time	00·0825
Which add to the registered hourly difference for 16d. 0h	28·30
	28·3825
Multiply by the given time	4
Proportional increase in declination in 4h...	1′ 53·5300″
	d. m. s.
As the declination is decreasing, subtract the above product from the registered declination on 16d. 0h	21 00 40·4
	1 53·5
The required declination for January 16, 4h.	20 58 46·9

Which corresponds with the answer in the *Nautical Almanac*.

By the Logarithm Table.

	d. m. s.
Registered declination for January 16, 0h...	21 00 40·4
" " " 17, 0h...	20 49 09·3
Difference	00 11 31·1

	d. m. s. 0 11 31	·3198
	h. m. s. 4 00 00	·7781
Proportional difference	1 57 =	1·0979

	d. m. s.
Declination on January 16, 0h., (decreasing)	21 00 40·4
Subtract proportional difference	1 57
The required declination for Jan. 16, 4h...	20 58 43·4

Required the equation of time on January 16, 3h. (apparent time), for the reduction of the latter to Greenwich mean time.

January 16, 0h., registered difference for 1h. (decreasing)	s. 0·864
January 17, 0h., registered difference for 1h.	0·834
$\frac{1·5h.}{24}$	16)0·030
	0·002
January 16, 0h., registered difference for 1h. (decreasing)	s. 0·864
Subtract the above quotient	0·002
Proportional equivalent for midway time	0·862
Multiply by the given time	3
	2·586
	m. s.
As the daily equation is increasing, add the above product to the registered equation on January 16, 0h	9 54·43
The required equation on January 16, 3h	9 57·02

By the Logarithm Table.

Jan. 16, 0h., registered equation (increasing)	9 54·43
" 17, 0h., " "	10 14·81
	0 20·38

h. m. s.	
0 00 20·4	1·8656
3 00 00	0·9031
2·5s. =	2·7687

January 16, 0h., registered equation	9 54·43
Proportional equivalent for 3h	+ 0 02·5
	9 56·9

As further illustrations, I purposed furnishing you with a set of computations of the declination for every 3m. in 1h., and for each hour in a day; but these papers would, I fear, occupy too much valuable space in the magazine. I shall, therefore, restrict myself to a few extracts from them, which will show that differences do exist in the results obtained by the *Nautical Almanac* rule, and by the logarithm table.

December 5, 1872.

h. m.	By *Nautical Almanac* Rule. d. m. s.	By Log. Table. d. m. s.	Difference of *N. A.* rule from Log. Table. m. s.
5 00	22 29 22·0	22 29 19·6	− 00 02·4
5 15	22 29 26·6	22 29 24·6	− 00 02·0
5 30	22 29 31·1	22 29 28·6	− 00 02·4
5 45	22 29 35·6	22 29 33·6	− 00 02·0
6 00	22 29 40·2	22 29 37·6	− 00 02·4
0 00	*22 27 50·6	†22 27 50·6	00 00·0
4 00	22 29 03·8	22 29 02·6	+ 00 1·2
8 00	22 30 16·3	22 30 13·6	+ 00 2·7
12 00	22 31 28·1	22 31 25·6	+ 00 2·5
16 00	22 32 39·3	22 32 36·6	+ 00 2·7
20 00	22 33 49·6	22 33 47·6	+ 00 2·0
24 00	*22 34 59·2	†22 34 59·2	00 00·0

* These quantities were computed.

† These quantities were, of course, taken from the *Nautical Almanac*.

Here it may be proper for me to note that I have tested the accuracy of the computations by rule to the 3rd differences = ·000

I put this paper forth in the hope that some of your numerous correspondents and contributors will explain which of the two methods of computation is to be esteemed as accurate—*i.e.*, to "the nearest second."

ARIES.

POWERFUL GALVANIC BATTERY.

[4613.]—THE following form of battery is very cheap and simple, and has a potential about 50 per cent. higher than a Grove or Bunsen, and more than 150 per cent. higher than a Daniell. For positive, zinc in a solution of caustic potash or soda; for negative carbon in a porous cell packed with precipitated sulphur, granulated carbon, and peroxide of manganese, and filled up with dilute sulphuric acid. The internal resistance is rather large, but if common salt be used instead of caustic potash, the resistance is much less, but the potential sinks to rather more than 10 per cent. higher than a Grove. On the whole, I think this is the cheapest and best battery that can be used for general purposes, and has no noxious fumes or other inconveniences.

2, The Cedars, Putney. H. HIGHTON.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[11554.]—**Pedestrian Tour.**—One of the greatest plagues to travellers, but especially to those on foot, is the uncertainty of obtaining sleeping accommodation at the places they desire to stop at. Often have I been obliged to go on when already tired, and to leave a more for a less interesting stopping place. It would not pay to build inns big enough to supply bedrooms for the largest number that ever want them, and so long as the numbers wanting bedrooms varies as much and as unexpectedly as it now does, this serious evil must be endured. I have often wondered that the following very simple mode of removing, or at least greatly diminishing, the evil has never, so far as I know, even been tried—namely, that of erecting large marquees, and slinging in them hammocks for travellers who may be in excess of the bedrooms provided. A tired man would far prefer sleeping in a hammock to seeking a bed half a dozen miles off, with no certainty of finding one unoccupied; indeed, I do not think it would be thought any hardship at all. The cost of providing hammocks would be very small, as in warm weather, in the tourist's season, hardly any bedding would be wanted, while the marquee would be useful in the daytime as a refreshment-room, unless the inn had ample accommodation of that sort, and if it had the hammocks might be slung in them, or under the sheds of railway stations, where there is little or no night traffic, as is generally the case at places much resorted to by tourists. A more experienced pedestrian than I am says I am quite wrong in carrying anything unusual in my pockets. He says a very light coat that will not bear heavily loaded pockets is best for walking in, and that baggage should not be carried either in pockets, or knapsack, or satchel, or a pack, but divided in two packs, which may be carried in various ways, *e. g.*, hanging by straps over the shoulders, one before the other behind, or one beneath each arm, or one in each hand, or both in one hand. He says carry no more than you will want, and do not carry yourself what you can get some one to carry for you. Often you may get your traps sent on by some conveyance to your intended sleeping-place, and secure a bed there too. The packs may be either wrapped in light waterproof cloths, or such used to shelter both them and you.—PHILO.

[11589.]—**Dry Steam.**—In saying that thirty-pound steam, escaping into air with only half-pound steam in it, would expand "instantly sixtyfold," I did not mean quite so instantly as if no air, but only the half-pound steam, were present. Does "Philo," however, imagine that if a piston rests at one end of a cylinder, the other end open to the air, and if 30lb. (or double atmosphere) steam be admitted to drive it just a quarter the cylinder's length, and then cut off, the piston will go no further than half-way? It will certainly go nearly to the other end, the steam expanding not merely twofold, but nearly fourfold, and becoming, for a moment, only 8lb. steam or thereabout, though recompressed to above 15 by the atmosphere's reaction, and again rebounding, till after some oscillations the piston rests midway. Now, with an escape into air, without the piston, the same first overshooting of the mere balance takes place, with this difference, that the air cannot react and compress it again at all, as the two dissimilar fluids interpenetrate, and cannot be brought to oppose one another, but any diffusion once gained is extended further. Indeed, the higher the steam's original pressure the quicker will it expand, not merely down to atmospheric pressure, but to far less; and the hotter its original temperature the quicker must it cool, and the greater the chance of forming snow instead of raincloud. Of course "A., Liverpool," is totally wrong about high pressure steam having less water than low. On the contrary, among all such steam as engines use—*i.e.*, wet steam between the temperatures of 200° and 300°—the quantity of water is *nearly* in proportion to the pressure, which is probably what "Philo" wrote in his last sentence but one (p. 466), and the printer has changed *nearly* into *really*, which is not true. A sixfold pressure involves only about a fivefold quantity of water.—E. L. G.

[11589.]—**Dry Steam.**—I am not sufficiently read up as to the received opinions relative to the formation of steam of various pressures, to know whether my ideas are novel or erroneous. But view it in this light, that if we have steam of any given pressure in a boiler, by the application of more heat we increase the pressure, not merely by conveying additional water into steam, but also by conveying more heat to that which is already formed, and thereby obtaining increased pressure without a proportionate increase of water converted into steam, whereas I understand "Philo" to maintain that the pressure is caused merely by the addition of a number of, shall I say, particles to those already formed. This appears to me to be the real *casus belli*, and shall be happy to be corrected if wrong. It appears to me that after perusing this last letter of "E. L. G.'s," "Caloric" must admit that the question is settled without the aid of the chemist he was so desirous to call in, and that I am correct, after all, in asserting that superheated steam is simply a higher pressure steam, containing, as admitted by "E. L. G.," more heat and less water, as he admits that it will occupy more space.—A., Liverpool.

[11778.]—**Cleaning Silk.**—I use potato-water for all colours and kinds, but I was taught to grate them into cold spring water, say a large potato to every quart of water, of which five or six will do for a couple of dresses. If for very light silk, pare the potatoes; if any way dark, merely wash them clean. The pan of water must not be stirred in the least for forty-eight hours; then, very slowly and steadily pour off the clear liquor, but not a particle of the sediment, into an open vessel—a bath, or such like—dip the pieces of silk into this liquid up and down a few times, without the least creasing them; then wipe them on a flat table with a clean towel, first one side, then the other. It is good to hang each one as dipped upon a line to allow the drops to drain off a little before wiping. Have a damp cloth to cover them in till all is done; then iron one way, on the soiled side. It astonishes one to see how stiff and nice a dress looks done in this manner. Any material, silk, woollen, mourning cottons, &c., may be so cleansed. For many years back I have never turned a dress without it.—H. O'B.

[11892.]—**Steel Combs** (U.Q.)—I beg to thank "R. H." for the very kind manner in which he has noticed my query, and I wish to inform him that I want to make the combs about 2½in. long, and containing about sixty pins or teeth.—DUSTY MILLER.

[11984.]—**Tea Testing.**—"Saul Rymea" is right so far as he goes, but he has omitted the fact that the very necessity for thus tasting teas injures the health (the nerves), and many a man has been compelled to abandon that branch of emolument from this cause, and they deserve good salaries for the risk.—B.

[12001.]—**Hair Turning White** (U. Q.).—I had my hair go red all round my head; with the use of soap my face got spots upon it. I took to washing in warm water, adding every time about six drops of pure carbolic acid; in a short time my hair went as black as a coal and curly. I never use hair oil or fat, oil and fat stop hair from being silky and curly. Finding this happen, an old gentleman with white hair, always wishing for black, used the carbolic acid. He now has jet black hair. There are two sorts of carbolic acid, pure and impure, the pure is white, the impure just the colour of bad treacle, or black red, also a crystal, all made from coal tar. Beware, and not use too much of it, it will make the skin smart and come off. A piece of cotton wool just wetted with it and put to a tooth will stop toothache in one minute.—OUTGENIOUS WHITESMITH.

[12001.]—**Hair Turning White** (U.Q.).—As "Auld Reekie" may be engaged, let me advise "J. A. A." to try pure glycerine as a strengthening lotion for the skin. After bathing the head and eyebrows with cold water and drying thoroughly, a little diluted, or in a mild form, may be applied with a piece of cloth or flesh-brush. The scalp will soon regain a healthy tone, and on the skin assuming a red and rough appearance, the glycerine may be discontinued. Cold bathing must, however, be still resorted to. No oils or "pomades," so called, are to be used, except good olive oil scented with a little rose-water or lavender occasionally. "J. A. A." may also find it necessary to remove the hair by shaving, and, as a probability, it will grow next time of a darker hue. Go into cheerful society, and if troubled with an excusable melancholy, try to forget yourself.—RAT-TAT.

[12002.]—**Aquarium.**—It is of very little consequence whether this or that water need be placed herein, or how many animals, provided only that the balance is fittingly preserved between the vegetable and the animal life. Experience will soon show this—if too much of the plants, they will overrun; if too little, they will dwindle. Sticklebacks (Jack Sharps) must not be placed with gold fish, nor with any of the similar delicate species, the "back" spines wound so fiercely. Neither be so cruel as to collect eels or other running water animals, because such will not, cannot be kept alive in still water. Neither put in large newts; a "Triton among the minnows" makes sad havoc.—H. O'B.

[12008.]—**Keeping Dust from Clocks** (U.Q.)—Fix a small fan, either of wood or tin, in a convenient place under the clock, have a weight and chain to it, and a little wheel gearing, so that you can wind up at certain times; or have a wind grinder at top of a pipe with a bell mouth, just over clock works, with a couple of inlet pipes at sides.—OUTGENIOUS WHITESMITH.

[12023.]—**Dissolving Bones** (U.Q.).—By digesting bones for several days in dilute hydrochloric acid they become gelatinous, and can be moulded into any required shape.—YOUNG SNIP.

[12053.]—**Canaries** (U.Q.).—Your canaries' eggs are rotten, because the birds did not pair soon enough. The wheezing you speak of is caused by giving them too heating food; take away the eggs and maw seed, and confine them to canary seed, which is the proper food. Maw seed is too fattening for them; hang out in the air every day and give plenty of green food; such as lettuce, endive, chickweed, watercress, or groundsell, and no doubt you will find them better.—T. B. S.

[12054.]—**The Needle Lock.**—The description of this lock by "Saul Rymea" (Vol. XV., p. 441) is very clear, but his last sentence misleading, inasmuch as he says, "It is one of the best locks ever invented, for only a key made for it will open it." I take it that it is absurd to call any lock "unpickable," for what the ingenuity of man can make that ingenuity can undo. Now, the needle lock, besides being by no means difficult to pick, is open to the fatal objection of yielding easily to force, which, I think, any burglar of note would resort to before wasting his time over the tedious operation of picking, or of manufacturing a false key. "Saul Rymea's" eulogium would have been more correct had he applied it to the Citadel lock or to Chubb's, for the needle lock has again another small defect, in readily getting out of order, and refusing to open with its own key, and whilst being very ingenious has not come up to its inventor's expectations.—Q. YORKE.

[12072.]—**Magnetic Moment.**—As far as I understand the formula for ascertaining the strength of a current by means of the tangent compass, it is independent of the strength of the needle because although the earth's magnetism exerts a greater force over a strong needle than over a weak one, yet as the power of the ring rises in the same proportion, the strength of the magnet does not enter into the final expression, which is $S = \frac{r \times T}{6 \cdot 2832} \times \tan d$. Where r = radius of the ring, T = horizontal intensity of the earth's magnetism, d = angle of deflection, and S = strength of current. The magnetic moment of the needle is in no way involved, and so I do not see how "Sigma" proposes to estimate it by "ascertaining in these units the current which produces a given deflection to each magnet in the same galvanometer." With respect to the second method mentioned, namely, measuring "the extra resistance produced by the magnet," I should be glad if "Sigma" would furnish me with details of the process, or rather the formula to be used. As regards the coil question, I may as well give the "note" from Tyndall, which runs as follows: "The primary circuit in its turn can, when complete, react upon the secondary. It is complete whenever contact is made by the automatic contact breaker. A great enfeeblement of the secondary current is the consequence. When the primary circuit is interrupted the reaction does not exist; there is no enfeeblement, the full power of the secondary being developed. It is on this account that in Rhumkorf's coil we obtain discharges in a single direction only, instead of discharges alternating in direction." The inference which I get from the above is that somehow the inverse induced current is put out by the extra current, and that, therefore, whatever be the distance between the poles of an induction coil, only the direct induced current passes; and this is, as I have before said, at variance with Ferguson; and I should like to hear more from "Sigma" on the subject, and at the same time beg to thank him for the trouble he has already taken. By the way, "Sigma" has not told me how to ascertain the position of the poles of a magnet.—BEACON LOUGH.

[12091.] — **Plums** (U.Q.).—As no one else has replied to "Derf Errac's" query—I think he will find his plums affected with disease—whether animalcular or fungoid, he should be able to discover by means of a microscope. The tree may also have more fruit than it can bring to perfection, but as he does not say so, I can only form the opinion expressed.—SAUL RYMEA.

[12093.]—**Budding or Grafting** (U.Q.).—A good work on this subject is Baltet's "L'Art de Greffer," Robinson's "Parks, Promenades, and Gardens, of Paris," contains much information on the subject; there is also a book by Glenny or edited by him, but I forget the title now. I do not grow my fruit-trees, but I know that the sorts mentioned are generally budded.—SAUL RYMEA.

[12103.]—**Staining Glass** (U.Q.).—A very fine red may be obtained from rust of iron, glass of antimony, yellow glass of lead (or litharge), each in equal quantity, to which a little sulphuret of silver is added. This composition, well ground, produces a very fine red colour on glass. Black: 8 parts of crystal glass, 2 parts of oxide of copper, and 1 of glass of antimony. Grind these ingredients together with strong vinegar. Green: 2oz. of brass calcined into an oxide, 2oz. of minium, and 8oz. of white sand. Reduce them to a fine powder, which is to be inclosed in a well luted crucible, and heated strongly in an air furnace for an hour; when the mixture is cold, grind it in a brass mortar. Green may, however, be advantageously produced by a yellow on one side, and a blue on the other. Oxide of chrome has been also employed to stain glass green. Yellow: A fine yellow by taking fine silver laminated, then dissolve in nitric acid (HNO_3), dilute with abundance of water, and precipitate with solution of sea salt. Mix this chloride of silver in a dry powder, with 3 times its weight of pipe clay, well burnt and pounded. Violet: 1 part of calcined black oxide of manganese, 1 of zaffre, 10 of white glass pounded, and 1 of red lead, mixed, fused, and ground.—CLINCHER.

[12117.]—**Restoring the Colour of Watch Plate** (U.Q.).—There are no efficient means of restoring the colour of watch plates, but regilding. The best plan is to have the plate regilt; this you can get done at any of the gilders in Clerkenwell for a very small amount.—ELECTRO.

[12156.]—**Mice Eating Peas.**—When putting in the seeds, cover them 2in. every way with fine coal ashes. Mice will not take the trouble to scratch so deep. To keep off birds from the young buds, make a network of white darning cotton, or fine twine, twisted round bits of stick a few inches high. N.B.—I have not yet discovered a plan for keeping away cats. Has any reader of "ours"? Cats may be scared, but must not be injured in the proposed plan or plans, for which I shall feel grateful.—H. O'B.

[12157.]—**Smell of Paint.**—It is true enough that a vessel of cold water left in the room will show a scum next morning, but as an intelligent workman told me that the gloss disappears from the painted surface in just equal degree, I recommend a little patience instead of any of the methods spoken of, and the smell will gradually yield to the influence of drying in a natural manner, assisted by a plentiful dose of open window.—H. O'B.

[12172.] — **Constipation.** — ("H. S. A." AND OTHERS.)—I know a great many folk of different ages and sexes cure themselves of the above troublesome symptom by drinking a tumblerful of hot water (not merely warm, but comfortably hot water) last thing going to bed for a few nights; one, two, or half a dozen, until the desired change takes place, and nature acts naturally! Kneading the flesh in any manner, so as to stir the various sluggish muscles, is an admirable assistant; but I must warn "our" readers against the delusion that "reddening the skin," which is recommended by one correspondent, will cure the malady without risking the producing of a new ailment in an irritated skin, which might prove painful and troublesome. The skin is given as a protection for the extremely delicate tissues of nerves, perspiratory pores, blood-vessels, &c., with which the Almighty has gifted his creature, man. We cannot with impunity do violence to these organs; the skin is given to man to take good care of; it needs to be daily cleansed by daily washing and wiping; but does not require irritation. Would any but a madman try to clean a fine kid glove by means of a hard brush or a coarse towel? Nay, nay; why, then, should we be told to scrub and rub till it becomes "well reddened," so marvellously beautiful a thing as our skin; finer, and more tenderly to be cared for than the most aristocratically delicate lady's glove! Sponge it, wash it, soap it, cleanse it, love it! but do it no mischief by rough usage, else you shall surely suffer. And perfect cleanliness of skin is compatible with perfect gentleness, and a gentle daily cleansing is what we require to keep our skin and ourselves in average health. The point now under consideration, constipation, often arises from too dry a state of the internal organs, and this too dry state may be produced by smoking, which causes a waste of the saliva, which is required to assist in lubricating the mucous membrane; that is, the internal skin, which lines the throat, chest, stomach, bowels, &c., and, as some learned folks assert, to also assist in the process of digestion; or, by the use of intoxicating liquors, which parch up the stomach and render all the secretions unhealthy—(to those who are unlearned I must explain that big word. The "secretions" consist of a method of nourishing our bodies by means of the circulation of the blood, conveying a renovating power to the different portions of the body as is required by each one; as, for instance, the secretion of the eyelids is called "tears," and every other "secretion" has its distinct name. The phlegm, so troublesome to those who suffer from colds or cough, is an unhealthy secretion)—or, by the non-use of vegetables at dinner and other times, because the bones and other parts of our "fleshy tabernacle" being very largely composed of water, require a large supply of watery diet to nourish them, whereas the too usual dinner of our middling and comfortable people consists too much of meat and white bread, and these wholesome articles have not in them enough of the vegetable or refusey nature. And why should mankind not eat green and root vegetables regularly as diet? Who does not relish a nice juicy beef-steak? The beast from whose carcase it is cut was most likely fed plentifully on (amongst other articles) cabbage, turnip, carrot, and such-like good things; these the cow "assimilated" and turned into meat (flesh). May I ask why we should not eat and assimilate the vegetables ourselves instead of employing the cow to do it for us? Why should not the flesh grow from the cabbage and turnip directly upon our bones instead of coming to us second-hand? And, chiefly, why should not we avail ourselves of the good gifts of Providence, bestowed for food upon the race of man? It would be wise to do so, and far fewer people would have to complain of indigestion, constipation, and kindred ailments.—AN OLD WOMAN DOCTOR.

[12184.]—**Roses.**—Pegging down roses must be resorted to early in the spring, before the buds come out, lest they be broken away in the process. A few strong forked pegs, 8in. to 12in. long, or even more, for the larger stems, so as to keep them well in place, tightening them closer down, week after week, as the stem yields to the new position. As the young shoots grow, they may be fastened down according to the taste and skill of the ruling spirit of the gardener with hair-pins. Yes! hair-pins. You buy a thousand for a few pence, any size required.—H. O'B.

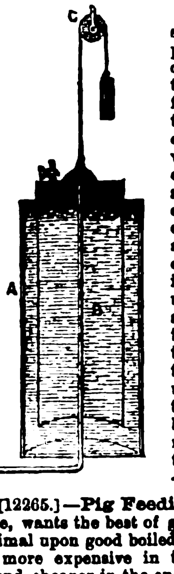
[12217.]—**Violin Tuning.**—I am very much obliged to "The Harmonious Blacksmith" for his reply on page 391 to my query on page 366. The subject of violin tuning is a complicated one, and on this account I wished to know from some one who could speak positively on it as to what violinists of high repute are in the habit of doing in respect of it. It seems that if the open stringed notes are to be made use of, the violin may be tuned in perfect fifths in the key of D, or that key which is founded on the third string as an open note, and that in the key of G the first string requires flattening by a comma. In the key of C the first string remains as in the key of G, and the second string requires flattening by a comma. In the key of F the first and second strings remain as in the key of C, and the third string requires flattening by a comma. In the key of B♭, the first, second, and third strings remain as in the key of F, and the fourth string requires flattening by a comma. It will now be seen that all the strings are flatter by a comma than when they were tuned in the key of D, and that each of the intervals from second to first string, from third to second string, and from fourth to third string, has been short of a perfect fifth by a comma. Of course, if the open stringed notes are not made use of, the equivalents to flattening the first, second, and third strings may be obtained on the second, third, and fourth strings; but if the G on the open string be required, it can only be flattened by tuning or altering the tension of the fourth string. In ascending by fourths or descending by fifths, the open notes sounded on the strings E, A, D, and G become E♭, A♭, D♭, and G♭ one after the other, and this lowering in pitch by a semitone is in addition to that by a comma spoken of above; but here, again, any alteration in the tension of the strings may be avoided excepting in the case of the open note on the fourth string, which now becomes lowered in pitch by a semitone, as well as by a comma as mentioned above. In ascending by fifths or descending by fourths, the open notes sounded on the G, D, A, and E strings become G♯, D♯, A♯, and E♯, one after the other, or are raised by a semitone; and in modulating still further, these notes become raised still more, to the extent of a comma, one after the other. It will readily be seen that when the notes become sharper through modulation, this sharpening can be accomplished on the finger-board without altering the tension or tuning of any of the strings. However, there can be no doubt but that, to obtain the full resonance of the instrument, and to obtain the best quality of notes, the instrument should be tuned for each key, according as the intervals from string to string are perfect or imperfect fifths, as the open strings will then resound of themselves if they are not sounded; and it would seem from "The Harmonious Blacksmith's" reply that Paganini altered the pitch relation of his strings sometimes to facilitate stopping in his difficult passages. By this I should understand he tuned for the key he meant to play in or modulate into. By asking the question, "how they tune in each key," I only meant to ask if violinists tune the open strings in perfect fifths for whatever key they may be playing in. Of course, between a note and its fifth there are an infinite number of notes on which to found an infinite number of major or minor scales; but when I asked the question, I supposed the modulation to be by perfect fifths.—WM. MEEK.

[12226.]—**The Portuguese Language.**—I am very much obliged to J. Gillaird for his answer to the above subject, and beg to acquaint him with that I am an optician, and used to make machinery in general. I am married, and have two children. The health of all of us is good. My means are rather limited.—CARL.

[12226.]—**The Portuguese Language.**—Grammars and dictionaries in Portuguese and English have existed for years. The best known are those by Vieyra. A Portuguese paper published in London is the *Echo Americano*, 66, Ludgate-hill.—H. MEYER, Sydenham.

[12239.]—**Soft Eggs.**—Hens may be given egg-shells, in all seasons, with great advantage to the "hen-wife," provided that the latter, after letting them dry for a few days, breaks them very small, and mixes them into the soft food.—PROVED.

[12260.]—**Cleaning Back of Teeth.**—What a beauty Miss "Beauty" must be to be actually able to write a letter to "our" journal, and not yet to have discovered that her jaws are hinged so as to open wide enough to admit of her putting a tooth-brush inside the teeth, both above and below, and scrubbing at them as long as she likes. She needs no peculiar shape of tool; and she ought (by rights) to use her brush and cold water after every meal, and at the very least, night and morning regularly. This is good sound warning and advice from—A TOOTHLESS OLD HAG.



[12261.]—**Spirometer.**—I send the description of a piece of apparatus a friend called a spirometer, to measure the amount of air discharged from the lungs at one expiration. I presume this is what our friend requires. A is a vessel containing water, inside of which is the meter B, with a stopcock at the top to discharge the air when it becomes elevated, a cord or chain with a weight attached serves as a counterpoise, and also by passing over the wheel G indicates upon the dial the amount of air in the instrument. The tube from the mouth passes through the outer vessel at the bottom, and is continued up into the little dome at the top. This prevents the bubbling noise which would be the result of the pipe ending at the bottom of the outer vessel. —JOHN HOPKINS.

[12265.]—**Pig Feeding.**—If "C. R.," or any one else, wants the best of good pig meat, let him feed the animal upon good boiled parsnips. 'Tis true this diet is more expensive in the beginning, but it will be found cheaper in the end. Test it—try it—as others have done.—A READER.

[12272.]—**Electrotyping.**—The best substances for making moulds for electrotyping are guttapercha and plaster of Paris. Guttapercha is the better one, because the outlines are sharp and well defined. If the object of which the cast is to be taken is metallic, the simplest way to form the cast is to use a fusible alloy, consisting of five parts of lead, eight of bismuth, and three of tin. The object is placed in a shallow box, and the melted alloy poured over it. A slight shock will disengage the cast from the mould. If guttapercha be used, the object should first be covered with graphite (blacklead) to prevent adhesion, and then the guttapercha, after being soaked in hot water, is pressed with the fingers against the object. This cast must be covered with graphite to make it conduct and connected with the negative pole of the battery. I am rather at a loss to know what "Zoo Andra" means by the "process of filling up at the back." Why not let the guttapercha, or whatever be used, be covered entirely with the deposit?—W. H. H. C.

[12297.]—**The Tremolo.**—See letter by "F.R.C.S." —ED.

[12301.]—**Unequal Sizes of Cone Pulleys.**—In my answer on p. 468, for 1ft. 1-16in. and 1ft. ⅞in. respectively read 1 1-16in. and 1⅞in. The "drop" means difference of radius, and in the case of my lathe-pulley the drop of 1⅞in. is from the largest to the smallest of four grooves, or three equal drops of ⅝in. each, corresponding to three equal drops of bare ⅝in. each on the fly-wheel.—J. K. P.

[12304.]—**Phrenology.**—"Philo," who appears to grumble because people laugh at him, might as well avoid giving them occasion to do so. Why cannot he content himself with giving occasional information (and occasional misinformation)? Can he not talk about what he knows or knows nothing about without snarling at others, and by misrepresenting them compelling unpleasant attention, which might not otherwise be called forth? Why should "Philo" trouble himself to tell me that I am "completely mistaken as to what John Locke and other great writers maintained?" I said nothing about John Locke, though I did use a phrase originated by him, I believe. I referred to a distinct mistake made by many, but I did not charge it to John Locke, nor do I know or much care whether he held it or no. That mistake is, that education is the chief or sole agent in forming dispositions, while I maintain that it is only capable of moulding to some extent the inherent faculties with which Nature endows us. "They taught (does "Sigma" deny ?) that a new-born child knows nothing." Well, as to mere facts, a child of course knows nothing till it lays in a stock of information by observation; but I very decidedly deny that any two children have the same powers of storing up these facts when presented to their observation. On the other hand, I say very distinctly that a child a month old manifests very decidedly the leading features of the disposition and powers it will possess through life, and that education can only mask and modify, not entirely change this disposition and powers; this is only the old and true saying, *Poeta nascitur, non fit.* Now, what the old question of electric sparks may have to do with this subject I can't see, but "Philo" chooses to drag it in—very foolishly, I think, because he only shows how incapable he is of understanding either what he reads or writes. The spark question was a mere detail, as I said at the time; he may have been right and I wrong as to whether a certain fact was established, that is nothing; but what was of consequence was that "Philo" talked authoritatively and dogmatically, and altogether erroneously, about principles. If he does not like being told this, he has only himself to thank.—SIGMA.

[12309.]—**Boiled Oil.**—Boiled oil is generally prepared by boiling a mixture of linseed oil and litharge in an open vessel until it thickens. If wanted for printers' ink it is generally set on fire towards the end of the boiling process. If it is wanted for colours which are bad dryers, it is prepared as follows:—Powdered asphaltum, litharge, or red lead, and burnt umber or manganese, each one ounce, are well stirred into one pint of linseed oil, and the mixture is gently simmered over a slow fire till the scum ceases to rise, and the fluid thickens on cooling. If the oil should be rancid, chalk or powdered talc, or magnesia may be advantageously added; it greatly assists the scum to rise, and also clears the oil by its subsidence. Gold size is generally made of boiled oil and Oxford ochre. The best vehicles for oil painting are linseed oil, poppy oil, boiled oil, and nut oil.—FREDERICA HAMILTON.

[12311.]—**Hydraulic.**—H. Meyer is incorrect, in my opinion, in stating that fluids extracted by pump, tap, or otherwise, from the lower part of a vessel descend from the surface in the first place to enter the orifice. It is the fluid immediately above the aperture which goes to supply that which is abstracted. If his view was correct, a tap or siphon inserted in the lower part of a muddy cask of beer, for instance, ought to draw the clear fluid from the surface, which clearly it does not, but if placed (say) half-way up, we shall obtain it tolerably clear; if at surface, quite so.—A., Liverpool.

[12318.]—**Gas Cooking.**—Accurate experiments to decide the real cost of cooking with gas are much wanted. The late eminent gas engineer, Samuel Clegg (often called Gas Clegg), estimated that the cost of cooking with common coal fire was about equal to the cost of cooking with gas at 4s. per 1,000 feet; but gas cooking has improved since Mr. Clegg told me this, and coal is dearer than it then was, some twenty years ago. The quantity of fuel generally wasted in cooking is enormous, and though less with gas than with coal, is with that needlessly great, as may be easily proved. I have succeeded in saving three-fifths of the coal before burnt in cooking, and have improved the cooking also by substituting a half open stove with large hot-plate for a common open fire range. The cost of fuel is, and is likely to be, so high, that it has become a duty for all, and a necessity for many, to diminish its consumption. Fortunately, that is very easy to do, by those who know how, or are not too prejudiced in favour of old ways to learn.—PHILO.

[12321.]—**Chess Player.**—For the benefit of "Willie Scorer," I send the following, and although it is not exactly what he wants, it is, I think, connected with the one mentioned:—M. Wolfgang de Kempelen, a Hungarian gentleman, and Aulic Councillor of the Royal Chamber of the domains of the Emperor in Hungary, called in that year [1769] to Vienna by the duties of his station, this gentleman was present at some experiments on magnetism, made before the Empress Maria Theresa, when he ventured to hint that he could construct for her Majesty a piece of mechanism far superior to any of those which had been exhibited. His manner of remarking this excited the attention of the Empress, who, encouraging him to make the effort, the automaton chess-player, which has since been exhibited in all the capitals of Europe, was, within six months after this period, presented at the Imperial Court. It is a presumption in favour of the pretensions of this contrivance to be a masterpiece of mere mechanism, that the original artist, after having gratified his exalted patroness and her Court with the exhibition of it, appeared for many years indifferent to its fame. He engaged himself in other mechanical pursuits with equal ardour, and is said to have so far neglected this as to have taken it partly to pieces, for the purpose of making other experiments. But the visit of the Russian Grand Duke Paul to the Court of Joseph II. again called our automaton to life. It was repaired and put in order in a few weeks; and from this period [1785] has been exhibited at intervals throughout Germany, at Paris, and in London; first by M. de Kempelen, and latterly by a purchaser of the property from his son, de Kempelen having died in 1808. I have also in my possession an account of the automaton flute-player, with a detail description of the mechanism.—ZOO ANDRA.

[12322.]—**Bees.**—"Willie Scorer" is in error in supposing that wasps destroyed his bees last year. Wasps are not aggressive, and never "attack" a hive under any conditions, but if from some cause a hive has got into a dwindling condition, and the bees are not able to defend themselves, wasps will help themselves, as will flies, ants, and earwigs. "Willie" need have no fear for his swarms, unless they be second swarms which have lost their queens or first swarms, from which maiden swarms have issued, in which case the the said first swarms, might also become queenless and dwindling, when wasps will as usual help themselves. Wasps are not enemies of bees, but they like honey and will steal it wherever opportunity offers, and will sneak about a hive for hours in the hope of obtaining entry, and often their persistency meets its reward, as by long trying at the entrance they attain the odour of the hive, and are admitted; but it is a fact, [illegible] understood perhaps from imperfect observation, that wasps never fight with bees under any conditions, and never attempt to use their stings against them. [illegible] "conscience doth make cowards of them all."—C[illegible] ABBOTT.

[12322.]—**Bees.**—Make the opening into the [illegible] narrower, the bees can then defend it better, and [illegible] keep the wasps at bay.—STRETTON.

[12330.]—**Re Slide Rest.**—My friend "J. [illegible]" requisitioned me some months ago to relieve him [illegible] task of making the promised drawings for ornam[illegible] slide rest; they have been done, but got put [illegible] consequence of my not having leisure to write the [illegible]sary description. I will, however, put my shoulder [illegible] the wheel, and send them in very shortly.—WA[illegible]

[12330.]—**Re Slide Rests.**—To "J. K. P."—I beg to thank "J. K. P." for his answer to my query, and at the same time mention that I am sorry he should think I would illuse any kindness shown me. I should not have asked for the drawings, but that, I believe, "J. K. P." has expressed his willingness to help those wishing to make their own apparatus, as in my case, and I should have certainly put them to better use than tracing them.—H. G.

[12332.]—**Chemical.**—Both.—CLINCHEY.

[12340.]—**Flour Paste.**—A little creosote or carbolic acid, mixed with paste, will preserve it from mould and maggots for a long time; very little is sufficient. A few drops of clove oil, and probably of any essential oil, have a similar but less powerful effect, as also have turpentine and camphor.—PHILO.

[12341.]—**Moths.**—I believe the best way to destroy moths and their grubs in a carpet is to stove it, and then sprinkle it with a solution of creosote in lime water. Carbolic acid is an effectual destroyer of insects, but its smell is unpleasant, at least to most persons.—PHILO.

[12360.]—**Pivots.**—To harden small drills make them red hot, cool in water, grind or rub bright, hold over bright fire, or over gas or candle, or get hold about ¼in. of end with pair of old smith's tongs, heat till point of drill is just blue, then cool in water.—OUTGENIOUS WHITESMITH.

[12360.]—**Pivots.**—"No Soft Solder" will find good staff steel best to make drills of, which can be bought at any good tool shop. Reduce steel to size, make blade of drill rather thick, harden either in oil or beeswax. I should advise him to fit new staff, which is more workmanlike and can be done in less time in many cases.—CONVERSION.

[12360.]—**Pivots.**—"No Soft Solder" must be prepared firstly with a large amount of patience to start with, because it frequently happens that when a "staff" pivot has broken off that staff must have been made from very highly tempered steel; and that a drill required for that small kind of work will seldom prove a success, even after hours of patient procedure. But to the reply. When drill is ready for hardening have a very small candle lighted, hold the blade of drill therein until just blood-red, immediately plunge it into the fat of the candle; it will then be hard, and after trimming it up upon the oil stone will be ready for use. If made a white red by heat before immersing in the tallow, the drill and steel are perished and useless. Use turpentine with the drill instead of oil.—SECONDS' PRACTICAL WATCHMAKER.

[12361.]—**Carbon or Charcoal Pipes.**—One process is to cut them from the solid carbon with a paring knife, and to mould them into required form with a peculiar kind of gouge and suitable instruments; another, to pulverize the carbon, mix with boiled linseed oil, and pass through moulds in the ordinary way. The pipes made by the latter process are not so light and porous as those made by the other. RAT-TAT.

[1236?.] — **Formula.** — To find the content of middle frustum of a circular spindle: (1) Find the distance of the centre of the middle frustum from the centre of the circle. (2) Find the area of a segment of a circle, the chord of which is equal to the length of the frustum and height half the distance between its greatest and least diameter, to which add the rectangle of the length of the frustum and half its least diameter; the result will be the generating surface. (3) From the square of the radius subtract the square of the central distance, the square root of the remainder will give half the length of the spindle. (4) From the square of half the length of the spindle take one-third of the square of half the length of the middle frustum, and multiply the remainder by the said half length. (5) Multiply the central distance by the generating surface, and subtract this product from the preceding, the remainder, multiplied by 6·2832, will give the solidity.—RAT-TAT.

[12365.]—**Elder Flower Wine.**—When the wine is just ready for bunging up, before you put the bung in just pop in a pint of best brandy to each gallon of wine (a sparkling remedy).—OUTGENIOUS WHITESMITH.

[12367.]—**Oval Turning.**—It is very possible to attach an oval chuck to any lathe whether it was ever intended or not. I have two lathes, ordinary shaped heads, with oval chucks attached by a simple arrangement, doing away with the clumsy flanges on each side of the head. If the writer will state the kind of bed I will give full information for adapting his lathe for oval-turning.—W. B. WINKLE.

[12368.] — **Imitation Bronze.** — Corrosive sublimate will dissolve readily in hot water, especially if there be a little hydrochloric acid added.—A. STONE.

[12369.]—**Water Powder.**—If "L. J. V. G." will go to any surgical instrument maker's, and ask for a spray producer, he will obtain what he requires. There are several varieties.—F.R.C.S.

[12371.]—**Truss.**—It is a great mistake to make trusses with but a single ligament. They should form a perfect support for the abdominal regions, and this can only be accomplished by forming a kind of india-rubber or canvas vessel to fit those parts, with necessary apertures, to be supported by spring or elastic pressure, or suitable bands from the shoulders. With such a truss and soft lining, which could be easily made, "Nosbor" could indulge without inconvenience in his favourite pastime of swimming, and attend his ordinary duties.—RAT-TAT.

[12372.]—**German Concertina.**—The steel is too stiff and rigid, and requires tempering or replacement by a softer metal.—RAT-TAT.

[12375.]—**Metallic Stain for Wood.**—Soaking the wood in a weak solution of nitrate of silver, and then exposing it to the light, will produce an intense black colour.—ALFRED H. ALLEN.

[12375.]—**Metallic Stain for Wood.**—I suppose you wish to stain wood black, if so, boil some chips of logwood in water for about a quarter of an hour. Then wash the piece of wood with it three or four times, allowing it to dry after each washing. Lastly, wash the wood by means of a common painting-brush, with a mixture prepared as follows:—Put one ounce of steel or iron filings into two ounces of vinegar, keep the phial near the fire so as to be gently heated for about two hours, then decant the vinegar, and keep it for use.—JOHN HOPKINS.

[12377.]—**Fall of a Bullet.**—In order to increase the range of the bullet, a rifle (on level ground) is always fired at a slight inclination upwards. We see that the sights are raised above the barrel, if fired horizontally on a horizontal plane, the elevation of the gun being 4ft. above the ground, a ball let drop from the hand will fall 4ft. in half a second, the ball fired from the rifle leaves the muzzle at a velocity of about 1,000ft. per second, but this velocity decreases rapidly from atmospheric resistance. The ball will go about 350ft., roughly estimated.—PHILANTHROPIST.

[12379.]—**Packing Piston Rings.**—In answer to "Dundalk," I beg to say that the piece of thin sheet brass must of course be inside, and fitted as per rough sketch, and as the piston head described by "X. M. S." appears unnecessarily complicated and objectionable, as liable to unscrew, Fig. 2 is a rough

FIG. 1

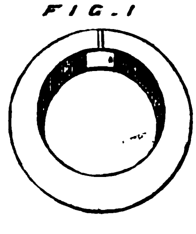
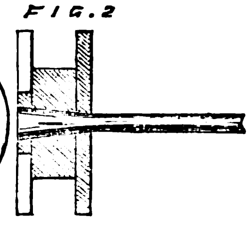


FIG. 2



sketch of what I have found to work well. The shaded part represents the solid head into which piston rod is fitted, taper as shown, and secured by a cotter. The loose cap is secured by three sunk screws. Of course this piston head must be turned after the rod is secured in place. "Dundalk" cannot do better, in my opinion, than to make the rings of gun metal.—A., Liverpool.

[12380.]—**Light.**—The difficulty has arisen by supposing light a material substance. If the undulatory theory be adopted the answer is evident. The luminiferous ether without is thrown into vibration by the sun; these vibrations are transmitted to the ether that exists inside the room, throwing it also into motion. This motion when communicated to the optic nerve produces the sensation of light. Now, when all access ceases, what happens? Why motion within as a natural consequence also ceases (the source being cut off), there is nothing to excite the optic nerve, and darkness is the result.—CENSOR.

[12380.]—**Light.**—If we suppose "Dai Bach y Ship" to be inside his darkened room he will see the reflected rays of light from the wall opposite the hole. The rays of light from the sun travel in straight lines, and will continue in a straight course unless reflected or refracted otherwise. Thus the light travels in a straight line to the door, and is there reflected back or absorbed, all but one portion; this portion meets with no opposition at the door for the reason that a part of the door is missing. Therefore the light passes on, and it falls to the lot of the wall opposite the hole to reflect the ray. Suppose a man outside directing a jet of water against the door and hole, all the water that struck the hole would pass through and strike upon the eye of "Dai Bach," if he was peeping; he would then, I think, see it. All that did not hit the hole, but the door, would bounce off. If I might use a Hibernian expression, I would say that this is just the same only a little different.—JOHN HOPKINS.

[12380.]—**Light.** — According to the undulatory theory of the origin of light, all bodies and the celestial spaces are filled with a subtle elastic medium, called luminiferous ether. The luminosity of a body is due to a rapid vibratory motion of its molecules, which, when communicated to the ether, is propagated in all directions in the form of spherical waves, there being no progressive motion of the particles themselves, but only of the state of disturbance which was communicated by the luminous body. When, therefore, the hole through which light has been allowed to pass into a dark room, is closed, the state of disturbance is arrested, and the waves inside come into a state of rest, and darkness is the consequence.—E. B. H.

[12380.]—**Light.** — According to the undulatory theory of modern writers, light has no material existence at all, but its effects are produced by vibrations and cease with these vibrations. If "Dai Bach y Ship" is content to accept this theory, he will find his rather curious question answered.—W. H. H. C.

[12381.]—**Education.**—Much would depend on the age of the boys. Belfast is cheap to live in. There are pretty good schools. Ten scholarships are given every year to first year students, also ten to second and third year students, besides senior scholarships to fourth year students—five for classics, five for mathematics. Engineering and medicine are also encouraged. The scholarships are worth about £24 in cash, and half fees saved (£4 or £5). Cork is dearer to live in than Belfast. I like the Cork College better. Further information if desired. Many Civil Service appointments in India have been obtained by Belfast students.—PHILANTHROPIST (Ex. 1st Science Scholar, Q. C. B.)

[12384.]—**Coppering Carbon.**—Try galvanizing the carbon first in a strong battery; but I do not think Mr. Wall will succeed, as the substance is too friable to retain the coating. If this does not succeed fix the plate to it with tinman's solder, using spirits of salts, sponged in with a rag to make the melted solder and carbon assimilate. Care, however, must be taken not to saturate the junction with the acid, or no connection can be formed.—RAT-TAT.

[12385.]—**Sulphur in Wall Papers.**—It is a fact familiar to chemists that ultramarine contains sulphur, and no doubt the tarnish noticed on the silver is due to its presence. As the sulphur is an essential constituent of ultramarine, it cannot be got rid of without destroying the colour. "Ggur" had better use another paper, say a bright yellow one which turns green when wetted and held over burning sulphur. Such a paper is coloured with chrome-yellow, which has a tendency to absorb and decompose sulphuretted hydrogen, and would so keep the silver bright.—ALFRED H. ALLEN.

[12385.]—**Sulphur in Wall Papers.**—If "Ggur" does not like to remove the paper from his glass case, which is the most effectual remedy, if the paper really contains sulphur, the diffusion of the sulphurous particles can be prevented for a time by coating with size, boiled oil, water-glass, or spirit-varnish. This must be again repeated when the paper loses its glossy appearance.—RAT-TAT.

[12386.]—**The Prevention of Incrustation in Steam Boilers.**—The astringent property of the tannin contained in the timber of the oak as well as in the bark, though not in the same proportion, no doubt exercises a counter attraction on the particles held in solution. By putting a few pieces of oak, as "J. D. K." suggests in the boiler, incrustation may be partly prevented, by weakening or destroying by an opposite affinity the inherent tendency of the particles to assimilate, or rendering less tenacious their adhesion to the sides of the vessel. The dark colour of the precipitate or sediment is derived from the oak, as "J. D. K." indirectly remarks.—RAT-TAT.

[12388.] — **Onions.** — Sow "Giant Rocca" in August and transplant in the spring. I have some now (July 15) over a foot in circumference.—M. W. G.

[12389.]—**Dirty Mercury.**—Dissolve a small quantity of the mercury in hot nitric acid. Shake the rest of the metal with the solution so produced till it is quite bright; wash well. Clean the barometer tube with nitric acid, wash with water and then with alcohol and dry thoroughly.—ALFRED H. ALLEN.

[12389.]—**Dirty Mercury.**—I presume that "C., Glasgow," has not more than two or three pounds of mercury to purify. Let him do as Regnault did when he required pure mercury, viz., agitate the metal with diluted nitric acid, using one ounce and a half of acid to two of water for every two pounds of mercury. This will eliminate a goodly portion of the impurity, then pour the solution off and digest with strong nitric acid, until nine-tenths have dissolved in the acid. Take this solution, which is nitrate of mercury, evaporate it to dryness, and then heat it strongly in a retort; it thus becomes converted, first into oxide of mercury, and afterwards this becomes decomposed into oxygen, a gas, and mercury, which distils over and is condensed in the neck of the retort, and may there be collected. Traces of oxide may be removed by agitating it with sulphuric acid, and afterwards well washing with pure water repeatedly, and afterwards drying at a very gentle and moderate heat. The barometer tube may be cleaned by pouring in slightly dilute nitric acid and shaking the tube; this will remove the film, and the tube should then be carefully and repeatedly washed to remove all traces of the acid, &c., and then carefully dried; previous to filling the tube, the mercury and tube should be slightly warmed to dry them. If "C. Glasgow" requires anything more I shall be glad to help him. By the bye, lead and tin are not combustibles, save under exceptional conditions, viz., great heat in pure oxygen.—A. STONE.

[12389.]—**Dirty Mercury.** — If "C. Glasgow," puts his mercury in a cup, and pours a little aquafortis on it, he will find it turn what he terms the adulteration to a white powder. Make a funnel of writing paper, and pour through to dry it, and stand the cup on the top of his kitchen stove till he cannot bear his finger in the mercury. Pour some of the clean mercury in the tube, run it up and down a few times, clean it the same way as before, but by no means put anything wet in the tube.—Q.

[12390.]—**Chemical.**—Let "Home Student" obtain Miller's "Chemistry," 3 Vols., Longmans and Co., or if this be too much for him, try Williamson or Roscoe (Macmillan). These are really useful and standard works, and Miller's is the finest treatise on chemistry for students' use that I have ever seen. But if he wants merely to look up chemical theory for the Science and Art Department Examinations he had better read Frankland's "Lecture Notes for Chemical Students" (Van Voorst), or Valentin's "Practical Chemistry," or Buckmaster's. These contain everything likely to be asked for in the Examinations, and they will give him an advanced idea of the frantic and dazzling system (?) of notation now in vogue.—A. STONE.

[12390.]—**Chemical.**—Miller's "Chemistry for Students," Houghton's "Gill's Chemistry," Roscoe's "Elementary Chemistry," Galloway's "First Step in Chemistry."—ALFRED H. ALLEN.

[12390.]—**Chemical.**—Roscoe.—CLINCHEY.

[12390.]—**Chemical.**—"Home Student," if he is beginning his chemical studies, would do well to get Barff's "Introduction to Scientific Chemistry," Jarmain's "Chemical Tables," and Jarmain's "Qualitative Analysis," and he will have there as much as he can master in twelve months. Total cost, 6s. He should get up the definitions and formulæ in the chemical tables at the outset, and he should carefully answer the questions at the end of Barff's Chapters, on paper, or on slate. He should go through all the experiments, if possible, and commence the analysis of Group I. at once. Mr. Bottone's chapters in the back numbers of the ENGLISH MECHANIC will assist him very much in his earlier difficulties.—R. P.

[12391.]—**National Losses.**—It is evident that we must have a number of charges on the debit side of our national ledger corresponding to those put down by the manufacturer for "depreciation of buildings," "wear and tear of machinery," &c. These are the charges I mean by absolute annual national loss. As an instance, suppose a person living up to a salary of £200 per annum, very probably at the end of the year out of the £200 he has spent he will not possess what will realise £40 or £50, perhaps not £20, the remainder having been spent in food, clothes, tobacco, cigars, &c., whose ultimate, as compared with their primary, value is, if not absolutely *nil*, at all events infinitesimal. This primary value, therefore, less the ultimate value, capitalised, represents what I require. In connection with this question perhaps some reader can inform me what is the estimated annual capital production of this country, less cost of production.—EXCELSIOR.

[12391]—**National Losses.**—The only estimate which "Excelsior" might rely on as the nearest approach to an accurate estimate of absolute losses indulged in by preconcerted arrangements is the amount of taxes raised annually. When institutions are made self-supporting, and useless offices and establishments, to which these absolute losses may be directly traced, are abolished, England, as a nation, will be saved from danger and decay. Englishmen in general are brave, energetic, and intelligent; but the slough of dormant contentment with existing social arrangements, thrown around them by a puerile and interested Machiavelism, will result in inevitable ruin. It needs no dabbling politician to see this end to all bauble-satisfied and "red tape" governed countries. It can be seen in the lamentable ignorance of the lower classes and the shuffling attempts at education. With an enforced secular and military education of all classes, England can see her way to genuine legislation, and to the enlightenment and benefit of the world, through her colonies and possessions, by the unrestrained energies of her people.—RAT-TAT.

[12392.]—**Bee Management.**—The maggots or grubs which "W. T. L." found on the floors of his hive are in all probability young moths, which are about the greatest destruction to honeycombs and bees in existence. The bees can be transferred to the new hive late in the evening, which is considered the best time. There are various plans for doing this. The one generally adopted is to first stupefy the bees by chloroform. An excellent way to do this has been given lately in a back number, but I would advise "W. T. L." not to have anything to do with chloroform; its enervating effects are felt by the bees for days after its application, and some, when they sally out for honey and are returning with their loads, fall from sheer exhaustion into ponds and pools. Tobacco smoke is far better to use than this powerful drug. It can be driven in by a few puffs from an ordinary bellows, to the nozzle of which is attached a tube containing a few leaves of lighted tobacco. The bees, half smothered with the smoke, will fall almost instantly from the combs on the table or stand. All remaining stragglers can be brushed out with a feather. While lying on the table the new hive, previously rubbed round with honey and a few bits of comb attached to the top, is placed over them; they will ascend after recovering from their stupefaction; but care must be taken, by stopping up the entrance-hole, not to allow them out for a few hours, or they will immediately commence depredations. The old hive must be removed far out of their reach, to a cellar underground if possible, where its odour will not reach them, or they will torture the inmates of the house. As "W. T. L.'s" wooden hive may be bottomed, the plan recommended may not be practicable. It would, in that case, be better for him to connect the two hives by means of a tube from one entrance to the other, or the hives may stand so close together that none of the bees can escape. In either case a small pasteboard trap-door, pierced with holes, is to be fixed inside the entrance of the new hive, so that when each bee enters it falls down behind him and does not allow of his going back. "W. T. L.," by looking at a mouse-trap, may see how the trap-door is to be constructed. When all is ready, he can commence operations by beating the straw hive regularly all round from top to bottom, and the bees will immediately come out to do battle with the disturber if they can. This is, of course, to be avoided as much as possible, and "W. T. L." will have the bees, with very little trouble, in his new hive after a quarter of an hour's beating. He must, however, see beforehand that the paper, board, or leather trap-door is not too heavy to be raised by a single bee.—RAT-TAT.

[12392.]—**Bee Management.**—If W. T. L." will take two pieces of cloth (any sort) about a yard square, cut a round hole in the centre of each about 8in. in diameter, and stitch the cloths together round the edges of the hole so cut, it will answer his purpose very well, by the first cloth being tied over the bottom of the wooden box, keeping the "hole" in cloth about the centre; then turn the hive and bees upside down and place the box on it, the other cloth falling over the hive, which must be tied immediately. The bees are now secured, and a few gentle taps on the hive will drive them into the box. Should the box be smaller than the hive a couple of sticks placed across the straw hive between the cloths will support it.—NOVICE.

[12392.]—**Bee Management.**—"W. T. L." might have profited by my hints on feeding in March last. If he had followed the instructions there given (No. 365, p. 14), he need not have lost his two stocks of bees in May. My hints were for such as he, but they seem to have been wasted in his case. The maggots which have traversed his combs are the larvæ of the wax moth, which deposits its eggs in, on, or near anything waxy in or about the hive; the larvæ hatch out and feed on the said wax and attain the combs if possible. Often when hives are improperly guarded, the moth, like the wasp, will gain admission, and deposit eggs in the combs, in which case it is bad for the stock, for the larvæ encase themselves in wool, and leave a woolly tunnel or trail behind them as they proceed in their work of devastation. They love the base of the cells, and, of course, in devouring that they render useless all the cells through which they have passed on both sides of the comb, and the worst feature of all is, that the bees are unable to remove the woolly case, tunnel, or trail which the wax worms have left in their track, and consequently cannot repair the mischief. What benefit "W. T. L." expects to obtain by transferring his light stock to a wooden hive I cannot make out. I see a "Berks Farmer" gives "W. T. L." a reply, but the "Berks Farmer" evidently does not understand "W. T. L." or his bees. My advice to "W. T. L." as to transferring is—don't; his stock is weak, and the chances are that his new hive, which he says is 11in. square, but which, perhaps, means 11in. cube, is about twice the size of his straw skip, and being so, how can it be expected that his weak stock will fill it? "W. T. L." should first ascertain if his bees are healthy, and if they are not, he had better take "Berks Farmer's" advice, and "stupefy them," taking care that none recover, for as he has only the one stock, if they are diseased, it would be better for himself and neighbours if they were "with the majority," as the Yankees say. If they are healthy, and simply weak from want, "W. T. L." had better feed them where they are, so as to give them a chance, and in the meantime if he would study Langstroth's wonderful work on the "Hive and Honey Bee," he would know what to do next spring.—C. N. ABBOTT.

[12393.]—**To Steady a Sketching Board.**—A heavy weight must be suspended from the centre of "Poloski's" sketching board to which the camera lucida is firmly attached, with clamp, screws, or otherwise, by means of a hooked iron rod, or cord, so as to be weighty enough to resist the action of the wind. The weight may touch the ground, or a nail to which it is tied might be driven between the paving stones. In fact, a couple of spikes driven into the ground to which the legs are tied would hold it securely in any position.—RAT-TAT.

[12395.]—**Extracting Wax from Old Comb.**—To extract wax from comb, crush the whole into the smallest compass, and put into a canvas bag. Boil it in a large saucepan or copper, and when done, *i.e.*, when the fire is down, press it with a weight, or board and stick while under water, and the wax will float on the surface. Very old comb is seldom worth the trouble, as there is so much bulk and so little wax.—C. N. ABBOTT.

[12395.]—**Extracting Wax from Old Comb.**—Before boiling it break it up into little pieces, then boil, and the dirt and scum will float on the top, and the wax will run together.—STRETTON.

[12395.]—**Extracting Wax from Old Comb.**—If the bees never filled the cells with honey, there is no wax in the old combs to extract. This is a curious fact.—H. O'B.

[12395.]—**Extracting Wax from Old Comb.**—Try this. Put the comb into a small pan, or pie-dish will do, and let it stand in the kitchen range oven, when there is not much fire (baker's oven won't do). The wax will then gradually melt, and can be strained in the usual way. I have always found old comb "more plague than profit." You had better break it up in small pieces, and scatter it on the ground near your fall hives, and your bees will then, I should think, make use of it.—SACRISTAN.

[12395.]—**Extracting Wax from Old Comb.**—The following method, after years of testing, I have never known to fail:—Make a bag of coarse straining cloth (about 4d. per yard), and fill it as full as you can with comb, or a piece large enough to tie the comb will do without the bag—does not matter how old or dirty the comb may be—put this into a pot or copper with enough water to cover it; let it boil, and keep it boiling, and you will soon see the wax floating on the water; keep this skimmed off into a pan of cold water as long as any rises; when done, take it from the water, melt it in a saucepan carefully, and pour into a mould or pan; you will find only refuse in the cloth. I can strongly recommend this way to W. Hawkins.—BERKS FARMER.

[12396.]—**Rouge.**—Lord Rosse (in the *Philosophical Transactions*) thus describes his process of preparing his polishing powder. I prepare the peroxide of iron by precipitation with water of ammonia from a pure dilute solution of sulphate of iron. The precipitate is washed, pressed in a screw press till nearly dry, and exposed to a heat which, in the dark appears a dull low red. The only points of importance are, that the sulphate of iron should be pure, and the water of ammonia should be decidedly in excess, and the heat should not exceed that I have described. The colour will be a bright crimson inclining to yellow. Jewellers rouge is, however, frequently prepared in London by precipitating sulphate of iron with potash, well working the yellow oxide, and calcining it until it acquires a scarlet colour.—CLINCHEY.

[12396.]—**Rouge.**—Rouge is got by heating sulphate of iron first to about 540 F., afterwards to redness, in a retort of refractory material. Nordhausen sulphuric acid is given off, and the residue is rouge. Synonym Colcothar, Crocus Martis, *Caput Mortuum Vitrioli*.—A. STONE.

[12397.]—**Boat Building.**—It would take more room than the Editor would allow to describe fully the art of boat building, but it may be of some use to "W. S." to know that there are two ways of doing this—one called carvel building, in which the stem, sternpost, keel, and ribs called timbers, are first erected, and the planking afterwards applied, these timbers being usually cut to the required shape first. The other called clincher, in which method, after erecting stem, sternpost, keel, and one or more frames, as described by me in reply 12212, we proceed to fit the garboard streak, or first board to keel, stem and sternpost grooves, forcing it out gradually to the required shape by means of sticks bearing against a stout scantling extending from stem to stern; it being understood that keel is secured to a horizontal piece of timber, and stem and sternpost to a firm upright at each end. When in required shape, mark a horizontal line along the upper edge, which will be found to be a peculiar curve; cut board for opposite side exactly similar, and then nail on both; then take next ditto; fix temporarily to first by means of what are termed clams, and having drawn pencil line inside along top of first board, cut accordingly both sides always together; allow them to overlap (say) ⅜in. according to size of boat, and rivet together every 6in. with nails and roughs, always keeping upper edge of board as nearly horizontal as may be desired. I prefer a slight shear. When the top is reached, the oak timbers are steamed, and secured in their places with one or two nails while hot and pliant, and afterwards riveted when all are in place, the gunwale the same. The difference is that the clincher is much the lighter boat, as the boards may be of (say) even ½in. in thickness, whereas the carvel requires that the planking be not less than (say) 1½in. to admit of being properly caulked. If "W. S." requires any farther instructions, and the Editor can find room, as far as my information goes, it is at his service. The planking may be of any desired timber, if durability is not an object, but for steaming timbers, oak is usually employed.—A, Liverpool.

[12400.]—**Parrots.**—I have one said to be an "Australian Lory," similar to that described by "F. S. M. W." I suppose it is more properly called "Pennant's Parrakeet." They are not likely to breed.—M. W. G.

[12401.]—**House Painting.**—White lead, 4lb., patent dryers, 2 oz.; ¼ gill of boiled oil; when for outside work, linseed oil ¾ gill, and turps ¼ gill. The colour of the above is white.—F. S. M. W.

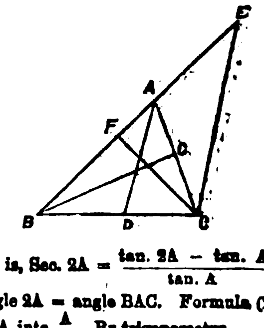
[12404.]—**Trigonometrical Theorems.**—With figure of Euclid VI., 3, draw B G, CF perpendicular to AC, AB. Then

$$FE = FA + AC \text{ and } \frac{BG}{AG} = \frac{CF}{AF} = \frac{CF}{EF} \cdot \frac{FA + AC}{AF}$$

$$= \frac{CF}{EF} \cdot \frac{AC}{AF} + \frac{CF}{EF}$$

$$\therefore \frac{CF}{EF} \cdot \frac{AC}{AF} = \frac{BG}{AG} - \frac{CF}{EF}$$

$$\therefore \frac{AC}{AF} = \frac{\frac{BG}{AG} - \frac{CF}{EF}}{\frac{CF}{EF}}$$



$$\text{That is, Sec. } 2A = \frac{\tan. 2A - \tan. A}{\tan. A} \quad (1)$$

Where angle 2A = angle BAC. Formula (2) follows by changing A into $\frac{A}{2}$. By trigonometry

$$\text{Sec. } 2A = \frac{1 + \tan.^2 A}{1 - \tan.^2 A} = \frac{2}{1 - \tan.^2 A} - 1 =$$

$$\frac{\tan. 2A}{\tan. A} - 1 = \frac{\tan. 2A - \tan. A}{\tan. A}.$$

—ALEPH.

[12404.]—**Trigometrical Theorems.**—The following is a solution to "Thetamu's" equation: With A as centre, and A C as radius, describe a circle; and draw a straight line, making an angle with A C = 2 A, and meeting the tangent C B in B. Bisect B A C by A D, cutting C B in D. Then, by Euclid VI. 3, $\frac{AB}{AC} = \frac{BD}{CD}$: but B D = B C − D C = tan. 2 A − tan. A; and C D = tan. A × A C.

$$\text{Therefore } \frac{AB}{AC} = \frac{\tan. 2A - \tan. A}{\tan. A \times AC}$$

$$\text{That is, sec. } 2A = \frac{\tan. 2A - \tan. A}{\tan. A}$$

If we now substitute A for 2 A (as this formula is perfectly general) we obtain—

$$\text{Sec. } A = \frac{\tan. A - \tan. \frac{A}{2}}{\tan. \frac{A}{2}}$$

—N. H. H. C.

[H. Mayer, G. H., Xenophon, E. W. H., and J. Sargill have also answered this query.—ED.]

[12406.]—**Worm eaten Violin.**—Use turpentine; take a little of the second string, dip in the turps, and drop in the holes. If you are no player, and the violin a very good one, give it to some one that can play and that will stop it.—E. W.

[12406.]—**Worm-eaten Violin.**—Take 1 drachm of corrosive sublimate (poison), put it into a 2oz. bottle of spirits of wine, let stand all night. Apply the solution to the interior of the violin by means of a small brush, fastened to a piece of copper wire, which can be bent and passed through the holes of the violin.—SARAH.

[12407.]—**Checkering Tool.**—The rings can be cut with a punch formed of two concentric ring cutters of hard steel, attached to suitable handle. "A Trimmer" can easily construct and arrange the rings so as to cut the dimensions given. Of course the steel must be in plates and red hot when the punch is applied.—RAT-TAT.

[12408.]—**Quill Pens.**—They are passed through hot ashes to purify them and remove the grosser fat and moisture, and render them transparent. Another method, and the one more in use, is to dip them in a solution of alum in hot water, and then place them by till they are hard.—C. P. E.

[12408.]—**Quill Pens.**—Get a baker to let you put your quills on the top of his oven for three or four weeks; be careful that there is not sufficient heat to split them; you will know when they are done by trying to make a pen with one.—SACRISTAN.

[12409.]—**Transferring Pencil Drawings on Paper to Boxwood for Engraving.**—The boxwood block must have a uniform white surface, which is got by rubbing over with flake white, wetted with water or saliva and allowed to dry. If the drawing is to be reversed for printing, it must be done upon tracing paper. A piece of paper smeared over with blacklead must be placed upon the white surface of the block, then the drawing. Go over the lines with a steel point, and the result is a clear sketch left upon the boxwood. Drawings for wood engravers are generally done upon thin white paper, and it is usual to gum them round the edges while tracing.—SARAH.

[12409.]—**Transferring Pencil Drawings on Paper to Boxwood for Engraving.** — Take a tracing of the drawing on thin paper, then scrape a little red chalk on the back of it, and rub it well all over with the fingers. Lay this on the prepared block, and go over it with a style. When this is done, you have got it on the wood in red, then pencil it over. Another way is to burnish it on to a prepared block.—XYLOGRAPHER.

[12409.]—**Transferring Pencil Drawings on Paper to Boxwood for Engraving.** — Place a sheet of black transfer paper over the face of the wood, lay upon the transfer paper the pencil drawing, then run over the pencil marks with a dull pointed instrument. I have taken copies of pencil drawings upon other sheets of paper, and I doubt not the plan will succeed in your case.—JOHN HOPKINS.

[12412.]—**Skew Bridge.**—The counterforts of all skew bridges that have come under my notice have been parallel with the face of the bridge, and this is at least a convenient arrangement, but whether in that position they react with the greatest effect against the forces brought to bear upon them depends, I imagine, upon the nature of the materials and manner in which the abutment is built, for if built so soundly that it may be acted upon as one homogeneous mass, and consequently that a thrust against it has the effect of tending to overturn it bodily on its outer footing, then the counterforts would react with the greatest effect if placed at right angles to the line of abutment; but if it is assumed that the materials of the abutment cannot be cemented together into one solid mass, then, to prevent fracture, the line of the counterforts should be at right angles to the bed joints of the arch, which is the line of face of the bridge, and is the direction in which they have been placed, as far as my experience has gone.—C. S.

[12412.]—**Skew Bridge.**—The corner buttresses ought certainly to diverge, and it is usual to make one parallel to the face of arch, the other perpendicular to its side wall, so that there may be no acute angle in the plan, but two of the jambs be right and two obtuse angles. Intermediate buttresses would be best set in an intermediate direction.—E. L. G.

[12414.]—**Cleaning Feathers.**—Use raw starch blended in cold water to the consistence of cream; cover the whole surface with this, but be careful not to lay it on so heavy as that the paste will drop off. In a week or less, in very dry weather, it will have hardened; knock it off gently, and the feathers will be clean; and "plumed," too, if you begin at the right end.—A NATURALIST.

[12415.]—**Provision for Child.**—This very important class of query, which I marvel has not occurred frequently, could hardly be answered at all, even now, but for a valuable contribution to the last number of the *Journal of Society of Actuaries* (April, p. 30), on child mortality, a branch of statistics hitherto most neglected. The following are the data necessary for "J. R.'s" calculation:—Out of 100,000 born there die in the

First year..	9,099	leaving	90,901	(discounted =	88,253)
Second	3,498	,,	87,403	,,	82,386
Third	1,791	,,	85,612	,,	78,347
Fourth	1,113	,,	84,499	,,	75,076
Fifth	927	,,	83,572	,,	72,090
Sixth......	779	,,	82,793	,,	69,338
Seventh ..	655	,,	82,138	,,	66,786
Eighth	559	,,	81,579	,,	64,399
Ninth	490	,,	81,089	,,	62,148
Tenth	446	,,	80,643	,,	60,008
Eleventh ..	430	,,	80,213	,,	57,947
Twelfth....	420	,,	79,793	,,	55,965
Thirteenth..	396	,,	79,397	,,	54,065

The numbers in the last column are those of the second, each discounted for Government interest at 3 per cent. —that is to say, the first is diminished as 103 : 100, the second in the ratio $\left(\frac{100}{103}\right)^2$, the third in the ratio $\left(\frac{100}{103}\right)^3$, and so on to $\left(\frac{100}{103}\right)^{13}$; by taking the logarithm of each number in col. 2, subtracting as many times the log. of 1·03 as the line is from the top of the table, and this leaves the log. of the number for col. 3. Thus, of 100,000 children born to-day, if we engage to pay £1 for each living this day twelvemonth, the pounds then to be paid will be 90,901, but the sum now necessary to provide this is only £88,253. Hence the numbers of col. 3 are present values of a promise of £100,000, to be paid this day year, 2 years, 3 years, &c., on condition that a child born to-day is then living. If "J. R." then adds the 13 up, he has the present value of an annuity of £100,000, the first payment this day twelvemonth, the latest possible this day thirteen years, but all contingent on the life of the child born to-day. If he omits the first line, and augments the sum of the last 12 in the ratio of 88253 : 100000, he will have the present value of similar annuity, the first payment a year hence (the child being then supposed two years old), and the last this day 12 years (all 12 contingent on life). If he omitted the last line, 54,065 and substituted the first, 88,253 (which on augmentation becomes 100,000), he would have the present value of similar annuity, the first payment certain to-day, the others contingent, and the last this day eleven years. Now, a mean between these two sums will be very nearly the value of the contingent weekly payment for these 12 years, if its annual amount were £100,000. Hence he will, by simple proportion, find its value corresponding to 5s. a week, or £13 1s. per annum. See No. 348, p. 248, especially p. 249, paragraphs numbered 9—14. P.S.—By the above data, the value for which "J. R." asks comes out £120 12s. 2½d. The "English Life-Table," calculated from the Registrar's census by the Swedish calculating engine, and published ten years ago, affords similar data; and if this query excites any interest, I will make a table of this value's variation from before birth to every three months of a child's age.—E. L. G.

[12416.]—**Spinning.**—Speed of spindle about 6000 revolutions per minute for medium counts on mules. "J. R." will find the following very useful for finding the twist per inch, for either twist or weft:—Take 50's for the standard, say 26 revolutions for twist, and 23 weft. Now we have 26 revolutions per minute for 50's twist, what shall we require for, say, 60's twist. Then we have—

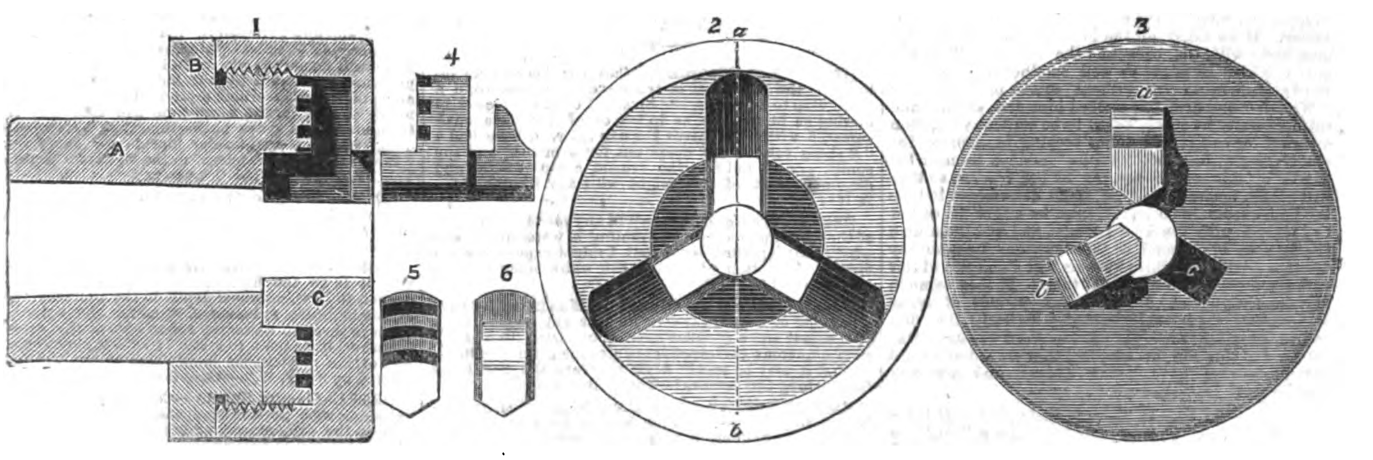
$$\frac{26^2 \times 60}{50} = \sqrt{40560} = 28{\cdot}47$$

—C. M.

[12417.]—**Hardening Spiral Springs.**—I have made hundreds of spiral springs out of 1-16in., ⅛in., and ¼in. iron, not tempered. I had straight pieces of round iron and steel which I fixed in lathe, I fixed my driver on one end, I had a small hole at the other to put end of wire through; these springs are lapped close. Some of them have worked now for about ten years and are good yet; they stand a pull and spring back; for steel springs of wire to remain open, to make them quick, you want screws for your lathe the proper pitch, with a hole at one end and driver at the other. Put wire through hole hard as you get it. Make your springs as fast as you can count them; don't do anything at them, only cut them the proper length.—OUTGENIOUS WHITESMITH.

[12419.]—**Photography.**—The fixing solution for pictures taken on gelatine and bichromate of potass is simply water slightly warmed, which removes that portion of the film which has not been acted upon by the light. The process may be briefly described as follows. Having selected a suitable paper, it is coated by means of a large flat brush with a warm solution of gelatine, in which is dissolved some pigment, of the colour required in the finished picture; the paper being coated with the coloured gelatine is put aside till dry, and is then rendered sensitive to light by being floated on a solution of bichromate of potass. When dry it may be exposed under a negative in a printing frame, as in ordinary silver printing. After exposing for a sufficient time, the paper is taken from the frame, and plunged in a drop of slightly warm water, these portions of the film unacted upon by the light being washed away, and leaving a representation of the negative in coloured gelatine. If "A." requires fuller details of the process he had better purchase "A Manual on Carbon Printing," published by Mawson and Swan, Newcastle-on-Tyne. I have omitted to state that the operations should be carried on in a yellow light as in the ordinary silver printing.—PHOTO. BRISTOLIENSIS.

[12420.]—**American Chucks.**—As an instalment in reply to this query, I send drawing in detail of the Warwick drill chuck; I shall be able to forward also the Becher, and later on the details of the Scroll chuck. The Excelsior appears from a drawing I have seen to be only an enlarged type of the Becher. Another kind, working with a key at the side, but in other respects like the Warwick, is shown in the advertising sheets of this journal, but I have never seen one of them. 1 is section through the chuck on line *a b*, Fig. 2, which is a plan of the cap piece C, Fig. 1, seen from the inside, and Fig. 3 is plan of same seen outside, showing one of the dies *a*, in position when open to fullest extent, *b*, the position of die when closed on centre, and *c* the size of gap through the front plate for the passage of dies. It will be seen that this chuck consists mainly of three pieces—the body A having the hollow at one end, and the scroll at the



other, B a collar fitting over A and screwing into the cap C, which carries the dies. This cap has a solid concentric block which is recessed out radially to guide the dies, which when in place occupy the space left unshaded in Fig. 1, 4, 5 and 6 are side view, plan as seen from inside, and plan seen from outside of one of the dies. The pitch of the scroll is one-eighth of an inch, and the thread of collar and cap left-handed, to prevent the chuck unscrewing when pulled towards you in releasing a drill.—Wakenaam.

[12421.]—**Enlarging Photographs.**—Does "Industrious Will" particularly want to use the magnesium light for enlarging, or can he be contented to work by daylight? if the latter, I can describe a small contrivance costing but a few pence, by the aid of which, with a quarter plate lens, carte negatives may be enlarged to 10 by 12, or still larger. The magnesium light is both expensive and troublesome to manage; daylight is at our command and costs nothing. If "Industrious Will" will say if daylight will do, and the Editor can insert a small engraving, I will forward drawing and description.—Photo. Bristoliensis.

[12423.]—**More Light Wanted.**—I should think the best way would be to whitewash, or paint white, the fronts of the angle houses. You don't mention what aspect they have.—Lumen.

[12423.]—**More Light Wanted.**—If there be a thick angular pier or post, it might be replaced by two thinner, with a diagonal light between them; and if the general posts be above a few inches deep from exterior to interior, lining their sides next the corner with tin or silvered glass will assist, especially if in short pieces tilted out from the post some degrees at their bottoms. If the shops have a story above them, these seem the only available resources.—E. L. G.

[12424.]—**Preserving Green Peas, Gooseberries, &c.**—Put your gooseberries in bottles (having picked off the tops and tails), then fill up the space between them with powdered lump sugar. Place these bottles in a boiler, having in it as much cold water as it will hold without floating the bottles; place the boiler on the fire and let it remain there till the sugar is dissolved by the heat. Then cork them down, and if they are air-tight they will keep for years. Be very careful that no water gets into the bottles. This is called bottling. A cheaper, and, to my mind, a nicer way is to put the fruit into bottles and then cork and seal them, and bury them about three feet in the ground. I have never tried peas, but I should think they would keep, if treated in this way. French beans may be preserved as follows:—Wash, cut, and prepare for cooking some young beans, then procure a large-mouthed glazed jar, and put a layer of salt at the bottom about an inch thick, then wipe your beans quite dry, and put a layer of them in, then some more salt, and so on. Tie your jar down and keep it in a dry place, soak them in cold water for six or eight hours before you use them, and you will be able to have fresh French beans for your Christmas dinner.—Sacristan.

[12424.]—**Preserving Green Peas and Gooseberries.**—I have always seen gooseberries, &c., preserved during the winter in bottles. Take some dry bottles and cork them down tightly, then place a seal over the cork and bury them in the earth in your garden.—Tom-Tit.

[12427.]—**Entomological.** — Will "Mimosa please to describe the "maggot" in the cabbage stem. Is it stiff and yellow? "Mimosa" speaks as if there was but one insect peculiar to decaying cabbages. How I wish it was so!—Old Amateur Gardener.

[12431.]—**Bees.**—"Willie Scorer" in trouble again; but "Willie" should give more particulars. He should say what kind of hive he wants to deprive, what it weighs, and whether the weight is made up of brood or honey. If he takes all the honey, what does he propose to do with the bees and the brood? If he has only one hive he might as well smother them at once as expect them to live without combs or honey. If "Willie's" one hive has yielded him first, second, and third swarms, he surely ought to be content with them as profit for one year, without seeking to deprive the old stock still further. "Willie" cannot transfer the combs of this year's swarms to bar frames, as they will be too tender, otherwise, if he determined to take the honey from his original hive, he might fill one or two frames with the brood combs, and add them with the bees to his second or third swarm. I cannot say whether second or third swarms will stand the winter without knowing more about them. If they came in May and were tickled with a few pounds of syrup at intervals they would probably outstrip the first swarm, provided they did not lose their queens. One reason for this lies in the fact that second and third swarms always have young queens, and are very vigorous.—C. N. Abbott.

[12441.]—**Ants.**—If Thomas Letchford will lay a few pieces of camphor in their tracts, he will find that they will cease their depredations.—Clinchey.

[12446 and 12453.] — **Manganese Battery.**— "Edward Henry's" difficulty arose from damp facilitating the capillary rise of the liquid. He must not connect both ends to earth on any account, or his battery will rapidly work itself to exhaustion, but this has nothing to do with the injury to the connection. "D. J." has made a very bad connection; no solder should be used with the platinum, but simply a piece of foil inserted at the contact. The best connection is made by depositing copper on the top and thoroughly soaking the upper part of the carbon with paraffin. The next best is put the top of the carbon in a mould and run lead over it, also saturating the upper part afterwards with paraffin to prevent the creeping up of the solution.—Sigma.

[12469.]—**Bees: How to get a Swarm.**—"G. F. Godden" does not understand the driving or drumming process evidently. When a swarm is drummed up as described by Mr. Godden, the queen should be with it, and unless it is ascertained from actual observation that the queen is there, the swarm cannot be considered perfect. The great mystery as to queens is in the mode of transforming the ordinary worker egg into a queen bee instead of a worker bee. The so-called woman's reason, "'Cos it is," is not sufficient for scientific bee-keepers; but all their research and observation have not enabled the best of them as yet to give a better, so it is still a question under discussion. It will be for the old stock to raise a new queen. Driving is simple and easy enough; but the question of its desirability at this time of year is another matter, which depends, of course, on circumstances of which the minutiæ are not given. Bees hanging out is an indication of overcrowding, but not always of intended swarming, and Mr. Godden would have been wiser, if, instead of waiting for a second swarm, he had given his bees more room. Is Mr. Godden quite sure that his bees are not queenless? Queenlessness will induce apparent laziness in bees after a short time for the simple reason that after a swarm has left the occupants of the hive fill each cell with honey as it is vacated by the young bee, and the failure of the young queen on her wedding trip renders it impossible either for the bees to take possession of the offered super, or to send out another swarm. Consequently, they fill up the cells as fast as they are vacated, and themselves are crowded out for the time being. If Mr. Godden intends to drive out a swarm, he should do it quickly, as if long delayed the swarm will not only be liable to perish in winter for want of stores, but the old stock may perish for lack of drones to fertilise the young queen. I cannot recommend driving at this late period. If Mr. Godden has lost his chance of a super while waiting for a second swarm, he had better accept the position, and be wiser next time. Perhaps he could cut out the side combs of his hive, which are almost sure to be filled with honey, and there will yet be time for his bees, if they are strong, to replace it; but for the information of all those who intend to cut out honeycomb from their stock hives, it may be well to state how that, as a rule, all new comb built now for storing purposes will be drone comb.—C. N. Abbott.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Dusty Miller" has answered 11892; "Outgenious Whitesmith," 12001, 12008; "Rat-Tat." 12001; "Young Snip," 12023; "T. B. S.," 12053; "Saul Rymea," 12091, 12093; "Clinchey," 12103; "Electro," 12117.

12139 Mechanical Education, p. 341
12140 Chemical, 341
12141 Watchmaking, 341
12147 Cochineal, 341
12153 Ant-hill Earth, 341
12159 Limejuice, 341
12166 Enfield Rifle, 341
12167 Dry Soap, 341
12170 Dyeing, 341

QUERIES.

[12476.]—**Bee Keeping.**—Can any beekeepers inform me the best mode of transferring the bees from a straw skip to a wooden bar hive? I cannot succeed in driving or fumigation, as in two cases they have amalgamated with other hives the day after. I have had a "Myborg cabinet" in operation for a month, and the combs are all built in the second compartment, and diagonally instead of straight with the frames, &c.—B. H. J.

[12477.]—**Water-glass.**—Will any reader inform me of the best method of constructing a water-glass, and what is the greatest depth that I might expect to get a view of the bottom of the sea, the water being clear at the time?—L. Z. J. B.

[12478.]—**Sour Ale.—Heats of Mashing.**—I have a brewing of ale over twelve months old, which has an opal colour and a peculiar sweet-sour taste. Can any of your numerous correspondents give me a remedy for it, so that it may be sold? Also, what are the best heats for mashing two mashes?—Young Brewer.

[12479.]—**Scouring and Bleaching Flannels.**—Would some correspondents inform me how to scour and bleach flannels a very pure white (stating the chemicals and their quantities), and name a good modern work on the subject and its author?—Old Fuller.

[12480.]—**Silk Working.**—A portion of our silk works through small iron holes called males, attached to thread, and, by standing, it has rusted them, making them too rough for the silk. What is the best thing for taking the rust off without injuring the thread attached?—Anxious.

[12481.]—**Wax Moth.**—It would greatly oblige me if some friend or beekeeper would inform me how to destroy the egg or maggot of the wax moth in some empty combs that I wish to save, and what is the best way to keep brood combs free from this destructive little moth?—R. A.

[12482.]—**Integral and Differential Calculus.**—What is the practical scientific use of the integral and differential calculus? With what branches of mathematics is an acquaintance necessary before entering upon this one? Which is the best rudimentary treatise?—Excelsior.

[12483.]—**Rewiring Old Piano.**—I have an old square piano, 5 octaves, it has very thin wires, some of which are broken. I think of rewiring it with thicker ones. Will some brother reader kindly inform me what numbers of wire I ought to put in, stating where each number breaks off and the next begins? Also, if it will do to put plain wire for the bottom notes, instead of covered?—H. W.

[12484.]—**Inorganic Chemistry.**—Will any of your readers kindly inform me what book or books to study, in order to pass first class in the third stage for honours, in the next examinations of the Science and Art Department? I should also like to know what the honours consist of, and for what they will be given. Any information on the above will be thankfully received.—Science and Art.

[12485.]—**Electrotype Casting.**—Having a cast in lead of the Lord's Supper, and wishing to obtain an electrotype of the same in copper, I should feel much obliged if any of your readers could inform me the easiest way of doing it.—An Admirer of the Art.

[12486.]—**Machine for Cleaning Boots.**—Will some kind reader tell me if there is a machine for cleaning boots? If so, please give a description of it.—S. J. R.

[12487.] — **Annealing Spring Steel.**—Will any brother reader kindly describe a simple method of annealing spring steel, so that it may be welded as easy as iron? Also tempering elliptic springs.—Blaze.

[12488.]—**Zinc for Hot-water Tank.**—I am about to build a hot-water tank for cucumber growing. Will zinc stand hot water? I have been told that it will not. Will some kind friends give me their experience or opinion of it? I have tried galvanised iron, but that soon rusts.—F. G. C.

[12489.]—**Lacquering Brasswork.**—I have been lacquering some brasswork, the colour of which is hardly deep enough. Will any of "our" readers inform me if brass-finishers ever apply more than one coat of lacquer—if so, must the work be re-heated or how?—Electro.

[12490.]—**Grape Culture.**—Will some kind reader inform me of a good practical book of instructions on the culture of grapes and greenhouse plants of the commoner species—viz., bedding plants, &c.?—Horatio.

[12491.]—**Overgraining.**—Can any of your correspondents recommend a good substitute for beer, so largely used in overgraining? I have frequently noticed a newly grained door, even after two good coats of varnish have been applied, go quite dead on those places overgrained, while the remainder has kept bright. This, I think, shows that the beer used utterly destroys the varnish. Perhaps some of "our" practical friends will throw a light on the subject.—Harry G. Newton.

[12492.]—**Show-stand.**—I shall be obliged if some one of "our" kind readers will give me a hint or two as to the best and cheapest system of driving the above, for being placed in the window of a draper. I want to work about 3 or 4 revolutions per minute. The stand is 24in. diameter and 6ft. tall, intended to be filled with light articles.—Omnes.

[12493.] — **Grove's Gas Battery.**—Would some kind electrical correspondent to "ours" give a description of "Grove's gas battery," and tell how many square feet of platinum it would require to make 20 cubic feet of the mixed gases at the pressure of the atmosphere combine and form water; also, how many wires to conduct the electricity away would be wanted; and, if I decomposed water with the current of electricity, how much less of the mixed gases would be made than I had in the first place?—Vulcanite.

[12494.]—**Hardening Teeth.**—Last winter I had a severe attack of ticdoloreux, and I took some quinine as advised, but since then I have repeatedly had pieces of my teeth breaking off whilst eating. Would some fellow reader tell me what I could take as a remedy?—W. E.

[12495.] — **Watchmaking.**—To "Seconds' Practical Watchmaker."—Referring to the article on "The Watch, and how to Repair it," in the English Mechanic, by "Seconds' Practical Watchmaker," I wish to ask him if he will favour us with a full description of the improvements effected by our foreign neighbours in the angle of the escape-wheel tooth in the horizontal escapement. I may at the same time ask him why a fast train movement keeps better time than a slow train, in doing which I would refer him to my query on the "Trains of Lever Watches," in the English Mechanic, Vol. XV., p. 492.—West Cornwall.

[12496.]—**Stained Scarlet Tunic.**—Will some one kindly tell me what will take stains out of a scarlet tunic? The stains have been caused by the hilt of a sword rubbing against the cloth.—E. B. H.

[12497.]—**Horizontal Escapement.**—I would ask why it is in the horizontal escapement that if you deepen the escape-wheel depth in the cylinder the arc of free vibration is lessened, although the balance has to move through a greater arc to obtain the escape of the wheel from tooth to tooth. I have my own explanation of the matter, but should like to see the subject treated by "S. P. W."—West Cornwall.

[12498.]—**Green Shade.**—Can I put anything in the vat along with lime, indigo, and sulphite of iron, so as to keep the oxygen from acting upon it, and not turn blue as it always does when exposed to air? I want to keep the green shade as it is when it comes out of the vat.—Omnes.

[12499.]—**Trigonometrical.**—The hypothenuse AB of a right-angled triangle is divided at D, so that AD is to BD as CB is to CA. Show that—

$$\tan. \angle CD = \frac{a^2}{b^2}$$

$$CD = \frac{\sqrt{a^4 + b^4}}{a + b}$$

Can any one show me how this is proved, and say whether there are two solutions or not?—W. H. H. C.

[12500.]—**Land Surveyor.**—Will some reader of "ours" inform me what are the duties of a land surveyor? Also, what course of studies should an intending one go through, what books should be read, and what instruments are required?—Thomas Tomlinson.

[12501.]—**A Cheap Gas.**—I would feel much obliged to any of "our" chemists for the information as to the cheapest materials and how to use them in order to produce a gas in quantity, which need not necessarily be inflammable, but must not be heavier than air, and to state probable cost of producing any given quantity of same.—A., Liverpool.

[12502.]—**Neville's Bread.**—Will some one inform me how this kind of bread is made?—GRAMNIVOROUS.

[12503.]—**Testing Tartaric Acid.**—I am using a large quantity of tartaric acid, and I think that it is not pure, but it is adulterated with alum. If so, can any reader give me a simple test to find alum, and oblige—AERATED WATER.

[12504.]—**Sketching from Nature.**—Would some correspondent inform me of an apparatus (cheap and portable) to get in the proportions of a view from nature, or tell me how to make it? A drawing of it would greatly oblige—THOMAS KING.

[12505.]—**Plating Steelwork of Bicycles.**—Can some one tell me the process of nickel or silver plating bicycles; the apparatus required, and the cost for a 48in. ariel bicycle?—EDDY.

[12506.]—**Power of Engine.**—Would some one tell me the nominal and effective power of this engine:—Cylinder, 20in. diameter, 18in. stroke, steam cut off at two-thirds of stroke 100 revolutions per minute, 40lb. pressure of steam in boiler.—HECLA.

[12507.]—**Cricket-bat Making.**—I would feel obliged if any person would give me some particulars concerning the making of cricket-bats; also the kind of wood used.—W. B.

[12508.]—**Eloby.**—Will one acquainted with the West Coast of Africa say where a place called Eloby is, and what is the character of the climate there? I fancy it is a trading-port on one of the coast rivers.—T. SINCLAIR.

[12509.]—**Chemical.**—Will "Sigma" kindly say if there are any salts of carbolic acid which are insoluble in salt water?—T. SINCLAIR.

[12510.]—**Camera Obscura.**—I am wishful to construct a camera obscura as per the instructions given in ENGLISH MECHANIC, No. 332, p. 494. Will some kind friend oblige me with the dimensions of the necessary oblong and sliding boxes? I hardly understand the plan given with respect to the square K. L., cut away at the top of the box in which the ground-glass is inserted. Is it inserted flat or is it placed in a raised position?—G. F. FURNISS.

[12511.]—**Gas.**—Will some one kindly state about how many cubic feet of gas can be produced from a ton of ordinary gas coal?—A., Liverpool.

[12512.]—**Spotted Kid Gloves.**—Can any of your readers inform me whether any remedy is known for gloves (coloured kid) which have been spotted through exposure to damp, as I have a large stock of them and wish to avoid loss if possible?—W. S. B.

[12513.]—**Astronomical.**—Would "F. R. A. S." or some other correspondent kindly inform me what are the corresponding numbers in the B. A. catalogue to Struve's 73 Ophiuchi, 2406 Draconis, 2878 Pegasi, 26 Pegasi, and 36 Andromedæ.—C.

[12514.]—**Elder Flower Water.**—Will any one kindly give me directions how to make elder flower water as sold by chemists: also lavender water?—T. H.

[12515.]—**Mowing Machine.**—I have a mowing machine by Burgess and Key, the knives of which are constantly breaking. They are driven by a very short rod, and all other machines have a long rod; is that the cause of its breaking? The machine is very good if we could get over that difficulty.—A COUNTRYMAN.

[12516.]—**Mathematical.**—It is known that—

$$\cdot 1 = \frac{1}{10} = \frac{100}{1000}$$
$$\cdot 11 = \frac{11}{100} = \frac{110}{1000}$$
$$\cdot 111 = \frac{111}{1000}$$

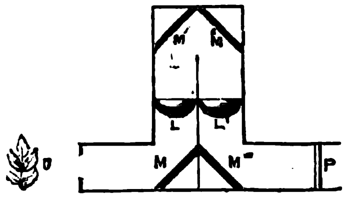
i. e., as the number of figures in the decimal is increased, the numerator of the fraction formed differs less and less from the denominator. Therefore, in the limit, which is $\cdot\dot{1}$, will not the numerator be theoretically equal to the denominator, and $\cdot\dot{1}$ equal to 1 instead of $\frac{1}{9}$?—NEANISCOS.

[12517.]—**Mathematical Machines and Tables.**—Some time since I saw Babbage's calculating machine—I think in Kensington Museum. I am at a loss to understand the exact object the inventor had in view, and although I have read several popular descriptions of it, still they do not describe it as I could wish. Perhaps some of "our" mathematical friends will kindly explain the matter, or tell me in what book a clear and full account of the machine is given. The information I am anxious for is:—1. Are the *Nautical Almanac* tables calculated by such a machine? 2. Are such tables formed in regular progressional numbers, or are they differential? 3. If differential, is the ratio regular, or do the tables consist of combinations of ratios differential or regular? 4. Did the machine in question ever realise the expectations of its inventor and become of use, or has any other machine supplanted it? An example of the tables, to illustrate them, would no doubt interest many besides—A. B. W.

[12518.]—**The Island of Hayti.**—I shall be much obliged for information about this island. What is the present form of government and who is ruler? Does Spain still possess a part of it? What language is in use, and is there any commerce carried on with Great Britain? Closely connected with the island is the name of "Toussaint L'Ouverture," the great Negro chief, who was so cruelly deceived and maltreated by Napoleon I. I should like to know how and where he died, and what became of his family?—J. L. WHITAKER.

[12519.]—**Acarus Crossii.**—Many years since the late Mr. Cross announced a series of electrical experiments continued for a lengthened period, by means of which he produced the living electrical acarus. Can any of your correspondents give me any instructions as to the details of apparatus required? These curious experiments no doubt have been repeated by others. Any information on this subject will be highly valued, and will much oblige—AUSTRALIAN SUBSCRIBER.

[12520.]—**Fluid Lens for Photography.**—Will any one tell me if it would be possible to construct a camera obscura by the following arrangement?—The rays of light flowing from the object O, are by the series of mirrors M M' M'' and M''' sent through the lenses L and L', which I propose to make of watch-glasses, L to be filled with water, and L' with sulphuric acid, in order to have them of different densities and thus make



them achromatic. P is the prepared plate on which the image would be reflected by M'''. I should also like to know how to find the focus. Suppose it found, would moving the object nearer to or further away from M alter it? Would the focal length be from L' to the plate, or only from L' to the mirror M'''?—TNETAP.

[12521.]—**Value of Locomotives.**—Can any one inform me what is the value of goods and passenger locomotives, such as the London and North Western Company are now building, according to present state of iron and labour markets?—EXCELSIOR.

[12522.]—**Length of Pendulum.**—Will some kind brother in the watch trade please give me his opinion as to the length of pendulum springs, as I find they vary from 8 to 12 turns, the more coils the less affected by change of temperature?—CONVERSION.

[12523.]—**Lacquer.**—How can I make a blue lacquer suitable for gun furniture and edge tools, and how is it applied?—WALSALL.

[12524.]—**Holtz Electrical Machine.**—Do you think it would be possible to substitute a disc of tin covered with sealing-wax varnish in the place of the smaller glass disc in the Holtz electrical machine?—TNETAP.

[12525.]—**To "F.R.A.S."**—In using "Bessel's Tables" and making the necessary corrections for refraction, how is the observer to calculate or ascertain the "apparent altitude" of a star above the horizon at the particular moment of observation, so as to determine the exact allowance to be made in setting the circles of his equatorial? A few lines in explanation of this matter would greatly oblige a puzzled—TYRO.

[12526.]—**Camera Lucida.**—Will any reader kindly give instructions for making a cheap camera lucida for the microscope?—ALF.

[12527.]—**Mounting Chalk for the Microscope.**—Will any subscriber kindly tell me the way to prepare chalk as an object for the microscope?—ALF.

[12528.]—**Hay Asthma.**—I shall feel extremely obliged to some of "our" correspondents if they could tell me of any means that I could use that would relieve my complaint. I am troubled every year for several months with what is called the hay asthma. I am under seventeen.—KATE.

[12529.]—**Improved Machine for Making Aerated Drinks.**—In the letter of "H. B. E." (4406) upon the above subject, he says the gas for aërated drinks is made from sulphuric acid and common whiting. Would he kindly let me knew the proportions, and whether it can be produced by any other compounds?—495.

[12530.]—**Name of Plant.**—Will some one tell me the name of a plant or herb that grows by the side of hedges with willow-like leaves on the ground, from whence rises up a stalk branching out into four or five branches with leaves at the bottom, and a flower spike at the top nearly a foot in length almost like agrimony, but the flowers are of a green colour, after which come four or five small green seeds.—T. B. S.

[12531.]—**Flatting.**—Having a little knowledge of house painting I have painted the walls of my room 7ft. high, and should be glad if some kind friend would let me know if there is any method of keeping the last coat called flatting alive sufficiently long, so that I may do a flank at a time by myself, and with due care have a dead colour. I have heard of a few drops of olive oil being applied, but it has gone off and part is left shiny.—PUTTY.

[12532.]—**Republican Months.**—Can any reader inform me the names of the months according to the ideas of the French Republic and their English equivalents?—J. L. WHITAKER.

[12533.]—**Magnetic Machine.**—Will "Sigma" or any reader tell me how the connections of the wires in an electro-magnetic machine are made in using different powers (say 1, 2, 3, 4 powers)? I have thought of insulating the primary coil from the secondary by gutta-percha tissue; and in winding on the secondary wire should I coil a portion of the wire, say for the first power, insulate again, wind on another portion and insulate again, and call that the second power, and wind and again insulate for the third power? A diagram of the connections will greatly assist.—CRITERION.

[12534.]—**Spring Furnace.**—Would any brother reader oblige with drawing of furnace, used to temper the leaves of bearing springs for railway trucks?—A. E.

[12535.]—**Spots on Whitechapel.**—What is the cause of water-stains on my "Whitechapel." When the man washes the trap, no matter whether dry or damp weather, the stains set as soon as water is thrown on, and no amount of drying with leather or sponge will take them out, but I have found that when it has not been used at long intervals of (say) a fortnight, they nearly fade away. I should be thankful to know the cause and prevention of this?—J. W.

[12536.]—**Speculum Grinding.**—Would Mr. Purkiss kindly answer the following queries? Suppose a 6in. speculum placed on the centre of a grinding tool does the stroke (⅓ diameter, or 2in.) mean 2in. over each side of the tool, or only 1in. over each side? and if the side motion (¼ diameter or 1½in.) means 4½in. over each side, or only ¾in. over? Does the 2in. stroke mean 2in. over one side only, and the speculum brought back again to the centre?—W. S. S.

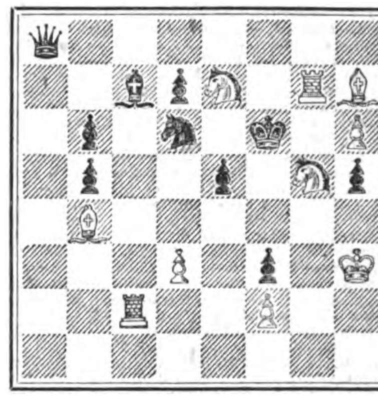
CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The contest for the "Challenge Cup," open to English players only, has terminated in favour of Mr. Wisker, who, having won the cup twice in succession, is, according to the conditions of the competition, entitled to its possession. The cup was presented by the "Association" in 1866, on which occasion it was won by Mr. de Vere. In 1868 Mr. de Vere and Mr. Blackburne tied, but ultimately the latter was declared the victor. In 1870 Mr. Wisker won the cup. This year he and Mr. de Vere tied, but in playing the final game fortune favoured Mr. Wisker, who thus retains the chess championship of the country.

PROBLEM VIII.—BY R. B. WORMALD.

Black.



White.

White to play and mate in three moves

SOLUTION TO PROBLEM VII.

White.	*Black.*
1. Kt to Q 3	Black's moves are forced
2. K to K Kt 5	
3. Kt mates	

TO CORRESPONDENTS.

INDUCTORIUM AND HERMES.—The reply to the moves you suggest in Problem VI. are respectively (1.) R to Kt sq. dis. ch. and mate, and (2.) B to R 2 dis. ch. and mate.

A. L. (Dulwich).—The *Westminster Papers* can be obtained through W. Kent and Co., Paternoster-row.

M. MARKS (Swansea).—The best way of marking the position of the men on blank diagrams is by inscribing their initials: W K for white king, B Kt for black knight, &c.

W. H. WHITFIELD.—Your problem is correct, and shall appear as an enigma.

Problems received with thanks from H. Meyer, G. Heywood, and Inductorium.

Correct solutions to Problem VI. (continued).—J. Beresford (Vauxhall), T. M. T., S. H. H., York.

Correct solutions to Problem VII. have been received from A. W. Cooper, R. A. Proctor, C. J. L. (Portsmouth), H. Cherry, J. Beresford, G. Heywood (Great Torrington), and H. A. Hall, Chester. All others are wrong.

MR. H. H. CROFT, of Toronto, has discovered that the air over crystallising iodic acid becomes ozonised in a striking manner.

Embalming Bodies by Injection.—*Les Mondes* reports that the system of M. Gannal, of embalming bodies by injection, which was effected by opening the jugular vein or the carotid artery, will probably be superseded by M. Audigier's plan, in which the preserving fluid is introduced through the mouth and the larynx. About six ounces of the fluid is sufficient for the purpose, and the body should be covered with some vegetable powder soaked in the same liquid. The body is by these means completely preserved, and is entirely "mummified;" it requires a durability equal to that of wood or stone, and the facial colour remains as it was at the moment of decease. The most eminent physicians, surgeons, and anatomists in France have, it is said, testified to the efficacy of the system, which has, in addition to the advantages already mentioned that of perfect innocuousness and complete disinfection. The liquid is believed to be carbolic acid, and the mode of application is the same as that devised by Professor C. A. Seeley, of New York, and by him very successfully applied to the preservation of bodies at the hospitals there.

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Amount previously acknowledged	£338	3	1
F. M. C	1	1	0
H. Neal, Rosenech, Vaud	0	4	2
	£339	8	3

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, July 23, and unacknowledged elsewhere:—

L. de Fontainemoreau and Co.—Wm. N. Roberts.—Major Locke.—Right Rev. James Lynch.—Irish Mechanic.—Jack of All Trades.—Wm. Coleman.—Wm. Piper.—S. Bottone.—J. J. Pyne.—Exhibitor.—W. H. P.—An English Mechanic.—Majico.—E. S. T.—Templar.—S. Trevail.—Julius Hall.—F. R. Leyden.—Charles Woodhead.—Mrs. Ethell.—Alfred W. Allen.—Wm. Brown.—R. Middleton.—Enquirer.—W. J. V. Gerard.—E. L. G.—Planette.—An Improver.—Veritas.—J. Rushwood.—Ignorant.—C. J. C.—Joseph Hudson.—P. E. M.—Administrator.—W. M. Colles.—Athelstane.—H. J. W.—F. R. C. P.—W. E. Parker.—J. R. F.—Plus.—Anxious.—Out of Pocket.—Colonist.—Rodger.—A Distressed One.—W. A. G.—S. Selwyn.—Shamrock.—Pegasus.—A Sawney.—Non Science.—Landsend.—G. Moulder.—Green Drake.—C. N. Abbott.—J. T. Culpepper.—W. R. Bird.—G. W. K. L.—Inquirer.—Gy.—J. L.—A. B. M.—H. Meyer.—Suffolk Amateur.—M. Paris.—C. J. Hindle.—A Young Astronomer.—J. Gillingham.—Delta.—W. Clarke.—W. H. Neal.—William Lea.—X. Y. Z.—A Five Years' Subscriber.—Bernardin.—Wm. Tipper.—R. K. Jones.—R. A. Proctor.—Albert S. Bradley.—James Hill.—March and Pattison.—Sigma.—J. W. Buck.—F. M. Crichton.—W. B. Hibbs.—W. Wade.—Mechanic.—A. J. Wilson.—James Cain.—J. R. Nichols and Co.—Geo. Sant.—Charles Baker.—Thomas Fletcher.—The Harmonious Blacksmith.—Seconds' Practical Watchmaker.—M. A.—Banjo.—R. N. S.—Violinist.—Analyst.—W. H. H. C.—M. A. B.—Francis Lewis.—One in a Fix.—E. Parker.—G. W. C. H.—R. M. M. S.—E. H.—E. B. Shaw.—Ohio.—Marcus Ruddle.—Old Ploughman.—Philo.—W. W.—R. P.—Linum.—Water.—A Sufferer.—Sucram.—G. A. Ames.—H. G. W.—F. F. C.—Theodolite.—A County Bookbinder.—W. Wray.—Joseph Wm. Fennell.—J. M. G. Brookwood.—Duplex.—Glatton.

W. H. H. C.—Quite in order. The query next week.

James Hill.—No stamps inclosed for "Exchange" advertisement.

Disappointed Subscriber.—It is not our fault. Try another newsagent.

C. H. Waters.—See "Hints to Correspondents," No. 6.

E. S.—No. It would be a bad precedent.

J. F. Thompson.—We know nothing more about the "graphite paint" than what was said on p. 425.

Lewes Hutchins.—See "Hints to Correspondents," No. 6.

Liver.—Much too "advanced" for discussion in these columns. Get good medical advice.

Young Mechanic, A Carpenter, L. W. L., Irwell, Sufferer, F. A. R., Gy., Young Hopeful, New Trowell, J. E. P., Mechanical Publican, are referred to indices to back volumes.

Communications which can only appear as advertisements to hand from L. W. L., M. P., J. W. S., H. D. E., A Subscriber.

W. Hewitt.—Shall be glad to receive continuation of the proposed series.

Chas. Lennox.—We do not know; suppose you write to one of them and ask him.

W. S. C.—You must be regularly apprenticed to the business.

Thomas Buchanan.—Your introductory paper on astronomy is rather too imaginative for us. You lead off in this style: "What are these brilliant scintillations? Whence and wherefore their eternal fires? Are they the distant lamps of celestial palaces, kindled on the floor of heaven (!) and showering down their nightly radiance on the soul of the sleepless gazer, for the sublime purpose of exalting his aspirations to some nobler state of being?" &c., &c. We do not know, but "F. R. A. S." would doubtless at once give the required information.

Cottager.—Your plan of laying out a garden would take a much larger engraving than we could afford space for.

W. E.—Your able letter on Linguistic Theories in answer to "E. L. G.," would inevitably launch us on a sea of theological discussion, and we therefore cannot insert it.

C. E.—The omission of the word "water" in the paragraph headed "A New Dryer," p. 439, renders it useless. We reproduce it in a corrected form this week. Thanks.

Walsall.—For information how to make emery wheels, see Vol. XIII., pp. 292, 366, 520.

Jack of All Trades.—"Suffolk Amateur" writes: "Though your subscription list seems closed, may I ask you to allot me a share in the contribution to your clever and obliging correspondent 'Jack of All Trades,' for whom I inclose my cheque for £3. I dare say it will not be a bad investment." We have forwarded the money to "Jack," and in his name thank "Suffolk Amateur."

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JULY 16, 1872.

1989 J. Rabone, Birmingham, for improvements in spirit levels and plumb spirit levels. A communication.

1990 H. J. H. King, Glasgow, for improvements in apparatus for obtaining motive power for pumping or for measuring fluids.

1991 W. K. Birkinshaw, Derby, for improvements in machinery for cutting or holeing coal.

1992 J. Chenhall, Totness, Devonshire, for improvements in sewing machines.

1993 J. Holmes, G. T. Holmes, and F. R. Holmes, Norwich, for improvements in the construction of machinery for elevating, raising, and stacking hay, corn, straw, and other substances.

1994 A. Kay, Ince, Wigan, for a combined machine of wood and iron for ice breaking, and beveled swinging drawing paddle for boats or barges on still water.

1995 E. Davies, Liverpool, and S. Dawson, Manchester, for an improved exhaust and blast for millstones.

1996 J. M. B. Baker, Southsea, for an improved disinfecting and deodorising apparatus for water-closets and other purposes.

1997 W. E. Newton, Chancery-lane, for an improved process for surface-hardening steel. A communication.

1998 W. Evans, Willesden, and H. Cochrane, George-street, Portman-square, for improvements in table knives and forks.

1999 J. Wallace, Grove-street-road, N.E., for improvements in gas stoves and burners, and regulating apparatus to be used in connection therewith.

2000 J. Gillott and P. Copley, Barnsley, Yorkshire, for improvements in machinery or apparatus for cutting or getting coal, stone, and other minerals.

2001 J. L. de Montolson, Chancery-lane, for improvements in means and apparatus for removing the hair or fur from skins, and applying the same to various useful purposes.

2002 J. L. de Montolson, Chancery-lane, for improvements in tanning and in apparatus connected therewith.

2003 W. Thwaites, Cromwell-road, Brixton, and E. Fondeville and G. Bertin, Gaisford-street, Kentish Town, for improvements in the preparation of glaze or coating suitable for covering stone, earthenware, plaster, furniture, and other surfaces.

2004 W. Thwaites, Cromwell-road, Brixton, and E. Fendeville and G. Bertin, Gaisford-street, Kentish Town, for an improved composition or admixture for preserving walls from dampness, and for other purposes.

2005 W. Mitchell, Brandon, Suffolk, for improvements in ladders.

2006 G. Noble, Woodford-bridge, Essex, for improvements in the method of treating various kinds of fibrous materials for the manufacture of writing, printing, and other paper.

2007 J. Stones, Ulverston, Lancashire, and J. Castles, Manchester, for improvements in revolving and other shutters, and in temporary partitions, parts of which improvements are particularly applicable for preventing the transmission of sound while giving access between portions of a schoolroom, chamber, or other apartment temporarily divided.

2008 E. Le Gros, Stoke Newington, for improvements in drilling machinery. A communication.

2009 H. D. Furness, Whickham, Durham, for improvements in hydrostatic weighing and lifting machines for adjusting the weight on springs of locomotives, waggons, and carriages, and for other purposes.

2010 J. Vine, sen., J. Vine, jun., J. Brown, and J. A. Skinner, Eastbourne, for improvements in fire-arms.

2011 E. Newbold, Nottingham, for improvements in furnace bars.

2012 P. Newall and J. Barker, Warrington, for improvements in machinery or apparatus for dressing or finishing leather.

2013 R. Turnbull, Campbell-road, Bow, for an improved means of raising and lowering vessels for repairs, and for other purposes, and in the construction and arrangements of submergable pontoons and apparatus connected therewith.

2014 J. T. Parlour, Rutland-street, Pimlico, for improvements in apparatus to be used in the formation of asphalte and other pavements.

2015 S. J. Payne, Charlton, Kent, for an improvement in the manufacture of fire-bricks, crucibles, retorts, and other fire-ware goods.

2016 J. Crop, Homerton, for improvements in tobacco pipes.

2017 W. Gorman, Glasgow, for improvements in manufacturing iron and steel and in apparatus connected therewith, part or parts of such improvements being applicable to various kinds of furnaces, and for the production of gases for heating and illuminating purposes, and for coking, carbonising, or calcining other substances.

2018 G. Westinghouse, jun., Southampton buildings, for improvements in brake apparatus for railway carriages.

2019 D. Cunningham, Dundee, for improvements in the construction of breakwaters, sea walls, and other subaqueous works.

2020 J. F. Stewart and H. Defty, Middlesbrough, for improvements in and connected with puddling furnaces.

2021 W. McLaren, Glasgow, for improvements in machinery for sawing or cutting wood.

2022 P. Jensen, Chancery-lane, for improvements in charging furnaces and in the construction of furnaces and steam boilers. A communication.

2023 W. Richter, Prussia, for an improved machine for breaking bar iron.

2024 A. Sauvée, Parliament-street, Westminster, for improvements in the distribution for engines multiplying the power of the prime mover. A communication.

2025 J. Vavasseur, Southampton-street, S.E., for improvements in breech-loading ordnance.

2026 H. Uhry, Haxell's Hotel, Strand, for improvements in locomotive engines.

2027 L. P. Dore, Store-street, Bedford-square, for an improved contrivance for securing false hair on ladies' heads.

2028 W. Smith, Dublin, for improvements in railroads and in carriages to be used thereon.

2029 B. J. B. Mills, Southampton-buildings, for improvements in sizing paper, paper pulp, cotton, linen, and other fabrics and materials, and in materials to be employed therefor. A communication.

2030 Sir J. Bethune, Fifeshire, N.B., for improvements in wheels, especially applicable to traction engines.

2031 T. Clark, Aberdeen, for improvements in winnowing or seed-dressing machines.

2032 S. Alley, Glasgow, for improvement in steam boilers.

2033 J. Miller, Aberdeen, for improvements in purifying and decolourising hydrocarbons.

2034 R. H. Allen, Essex, for improvements in the construction and general arrangement of ships' passengers' berths for married couples.

2035 B. Todd, Newcastle-upon-Tyne, for improvements in the treatment of gases and fumes.

2036 E. J. L. Coillot, Barcelona, Spain, for improvements in the manufacture of lighting and heating gas, and in apparatus and burners connected therewith.

2037 W. Brunskill, Liverpool, for improvements in mechanism for forming bungs and similar tapered articles.

2038 I. Simonett and G. Roberton, jun., Bradford, for improved machinery or apparatus to be employed for removing motes and burrs from woven fabrics.

2039 E. Umbers, Leamington Spa, Warwickshire, and A. G. Fenn, Beccles, Suffolk, for improvements in and apparatus for signalling on railways.

2040 T. H. Ward, Staffordshire, for improvements in pulley blocks for raising and lowering weights or heavy bodies.

2041 A. M. Clark, Chancery-lane, for improvements in cylinder printing machines. A communication.

2042 D. Peattie, Edinburgh, for improvements in shades or blinds for windows.

2043 J. Foster, jun., Westmoreland, for improvements in machinery for manufacturing twine and other cord.

2044 W. Weldon, The Cedars, Putney, for improvements relating to the utilisation of dilute chlorine.

2045 W. W. Tonkin, Brixton-road, for improvements in the means of actuating the valves of engines, pumps, or liquid meters.

2046 E. P. H. Vaughan, F.C.S., Chancery-lane, for improvements in the mode of utilising the waste gases of metallurgical and other furnaces. A communication.

2047 J. Crofts and R. Dawson, Leeds, for improvements in apparatus employed in combing wool and other fibres.

2048 J. F. Elwell and J. Grove, Birmingham, for improvements in safes.

2049 C. F. Schlesinger, Holloway, for a new or improved apparatus for beating carpets and other fabrics. A communication.

2050 W. R. Lake, Southampton-buildings, for an improved process of welding brass or other alloy of copper upon iron or steel, applicable to the construction of journal boxes of axle bearings for railway carriages and machinery. A communication.

2051 J. Mathews, Tavistock, for improvements in jigging machinery for dressing ores. A communication.

2052 W. Holbrook, Manchester, for improvements in fasteners for sash and casement windows, shutters, and doors.

2053 W. R. Lake, Southampton-buildings, for an improved ventilating apparatus. A communication.

2054 J. H. Johnson, Lincoln's Inn-fields, for improvements in cooling air and gases and in the apparatus or means to be employed therein. A communication.

2055 R. R. Donovan, Dublin, for an improved drill-stock.

2056 J. Thomson and J. M. Thomson, Glasgow, for a new or improved radial drilling machine.

2057 H. R. Marsden, Leeds, for improvements in the jaws for stone breaking machines.

2058 C. D. Abel, Southampton-buildings, for an improved portable apparatus for impregnating air with hydrocarbon vapours or volatile oils for lighting and heating purposes. A communication.

2059 A. Prince, Trafalgar-square, Charing-cross, for a new or improved boring instrument. A communication.

2060 J. Vogan, Dockhead, Surrey, for improvements in raising or elevating corn, grain, or seed from one level to another.

2061 A. B. Barry, Crutched-friars, City, for improvements in sewing machines.

2062 J. O'Neill, Liverpool, for improvements in apparatus for signalling on railway trains.

2063 J. Gomersall and J. F. Gomersall, Dewsbury, for improvements in the manufacture of reversible twill cloth.

2064 W. Morgan-Brown, Southampton buildings, for improvements in type wheels for printing telegraphs. A communication.

2065 W. R. Lake, Southampton-buildings, for an improved compound, and method of preparing the same, for the construction of street pavements, and for other like purposes. A communication.

2066 J. Downes, Handsworth, Staffordshire, for improvements in locomotive and stationary steam-engines.

2067 W. R. Lake, Southampton-buildings, for improvements in fire-extinguishing apparatus. A communication.

2068 F. G. Marchant, North-street, Wandsworth, for improvements in wheels and apparatus connected therewith, chiefly designed for facilitating the movement of road engines and other heavy vehicles.

2069 J. Cook and H. Lafone, Liverpool, for improvements in blow-pipes and means of generating heat by the use of hydrocarbon or other volatile fluid, material, or substance.

2070 P. F. Guerin, College-street, Chelsea, for improvements in the construction of horse-shoes.

2071 C. M. Barker, Kennington-park-road, for improvements in propelling ships or vessels, and in the propellers to be employed therein.

2072 W. Clissold, Gloucester, for improved machinery for condensing and drawing fibrous substances.

2073 W. Morgan-Brown, Southampton-buildings, for improvements in printing-telegraph instruments. A communication.

1074 H. Lancaster, Lancashire, for improvements in locks or fastenings, principally intended as a substitute for ordinary padlocks.

2075 W. E. Ellson, Greywell, Southampton, for guarding and saving large and small ships from strandings and wrecks, and applicable to any present built ship.

2076 W. B. Adams, Lewisham, for improvements in locomotive engines and vehicles for railways, tramways, and common roads, parts of which are applicable to other like purposes.

2077 H. A. Bonneville, Piccadilly, for improvements in bits. A communication.

2078 F. J. Ritchie, Edinburgh, for improvements in sympathetic clocks.

2079 R. B. Starr, Finsbury-square, for an improved apparatus to be applied to omnibuses, tramway cars, or similar vehicles, to register the number of passenger carried and the various fares paid during a journey.

2080 G. Webb, Dublin, for improvements in coverings for draft horses.

2081 W. Morgan-Brown, Southampton-buildings, for an improvement in unison stops for printing-telegraphs. A communication.

2082 W. C. S. Percy, Manchester, for improvements in apparatus for protecting outside passengers on omnibuses and other carriages.

2083 H. E. Townsend, Southampton-buildings, for improvements in the standing rigging of ships and other vessels.

2084 A. M. Clark, Chancery-lane, for improvements in pads for stair and other carpets. A communication.

2085 C. A. McEvoy, Southwark, for improvements in circuit closers for torpedoes, and in connecting electric cables and conductors for use with torpedoes and for other purposes.

2086 W. Easton and F. Tattersall, Leeds, for improvements in air-compressing engines.

2087 J. H. Bass, Featherstone-street, City, for improvements in pots or vessels for making coffee.

2088 W. Fern, Cullingworth, Yorkshire, for an improved apparatus for economising fuel and effecting the consumption of smoke.

2089 G. D. Davis, Woodstock-road, Poplar, and T. Hopcraft, Mincing-lane, City, for improvements in machinery for working rudders.

2090 J. Chandler, Mile-end-road, for improvements in bath and other apparatus for the control of water and preventing waste thereof.

2091 F. Cole, Albany-road, Camberwell, and R. G. Acton, Thames-street, Greenwich, for an apparatus by means of which compressed air may be used instead of steam as a motive power for working engines.

2092 M. A. Muir and J. McIlwham, Glasgow, for improved appliances in connection with rotating shuttle boxes of looms.

2093 J. R. Casbay, Newman-street, Oxford-street, for an improved compound to be applied to the surfaces of wood or metal to preserve the same from corrosion or decay.

2094 A. F. Lagrange, Paris, for improvements in typographic presses, also applicable to lithography, autography, and metallography.

2095 S. Holdsworth, Durham, for improvements in looms for the manufacture of tufted carpets and other tufted pile fabrics.

2096 W. G. Beattie, Nine Elms, for improvements in axle boxes.

2097 H. C. Hill, Stevenage, Herts, for improvements in paving roads, streets, and footways, and in the construction and paving of tramroads.

2098 W. R. Lake, Southampton-buildings, for improvements in shirts. A communication.

2099 W. R. Lake, Southampton-buildings, for improvements in ties or fastenings for securing bales of cotton and other merchandise. A communication.

2100 W. Warnes, King's Lynn, and W. Mitchell, Brandon, Suffolk, for an improved apparatus for stacking or unstacking hay, straw, and other agricultural produce.

2101 W. H. Bennett, Parliament-street, Westminster, for improvements in apparatus for lighting and extinguishing public and other gas lamps or lights. A communication.

2102 D. Glass, High-street, Whitechapel, and D. Heslin, Phœnix-place, Clerkenwell, for improvements in the construction of Hansom cabs or that class of vehicles on two wheels and where the driver sits behind the passengers.

2103 J. W. Chambers, Manchester, for an improved means of affording additional security to safes, strong rooms, and other similar depositories.

2104 W. N. Nicholson, Newark-upon-Trent, for improvements in horse rakes, part of such invention being applicable to other machines.

2105 J. Salmon and J. Brownhill, Manchester, for improvements in machinery for bronzing or otherwise ornamenting paper and other materials.

2106 E. T. Simpson and F. Hurd, Walton, Wakefield, for a portable air compressor worked by animal or manual power.

2107 G. de Lara and M. de Salomos, Fleet-street, for keeping continually before the eyes of the public with the tremble of reference by means of an interleaved diary all descriptions of trades, businesses, all places of public resort and all requirements of the public which are or can or may be advertised.

2108 G. Smith, Brentford-road, Middlesex, for improvements in apparatus and means to be used when drawing off wine, beer, and other liquids.

2109 E. L. Owen, Bristol, and G. Underwood, Cornhill, City, for improvements in the purification of gas.

2110 C. Bray, Rochford, for an improved hair restorer.

2111 W. R. Lake, Southampton-buildings, for improvements in machinery for making and composing type for printing. A communication.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 2, 1872.

OCEANIC CIRCULATION.

In Two Parts.

BY RICHARD A. PROCTOR, B.A., Hon. Sec. R. A. S.

Author of "The Sun," "Light Science," "Essays on Astronomy," &c.

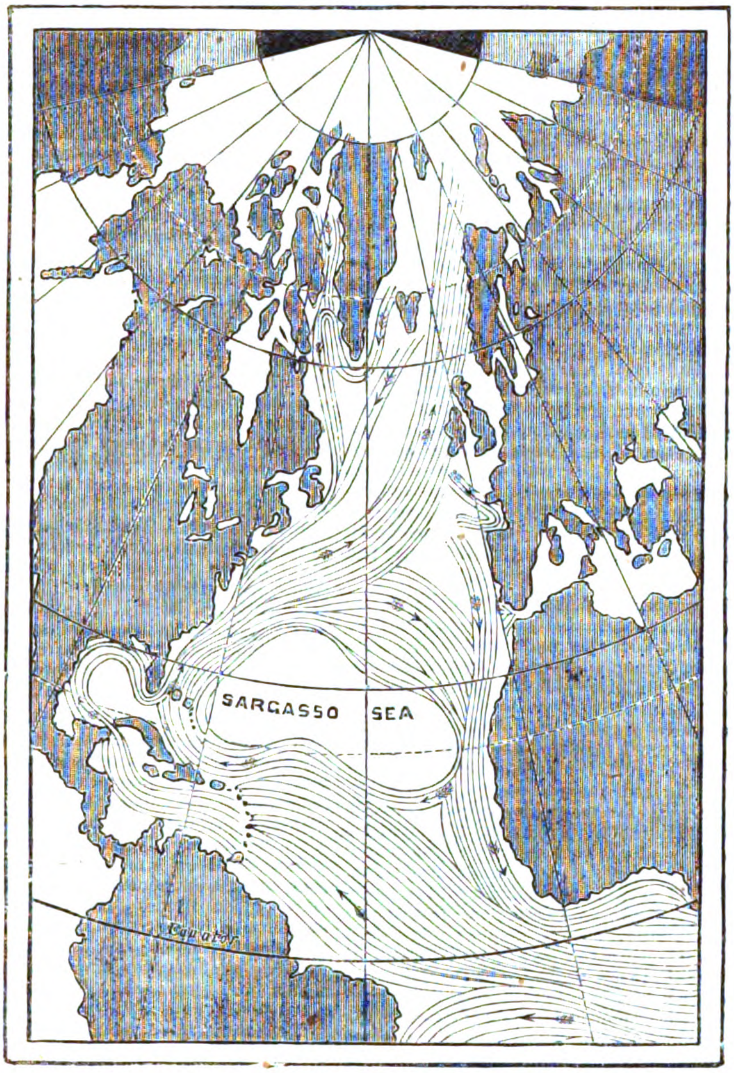
PART II.

IT is impossible to consider carefully the nature and distribution of the surface circulation without recognising the fact that there must be currents beneath the surface. It is true that one can conceive the existence of a complete system of oceanic circulation without any movement in the depths of the sea; but when we examine the actual surface-currents we find that either the commencement or the prolongation of some currents must necessarily be submarine. For instance, the quantity of water carried by the great north-easterly drift into the Arctic Ocean is very much greater than that which flows out of the Arctic Ocean, by the so-called Arctic current, past Greenland. Examining, indeed, the ordinary current charts, always drawn on Mercator's projection (seemingly because this projection is the very worst that could be devised for the purpose), we might suppose that this arctic stream was much more extensive than it really is. But what can be expected of a projection which makes Greenland (whose real area is not much greater than that of the Scandinavian peninsula) actually as large as South America. The arctic current, however, affords yet better evidence of the occurrence of submarine streams, for the extension which passes between the Gulf Stream and the United States, is in places completely lost sight of (the Gulf Stream touching the American shores), and reappears farther on. It is clear that it must have passed under the Gulf Stream in such cases.

Now, the study of the submarine currents has of late years thrown considerable light on the whole question of oceanic circulation, and has supplied the solution of some problems which had formerly appeared altogether perplexing.

We owe to Drs. Carpenter and Wyville Thomson some of the most important facts recently ascertained. Others, however, have shared in the work. I would, indeed, particularly invite attention to the fact that I do not here pretend to give anything like a complete history of recent investigations into the subject. I select only those facts which bear most significantly on the wider relations—the more marked features—of oceanic circulation.

In the first place, a result which had long perplexed physical geographers has been shown to be erroneous. It had been supposed that the temperature of sea-water below a certain depth is in all latitudes constant, and about seven degrees above the temperature at which fresh water freezes. Sir John Herschel, in his "Physical Geography," adopted this supposed discovery as well established. Now, let one consequence of such a relation be carefully noted. The surface water in the tropics is warmer than this supposed constant bottom-temperature; the surface water in arctic regions is cooler; at some intermediate latitude the surface water has the same temperature as the water at the bottom. Hence in this intermediate latitude the water is uniformly warm (according to the supposed relation) from the surface to the bottom. We may, therefore, regard the water in this latitude as constituting, in effect, a constant barrier between the tropical waters and the arctic waters. Without regarding it as absolutely immovable we should yet be compelled to regard it as so far steadfast as to negative the theory of the existence of submarine currents of an importance corresponding to that of the surface currents. Accordingly, the theory put forward by Humboldt and Pouillet to the effect tha there is an interchange of waters between polar and equatorial regions was discredited by this supposed discovery.



Drs. Carpenter and Wyville Thomson, however, have been able to show that no such relation exists. There are vast submarine regions of the Atlantic where the temperature of the water is far lower than the constant and uniform temperature believed in by Sir John Herschel. The temperature is, indeed, in places as low, or very nearly so, as the freezing point of fresh water, under a surface-temperature 20 degrees or so higher. But in other regions having the same surface-temperature the depths are 10, 12, or 14 degrees higher than that of freezing fresh water. Moreover these relations are constant, so far as the deep water is concerned.

Now, there can be only one interpretation of the circumstances here mentioned. If the depths of the ocean were unmoved by any process of submarine circulation there can be no question that a general uniformity of deep sea temperature would prevail in given latitudes. We should not find the bottom water in one region 13 or 14 degrees warmer than the water in a closely adjacent region. We have only to inquire what is the case in inland seas where no great influx of water of alien temperature can take place, to see that this must be so. Take, for instance, the Mediterranean. Here we learn from Dr. Carpenter's recent researches that "the temperature at every depth beneath 100 fathoms is found to be uniform, even down to a bottom of 1,900 fathoms; as had, indeed, been previously ascertained by Captain Spratt, although his observations, made with thermometers not protected against pressure, set this uniform temperature too high. In the western basin of the Mediterranean, as shown by the *Porcupine* observations of 1870, the uniform temperature is 54 or 55 degrees; being, in fact, the winter temperature of the entire con'ents of the basin, from the surface downwards; and being also, it would appear, the mean temperature of the crust of the earth in that region." We learn, then, two things—viz., first, that where extensive submarine motions are impossible, a constant submarine temperature may be expected to prevail in the same latitudes; and secondly, that in the latitude of the Mediterranean, the submarine temperature is about 54 or 55 degrees Fahr. Thus, it is clear, in the first place, that the varieties of temperature observed in the depths of the Atlantic must be due to the continual arrival of water of the observed temperatures, at a rate great enough to prevent the deep water from acquiring a constant temperature; and in the second place, it becomes possible to tell whence the submarine currents are flowing. If they are cooler than they should be, supposing latitude alone in question, then they are travelling from arctic towards tropical regions; and *vice versâ*. On this last point no doubt remains. In a latitude corresponding to that of the Mediterranean basin, the depths of the Atlantic are far colder, even in their warmest portions, than they would be if latitude alone were in question. "In regard to surface-temperature," says Dr. Carpenter, "there is no indication of any essential difference between the Mediterranean and the Eastern Atlantic" in the same latitudes; "and the thickness of the stratum that undergoes superheating during the summer is about the same. . . . At the depth of a hundred fathoms, in the Atlantic as in the Mediterranean, the effect of the superheating seems extinct, the thermometer standing at about 53 degrees; and beneath this" (in the Atlantic only), "there is a slow and tolerably uniform reduction at the rate of about two-thirds of a degree for every fathom, down to 700, at which depth the thermometer registers 49 degrees. But the rate of reduction then suddenly changes in the most marked manner; the thermometer showing a fall of no less than nine degrees in the next 200 fathoms, so that at 900 fathoms it stands at 40 degrees. Beneath this depth the reduction again becomes very gradual; the temperatures shown at 1,500, 2,000, and 2,435 fathoms (the last being the deepest reliable temperature-sounding yet obtained) being, respectively, 38, 37, and 36½ degrees."

Thus, there can be no possible question that the depths of the Atlantic are occupied by a vast current much colder than the deep sea temperature due to the latitude, and, therefore, necessarily flowing from the arctic towards the tropical seas.

Such are the broad facts of the Atlantic circulation. We have a surface circulation whose general features are such as have been described, and are generally admitted, though a dispute has arisen as to a question of nomenclature; and then we have a general submarine "set" of water from the arctic regions towards the tropics, the existence of which is also generally admitted.

But now we again approach a subject of controversy, and one which is certainly better worthy of discussion than that which we considered above. It relates, in fact, to the question *how* this wonderful system of oceanic circulation is brought about.

Passing over several crude theories which have long since been disposed of, we come first to the theory that the system of oceanic circulation is due to the action of the trade-winds. This theory has been maintained by Franklin and others in former times, by Sir John Herschel in our own, and is warmly advocated in the present day, by many whose opinions are not to be rashly contradicted.

Against this theory it has been urged by Captain Maury—"with singular wrongheadedness" according to the Edinburgh Reviewer, but as it seems to me with no small degree of reason—that the trade-winds are neither powerful enough nor persistent enough to account for the great equatorial currents, or therefore for the Gulf Stream. Maury says, "with the view of ascertaining the average number of days during the year that the north-east trade-winds of the Atlantic operate upon the water between the equator and 25 degrees north latitude, log-books containing no less than 380,284 observations on the force and direction of the wind in that ocean were examined. The data thus afforded were carefully compared and discussed. The results show that within these latitudes—and on the average—the wind from the north-east is in excess of the wind from the south-west only 111 days out of the 366. Now, can the north-east trades, by blowing for less than one-third of the time, cause the Gulf Stream to run all the time, and without varying its velocity either to their force or prevalence." Our reviewer not only dwells on the wrongheadedness of this argument—wholly irresistible as it appears—but asserts that "the trade-wind origin of the Gulf Stream is about as certain as the rotundity of the earth." It could have been wished that in place of abusing Captain Maury for wrongheadedness, the reviewer would have devoted a few lines to the demolition of Maury's argument.

Maury himself advanced the relative lightness of the equatorial water as the true reason of the oceanic circulation. But granting that the expansion of the equatorial water under the sun's heat, as well as the resulting buoyancy, would cause an overflow of equatorial water polewards, this overflow would be an exceedingly slow movement, and it would result in an eastwardly instead of a westwardly flow, for the very same reason that the counter trade-winds travelling polewards assume an eastwardly direction.

In the *Student* for July, 1868, I advanced another explanation. I urged that the sun's action on the equatorial and tropical regions of the Atlantic, raising immense quantities of water by evaporation, causes an influx of water from below. "There can be no question," I then wrote, "that under-currents arriving in this manner, whether from the north or from the south" (that is from arctic or from antarctic regions) "would acquire a strong westerly motion (just as the trade-winds do). Thus they would generate *from below* the great equatorial westerly current. In this upflow of cool currents having a strong westerly motion, we find the mainspring of the series of motions. The water thus pouring in towards the equator is withdrawn from beneath the temperate and arctic zones, so that room is continually being made for that north-easterly surface-stream which is the necessary consequence of the continual flow of the great western equatorial current against the barrier formed by the American current. . . Captain Maury's views seem only to require the mainspring or starting-force towards the west which has been here suggested, to supply a complete, efficient, and natural explanation of the whole series of phenomena presented by the great ocean currents."

Four or five months later, and while the results on which Dr. Carpenter subsequently based his theory of the oceanic circulation were as yet unpublished, I drew attention in the columns of the *Daily News* to the comparatively limited extent of the influences due to polar cold. This cause, I pointed out, "scarcely has any influence in latitudes lower than the parallel of 50 degrees."

In the year 1869 Dr. Carpenter was first led to advocate the theory that the continual descent of cold water in the Arctic Seas is the mainspring of the system of oceanic circulation. He reasoned that the Arctic Seas being exposed to great cold, the surface water "descends in virtue of its reduction in temperature and increase of density, its place being taken, not by the rising up of water from beneath, but by an inflow of water from the neighbouring area; and since sea-water becomes continually heavier in proportion to its reduction of temperature, this cooling action will go on without the check which is interposed in the case of fresh water."* Thus, the water becoming denser and heavier will descend, and "there will be a continual tendency to the flowing off of its deepest portion into the warmer area by which the polar basin is surrounded; producing a reduction in the level of the polar area, which must create a fresh in-draught of surface-water from the warmer area around to supply its place. This, in its turn, being subjected to the same cooling action, will descend and flow off at the bottom, producing a fresh reduction of level and a renewed in-draught at the surface."

Dr. Carpenter illustrated this theory, or rather the combined action of polar cold and equatorial heat, by an experiment, the plan of which had occurred also to myself, and been described by me in conversation somewhat earlier. "A long narrow trough having glass sides was filled with water, and a piece of ice was wedged in at one end between its side plates just beneath the top, whilst the surface of the water at the other end was warmed by a piece of metal, of which a part projected beyond the trough, and was heated by a spirit lamp placed beneath it; thus representing the relative thermal conditions of the polar and equatorial basins. A colouring liquid viscid enough to hold together in the water, while mixing with it sufficiently to move as it moves, being then introduced, the liquid as it impinged on the ice was seen to sink rapidly to the bottom, then to flow slowly along the floor of the trough towards the opposite extremity, then gradually to rise beneath the heated plate, and then to flow slowly along the surface towards the glacial end, repeating the same movement until the ice had melted."

It will be observed that in this experiment the effect of cold is not exerted alone, so that it by no means proves that the arctic cold is the chief agent in producing the system of oceanic circulation. Moreover, the conditions of the polar and equatorial basins are in one respect not accurately (or even nearly) reproduced, for the real arctic area is very much smaller, compared with the real equatorial area, than in the case of the experiment. Indeed, it appears to me that Dr. Carpenter paid far too little attention to the relative smallness of the arctic area. This may have been partly due to the erroneous ideas suggested by the ordinary maps on Mercator's Projection, in which, as I have already mentioned, the arctic regions are enormously exaggerated. It is almost impossible to study such a map as that which illustrates this paper (see part I., p. 473) without feeling that the theory presented by Dr. Carpenter will scarcely hold water, or rather—if this way of presenting the argument be permitted—that the arctic area does not hold water enough to produce the effects described by Dr. Carpenter. For in that map the whole area of the Arctic Ocean is presented;† and from out of that area, be it noted, must come the northern supply of descending water, not only for the Atlantic equatorial current, but for the much larger equatorial current of the Pacific, if Dr. Carpenter's theory be sound.

The following letter, written by Sir John Herschel only a few weeks before his lamented decease, has been very widely quoted in favour of Dr. Carpenter's theory; yet if carefully studied it will be found rather to set forth the strength of the theory advocated a year earlier by the present writer. In this letter, at least, Sir John Herschel appears to be disposed, *in so far as he concedes the efficiency of heat, cold, and evaporation*, to incline to the equatorial action as the most important. Answering Dr. Carpenter, who had addressed a letter to him on the subject, he says: "After well considering all you say, as well as the common-sense of the matter, and the experience of our hot-water circulation pipes in our green-houses, &c., there is no refusing to admit that an oceanic circulation of some sort must arise from mere heat, cold, and evaporation, as *veræ causæ*; and you have brought forward with singular emphasis* the more powerful action of the polar cold, or rather, the more *intense* action, as its maximum effect is limited to a much smaller area than that of the maximum of equatorial heat. The action of the trade and counter-trade winds, in like manner, cannot be ignored; and henceforward the question of ocean-currents will have to be considered under a two-fold point of view."

It appears to us that not only is the equatorial or rather tropical action much wider in range, but it is also more intense than the polar action. For, let us consider what happens during the heat of the day over the tropical Atlantic. Here, over an area enormously exceeding the whole Arctic basin (we are considering, be it understood, only the northern part of the system of circulation) a process of evaporation is taking place at so rapid a rate as to furnish almost the whole of that rain-supply whence the rivers of Europe and North America (east of the Rocky Mountains), take their origin. There is thus produced a continual defect of pressure, not merely along an equatorial strip, but so far as 20 or even 30 degrees of north latitude, while the downfall of rain which, taking one part with another of the temperate and sub-arctic Atlantic, may be regarded as incessant, continually adds to the pressure in these last-mentioned regions. That on the whole there must result a most effective excess of pressure over the temperate zone of the Atlantic, as compared with the tropical and equatorial portion, seems to me indisputable. Now, if we compare this with the effects of refrigeration over the relatively insignificant arctic area, which, as I have said, has to supply the North Pacific submarine circulation (if Dr. Carpenter's theory be true), as well as that of the North Atlantic, we can scarcely doubt, as it seems to me, which cause is the more effective. I would venture to predict that if Dr. Carpenter's experiment were tried first with the ice alone to produce circulation, and secondly with the heat alone, the superior efficiency of the latter cause would be at once recognised; but I much more confidently predict that if, as in the experiment I myself proposed, the relative areas of the equatorial and arctic basins were represented, there would be found to be scarcely any comparison between the effects of arctic cold and equatorial heat, so largely would the latter predominate.

It is necessary to mention, however, that the principle itself of the experiment has been objected to, on the ground that the gradation of temperature must always be much more rapid in such an experiment than in the actual case of the Atlantic Ocean. This objection, however, is, in reality, based on a misapprehension. It is sufficient that the difference of temperature at the two ends of the trough should correspond to the difference between the temperature of the Arctic and equatorial seas; and it is a matter of no importance whatever that the real rate of gradation should be represented. The case may be compared to the illustration of the descent of water to form springs or the like. Here an experiment would be valid in which the outflow of the illustrative spring was obtained by causing the vent to be so much below the level of the reservoir, though the slope from the reservoir to the vent were very much greater than in the case of any natural spring. Just as in the case of a spring it is the *difference of level*, and not the *rate of slope*, which is effective in causing the rate of outflow, so in the case of the oceanic vertical circulation, it is the actual difference of temperature, and not the rate of gradation, which produces the activity of the circulation.

Another objection has been urged against the "heat and cold theory" by a very skilful mathematician, Mr. Croll. He reasons on this wise. Since the water which is carried from the equator to the latitude of England † (say) must have partaken, when at the equator, of the earth's rotation there, which has a velocity of more than

* Fresh water expands with reduction of temperature near the freezing point, and hence, becoming lighter, the descending motion above described is interfered with in the case of fresh water.

† The bounding lines drawn from the pole on the right and left of the white space represent one and the same meridian.

* In Sir John Herschel's letters one can often recognise slight touches, we will not say of sarcasm (for he was incapable of saying aught that could be considered bitter or unpleasant), but of what may be described as a humorous suggestiveness.

† I present the general nature of Mr. Croll's reasoning, without following him in details.

1,000 miles per hour eastwards, whereas, when it reaches our latitudes, it partakes of a rotation-movement reduced to about 620 miles per hour, it follows that, neglecting the drift motions as relatively quite insignificant, friction has deprived the water which has thus travelled from the equator to our latitudes of a velocity amounting to no less than 380 miles per hour. If friction is thus effective, how utterly inconceivable is it, says Mr. Croll, that the descending currents of Dr. Carpenter's theory (or the ascending currents of the evaporation theory) should maintain their motion. Hence, Mr. Croll is an earnest advocate of the trade-wind theory.

The worst of this reasoning is that it proves too much. If friction is so effective, then when the trade-winds flag, as we have seen that they do, the ocean currents ought to be brought to a standstill. Moreover, the submarine currents exist, and the wind theory leaves them unexplained. The fact really is that Mr. Croll's reasoning has no application to a system of fluid circulation, where the advance of one part of the fluid is always made room for, so to speak, by the removal of that which it replaces. We might equally well apply Mr. Croll's reasoning to prove that a river cannot flow because of the friction along its banks, as to show that ocean currents cannot flow within their liquid banks. Indeed, many of the points in dispute in this matter of oceanic circulation may be excellently illustrated by considering the case of a river. I propose to draw this paper to a conclusion by setting forth such an illustration. My readers will not fail to recognise the opinions here severally parodied, so to speak, and so to infer the theory which I regard as affording, on the whole, the best explanation of the observed relations.

"Shallow persons," might one say, "have launched all sorts of stupidities upon the Mississippi River. Physical geographers have deluged the world with their assumptions respecting it; theorists of all kinds have floated their notions upon it. One says that it brings down, past Baton Rouge and New Orleans, the drainage of half the United States; others ascribe to it the *detritus* around the delta of that great river which flows into the Gulf of Mexico; yet others consider that it breeds the fogs infesting the path of the great stream which flows from Vicksburg to Placquemines. All this is utter nonsense. The Mississippi has no more to do with the great stream flowing through Louisiana than with the Thames at London. The real Mississippi is a stream of singular purity, and presents other characteristics clearly recognisable as far as its junction with the Missouri; but in the stream which runs past St. Louis none of the characteristics of the Mississippi can be traced. Here, to all intents and purposes, the Mississippi comes to an end. As for the cause of the motion of the great stream itself there can be little question. Some have urged that it is due to the gradual slope of the land; but in all the experimental illustrations of the effects of such slope which we have yet seen, the inclination has been monstrously exaggerated. If slope were the cause of the river's flow, then unquestionably the effective part of the action must reside in the Rocky Mountains, and not in the great reaches of the river. We admit that the chief bulk of the river lies in the great reaches; but this fact has no bearing, we assert, on the question at issue. However, it is demonstrable that no cause of this sort can be in question. For *let the following reasoning be carefully marked*. In Wisconsin, in 40 degrees north latitude, the river partakes of the earth's rotation motion, there equal in rate to about 800 miles per hour; in Louisiana, in 30 degrees north latitude, the river still partakes of the earth's rotation movement, here equal to about 900 miles per hour. Hence, were it not for the friction exerted by the banks, the water of the river in Louisiana would be flowing at the rate of 100 miles per hour westwards. If, then, friction deprives the river of this enormous velocity—as it obviously does—how much more must it deprive the river of the minute velocity of four or five miles per hour due to slope or inclination. It is certain, therefore, that the flow of the stream is due to the prevalent northerly winds of the so-called Mississippi valley. There are not wanting those, indeed, who assert that this cannot be the case, because northerly winds are *not* prevalent in this region. But the singular wrongheadedness of this reasoning renders reply unnecessary. That the flow of the great stream is caused by these winds is as certain as the rotundity of the earth."

ELECTRO-METALLURGY.—IV.

By J. T. Sprague.

7.—Sulphuric Acid.—This is the most important article used in ordinary batteries, and as it varies very much in quality and strength, it is desirable that its properties should be understood. Real O.V. oil of vitriol has a specific gravity of 1·845, and contains about 99 per cent. of the true acid HSO_4 (H_2SO_4, new notation); it is of a clear colour, and has an oily appearance: this is the acid always meant when sulphuric acid is spoken of. Brown oil of vitriol is the ordinary product of the chambers, or this boiled down in lead pans, and contains variable quantities of acid; this is a question of price only, but this acid often contains impurities of serious consequence.

Brown colour may be due to dissolved organic matter, straw, &c., and is of no moment.

Arsenic is often present, and must be strictly avoided, as it unites with the hydrogen given off, forming a deadly poison when strong, and being in any case injurious to health. It is detected by diluting the acid, and, passing a stream of sulphuretted hydrogen; arsenic forms a yellow precipitate; another plan is to put the dilute acid in a flask with scrap zinc, closing the flask with a cork in which is fitted a small glass tube bent at right angles; a Bunsen's gas-burner or spirit lamp is so placed as to make a part of this tube red hot; the gas carries off the arsenic and deposits it as a black film in the neighbourhood of this spot.

Lead is often present as sulphate and must be carefully removed, or it will deposit on the negative metal; it is only necessary to dilute the acid in a separate vessel, allow it to cool, and filter it off before use.

Nitrous acid is often present and wastes the zinc, but is otherwise of no consequence. It is detected by mixing the acid in a test tube with two or three parts water; when cool drop in a crystal of sulphate of iron, if, as it dissolves, a brown colour is produced there is nitrous acid present.

The strength of acid used in batteries may vary from one-twentieth to one-tenth by measure of acid to water.

Specific Gravity of Sulphuric Acid.

One-twentieth..	1·055	... 70·	... 1·598
One-tenth	1·100	... 80·	... 1·708
One-third	1·259	... 90·	... 1·807
50 per cent....	1·388	... 100·	... 1·846
60 „ ...	1·486		

The third line is that strength of acid which has least resistance to the passage of current, and contains one-third by *weight* of HSO_4. The following ratios are percentages by weight.

8. *Galvanometers.*—In order to obtain real definite knowledge, experiment is necessary, and to make experiment intelligently, careful measurement is essential. I therefore advise every one who makes experiments in current electricity always to have a galvanometer in circuit, and to watch its indications. Galvanometers as usually made do not convey that exact knowledge the importance of which I am pressing on my readers; they are invariably marked in degrees of the circle, and the indications of one tell nothing as to those of others. The deflection of a magnet is due wholly to the *current* passing, and for any one deflection a given and fixed chemical action occurs in each cell, &c., no matter whether one or 100 cells are generating the current, and no matter what the resistance is. It is obvious, therefore, that what we really require to know is, not the degrees deflected, but the real *current* in some definite measure, which causes this deflection. This is easy with a tangent or sine galvanometer, because we need only to obtain any constant deflection for a few hours while depositing copper or silver, and from this we can calculate the value of every other deflection on that one galvanometer. I explained this fully in No. 283, Vol. X., p. 530, and therefore need not go into it here.

Having once obtained the real value for any one instrument, it is easy to graduate others from it by including them in the same circuit; and further, if a number of instruments are made upon the same plan and with needles of the same size, all these instruments will indicate alike; at all events, sufficiently nearly so for all practical purposes. I therefore intend now to describe an instrument devised by me to suit all ordinary purposes so that readers can construct it. I have also, for the convenience of those unable to make it themselves, given the description to an instrument maker, Mr. Baker, 244, High Holborn, London, from whom it can be obtained. A few words first on general principles. If a magnetic needle be suspended *over* and parallel with a wire conveying a current entering at the north end, its north end will be turned to the *left* a certain number of degrees; if it is placed *under* the same wire, at the same distance, it will turn the same number of degrees to the *right*. If the direction of the current is reversed, so will the direction of the deflections. If now the wire is doubled back upon itself, and the needle placed between the two parts, it is evident that the direction of the current is thus reversed in the lower part, and that consequently each part acts upon the needle in the same direction, and, therefore, with doubled energy; in fact, the deflection will be doubled, not in the actual number of degrees, but in the value of the deflection itself. If we now take the effect of one complete turn of the wire as the unit, and pass another turn and then ten turns we shall increase the action on the needle double and ten fold: The distance of the wire from the needle does not affect the result, as the greater length of wire in the more distant turns compensates for the distance, exactly in circular wires and nearly so in the ordinary flat coils: thus, if we know the value of the deflections produced by different currents upon the needle in one turn and graduate the dial to this, we know that these same deflections produced by means of ten turns are caused by currents of only one-tenth in amount, but acting ten times on the needle. On this principle I have constructed what may be called a "universal galvanometer" as applicable to so many purposes, and giving its information in exact measures, not in mere degrees.

A reference to No. 287, Vol. XII., p. 1, will assist greatly in the construction. On a piece of wood or iron 2in. wide and ¼in. thick, is formed a sheath of thin copper about 5in. long, with an opening ¼in. wide cut across its upper face; this forms the chamber in which the magnet will play in the middle of the coils; a piece of hard wood ¼in. thick, 3½in. long, and 1¾in. high, with a mortice across the middle 2in. by ¼in., is fixed across the middle of the sheath, and another piece ¾in. thick on each side of it ¾in. distant, the copper ends being then turned up and cemented to the outsides; this forms two channels ¾in. wide, and deep, in which the wires are to be laid, the part of the middle piece corresponding to the opening in the face of the copper is to be removed when the instrument is completed, forming a passage through the face and body by which the magnet is placed in its chamber.

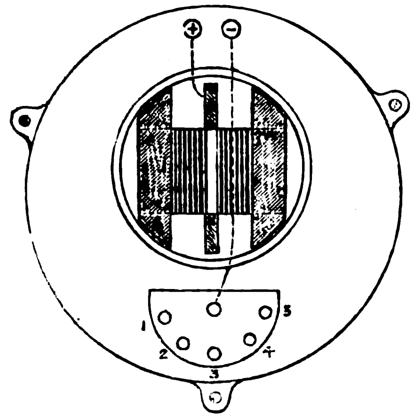
The laying on of the wire must begin in the middle, and each end must be connected so as to complete an exact turn at the middle, otherwise the indications will be inaccurate. First lay on 80 turns of No. 20 cotton covered copper wire, leaving six inches of the end for connection; the sizes given will allow exactly 10 turns to be placed in each channel, and thus four layers on each side will complete the 80 turns. Solder the end of the No. 20 (at the exact turn) to a length of No. 16, leaving [illegible]in. or 5in. of this last to come out for the connection, and lay on five turns in each channel, which is best done by two layers of 3 and 2 close up to the middle; at the tenth turn solder on a piece of the same, or stouter wire, to come out for a connection, and continue winding 8 more turns, 4 on each side, in two layers, which will fill up the space left in the outer part of the channels in the former layers. Now cut two strips ½in. wide of soft sheet copper 15in. long, and solder their ends to the 16 wire, leaving a projecting end of this for a connection; take one turn with these strips, one in each side channel, so that the current will divide itself between the two. At the exact point which completes a turn solder across the two a stout wire for a connection, and make one turn more, bringing the ends of the strips out. These last ends will be the beginning of the instrument, and when mounted are to be connected to the binding screw of the stand direct; the other wires will be connections by which the different coils can be thrown in circuit, and the effect will be thus:

Wire.	Turns.	Total turns.	Resistance.
1 ...	1 ...	1 ...	·005 Ohm.
2 ...	1 ...	2 ...	·006 „
3 ...	8 ...	10 ...	·015 „
4 ...	10 ...	20 ...	·025 „
5 ...	80 ...	100 ...	·440 „

These ends are to be led to a commutator, such as is commonly used on medical coils, a central spring traversing over five studs. I prefer to use mercury cups thus—a block of hard wood an inch thick has a central and five radial holes ⅜in.

deep by ¼in. bored in it, and when fixed on a stand, holes are bored through just large enough to pass a No. 12 copper wire, on which a head has been hammered up. These heads are well amalgamated, and a piece of wire bent twice at right angles passes from the central cup to the one desired to be used; the resistances are thus kept very small, and those of my own instrument are given above in the last column; they are so small that when used for measuring batteries, &c., they may be ignored.

The coil as described and the commutator are mounted on a stand 8in. wide, fitted with three levelling screws, and the diagram will make it plain.



The binding screws are so placed that the various currents, not forming part of the coils, balance each other, a source of error often overlooked. The ends of the two strips are to be connected direct to either + or — according to the way the coils are wound, so that the needle turns to the side to which the positive pole is connected. The other screw is joined to the centre of the commutator, and the studs, or cups, of the commutator are joined to the wires as numbered above. These connections are, of course, made below the stand. On the top of the coils is fixed a thin piece of wood, or metal, with an opening 2in. by ½in. in it, and on this is placed the dial of card to be described.

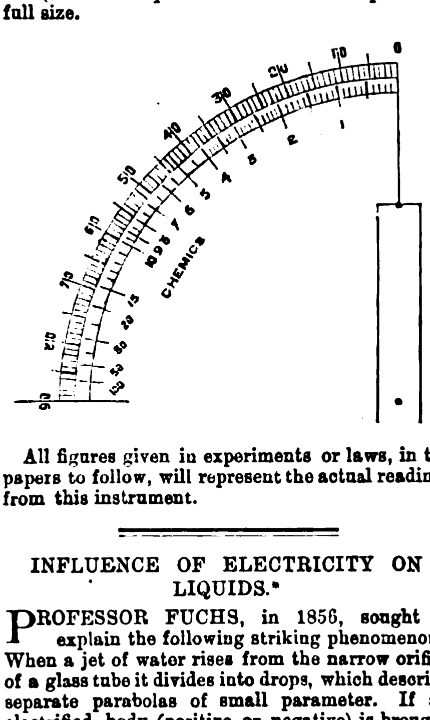
A small hole is to be bored in the middle of this opening, and into the middle wood through the bottom of the copper chamber, in which is to be inserted a steel needle, with its point rising somewhat above the dial: on this the magnetic needle turns. The needle itself is 1¾in. long; my own is made of four strips of watch spring, secured upon a piece of very fine ⅛in. tubing 1¼in. long, in the top of which is an agate centre, and on which is also secured an indicator of thin brass or aluminium, 3¼in. long, with its points exactly corresponding with those of the magnet itself, so that while the latter plays in the inner chamber the indicator marks its position on the dial. A round or square case, the top of which is glass, slips over the coil frame and protects the needle from disturbance.

9. *The Graduation.*—This is effected by placing the instrument in circuit with my tangent galvanometer, the value of which is known, with several large Daniell's cells coupled "for quantity" and a set of resistances. The dial is marked off in degrees as usual, and careful readings taken of the deflections produced when the tangent galvanometer marks the several currents required. I found that the instrument itself is roughly a tangential one, and, rather strangely, the single turn corresponds nearly in degrees of deflection with those of the four turns on the tangent instrument. The lower figures are easily marked off with No. 1 in circuit, but it is not easy to get beyond 10 Chemics. However, having done this, if we bring the tangent back to 1 Chemic and put No. 3 in circuit the instrument marks 10, while No. 5 will indicate 100. So that using this means of multiplying the readings of the tangent the whole dial is easily graduated. I thus constructed the following table, which will enable any one making an instrument on my directions to graduate it so that it will show pretty exactly the work any current is equivalent to, and if used while electrotyping, to ascertain exactly the weight of metal deposited in any time. I should think it well to mark one quadrant from this table and the opposite one, with half the values to read off for Nos. 2 and 4, and to mark the other quadrants similarly, but with Vebers, to work with the common British Association units; of course, also, it is as well to mark the ordinary degrees on an outer circle. Those who have efficient resistance instruments can readily graduate any galvanometer by the formula $C = \frac{E}{R}$, for the Daniell being 1·079 Volt, a total resistance of 1·079 marks 1 Veber, or, calling it $1{\cdot}079 \times 5{\cdot}68 = 6{\cdot}129$, and introducing that resistance in Ohm's $\frac{6{\cdot}129}{6{\cdot}129} = 1$ Chemic current, and all others are readily deduced by multiples of these figures—

Chemics.	Degrees.	Chemics.	Degrees.
1	11·3	9	58
2	22	10	60
3	31	15	69
4	38	20	73
5	43	30	79
6	47·5	50	83·5
7	52	100	86·5
8	55·5		

Thus, multiplying the figures by the equivalents of the substances, if, while coppering, the needle pointed to 79° or 30 Chemics, $31.75 \times 30 \div 10$ shows a deposit of 95 grains per hour; if it were silvering, then $108 \times 30 \div 10 = 324$ grains per hour. Galvanometers for use in practical operations could, of course, be as easily graduated to show how many ounces per hour of a metal were being deposited. As will be seen hereafter, it is quite easy to measure thus, even when several operations are going on in one vessel, and from one anode, while any irregularity which may and does frequently happen is instantly pointed out.

I give here a quadrant of the dial complete and full size.



All figures given in experiments or laws, in the papers to follow, will represent the actual readings from this instrument.

INFLUENCE OF ELECTRICITY ON LIQUIDS.*

PROFESSOR FUCHS, in 1856, sought to explain the following striking phenomenon: When a jet of water rises from the narrow orifice of a glass tube it divides into drops, which describe separate parabolas of small parameter. If an electrified body (positive or negative) is brought near, the stream contracts into a single undivided column. If the electrified body is approached still nearer, the jet again divides, and into much smaller drops, which describe wider parabolas than the former did. To explain this Professor Fuchs asked first: Why does the stream in its normal state divide into drops? and gives the quite correct answer, that it is due to the adhesion of the water to the sides of the orifice, so that the division ceased when the mouth of the tube was greased internally. He further supposed that when an electrified body is brought near, the electric tension produced in the liquid and in the mouth of the tube destroyed the adhesion, so that, as from the greased mouth, the stream rose in a coherent form. How this could happen with such slight tension was unexplained.

More recently Professor Reitlinger has taken up the subject. He found that an oil of turpentine jet, which, like water, was broken into drops, was not altered on approach of the electrified body; and that a quicksilver jet from a glass tube rose in a coherent state; while from a copper mouth it divided into drops as soon as the copper had undergone a certain amalgamation, but that then, as with oil of turpentine, the electrified body had no effect on it. He supposed that the removal of the adhesion (in the case of water) was due to the production, electrolytically, of a thin layer of gas—a somewhat bold supposition, especially where the mouthpiece is of glass, as it is not easy to see how the gas could arise in that case.

But this supposed removal of adhesion may be put aside from the question. The experiment which led Professor Fuchs to suppose that electricity produced its effect by action on the mouthpiece was, that when he surrounded the mouthpiece with another tube, he did not obtain a contraction of the jet, but when the jet was so surrounded, and the mouth-piece free, he obtained it readily. The observation is not strictly correct: it is not the mouthpiece that must be put into the electrified "shadow" (in order to prevent contraction of the stream), but the lower coherent part of the stream itself. Let the matter be brought to the test of experiment as follows:—A glass vessel filled with water is placed on an insulating stand. From its lower part proceeds a glass tube, which is bent downwards, then upwards, terminating in a fine point. A jet is in this way thrown up about 20 centimetres in height, and in a direction slightly out of the vertical. From the mouth of the tube to a height of three centimetres the stream is perfectly coherent, then it breaks up into drops, which form the parabolic "branches." For the sake of brevity we may call the coherent part the stem, the divided part the branches. (That the stem is quite coherent may be proved by means of an electroscope.) A tin plate with a circular hole in its central part (of five millimetres diameter) is placed horizontally, so that the jet passes through the hole. The falling drops pass just outside of this screen. A wire ring connected with an insulated conductor also surrounds the jet. Suppose it, once for all, negatively electrified. If, now, the screen is placed at the lower part of the stem, while the ring encircles the jet, say 12 centimetres above the orifice, the jet is contracted. Raise the screen so that the stem is quite in the electric shadow, then no contraction takes place. It recurs, however, if the ring is brought under the screen. While these things are being done let a wire connected with an electroscope be dipped into the water in the vessel, and another, connected with a second electroscope, be brought into the upper part of the jet. If the stem of the jet is shaded by the screen from the electricity of the ring the water in the vessel remains unelectrified, while the jet shows little or no negative electricity, except in the neighbourhood of the ring, where it is strongly negative; drops first attracted by the ring are then repelled, and so carry the negative electricity direct to the electroscope. If, however, the stem is not in the electric shadow, the water in the vessel becomes negative, and continues so even when the ring is discharged by being touched. The positive electricity carried away by the drops is communicated to the second electroscope, which, in this case, is charged positively. If an insulating liquid, as petroleum, be substituted for the water, the electroscopes give no indications of electricity, and the jet undergoes no alteration in form. The same insusceptibility was noticed by Professor Reitlinger in the case of oil of turpentine.

The foregoing experiment will enable us to understand what takes place when the jet is contracted. The outer part of the stem consists of particles which have received an eccentric impulse through friction at the mouth of the tube. They, therefore gradually separate from the central part of the stem to pursue their parabolic courses. When the stem is positively electrified by induction, the separated drops carry with them some of the positive electricity of the surface. The inner, unelectrified drops, are thus surrounded by electrified drops, which are thus turned back from their divergent course, and brought nearer to the axis. The jet in its further course does not become perfectly coherent; the end of the stem is only carried somewhat higher than before.

The drops describe parabolas of small parameter. If the electric influence is very strong the mutual repulsion of the drops proves superior to their attraction to the axis, and a finer and wider dispersion takes place. It appears, then, that the influence causing contraction of the jet acts at the end of the stem, not at the mouth of the tube, and the theory of adhesion being changed by electric influence may, therefore, be laid aside.

A. B. M.

* Abstract of a recent paper in *Poggendorff's Annalen*, by W. Beetz.

THE WATCH, AND HOW TO REPAIR IT.

By "'Seconds' Practical Watchmaker."

(*Continued from page* 448.)

The Verge Watch.

THERE are several kinds of watches, but there are but five at the present day in general use. We will, therefore, at once become acquainted with our old friend the verge, occasionally recall early recollections, and ultimately apply ourselves to general repairs. The first kind of watch which has to be noticed is the old-fashioned one, which may be recognised chiefly by its loud and short tick, in addition to its being thick and usually of large size. There is another kind of watch which has a tick very similar to it, yet that tick is smoother and more silent. For the amateur to be certain of the description the watch must be opened, and if a broad-rimmed wheel, with teeth perpendicular to its rim, can be seen just inside the two plates which form the framework by which the wheels and parts are kept in their places, and when looking farther inside among the works another wheel is there resembling the radial coronet-like wheel, as represented in Fig. 1, F, that is a verge watch, to describe which with any degree of clearness we must make reference again to illustration. Fig. 2 represents the old-fashioned verge watch when stopping for the want of being wound up, having the top—or upper plate, as it is technically termed—removed (see Fig. 1), so as to show all the wheels which constitute that part of the watch termed the "train." The circular plate (Fig. 2), in the holes of which all the wheels stand, is termed the pillar-plate, because in it are riveted four pillars, which support the upper plate, Fig. 1.

The parts pointed at by reference of letters, as follows, are thus known by watchmakers:—A, the barrel or box which contains the mainspring; B, fusee, on which the chain is coiled by the act of winding up the watch; C, centre-wheel; D, third-wheel; E, contrate-wheel; F, balance-wheel; G, stop-stud; H, stop; I, potence; K, follower; L, stop-spring and screw. Each part here distinguished by capital letter has to be separately described, therefore we pass at once to the engraving Fig. 2, the pillar-plate, and proceed to explain the office of the barrel, it being the prime mover. A is a cylindrical brass box, which is shown with the lid (or cover) removed, and the mainspring within it at its least tension. In the centre of this barrel will be seen a solid central axis, which is made of steel, termed the barrel-arbor; upon that the barrel revolves, being made a fixture on the other side of the pillar-plate. The mainspring is made secure at the inner end upon a small projecting hook fixed in the side of this arbor, and the outer end of the spring is fixed by another hook which is in the inside of the barrel, therefore when the barrel turns it carries with it the inclosed mainspring, which of necessity must be turned round the arbor. Now, as the mainspring is a thin and very elastic ribbon of steel, after having been compelled to follow the circular motion of the barrel it becomes coiled up into a smaller compass, and by its elasticity it has a tendency to uncoil, if left in its quiescent state; and if coiled to the utmost—which would be the case should the barrel be turned about four or five revolutions—and then suddenly let go, the barrel would have regained its original position with respect to the arbor in a few seconds, and therefore no elastic force or power would remain in action until the mainspring was again coiled round the central axis or arbor. Thus the power or force by which the whole series of wheels and parts of the watch are kept in motion lies in the barrel and mainspring; therefore, to connect the spring with the train of wheels, a steel chain is made use of, and attached to the barrel by a small hook which is inserted in a hole made on the outside, at the top of the barrel. Fig. 3 shows the peculiar construction of the chain, which is a special kind used only for watchwork, composed of small links, each part, or linking, consisting of three pieces of equal size (No. 2), having been struck from the same die. One piece being placed between two others, a rivet passes through the three pieces, so that every link has two pins or rivets in it, and when it is completed has the appearance of No. 3. By this construction the chain is rendered flexible in one plane only, and not in all directions, as is the case with chains generally. At the other end of the chain another hook is fixed, which enters a notch at the lower part of the cone, termed the "fusee," B; across this notch is a small pin on which the hook No. 4 catches. No. 1 represents the hook for the barrel. These links and hooks are very thin and small, there being in some watch-chains of old make as many as 300 pieces.

Attached to the lower part of the fusee is a wheel termed the great wheel, being that one which imparts motion to the train of wheels, and we must not omit one very important circumstance connected with the barrel and fusee prior to the description of the train itself.

The form of the fusee is seen in Fig. 2, B; its surface is cut into a spiral flat groove, wide enough to admit the chain, and deep enough to prevent it from slipping out of it. A key being applied to the squared steel arbor, the fusee by this means is turned round and round till the chain is wound on it, and thus fills the groove from bottom to top; this motion turns the barrel with it, and therefore coils up the mainspring so as to cause it to exert its greatest force. The mainspring by its elasticity produces most force when first wound up, and this force gradually diminishes as the spring uncoils; when, therefore, the watch is nearly down, and all the chain nearly off the fusee and wrapped round the barrel, the train will be turned slower and slower until quite down, because the mainspring gradually loses its power. The fusee is a means adopted to remedy this progressive diminution in the strength or power of the mainspring.

FIG. 1

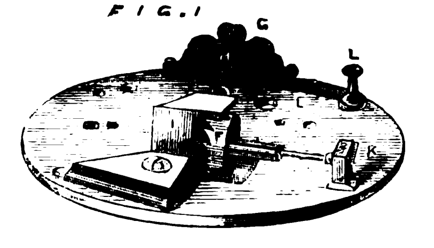


FIG. 2

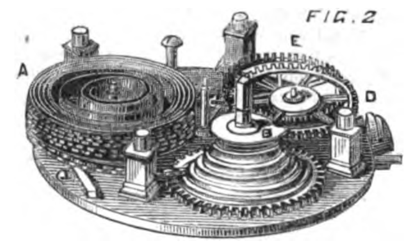
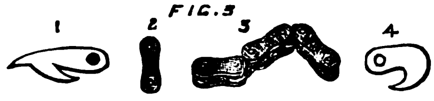


FIG. 3



As this power gradually diminishes by the watch going down, the spiral groove of the fusee is so shaped as to cause the mainspring, when it is at its greatest force, to pull the fusee round from a point nearest to its axis. The imaginary straight line from this point, where the chain leaves the groove to the axis of the fusee is a lever, which the spiral groove causes to lengthen gradually as the spring diminishes in force; and from the well-known principle of that mechanical power, as this lever lengthens, a gradually lessening force applied at one end will produce a constant effect, or overcome a constant resistance at the other end of the lever, so that the fusee will be always turned with the same constant motion, though turned by a gradually diminishing force of the mainspring. But although general theory directs the form of the fusee it is found in practice that each watch must have its fusee adjusted to its mainspring. No two mainsprings of different watches can be relied upon to suit the fusee of another watch. To make adjustment of the mainspring and fusee correct, the outline of the fusee must not be strictly conical, for if it were the lever above alluded to would lengthen equally after equal portions of motion in the fusee; therefore, to counteract the inequality in the diminishing force of the mainspring, the leverage of the fusee must increase exactly as the force of the mainspring decreases. In connection with the foregoing we quote the following from Hutton's "Mathematical Dictionary:"—"To correct the inequality of the spring it was very happily contrived to have the spring applied to the arms of levers, which are continually longer as the force of the spring is weaker; this foreign assistance, always increasing as it is most needed, maintains the action and effect of the spring in an equality."

The first procedure, therefore, in the examination of a watch before finally putting it together, will be to see if this adjustment of the mainspring is correct, because, if not, no watch can keep good time, for this reason: If the force of mainspring be greater at the first part, after having been fully wound up, than it is at its intermediate periods, the wheels will be accelerated in their motions, and hence the watch will gain time when first wound, and lose time when going down; and just the contrary will be the case if these conditions of the mainspring and fusee be reversed, for although the fusee and mainspring may be in exact correspondence to each other, either gaining or losing time at the commencement of action can be effected by a workman who understands the mode of adjusting the mainspring. In the next paper we intend devoting a small space to this important and interesting subject.

(*To be continued.*)

ARTIFICIAL SO-CALLED ORGANIC CONCRETIONS.

EARLY in the present year I gave in my "Microscopical Notes" an abstract of an interesting paper on "Molecular Coalescence," published in the *Quarterly Journal of Microscopical Science* for January, 1872. The current (July) number of the *Quarterly Journal* contains a lengthy article on the same subject by W. M. Orb, M.B., in which several new points are brought out, and much fuller details given of the processes followed.

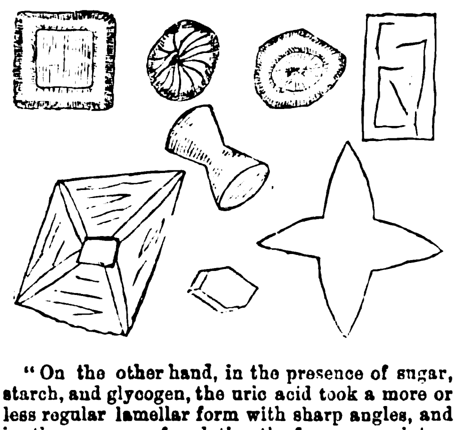
Mr. Orb, I think very justly, calls attention to the fact, well known to British microscopists, that Mr. Rainey published some notes on the subject as far back as 1858, and in the same year published a book "On the Mode of Formation of Shells of Animals, of Bone, and of several other structures by a process of Molecular Coalescence demonstrable by certain artifically formed products." Mr. Rainey makes calcium carbonate the starting point in his investigations. The following is Mr. Rainey's description of the method of obtaining the globular form (*Calcospherites*. See English Mechanic, January, 1872) of carbonate of lime.* "It consists in introducing into a two-ounce phial, about three inches in height, with a mouth about one inch and a quarter in width, half an ounce by measure of a solution of gum arabic saturated with carbonate of potash. The specific gravity of the compound solution should be 1·4068, when 1oz. will weigh 672grs. This solution must be perfectly clear; all the carbonate of lime which had been formed by the decomposition of the malate of lime contained in the gum, and also all the triple phosphate set free by the alkali, must have been allowed completely to subside. Next, two clean slides of the ordinary dimensions (3" × 1") are to be introduced with the upper end of one slide resting against that of the other, and with their lower ends separated as far as the width of the phial will permit; and, lastly, the bottle is to be filled up with a solution of gum arabic in common water, of specific gravity 1·0844, 1oz. of which will weigh 520grs. This solution also must be perfectly clear, having been strained through cloth and then left to stand some days to allow of the subsidence of all the floating vegetable matter. It must be carefully added to the alkaline solution that the two may be mixed as little as possible in this part of the process. The bottle must now be kept perfectly still, covered with a piece of paper to prevent the admission of dust, for three weeks or a month. The soluble salts of lime to be decomposed by the carbonate of potash are contained in the gum in combination with malic acid, and also in the common water. Ammoniaco-magnesian, or triple phosphate, is also contained in the gum and is set free by the alkali. Muriate of lime, dissolved in a solution of gum from which all the lime had been previously separated, would answer a similar purpose, provided the muriate were not in too great excess for the gum, in which case crystals of carbonate would be formed together with the globules, and the surface of the slide would be covered with coalescing patches of the latter. Also muriate of barytes, and muriate of strontia, when treated in the same manner as muriate of lime, furnish each a globular carbonate, the spherical

* It is, of course, understood that the following, and, indeed, pretty much of what I write here, is a more or less free abstract of Mr. Orb's article.

form of the latter being particularly perfect and beautiful. But muriate of magnesia, when decomposed in the same manner and under precisely the same conditions, does not furnish globules, but crystals of carbonate of magnesia evincing no tendency to become globular."

Mr. Rainey, working out step by step each new condition and appearance induced by variation in the composition of the fluid decomposed, and by the modifying influences of the introduction of additional matter as certain phosphates, proceeded to point out "that simple physical laws are capable of leading to the construction of many structural forms found in living bodies." He demonstrated this in the globular calculi, observed by him in the urine of the horse as early as 1849; in the shells of Crustacea and Mollusca; in bone, tooth, in the half-bony tendons of birds; and he is not stopped after exhausting those formations in which earthy matter takes a part, but he boldly applies his principles to the structure of the scleroηs tissue of vegetables, of starch globules, pigment cells, glomeruli, and of the lens of the eye.

Mr. Orb remarks that in 1870 he, himself, showed that the "great variety of forms assumed by uric acid in urine might, at least in part, be explained by the nature of the associated constituents in each case. It was found by experiment, for instance, that where uric acid was deposited in the presence of albumen it took the form of either small crystals with rounded angles, of dumb-bells, of sub-spherical bodies, or even of spheres.* (See Fig.)



"On the other hand, in the presence of sugar, starch, and glycogen, the uric acid took a more or less regular lamellar form with sharp angles, and in the presence of gelatine the forms were intermediate between the two. [See Fig.] In albuminous urine the acid was found always taking the form of short, stout, barrel-like crystals, with rounded sides and angles, or making approach to dumb-bell shape."

In face of these observations it occurred to Mr. Orb to apply a modification of Mr. Rainey's plan of experiment to the determination of some of the conditions under which dumb-bells might be formed, to fix with more certainty the relations between the octahedron and the dumb-bell of oxalate of lime; to try, in fact, to turn the one into the other.

"Some perfectly clear jelly prepared from isinglass was melted in a flat-bottomed jar in quantity enough to form a layer $\frac{3}{4}$in. deep. In this, whilst still liquid, a number of glass tubes, each about 4in. long, $\frac{1}{4}$in. in diameter, and open at both ends, were placed upright, so that each tube was immersed to the depth of nearly $\frac{3}{4}$in. After cooling the tubes were removed, and each was found plugged with firm clear jelly, so as to be thoroughly watertight. Six of these tubes were filled with a slightly alkaline solution of potassium oxalate, and placed in a weak solution (6grs. to 1oz.) of chloride of calcium, the level of the solution in the tubes being much higher than the level of the calcium fluid. The plug of jelly was thus interposed between the two solutions in the hope that diffusion slowly occurring the results of the mutual decomposition of the oxalate and calcium salt might be found after a time in the jelly. The experiment was performed in a room of the average temperature of 57 Fahr." The intention being to imitate as far as possible the conditions under which certain concretions are formed in the renal tubes. At the expiration of three months transverse sections of the plug were made at thirteen different points, the sections transferred to glass slides, the jelly melted with the slightest possible heat, and examined with a $\frac{1}{4}$in. objective. For the full results of the examination I have not space. It was found that the forms existing on the side of the oxalate were very different from those on the side of the calcium salt, and a remarkable series of gradations led easily from the one series to the other. Dr. Orb gives an excessively interesting series of drawings, too numerous to reproduce here, which will be found worthy of the most careful examination, and in themselves amply remunerate the student of biology for the cost of the number. The most interesting forms, perhaps, were produced under a variation of the experiment just described. "Acetic acid was added in considerable excess to the solution of oxalate of potash, and all the carbonic acid expelled. The solution was now used as before, and the plug was found, at the end of five days, white and opaque, with deposit in its lower portion adjoining the calcium solution. Above this it was almost clear, the acetic acid having, apparently in virtue of its greater diffusibility, driven back as it were—outstripped (?)—the calcium salt. At the calcic end were wheat sheaves, and the crystalline kind of dumb-bell, mixed with long, narrow-pointed, and very regular tablets; the octohedra were very few and small." Further experiments were performed, using in the tubes solution of oxalic acid (*a*), the calcium salt being as before, and (*b*) the calcium salt largely in excess of the oxalic acid. Solutions of oxalate of ammonium carefully purified, and of calcium chloride of known strength were also used. The formula of ammonium oxalate is given in Miller's "Elements of Chemistry" as—

$$(H_4N)_2C_2O_4, H_2O = 142.$$

Of calcium chloride, in the fusible form, as follows:—

$$CaCl_2, 6H_2O = 219.$$

From which it can be calculated that 100 parts of calcium chloride will be decomposed by 65 parts of ammonium oxalate. The solutions were, therefore, made to contain respectively 100grs. of calcium chloride and 65grs. of the ammonium oxalate in 4ozs. of distilled water.

Experiments were carried on—

1. With equivalents of the salts.
2. With 4 equivalents of oxalate to 1 equivalent of the chloride.
3. With 1 equivalent of oxalate to 4 equivalents of the chloride.

The results obtained were exceedingly interesting. In No. 3 the "wheat sheaves" were replaced by smaller, rounded, homogeneous dumb-bells of great beauty, and there were several other beautiful forms, as well as others more interesting than beautiful.

Further sets of experiments, involving the modifying influences of electricity, magnetism, and heat, were entered upon. Common horseshoe magnets of moderate power were at first made use of. "In some experiments, the plugged tubes being arranged as in the first experiment, the magnets were so placed that the lines of greatest deposit would run between their poles, in other cases, so that the length of the plug would be parallel to the line joining the poles. In other experiments little jars were partly filled with gelatine imbued with chloride of calcium, the poles being thrust into the gelatine whilst warm, and the jars on cooling filled up with solution of oxalate of ammonia. The general result was that there was an extraordinary increase in the size of all the forms where the plug or gelatine was subjected to the action of magnetism, but that there was no production of new germs or greater tendency to sphericity."

The influence of temperature was beautifully evident in tubes placed in the kitchen (temp. 55° to 65° Fahr.), the coalescence forms were three to four times as numerous as the crystalline. In the garden (27° to 45° Fahr.) this condition was more than reversed.

For notice of the experiments of the greatest biological interest there is now little space left.

In these experiments tubes stopped with albumen were used. The mode of stopping was very simple. "Beakers were filled to the depth of $\frac{3}{4}$in. with fresh white of an egg, the tubes were introduced and heat gradually applied by means of a water bath till the albumen was thoroughly coagulated. When this was carefully carried out with a temperature not exceeding 200° Fahr., the plugs were firm, homogeneous, and water tight, no leakage occurring after the tubes had been filled with water, and left for twenty-four hours. Oxalate of calcium deposited in these tubes at 50° to 60° Fahr., took almost entirely the coalescence form.

"When a plug was carefully examined, it was found firm and blueish in colour at the oxalic end, soft and yellow at the calcic. In the third next, the oxalate, no forms whatever of crystalline or coalescence order existed, but the albumen was remarkably fibrillated.* Below this appeared, in small numbers, large, perfect homogeneous spheres, isolated, refracting light energetically, and polarising with one perfect cross."†

Out of these arose a wider field of inquiry, which I can only very briefly summarise.

Phosphate of lime was taken:

64·4 Phosphate, 7·03 carb. calcium, as in bones of hawk.

59·6 phosphate, 7·3 carb. calcium, as in bones of man.

52·6 phosphate, 12·53 carb. calcium, as in tortoise.

57·3 phosphate, 4·9 carb. calcium, as in cod.

The first two were placed in hot-beds of different degrees of temperature, the hawk quantities being in the warmer; the others were left in a cool room, so that the temperature of about 85°, 75°, 60° Fahr. were severally obtained. It followed that in warmth or in cold, phosphate of lime was evenly distributed through the albumen in definite strata not forming crystals or spheres, but cementing the albumen to great hardness, particularly at the line of greatest density. Carbonate of lime, on the other hand, never failed to form spheres at the highest temperature used.

In the bone salt experiments a nearly uniform result was obtained. The carbonate of lime was subdued, as it were, by the phosphate, and an even sub-crystalline but continuous deposit was produced. The use of the phosphate as a cement and manipulator of the less tractable carbonate was well indicated. The relations between the mean temperature of the organism and the relative proportions of phosphate and carbonate were investigated, and, with the question of the influence of certain mineral medicines upon particular tissue, are deserving the farther investigation they will doubtless receive. H. P. H.

* The two latter I obtained in small quantities during some experiments on albuminous urine some months since. Macled tabular crystals I have not unfrequently obtained in presence of semi-decomposed epithelial matter.—H. P. H.

* Mr. Orb foot-notes a query—"Did this indicate combination?"

† Similar but small spheres occur in certain albuminous urine with calcium oxalate—temp. 60° to 80°.

HISTORICAL NOTES ON POISONING.

(Concluded from page 459.)

THE symptoms and signs which were accepted at that date [Roman empire] as evidence of poisoning are interesting in a medico legal point of view. They were, as may be supposed, sufficiently crude to inspire us with considerable doubt as to the reliability of many of the narrated cases of poisoning. That there were certain post-mortem appearances which were generally considered as evidences of death by poison, appears from the writings of Cicero, Tacitus, and others. Cicero speaks of "ea quæ solent esse indicia et vestigia veneni;" and in the account given by Suetonius of the death of Germanicus, who was poisoned by Piso, at the instigation of Tiberius, we find them enumerated as livid spots on the face and body, foam at the mouth, and the fact that the heart remained unconsumed when the rest of the body was burnt. It was also believed that worms did not become generated in the bodies of persons who died of poison. There were no judicial post-mortem examinations; and, in such inspections as were made, medical men were not specially employed. The body was simply exposed to the people, who were supposed to be able to form a sufficiently accurate judgment for themselves as to the cause of death. It is related by Dion Cassius that Nero, fearing lest his murder of Britannicus might be discovered, concealed the lividity of the face by a coating of chalk; but that a shower of rain washed away the chalk and displayed to the people the evidences of his fratricidal crime. It was not till the time of the Emperor Justinian, about the middle of the sixth century, that the aid of medical men was specially required in the judicial investigation of the questions which now fall to the province of the medical jurist. Even then, little room was left for the expression of an independent opinion, as the cases were for the most part decided on the authority of the learned Hippocrates.

The provisions of the Justinian code were incorporated in the capitularies of Charlemagne, and the foundations of State Medicine were laid. They were not yet, however, destined to be built upon. At the breaking up of the empire, there was a lapse into darkness worse than the first, and for many long years all progress was in a backward direction.

What little had been gained in medicine was carried off to Arabia or shut up in the monasteries. Much more might have been done by the monks, but the study of medicine was proscribed to them by several of the œcumenical councils of the twelfth century, as causing too great distraction from their religious duties. Superstition, bred of ignorance, was rampant, and led to results often far more disastrous than the worst of crimes. The art of poisoning had not been lost, however, as we have sufficient evidence to prove, though credulity and superstition often saw it where it did not really exist. The history of the Italian republics in the middle ages is replete with instances of poisoning and assassination.

Every one is acquainted with the history of the Borgias, and the long catalogue of crimes, in which poisoning figured conspicuously, which have been laid at the door of Pope Alexander VI. and his son Cæsar Borgia. Perhaps many of these have been considerably embellished by tradition, and many of the diabolical artifices to which they are said to have resorted may have only an apocryphal existence. Cæsar Borgia is said to have worn a ring containing a concealed point tipped with deadly poison; and a particularly cordial shake of the hand, under the guise of the warmest friendship, was, to the person so highly favoured, the grasp of death. That there is nothing inherently impossible in such an artifice what we know at the present day regarding poisons would give us many reasons to believe, however much we may doubt the credibility of the narratives. In later times, Philip II. of Spain was universally feared on account of the numerous villanies which he perpetrated by means of a poison which he called his "requiescat in pace." Pope Sixtus V., who ultimately fell a victim to this, used to say to the Spanish ambassador that Philip's "requiescat in pace" was the only thing he feared. The right of sanctuary (*jus asyli*), which was strenuously maintained by the Church, did much to shelter criminals both clerical and lay, and to render null and void the statutes enacted to check the frightful frequency of poisoning. Henry II. of England was one of the first to break through this privilege, and to bring to justice criminals of whatever class and from whatever place they had fled to for refuge. Burning alive and other cruel modes of death were the penalty of those convicted of this crime. While, therefore, real cases of poisoning were common and frequent, falsely imputed ones were not less so, and were productive of even greater evils.

The open neglect of all hygienic measures, the deluded reliance on absurd charms as prophylactic against all kinds of disease, and the mistaken ideas of mortifying the flesh, had much to do with the origination and propagation of those deadly epidemics which decimated the nations of the Middle Ages. The people, ignorant alike and superstitious, in most cases attributed these to wilful poisoning of the wells; and the occurrence of an epidemic was the signal for a murderous attack on the unfortunate Jews, who were generally accused of this crime. Many thousands of them were thus massacred. Even as late as 1831, when cholera broke out at St. Petersburg, a similar idea of poisoning the wells was entertained by the people.

A profound faith in universal antidotes against poison was characteristic of this age of the marvellous. This idea, however, did not originate with them, for it forms no inconsiderable part of the works of Nicander, Dioscorides, Galen, and others, and it continued to be spoken and treated of in many learned works up to a comparatively recent period in the history of medicine. One of the most celebrated of the ancient antidotes was that invented by Mithridates, and which was named after him. These *Mithridatiœ* and *Theriaca*, as they were termed, were variously modified at different periods. They consisted for the most part of an immense number of vegetable extracts and resins; and many works were written, specially devoted to the exact description and modes of compounding the various ingredients of these highly-prized alexipharmics. So late as the middle of the last century, Heberden wrote a special treatise showing their uselessness, and advocating their banishment from the pharmacopœias. More prized in the Middle Ages were the Bezoar Stones, first introduced by the Arabian physicians. So much were they valued, that they sold for ten times their weight in gold. These wonderful stones, of which there were two varieties—the oriental and the occidental—were nothing but the biliary calculi of different species of antelopes, goats, and camels. Amulets and charms of precious stones and coral, which blushed or turned pale when poison approached them; rings that became too hot to be worn; cups that cracked when poison was poured into them; and such-like, were equally relied on. Many other agents were employed, based on the idea of curing like by like, or on the equally scientific doctrine of Signatures, which saw, in whatever resembled the noxious substance in form or appearance, the proper antidote against it.

The promulgation of the "Constitutio Criminalis Carolina," in 1533, by the Emperor Charles V., was the dawn of a new era, and marks the commencement of the science of forensic medicine. The relations of medicine to jurisprudence were distinctly established, and medico-legal investigation by competent men was rendered imperative in the decision of numerous criminal and civil cases affecting the life and property of individuals. Numerous statutes were passed by various states, regulating and restricting the possession and sale of poisons, and stringent enactments were made against the poisonous adulteration of food and drink.

The use of poisons as medicinal remedies was also strongly condemned by many writers and teachers. Antimony was especially prohibited by the Universities of Paris and Heidelberg, and candidates for the degree of Doctor of Medicine were, about the middle of the sixteenth century, required to swear that they would never employ this substance in the treatment of disease. These regulations remained in force for many years. They were ostensibly for the purpose of preventing poisoning, but they were chiefly directed against the followers of Paracelsus, who used the mineral poisons largely as remedies. The attention of medical men now became directed to the scientific investigation of the nature and action of poisons, and of the means of detecting and checking their employment. Numerous memoirs on poisons and on subjects of legal medicine were written by distinguished men; and works specially treating of forensic medicine were written by Fortunatus Fidelis (1598), Paul Zacchias (about 1630), and others whom we regard as the fathers of the science. The foundation of a new physiology, chemistry, and allied sciences, led to a gradual emancipation from many absurd ideas regarding poisons.

Numerous exact experiments were made on the lower animals, and also on condemned criminals. A sense of humanity gradually put a stop to this latter mode of experimentation; but we, who have derived much valuable knowledge, though often obscured by absurd theories, from these experimenters, must not be too ready to find fault with them. In connection with this mode of experimentation, a name occurs which we commonly associate with a different employment; namely, that of Sir Christopher Wren.

Notwithstanding the general tendency to shake off mere tradition and subject everything to the canons of inductive research, yet many strange things retained their place in the works on forensic medicine in the seventeenth and eighteenth centuries. It was a very common belief, and accepted on the most slender evidence, that there were poisons in use so subtle that they might be conveyed in a letter which would prove fatal to the reader, or inhaled in the fragrance of a bouquet. We might to some extent credit these accounts, if we had grounds for supposing that the poisoners of old were skilful enough to isolate the zymotic poisons —the only poisons we know which can be carried in such a way. Prince Eugene is said to have received a poisoned letter, which, however, he suspected an immediately threw from him. To ascertain whether his suspicions were well founded, the letter was given to a dog, which was moreover fortified by an antidote. Notwithstanding this, the dog died. Marx, who relates the story, naïvely asks "Was not the dog poisoned by the antidote?" We might believe in poisoned gloves, but hardly in poisoned boots, poisoned saddles, and the like.

Pope Clement VIII. was said to have been killed by the fumes of a poisoned candle which was placed in his bedroom. Those who attributed his death to this cause, forgot, or did not know, that at the same time a brazier of burning charcoal was likewise placed in his holiness's apartment.

A belief in the existence of slow and secret poisons which could be prepared with such skill, and the dose calculated to such a degree of precision, as to cause death at any given period, according to the will of the poisoner, was more prevalent, and has not altogether passed away at the present day. It has descended from very ancient times. Theophrastus speaks of such a poison prepared from aconite which would produce its effects after two, three, or six months, or even after one or two years. The Carthaginians were said to have administered such a poison to Regulus, so that, whether he returned from his mission to Rome or not, he might not altogether escape. And it is related by Plutarch, that one of the Philips of Macedon caused such a poison to be administered to Aratus, King of Sicyon. This is said to have produced a gradual wasting of the whole body, accompanied by hæmoptysis. On one occasion, when he spat blood, Aratus, who believed he had been poisoned, exclaimed "This is a mark of the King's friendship!"

In more modern times the idea was founded on apparently better grounds, viz., on the effects attributed to the celebrated *aqua Tophana*. This poison derived its name from Tophana, a woman who resided at Naples in the latter part of the seventeenth century. It was sold in phials, which, in order to escape the scrutiny of the Government officials, were labelled "Manna of S. Nicholas," purporting to be an oily liquid of reputed supernatural virtues which was said to flow from underneath the tomb of S. Nicholas of Bari. The name "Manna of S. Nicholas" is familiar to all readers of "Kenilworth," though its mention there is somewhat of an anachronism. From four to six drops of this aqua or acquetta were said to be a fatal dose, and it was asserted that the dose could be so proportioned as to operate fatally at any fixed period after its administration. Tophana, who was convicted in 1707, and subsequently strangled by the orders of Charles VI., confessed to having been the means of destroying 600 lives. The wonderful effects ascribed to this poison led to many attempts to discover its composition. It was said to be a clear liquid, tasteless, odourless, and easily miscible in all kinds of food and drink. Halle, a writer on poisons, who was gifted with a marvellous amount of credulity, thought that it was a preparation from the foam of men tortured to death; and remarks, that if Italy could have been the parent of such wickedness, "then truly a seed of the forbidden fruit must have fallen in this garden of the devil!" The most probable of the many suppositions advanced regarding the composition of the *aqua Tophana* is that it was an arsenical solution. In support of this, Hoffman quotes a letter from Gasparelli, physician to the Emperor Charles, in which he asserts that he was informed by the Emperor himself (to whom Tophana confessed the secret of her preparation) that it was a solution of arsenic in an infusion of *cymbalaria* or toad-flax. The Abbé Gagliani and Ozanam assert that at least some of the preparations called *aqua Tophana* contained opium and cantharides. This, however, is not likely, if the *aqua Tophana* were really tasteless and odourless, as it was generally said to be. The accounts we have received of the effects which followed the administration of this poison would agree, in so far as they are trustworthy, with the symptoms of arsenical poisoning. The most likely explanation of the slow and subtle action ascribed to it, is that it was due to chronic poisoning caused by frequent administration. A similar explanation must be given of the almost equally celebrated *aqua mirabilis* of the Marchioness of Brinvilliers and the *poudres de succession* of La Voisin and Le Vigoureux.

The *aqua mirabilis* of the Marchioness of Brinvilliers was probably of a similar composition to the *aqua Tophana*. The career of this woman was one of the most remarkable in the history of poisoning. She carried on an intrigue with a young officer called S. Croix, which created such scandal that the father of the Marchioness caused S. Croix to be incarcerated in the Bastille. There he fell in with an Italian called Exili, from whom he learnt the art of secret poisoning. S. Croix, when liberated, instructed the Marchioness in the art which she afterwards practised with so little scruple. She is said to have assumed the character of a sister of mercy in order to try her nefarious mixtures on the unfortunate patients in the Hôtel Dieu. She subsequently made away with her father and brother. After a long career of crime, she was beheaded and burnt at Paris in 1676. The symptoms recorded in the case of her father and brother would confirm the opinion that arsenic was the chief constituent of her poisonous compounds. Closely connected with the Marchioness of Brinvilliers were two infamous women, named La Voisin and Le Vigoureux, the former of whom was a midwife in Paris. These women attained a great reputation as fortune-tellers, and were consulted by many eminent personages of both sexes regarding the probable time of death of their husbands or wives, or other obnoxious individuals. Their predictions were often marvellously verified, and no wonder, seeing that they had the fates in their own hand, and drove a wholesale trade in poisons. They were ultimately condemned and burnt alive by order of the Chambre de Poison or Chambre ardente instituted by Louis XIV. The poisons they made use of were called *poudres de succession*. To these, also, a slow and secret action was ascribed. Lead was said to form their principal constituent. From what we know, however, regarding acute and chronic lead-poisoning, we should be inclined to attribute the fatal effects to some more active agent, or possibly to the means employed to cure them. Most of the accounts of slow and secret poisoning are therefore manifestly fabulous, or are susceptible of such an explanation as given above. With the exception of the zymotic poisons and the hydrophobia-virus, which may long lie dormant in the system before producing their effects, but which we have no reason to believe were ever isolated or employed by the most skilled poisoners of old, we have nothing to warrant the assumption that such slow poisons ever existed except in the minds of the credulous. The existence, however, and frequent use of such poisons even at the present day, is maintained by a recent writer in a medical journal. He states that the Thugs of India possess and employ a slow poison called *tophayne*. And that poisons may be conveyed in letters which will prove fatal to the reader is considered probable, from the recent sudden death of two individuals after reading anonymous letters—one of these cases occurring in Canada, and the other, that of General Cugia, at the last Carnival in Rome.

Unless better evidence be brought forward than examples like these, we must regard conclusions from such data as manifestly worthless. Thanks to the knowledge which we now possess of the natural history of disease, and to the perfection of the means of detecting poisoning, together with the restrictions that are put on the sale of poisons, the crime is becoming more and more rare, and cannot, even in the most skilful hands, long remain undetected. Fortunately, those who have it most in their power are those who have been least guilty of it, with some few noted and universally execrated exceptions. Medical men have been in general true to their Hippocratic oath, and are ready to echo the sentiments of the surgeon in the army of Napoleon, who, when requested to poison 500 unfortunate invalid soldiers whom it was inconvenient to take with the army or to leave behind, indignantly exclaimed, "Neither my principles nor the dignity of my profession allow me to become an assassin!"

THE MANUFACTURE OF TEXTILE FABRICS AT POMPEII.

SOME interesting particulars of the ancient method of cleansing and finishing woven fabrics, as revealed by the ruins of Pompeii, are given by M. Beulé, who inspected the remains of a fulling and bleaching establishment in the buried city. The house in question was unearthed some time back, but the descriptions of its contents seem to have been confined to the pictures.

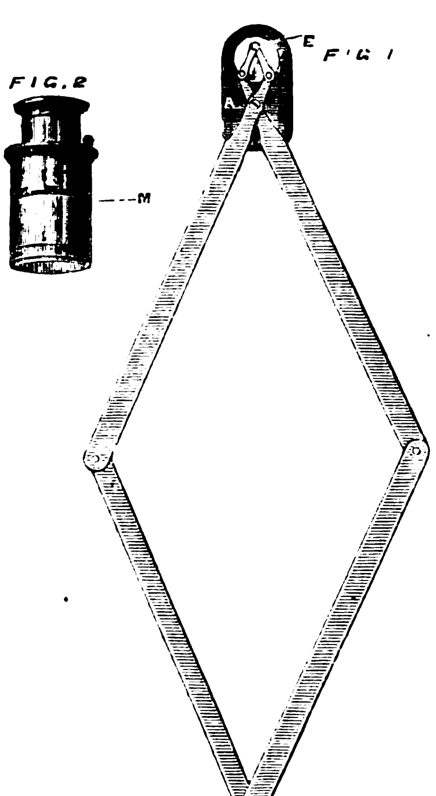
The largest and best executed paintings representative of the art were discovered in 1820, in the house of a fuller, opening on one side on the street of Mercury, and on the other on a street called after him, Fullonica. In the court a pillar covered with pictures was standing alongside a fountain. This pillar has been removed and deposited in the Naples Museum. In the lowest division, a woman, sitting, hands a piece of cloth to a little female slave. A workman, whose tunic is closely tied around the body, is looking at them, while at the same time carding a white cloak with a purple border, suspended from a stick. Another workman is in the act of sitting down alongside a crate of wicker-work on which the cloth is to be spread out; in one hand he holds a vase on which sulphur thrown on burning charcoal will develop a gas capable of bleaching the cloak. This is the same method, says M. Beulé, which is used to-day. On another face of the pillar arched niches contain large vats where the goods are soaked. Slaves standing in those vats trample the fabric with their bare feet in the same manner as Arabian women wash their linen by trampling them against the rocky bed of a stream; this is what the ancients called "the fuller's dance" (*saltus fullonicus*). The artist has painted with the same care the press with its two uprights, its two enormous screws, which were turned by means of cranks, in order to flatten the cloth beneath the planks which imparted the necessary finish. Finally, the drying chamber is shown by long sticks hanging on chains from the ceiling. The linen is spread out on them; a slave hands to a young woman an open fabric, while the wife of the fuller makes a note of it on her tablets. I have visited with particular curiosity the houses in Pompeii where these pictures had been gathered. I counted there in a court twenty-two tanks constructed of stone, and at different levels, so that the water could run from one into the other. Little benches in front of them served for the reception of the goods. At the other end of the court, seven smaller tanks served for fulling. The store-room, with traces of the planks, which were laid like rays radiating from a centre, the hearths, the drying chamber, may still be recognised. In other fullers' establishments, I have seen very thick sheet-lead lining the interior of vats made of cement. Sometimes, also, we find jars full of a greasy earth, which must be the fuller's earth of which Pliny speaks, and which contributed as much to the whiteness of the goods as the fumigation with sulphur or the urine which was collected in vases placed at the corners of the streets. Thus, despite the differences of time and processes, it has been established, to our surprise, that moderns are but little inventive, or, rather, that the ancients had already discovered all that was essential, rational, and suited to the requirements of the art.

DRAWING FROM THE MICROSCOPE.

AN easy method of making accurate drawings of objects seen in the microscope is almost a necessity for the student who wishes to make himself proficient in the use of his instrument, and is of the first importance to the beginner who desires to acquire a knowledge of the objects he examines. Independently of the fact that all real advance in the science hangs upon the multiplication and circulation of accurate representations of the forms and phenomena disclosed by the microscope to the eyes of skilled observers, the tyro, who may possibly be cut off from all communication with proficients to whom he could take his objects and have his difficulties explained by oral and ocular demonstration, will find that the power of making a drawing of an object exactly as seen will be of the greatest value to him in his endeavours to acquire a knowledge of what has been already accomplished, and a great assistance in his attempts to explore new fields; for a drawing is easily transmitted through the post, and coming into the hands of a microscopist who has already passed along the same road and through similar difficulties, he is enabled to remove the obstacle and explain away the perplexity of the student with a far larger amount of assurance and consciousness of correctness than would be possible from the most elaborate verbal description. In his treatise on "How to Work with the Microscope," Dr. Beale justly observes, "It may be truly said that no real advance in our knowledge of the minute structure of animal or vegetable tissues can be communicated to others, unless accurate drawings are made." Yet, as a matter of fact, how very few amongst even earnest students of the microscope can draw at all, and what a very small number have acquired the valuable art of drawing accurately. There are several "accessories" to the microscope, which are more or less useful in enabling the observer to make a truthful copy of what he sees, not the least valuable of which is Dr. Beale's neutral tint reflector, some particulars of which will be found at p. 331, Vol. XIII., and an improved method of using it at p. 386 of the same volume.

One of the latest inventions for rendering the copying of an object as seen in the microscope both accurate and easy, was recently described by Mr. Isaac Roberts, F. G. S., to the Royal Microscopical Society, and an illustration was published in their *Journal*, from the pages of which we reproduce a diagram of the little "micro-pantograph" he has

FIG. 2 FIG. 1



designed. With the appliances hitherto in use, it is questionable whether in many instances they do not increase the difficulty of making an accurate reproduction; but with this "accessory," almost any one can, after a few hours' practice, make an accurate copy of the most elaborate object, accomplishing this, moreover, with facility. The instrument consists essentially of two parallelograms, having their major and minor sides and angles respectively proportioned in all positions in which the instrument can be placed. The major and minor sides rotate freely about the common centre or fulcrum, which is fixed to the eyepiece of the microscope in the focus of the eye-lens. A pencil is attached to the major end-joint of the instrument, and a small glass disc ruled with a micrometer-lined cross is attached to the minor, or eyepiece, end-joint, in the position where pointers are placed. To see both cross and object at the same time similar focussing is necessary to that which is employed to see an object and a pointer. When drawing the hand merely moves a pencil over the paper, and at the same time and by the same action guides the micrometer cross-lines over the field where the object appears in the microscope. The drawing paper should, of course, be laid on an inclined table capable of adjustment to the height of the microscope employed, the top being also made movable to suit the angle at which the microscope is being used. In the illustration Fig. 1 represents the micro-pantograph, and Fig. 2 the form and approximate position of the slit into which the minor end of the micro-pantograph and its support shown at the top of Fig. 1 are inserted. In Fig. 1 E is a glass disc with micrometer cross-lines ruled upon it. It is cemented over a small hole drilled through the centre of the rivet forming the joint at the minor extremity. A is a centre, or fulcrum, around which the parts of the instrument freely move. N is a holder for a drawing pencil, placed over a hole drilled through the rivet forming the joint of the major end of the instrument. In Fig. 2 M is a slit for the insertion of the minor end of the micro-pantograph with its support shown behind E A in Fig. 1. The instrument being firmly fixed in position in the eyepiece to draw any object, it is only necessary to place the eyepiece in the microscope, adjust the drawing table to the height and inclination of the plane of the pantograph, and with the right-hand forefinger and thumb guide the pencil with slight pressure over the paper, at the same time looking through the eyepiece at the object and guiding the centre of the micrometer cross-lines over the respective parts of it; an accurate drawing of the object will thus be traced upon the paper.

Mr. Roberts has not patented this useful contrivance but freely presents it to all workers with, and students of, the microscope. Many of our readers will be able to construct the instrument for themselves, but, doubtless, our opticians will soon be in a position to supply it and adapt it to any form of microscope. For those, however, who may desire to make for themselves, it is only necessary to say that the length of the minor sides of the parallelogram within the eyepiece is ¾in.; of the major sides 5¾in., the instrument when extended to the full length measuring 12¼in.

NOTES OF COMMUNICATIONS TO THE ACADEMY OF SCIENCES, PARIS.*

INDUSTRIAL CHEMISTRY. — DECORATIVE PAINTING ON TIN.—Tinfoil is spread out upon a smooth surface, such as glass, the latter having been first moistened to aid the laying out of the foil and to maintain it in its position. The painting is then executed upon it in oil. This painting on tin, when dried and varnished, can be rolled up like ordinary paper-hangings, from which it essentially differs in possessing all the variety of tones and colouring that oil-paintings admit of. The tin groundwork constitutes a waterproof protection, and, on account of its great flexibility, will follow the various mouldings and contours of the object to be ornamented. To the latter should be applied a hydrofuge mixture, when it will be ready for the decorator. This method can replace ordinary gilding, as the gold can be applied in the workshop and the gilt tin fixed afterwards. The advantage of gilt tin over gilding on other metals is that it is inimical to oxidation; whereas it is known that gilding upon other metals, and notably upon zinc, deteriorates rapidly.—M. C. DANIEL.

[M. Dumas, one of the Commissaries appointed to report to the Academy on the above communication, was, with all who saw the remarkable specimens submitted, highly interested. He considered it of the greater importance to see an industry of this kind develop itself, as it has the sanction of long practice under a somewhat different form. The Chinese, in fact, employ painting upon tin for their furniture and lacquer work, and that which one commonly takes for gold on these objects is nothing but leaf tin covered with a yellow varnish.]

PHYSICS.—LIGHT OF THE VAPOUR OF IODINE.—Vapour of iodine presents a number of curious properties. The following is one that does not appear to have been previously noticed. This vapour at a high temperature gives out rays but little refrangible, furnishing a continued spectrum. Place in a tube of Bohemian glass a small crystal of iodine, and heat the tube strongly at a certain distance from the fragment; when sufficiently red, leave it to cool until almost invisible in the dark, the iodine then vaporizes rapidly. The coloured vapour, on arriving at the heated part, burns red in a very nice manner. By admitting an absorbing medium, the incandescence of this vapour can be produced in a very brilliant style. Seal in the interior of a glass tube a fine platinum spiral, which can be raised to a red heat by the electric pile; then introduce pure iodine into the tube, and seal the same after having expelled the air; volatilise the iodine, and establish the electrical communication. The incandescent platinum becomes surrounded with a vacillating flame, of which the colour is modified by absorption. It is a very rich red, and gives a fluted spectrum. The author expects to draw from these facts some interesting conclusions, but, before publishing them, purposes to submit them anew to experimental verification.—M. G. SALET.

METEOROLOGY.—RAIN OF SAND IN ITALY.—A fresh rain of sand fell in Italy on the nights of the 19th and 20th of April last. The same meteoric circumstances attended this as accompanied the shower of 10th March last. A heavy and sudden storm began

* Translated and abstracted for the ENGLISH MECHANIC

on the 15th April on the coasts of Scotland and Norway, attended with a great augmentation of heat all over Europe. The tempest traversed the west and centre on the 16th, and Italy on the 17th and 18th, directing itself towards Africa. On the night of the 19—20th, it returned upon Italy, charged with sand from the deserts of Africa, mixed with organic matter.—M. P. DENZA.

[We once witnessed a fall of blue clay and sand under similar circumstances at Zante, which laid about the streets, and discoloured the trees and bushes, and was about an inch thick on the deck of a man-of-war then in the harbour.—J. J. L.]

CHEMISTRY.—EFFECTS PRODUCED BY A CHASSEPOT BALL IN A CASE OF SUICIDE.—The lesions and derangements produced were such, that in the absence of other evidence, they might have been attributed to an explosible ball. The projectile presented a puffed up appearance, indicating a partial fusion. It seemed to have traversed the soft parts that it encountered without sensible loss of speed, and to have been brought up sharply by the vertebral column, where its impetus had been converted into heat. The author considers that we find realised herein the conditions pointed out by M. Melsens as necessary for lead to attain a temperature of 315°, its normal point of fusion.—M. ARNOULD THENARD.

PHYSICS.—OPTICAL PHENOMENA OBSERVED DURING A BALLOON ASCENT.—During a balloon voyage on the 8th June last, the ascent taking place from the establishment of M. Flaud, near the Champ-de-Mars, Paris, the following phenomena analogous to the Spectre of Ulloa, were observed. At 5.35 p.m. the balloon had passed the white cumuli that extended horizontally at the height of 1,900 metres. The sun was hot, and the expansion of the gas (hydrogen) determined the ascent towards more elevated regions; but as these could not be attained without danger, owing to the limited supply of ballast provided, the valves were used to descend. At this moment the aëronauts were sailing above a vast cloud, on which the sun projected a confused shadow of the balloon, which appeared to be surrounded by an aureola or glory, exhibiting the seven colours of the rainbow. Hardly had they time to look at the first phenomenon when they descended about 50 metres. They then passed very near the cumulus, which extended itself near the car and formed a screen of dazzling whiteness, of which the height was certainly not less than 70 to 80 metres. The shadow of the balloon now appeared near, very dark, and with great distinctness. The least details were visible, and the silhouettes of the voyagers were regularly displayed upon the silvery cloud, and when they raised their arms the movement appeared in the shadow. The shadow of the balloon was surrounded by a rather pale elliptic aureola, in which the seven colours of the spectrum distinctly appeared. Thermometer 14° Cent. Altitude nearly 1,900 metres.* Sky pure; sun hot. The cloud, upon the vertical wall of which the apparition was produced, was of considerable volume, and resembled a great block of snow brilliantly illuminated. There was a certain nebulosity surrounding the voyagers.—M. G. TISSANDIER.

JOHN J. LAKE.

THE MEDICINAL USE OF CARBOLIC ACID.

CARBOLIC ACID is very largely employed in the treatment of wounds and festering sores of all descriptions; but hitherto few experiments have been made with it as an internal remedy. There is good ground, however, for believing that in certain cases it will be found a very valuable therapeutic agent, and under these circumstances the *Lancet* describes some experiments which have been made by two French *savants* to ascertain in what doses it may be poisonous.

MM. Paul Bert and Jolyet, of Paris, have undertaken experiments to make out this point. Between forty-five and sixty grains will kill a dog of large size; nor should it be concluded that a man could bear a dose in proportion to his weight compared to that of the dog, as thirty grains of hydrochlorate of morphia have been injected into the jugular vein of a dog without killing him. Of course one-fourth of this dose would kill a man. The above-mentioned authors state that carbolic acid is a powerful poison, which, very imprudently, is left in the hands of anybody, either in solution or in the solid state. The former is the most dangerous, as some weak solutions for internal use are sold, as well as very strong ones intended for external use. Thus mistakes may easily occur. MM. Bert and Jolyet find that carbolic acid acts like strychnine on the excitability of the spinal marrow. It increases its sensibility, like strychnine, at first; but it diminishes that sensibility, or completely abolishes it, when the convulsive stage has exhausted the medulla. The phenomena resulting from carbolic acid are said by our authors to be quite similar to those produced by chloroform, chloral, ether, woorara, and the section of a motor nerve.

* A metre = 1yd. 0ft. 3·371in.

MECHANISM.*

(Continued from p. 480.)

IF we refer to what may be deemed an ever-present characteristic of continuous motion communicated by rolling, it will be seen in this—viz., that the curves used were of that class which returned into themselves. They are, in fact, completed curves, or portions of curves that may be completed, obeying a decided and a clearly-expressed law of formation as well as relation to each other. And we may notice further, that the shafts or axles on which these rolling curves are fixed, rotate. There is no other motion transferred by pure rolling than such as is expressed by the word "rotation." Some may say that motion communicated to a straight rack is a case of rolling, and that is not rotation. Practically it is not rotation; theoretically it is; for a rack is a straight line, and in the theory of mechanism straight lines are assumed to be the circumferences of circles with centres at infinite distances, for straight lines are really circles with infinity for a radius. Further, if "rolling" mechanism be examined, it will be noticed that the driver and follower are so connected that the precise extent of motion of the driver is of necessity transferred to the follower. In perfect rolling contact there is no escape from that law. The angular velocity, or the velocity of the shafts, may vary, but the length of the path of a point in the circumference of one wheel must be exactly equal to the length of the path of a point in the circumference of the other wheel. Bear in mind that there is a distinction between the angular velocity or the velocity of the shafts and the extent of travel of a point in the circumference of a wheel keyed on a shaft.

Further, the pathway in which the motion may be said to be transmitted is always in the line joining the two centres of rotation. The curves in contact move, but the pathway of communicated motion does not move. Remember, we are speaking of *pure* rolling contact. In this example of two wheels in rolling contact, the pathway in which motion is communicated is a line adjoining the two centres. As soon as the touching parts of the circumferences have left that line, they have left the pathway of communicated motion and ceased to communicate motion from the driver to the follower. The point in the pathway where the contact takes place may move. It may vibrate, as it were, in a line joining the centres of motion of the shafts, as in elliptic and eccentric wheels, or it may be fixed, as in circular wheels. But in all instances of pure rolling contact motion, equal lengths of the two contact surfaces cross that pathway in equal times.

Now, however, that motion is to be communicated by sliding, the relations between the moving pieces are very materially modified. Not only may the direction of the pathway in which the point of contact travels be ever varying, but the very idea of peripheries or circumferences rotating about the centres to which they are related, by some reentering law of curvature, vanishes. In rolling contact motions there are always peripheries; in sliding contact motions one or both of those peripheries disappear.

Let us see, then, how this preliminary alteration of affairs affects the mechanician in the case of rolling circles, ellipses, and lobe-wheels—by lobe-wheels are meant wheels based upon such figures as squares, with curves and teeth upon them (see Fig. 9, p. 480), of which there are some very beautiful photographs on the wall, well worth close inspection. It is cause for regret that, so little is mechanism appreciated as a study in England, that neither private enterprise nor the authorities in scientific museums have either exhibited or are possessed of copies of the originals from which many of the numerous photographs of mechanism in this room have been taken.

In the case of rolling circles, ellipses, and lobe-wheels, the velocities communicated depend on the ratio into which the point of contact divides the line connecting the centres of motion. This principle is applicable in all motions of pure mechanism. And there is a second condition. The freedom, perfection, and accuracy with which motion can be transferred are dependent upon the permanence of the line of direction in which the contact surfaces convey it. If the line of direction by which the motion is communicated varies, then accuracy in regard to the relations of the motions ceases. If the point is always in the same position in this line, then the velocity ratio of the shafts is constant, that is if, for example, one shaft makes ten revolutions, the other will make twenty; but if that point moves, the proportion of ten to twenty, or constant velocity ratio, fails.

You will find in this model (subject to the irregularities attendant upon all practical illustrations of pure rolling mechanism) there is on each wheel a piece of coloured paper, and as the wheels are turned round you see that these pieces come together again as at the first. The velocity ratio between the two is therefore constant. That point does not move. If, however, we take the case of these elliptical wheels (Fig. 11, p. 480) and bring them into contact at one point, you will observe that whilst the communication of motion by the rolling of the ellipses is perfect, the space passed through in that circumference and this circumference is the same. Equal travels have taken place in these elliptical wheels as regards the circumferences, but variable velocities in the shafts on which the wheels are keyed. Take, for example, these elliptical wheels, and see how the velocities of the shafts vary. There is a circle representing a section of the shaft divided into thirty parts. At the present moment the pointer is pointing to zero. While the wheel has gone half round, the shaft ought, according to the ordinary law, to have completed one half of a rotation, but you will find it is not so. The shaft has passed through twenty portions of the circle, but the other half rotation of the wheel takes the shaft through only ten portions.

Now, in these elliptic wheels without teeth, so long as pure rolling takes place, however varied may be the velocities of the circumferences of the cylindrical shafts, the circumferences of the wheels passed are equal. There is no evasion of that law; but assume they are in such circumstances that they are unequal, then one of the surfaces must have slid past the other. A sliding motion has entered into the mechanism which was not provided for at all. Perfection of workmanship and indestructibility of material can alone prevent a partial sliding in the very best of illustrative rolling contacts. What, therefore, cannot be averted must be accepted. Hence we must recognise rolling contact motions in connection with the motions consequent upon sliding, and we must therefore endeavour, as far as possible, to enlist the necessary sliding contact motions to aid in the promotion of rolling contact motions, the object being to impose an immutable law upon two pieces where one causes the motion of the other. As, for instance, in the case of clock-hands; if the minute hand did not move by an invariable connection with the hour hand, the clock would be very delusive. Since there is to be an immutable law between the two pieces, therefore, the uncertainties of sliding must be eliminated, whilst the presence of sliding must be recognised.

Now, put a piece of wood upon this rolling circle, and a pin or tracing pencil on the other; let the circles roll as before, and the pin mark a line upon the wood. Cut the wood to this line, and instead of the wheels rolling let arms from the centres carry the pencil-traced curve and a pin against its edge. The pressing and sliding action of the curve on the pin will cause the shafts to move as the rolling of the wheels did. Mathematicians can show the identity of the motions, and that they are the same as though communicated at the point in the line joining the centres. Were it not so, the preordained law of velocity-ratio would be broken.

The condition to be satisfied is that the motion be communicated exactly at the required point, and at no other.

The mechanician, or rather the mathematician—for we are now entering into that province which is forbidden ground, since the problem in this phase belongs to the mathematician—must determine the shapes of curves which may replace these rolling circles, the circles being entirely taken away; which curves shall so move in sliding contact that the line of pressure shall always intersect the line joining the centres of motion in the same point, or in a point whose law has been previously ordained. In the case of those elliptical wheels there is a law, and the point is continually varying. In the case of the circular wheels there is another law, and the point is constant. Although now trenching rather more on the province of mathematics than was originally intended, the conclusions to be drawn are so essential to the perfection of mechanism that a description of the principles which govern these conclusions must here be introduced.

Let us see why to use pure rolling contact for the communication of power is little more than theory, but to use it for the communication of velocity is practice, as those who were here on Monday last can testify. We had then the case of pure rolling contact for raising heavy weights; and if any of you go into the room at the Arsenal at Woolwich where large timber is sawn, and ask to be taken below where the driving machinery is, you will see a large circular saw—to the best of my recollection 4ft. or 5ft. in diameter—the rotation of which is accomplished by pure rolling contact. The saw is supported upon a simple shaft resting on two bearings. It is driven by two cones pressing against it. The cones have leather surfaces, with which they grip the saw, causing it to rotate, and in this case a high velocity is accomplished by pure rolling contact, and is utilised in the cross-cutting of baulks of timber.

Teeth on curves, or, as we usually call them, on wheels (although all curves can be made into wheels), are now the accepted mode for the communication of such motion as would take place if the rolling was perfect.

Let us see what should be the form of the teeth on curves, and how these teeth act and re-act upon each other.

(To be continued)

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly a possible.]

All communications should be addressed to the Editor of the English Mechanic, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

HARK BACK!—B. A. C. STARS—AND STAR ALTITUDES AND REFRACTION.

[4614.]—"Video" (query 12444, p. 471) should turn to Vol. XIII., p. 229, letter 1983; "H. Science" (query 12463, p. 471) to Vol. XI., p. 277; and "C. B." (query 12465, same page) either to Vol. III., p. 194, or to Vol. XIII., p. 153, letter 1839. "Excelsior," too (query 12482, p. 496), who inquires about the calculus, will find a curiously simple exposition of the elementary principles of the differential calculus and of its applications, in Vol. XII., pp. 361, 409, and 481, in a series of articles by Mr. Proctor. He will hence derive a notion of the extensive class of problems to the solution of which it is applied. As for the integral calculus, it is indispensable in the higher geometry, and is employed largely in dealing with the recondite subject of perturbations, &c., as also in certain branches of optics, and physics generally. If "Excelsior" will thoroughly master the ideas involved in Mr. Proctor's capital papers, he can go on to Todhunter's two books, his "Treatise on the Differential Calculus" and "Treatise on the Integral Calculus," published by Macmillan and Co. He, however, will scarcely get on without a tutor.

I may answer "C." (query 12518, p. 497) by telling him that 73 Ophiuchi is number 6155 in the British Association Catalogue; but that it is not 73 *Struve* Ophiuchi, as it is numbered 2281 in his list. Further, that Struve 2403 Draconis is B. A. C. 6410; that Struve 2878 Pegasi is not in the B. A. Catalogue at all; that 26 Pegasi is B. A. C. 7723; and, finally, that 36 Andromedæ is B. A. C. 250.

"Tyro" (query 12525, p. 497) asks a question which to answer in anything like detail would involve an employment of space scarcely permissible in a letter. I will, however, do what I can for him. I may, then, in the outset, explain that refraction tables are chiefly used in fixed observatories for the reduction of the observed *meridian* altitudes of objects to their true altitudes; and in a case of this sort we should, of course, for a star between the south point of the horizon and the zenith, add its declination to the co-latitude of the place of observation if such declination be north, or subtract it if it be south, to obtain its altitude at the instant of its transit. For example, what will be the meridian altitude of ι Pegasi at the time of its passage over the meridian, as seen from the Liverpool Observatory on the night of August 8? The latitude of our supposed observatory is 53° 24′ 4″, and its co-latitude, therefore, 36° 35′ 56″. If, then, to

36° 35′ 56″
we add 9 17 29, the star's declination north,

we get 45° 53′ 25″ as its actual meridian altitude.

The quantity to be added to this, from Bessel's tables, to obtain the apparent altitude "Tyro" can, of course, find for himself. He will do well to compute this correction for some mean height of the barometer for every degree from 0° to 90°, and then tabulate it against the degrees of north and south declination corresponding to particular ones of altitude for his own latitude. This is exceedingly simple. If, however, the star be at some distance from the meridian, its altitude may be computed by the following formula—

$$\tan. y = \cos. P \cot. \delta$$

$$\cos. z = \frac{\sin. \delta \sin. (y + \phi)}{\cos. y}$$

where z is the zenith distance of the star, P its hour angle from the meridian, δ its declination, and φ the latitude of the place. I need scarcely add that 90° − zenith distance = altitude. If "Tyro" possesses the smallest acquaintance with the use of trigonometrical tables, he will have no difficulty in computing an example from the above easy formula; but as for attempting to get "the *exact* allowance to be made in setting the circles of his equatoreal," that is a waste of time never perpetrated by the practical observer. As long as a star is sufficiently near the centre of the field for identification, it is the merest pedantic refinement and supererogation to insist upon its being absolutely in the line of collimation of the telescope. Besides, I question much if any ordinary equatorial mounting will admit of such hair-splitting accuracy.

A Fellow of the Royal Astronomical Society.

SOUND (OR UNSOUND) THEORY.

[4615.]—With reference to the query with which the letter (4607) of "The Harmonious Blacksmith" on p. 489 concludes, I must confess that (beyond the known fact that a confined column, or mass of air of definite length, vibrates rhythmically) I am unable to offer any satisfactory theoretical reason why a partly closed box should give greater resonance in connection with a vibrating string than a mere flat disc of wood employed as a sounding-board; but I have always understood and believed, that, as a matter of practice, it does. Of course, "The Harmonious Blacksmith" is familiar with the lecture-table experiment of increasing the sound emitted by a tuning-fork or bell by bringing it over the opening of a tube closed at the other end; and knows how enormously louder the resonant vibrations of the confined air cause the audible note of the fork to be. With his very great experience with stringed instruments, too, he must have had an opportunity of comparing the difference of quality in the tone of a guitar, which, like a violin, is a nearly closed box; and a banjo, which, I fancy, has no back at all. However, after all, *ars probat artificem.* "The proof of the pudding is in the eating;" and I cannot help wishing with "F. R. C. S." (let. 4598, p. 488), that our great musical contributor would have his funny fiddle constructed and played on, and furnish us with a full, true, and particular account of the result. It would be safer to theorise in the light of the knowledge thus acquired.

A Fellow of the Royal Astronomical Society.

A GIANT PLANET.

[4616.]—"Hyrab Sen" (let. 4573, p. 482) altogether misapprehends his position and my own. My theory is in no sense "on trial," merely because some one chooses to imagine objections to it, or because I consent to explain what it really is. I would point out, moreover, that in his remarks about my being "so great an authority," and again, "so great and potent an astronomer," he overlooks the fact that were I desirous of so asserting myself, I should refrain from making any explanatory remarks whatever in the correspondence columns of any journal, respecting the theories I have advanced. It is because I advocate a much greater degree of frankness than is at present usual among the students of science, and a much greater readiness to meet doubts and consider objections, though urged by the tyro, that I myself adopt a course so different from that which is commonly pursued. Such letters, and especially such rejoinders, as "Hyrab Sen's," make me doubt whether, after all, the better course would not be to yield to my natural tastes, and adopt the reticence of my fellow students of science. Certainly, that is the course which the consideration of my personal interests and convenience would suggest, and which I have long been urged to adopt by many for whose opinion I entertain a very high respect.

Let me at the outset point out that I should not be careful to defend my theory against "Hyrab Sen," even if he had attacked it. As a matter of fact, he is, for the most part, attacking points which do not belong to my theory at all, and have only been incidentally introduced into my essay on the subject.

As to the "midway" question, I reply that I used the expression midway rather than the technical term "geometrical mean," because it is proper to avoid technical terms in a popular essay. Again—having given the numbers, I did not proceed to explain in what sense I used the word, because it is *not* proper to insult one's readers. If it had occurred to me that any one would take *midway* to be synonymous with *half way*, or fail to see that 82,000 is not half way between 8,000 and 840,000, I should have explained the matter for his particular benefit, with many apologies to the rest of my readers.

I suppose it is quite useless to tell "Hyrab Sen" that when I speak of the light of Jupiter being seen through the cloudbelts which seem to us the densest, I mean that the clouds may not be close-packed, and that, from the satellites, Jupiter's real surface may be seen *between* the clouds (through the cloud-belts, not through the clouds themselves). I mention in my article that the best telescopes show a multitude of minute cloud-like objects over the ruddy equatorial zone.

As to a number of other ideas in "Hyrab Sen's" paper, he is as free to entertain them as I am to uphold the contrary—freer, indeed, a good deal—since I find myself fettered by some degree of acquaintance with the known facts of the case, whereas "Hyrab Sen" is apparently very little shackled in this way.

There was no petulance whatever in my remark that "I fancy 'Hyrab Sen' counts degrees Fahrenheit much as a schoolboy counts marbles." It is precisely as I expected. "Hyrab Sen" *does* think that degrees of heat may be counted up, multiplied, and divided, as marbles are counted by the schoolboy. And thus the 600th part of a temperature of 1200° Fahrenheit amounts, he imagines, to a temperature of 2° Fahrenheit! He may be aware, perhaps, that 1200° Fahrenheit correspond to 648·9° Centigrade; and according to his marble-counting method the 600th part of this temperature is 1·08° Centigrade, or nearly 34° Fahrenheit. So that the 600th part of a certain temperature may by the marble-counting method be shown to be either 2° or 34° Fahrenheit. I submit, therefore, that the method is open to objection.

His remark, that the method is similar to that which Sir John Herschel used in estimating the actual heat of the sun, is exquisite. For cool audacity, and rich though unconscious absurdity, it can only be paralleled by that astounding remark in the preface to a certain elementary compilation on astronomy, which announces that "the altogether admirable 'Popular Astronomy' from the pen of the Astronomer Royal" (a perfect masterpiece of popular writing) "may be looked upon as a sequel" to a book resembling the Astronomer Royal's work only in certain chapters which ought to be (but are not) adorned profusely with quotation marks. Sir John Herschel was a master on the subject "Hyrab Sen" is trying his "'prentis hand" upon—a Goliath where "Hyrab Sen" is not even a David—since, contemplating the great man's armour, he does not perceive that "*usum non habet*," and cannot even make a happy shot with his little sling and his well-counted marbles.

It is unfortunate that "Hyrab Sen's" method had not been thought of when Faye, Fizeau, St. Claire Deville, Becquerel, Vicaire, Vualle, and others, were maintaining before the Paris Academy of Sciences (as they still maintain) that the sun's heat does not exceed 10,000° Centigrade. "Hyrab Sen" might have come in triumphantly, first of all, with his known fact that the sun's heat is demonstrably thousands of times greater than that of red-hot iron, say 1,200° Fahrenheit—demonstrably, therefore, some millions of degrees Fahrenheit; but if that had not satisfied the Paris Academy he could have applied his marble-counting method to demolish the unhappy Frenchmen just as he supposes he has demolished me with it. Thus, the sun's heat, according to these benighted beings, is less than 18,000° Fahrenheit; but "the sun's rays at the earth's distance are spread over a sphere of the heavens which, roughly speaking, has a surface 47,000 times larger than the sun's; therefore, 18,000° ÷ 47,000, or less than ²/₅ths of a degree Fahrenheit, must be the amount of heat the sun imparts to the earth"—actually less, by "Hyrab Sen's" very own marble-counting method, than the heat which, by the same method, Jupiter is shown to supply to his outer satellite!

Now, perhaps, "Hyrab Sen" can guess why I "asked him the question" instead of "supplying a calculation myself." I gave him rope, so to speak, knowing how pleasingly he would use it. He had been so very eager to show his prowess and to demolish me, that I could not find it in my heart to pull him up until he had thoroughly shown his paces. With this desirable end in view I was quite willing to "bide a wee."

"With due deference to so great an authority," says "Hyrab Sen," "I decline to take Mr. Proctor's assertion," about luminous objects, "for granted, and though I know it is the orthodox scientific view that distance does not diminish brilliancy, I shall still persist in believing it does." Alas, for orthodox science! But probably "Hyrab Sen" understands the facts on which the accepted view is based as little as he does those which he urges against it. He may, after all, be converted some day. The orthodox may breathe again.

In trying to prove that "sunshine here is hundreds of times brighter than the light" of a body heated to redness, "Hyrab Sen" indulges in the remarks that "sunlight is demonstrably thousands of times brighter than moonlight." I take it that "sunshine here" is pretty nearly the same as sunshine at the moon, so that in comparing the luminosity of red-hot coke with that of the moon's disc, "Hyrab Sen" was comparing the former luminosity with sunshine here, and not with its thousandth part. I do not expect him to see this, however.

I quite understood "Hyrab Sen" to refer to Zöllner's results, which I certainly accept, in my essay, as the best yet extant. They are not what he supposes. He is all in a muddle on that part of his subject as throughout, and I really have not leisure to set him right. [I have always pitied poor Sisyphus.] Only let me remark that if, as he imagines, "there is no reason for supposing Jupiter to be a better reflector of light than Mars" (!), my case is proved; for we certainly get from Jupiter much more light than a globe of his size, constituted like Mars, would send us by reflexion. Of course, if Jupiter is a much better reflector of light than Mars, so much the smaller is the balance of inherent lustre.

But so far as "Hyrab Sen" is concerned, all this explanatory matter is thrown away. I cannot write further on the subject.

Richard A. Proctor.

REDUCTIONS BY *NAUTICAL ALMANAC* METHOD AND BY PROPORTIONAL LOGARITHMS.

[4617.]—In answer to "Aries" (let. 4612, p. 490), the *Nautical Almanac* method is altogether the most exact. The method given in nautical books is based on the assumption that the hourly change of declination is constant from one noon to the next. The *Nautical Almanac* method is based on the assumption that the *change* in the hourly change is constant.

Thus the sun's declination changes from 21° 0′ 40·4″ to 20° 49′ 9·3″ between Jan. 16, noon, and Jan. 17, noon, 1872, the change being − 11′ 31·1″. The rule in nautical books, when applied to find the declination at 4h., January 16 (or at noon, in longitude 60° west of Greenwich), amounts to taking ⁴/₂₄ths or ¹/₆th of this difference, or 1′ 55·2″, and subtracting it from 21° 0′ 40·4.″

[By the way, "Aries" either has very inaccurate tables, or is unfortunate in their use; for the diurnal prop. log. of 11′ 31″ is 8189, not 8198, and the arc corresponding to 1·0979 is 1′ 55″, not 1′ 57″. The arc corresponding to 1·0970 (the true sum) is 1′ 55·2″, as required. Again, in taking out the prop. log. of 20·4″, "Aries" has added, instead of subtracting, the prop. difference for 0·4″.]

Now, in the *Nautical Almanac* method, instead of assuming that the difference for 24h., or − 11′ 31·1″, is equally divided among the 24h., which would give an hourly difference of − 28 8″, we are given the hourly difference − 28·30″ at the beginning of the 24h., and − 29·29″ at the end. The difference between these or + 0·99″ is supposed to accrue uniformly during the 24h., giving an increase of ·04125″ per hour. Then, if we take the average for the beginning and end of each of the first four hours after noon January 16, and take *that* as the change during the hour, we get—

For the first hour, $-\frac{1}{2}$(28·30″ + 28·34125″).
For the second hour, $-\frac{1}{2}$(28·34125″ + 28·38250″).
For the third hour, $-\frac{1}{2}$(28·38250″ + 28·42375″).
For the fourth hour, $-\frac{1}{2}$(28·42375″ + 28·46500″).
Adding which, we have, for the four hours .... − 2 (28·30″ + 28·4650″).
= 1′ 53·5300″,

as by the *Nautical Almanac* rule, which is simply the just mathematical way of deducing the value of the above summation.

It will be obvious that we thus obtain a much nearer approximation to the true value than by a rule which does not take into account the hourly variation in the rate of change.

So with the other cases.

[I would strongly urge "Aries" and others to use the symbols °, ′, and ″, for degrees, minutes, and seconds of arc. The symbols m. and s. for *arcs* are as perplexing as the symbols ′ and ″ for *time*. Captain Noble did excellent service to science a few months ago by dwelling on this matter in a paper read before the R.A.S.]

RICHARD. A. PROCTOR.

THE GYROSCOPE.

[4618.]—IF "A., Liverpool" (let. 4594, p. 486), means that I do not understand *why* the second law of motion holds good, he is quite right. If, however, he means that I do not understand what the law means, I must simply say that he is mistaken.

His question "If a cannon ball be fired horizontally, how is the resistance to a change of plane of motion so nullified that it becomes of no effect whatever," is easily answered by a form of words which seems getting very much out of fashion—*I don't know*. (*Par parenthèse*, I may remark that the plane of motion is not changed. "A." doubtless means "line of motion." Still my reply is, *I've not the least idea*.)

Parkinson, the eminent mathematician, remarks of the second law of motion that "strictly speaking, it could only be proved by showing it to be true for every individual case that can occur, which is manifestly impracticable. But when the results of numerous and intricate calculations based upon it are invariably found to agree with observation, we arrive at a *moral conviction* of its truth."

Professor Nichol remarks, "There is, perhaps, no principle in philosophy on which so much vain logic has been expended, so that it might appear based on mathematical reasoning."

"A." is quite mistaken if he supposes that a weight can be swung by a string in a horizontal plane high as the point of support. It is no more possible to do this than to stretch a string so that it shall be strictly horizontal throughout its length.

RICHARD A. PROCTOR.

[4619.]—IF Mr. Proctor (let. 4587, p. 460) is "unable to spare the time for the *proper* discussion of this subject," would it not be better for him to let it alone altogether? I have that confidence in his intelligence and candour which assures me that if he could spare the time for the due consideration and discussion of the subject he would either at once admit that he has been in error or put forward a convincing demonstration of his accuracy. He is quite right as to the fact stated in the last sentence of his second paragraph, but neither I nor any one else has disputed that fact in the current discussion. The question was not whether the top falls slowly or quickly, but why it does not fall at all.

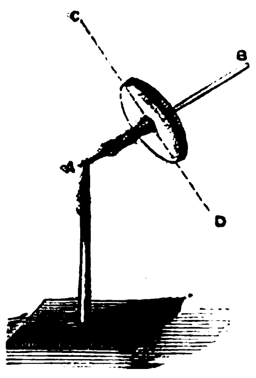
With reference to Mr. Proctor's third paragraph, I would recall to his recollection that at the former time he refers to, he himself put forward an explanation with diagrams. I have as yet contributed no explanation to the ENGLISH MECHANIC. I certainly contributed several letters on the former occasion, but all I claim to have done in them is to have shown that various proposed explanations, and amongst them Mr. Proctor's, were faulty. It strikes me as being a little cool for Mr. Proctor to advise that my explanation should not be published after he has himself made two attempts, which, to say the least, have not satisfied his readers.

Mr. Proctor's fourth paragraph is a random shot, which does not tell, for I have no new theory about nutation to bring forward. Mr. Proctor more than once reminds us that he has no doubt "mathematical analysis affords a complete account of all the phenomena of the gyroscope." I very much doubt, however, if he has been able to spare the time for the proper study of the analysis he refers to, for I cannot understand how, if he really had studied it, he could say as he does in reply to J. M. Taylor, that the motion of one particle under the action of gravity would tend to shift the plane in one direction and that of the opposite particle in precisely the opposite way, whereas the fact is that gravity tends to make both particles shift in precisely the same way—namely, in circular arcs having the point of support for their centre. The very first step towards an explanation is to point out that even if the top were not spinning, gravity would not make the several particles move vertically downwards, but in circular arcs round the point of support. In other words, gravity tends to produce rotation or turning about a horizontal axis passing through the point of support, and it is the effect of the combination of this rotation, or tendency to rotation, with the spinning motion of the top which is the subject of investigation.

Glasgow. E. H.

[4620.]—IF you can spare room for farther discussion on this subject, I trust you will consider the following worthy of insertion.

Since reading Mr. Taylor's letter (4510, p. 485), I have experimented on the weight of tops at rest, and when spinning vertically or at different angles, and I need hardly state that I detected or expected to detect the slightest difference in weight. I would, therefore, submit the following remarks to the notice of Mr. Taylor and others interested. I will first take the case of a top A B spinning in mid air, without the support A E, and consequently falling to the ground. Each particle has by the centrifugal force a tendency to move in the direction of the plane C D, at right angles to the axis A B, and having this tendency it must require a certain amount of force to overcome it before the angle of the plane C D can be altered; and, therefore, supposing the top to be spinning with sufficient rapidity, the axis must reach the ground in the same or parallel plane to that in which it commenced to fall, there being no other force except the slight resistance of the air to change its direction. But now spin the top and place it on the support A B, at any angle, and it will remain in that position as long as the rotation is quick enough to supply centrifugal force in the plane C D sufficient to withstand the effect of gravity, as it is evident the top cannot fall without altering the angle of C D. The whole of the weight is therefore borne by the support A E. L. H. O.

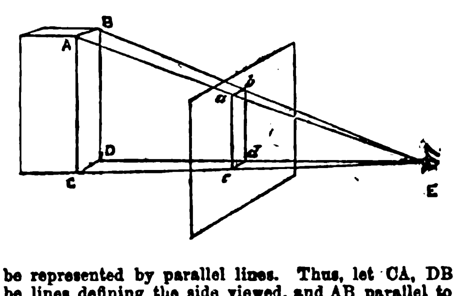


PERSPECTIVE.

[4621.]—ALTHOUGH you have decided to shelve this subject (rather early, by the way), I think you will admit that, as M. Paris (let. 4604, p. 489) charges me with begging the question, I am entitled to a reply. It shall be brief, however.

First, I by no means begged the question. The word vertical in my demonstration meant simply (as usual) perpendicular to the plane of the horizon—not lines apparently so, but lines actually so, like the sides of the supposed tower.

Secondly, it is not true that I am unable to grapple with Carpenter's difficulty; but that I am unable to admit that there is any difficulty in the matter. Of course the top of a tower (of equal breadth throughout) is farther from the sketcher than the base is; and, equally of course, it subtends a smaller visual angle, or is optically narrower. Nevertheless, its sides must be represented by parallel lines. Thus, let CA, DB be lines defining the side viewed, and AB parallel to CD. [That M. Paris may not suppose I am here begging the question, let me point out that AB and CD are the actual edges of a face of the tower; and that the parallelism spoken of is the real parallelism of these edges.] Let P be the plane of projection, E the eye. Then obviously the angle BEA is less than the angle DEC. Nevertheless, if $a\,b\,c\,d$ be the projection of ABCD, we have—



$$a\,b : \mathrm{AB} :: b\,\mathrm{E} : \mathrm{BE}$$
$$:: d\,\mathrm{E} : \mathrm{DE}$$
$$:: d\,c : \mathrm{DC}.$$

Hence $a\,b : d\,c :: \mathrm{AB} : \mathrm{DC} :: 1 : 1$. That is, $a\,b = d\,c$.

This method of proof can obviously be extended to the case where the tower is not looked at full front.

But my former proof is neater and more complete.

[I may just add, as another and complete proof that the vanishing-point of the sides of the tower (or of any plumb-lines) is the zenith, and that a line from the observer's eye to the zenith, being also vertical, cannot meet the vertical plane of projection. Hence there is no point on that plane (indefinitely extended) to which the projections of the tower's sides converge—in other words, they are parallel. *Q. E. D.*]

RICHARD A. PROCTOR.

[4622.]—THE enlarged appearance of the moon when on the horizon offers an example of pictorial perspective. What is called a harvest moon looks, perhaps, larger still, which may be owing to the colour with which the vapours prevalent on the surface of the earth at that season tinge it. However, at all times, whether white or red, the moon on the horizon appears considerably larger than what is sometimes called its natural size when seen at a considerable height in the heavens, and though it actually subtends no larger an angle, yet to produce the same effect in a picture, it must not be drawn in true (or linear) perspective, but considerably larger, *i.e.*, in pictorial perspective, to produce the effect of nature. It appears to me that this case is the same as that of distant mountains, though, from difference of colour, distance and the proportion of enlargement would be different. I believe that in any position, high or low, the moon is in a picture drawn considerably larger than its actual size subtended at the eye. This size is about 30′, and in a picture embracing an angle of 45°, and 12in. in width, this luminary in a moonlight scene should be about $\frac{1}{8}$in. in diameter. I think an artist would portray a full moon considerably larger than this, and a crescent moon larger still, in a picture of this size; and a harvest moon larger again. Pictorial perspective would demand this departure from exact linear perspective, and in a degree it would depend, perhaps, on the nature of the pigments used.

It may be a question whether we should call the natural size of the moon that which we view on the horizon or at a high altitude. In favour of the latter view it may be said that the natural size is that which we perceive when the moon is in the most usual position, *i. e.*, considerably above the horizon. In support of the former we may say that the natural size would be that which we perceive when looking in a horizontal direction, this being the most usual way of looking at distant objects, and I am inclined to think that this is the more correct mode of considering the question of the different apparent magnitudes of the moon, and also of the sun. I am, of course, speaking of their horizontal diameters, and not the vertical, which are more or less affected by refraction.

I once noticed a curious example of this apparent enlargement, in the case of a weathercock 4ft. long, which had been taken from the top of a steeple 200ft. high, and was resting against the foot of the tower, from which I was about 100 yards distant. In that situation it looked immense—at least three times its apparent length, when in its usual place on the steeple, which would then have been 120 yards distant from me, and ought, according to the strict rules of perspective, to have made it appear only 9in. short of the 4ft. instead of the apparent 82in. This is a very rough calculation, but the appearance was sufficiently striking to establish the fact I have mentioned.

While I am rambling, allow me to add a remark on let. 4538: While Mr. R. A. Proctor is, I need hardly say, correct in stating that the direction of motion of a swiftly-moving body changes slowly under the influence of gravity, the remarks of "G. M.," perhaps, to the same effect, are liable to an erroneous interpretation, which is of some importance, as they are intended to explain the matter to another. "G. M." writes: "'A.' is right in saying that a swiftly-moving body offers resistance to any force seeking to change the direction of its motion." The words "swiftly moving" are apt to mislead, as, if the swift motion were the cause of the resistance, which would be equally great in a slowly-moving body or a body at rest; and in the succeeding portion of the paragraph the mode in which the term "deflecting force of gravity" is used is liable to an erroneous interpretation, which the separation of the deflection from the force of gravity (which is the cause of deflection, while the variable horizontal velocity of the body is the cause of its variable amounts) would have obviated.

M. A.

[4623.]—OUR Arcadian friend, "The Welsh Shepherd," in let. 4566, p. 465, quitting his pipe and crook, takes up the pen to write me down an ass; of course, only a perspective ass. I doubt whether in these days of dear mutton and foot-and-mouth disease our shepherd is justified in leaving his flocks to wander at their own sweet will upon the breezy mountain with an impossible name to endeavour to convert me from my faith in Brewster. I do not ever swear in the words of any master, and I would have succumbed to (not conquered by) the Laputans cheerfully, had I not to my own satisfaction proved by experiment the truth of Sir David Brewster's opinion, that if we do not see the top of a square tower to be narrower than the base, it is owing to an optical illusion. It is possible, but not probable, that our friend, "The Welsh Shepherd," may be a greater authority in optical matters than Sir David; but since his letter placing me in the perspective pillory, *vice* Dr. Carpenter let off, reveals no original nor even noteworthy views, I may, perhaps, be allowed to pass his contradiction by. An ancient shepherd, a well-known co-respondent, was wont whenever he got the worst of a fight to take advantage of his patroness's nebulous conveyance, and to retire from the contest under a cloud. I have no wish to imitate my ancestor in this strategic movement, if I quote from Sir David Brewster's paper, in *Good Words* for 1862, what appears to bear upon the subject. Sir David notices a series of illusions relating to the vision of forms, such as plane surfaces and lines, mentioning the experiments of Bouguer, and applies the results to the architectural irregularities of the Parthenon and Theseum—upon which subject I should like our "E. L. G." to say something—adding, "The beauty and apparent symmetry of architectural forms must therefore depend on a certain class of optical illusions, which have not yet been sufficiently studied either by the architect or the man of science." I take the bearing of this to be that the Greeks built to counteract or increase, as required, the illusions of the eye. Sir David then proceeds to another class of ocular illusions called the Inversion of Perspective, and he writes as I quoted in my first letter: "This tendency of the eye to invert the perspective of rectangle prevents or diminishes that appearance of convergency on the plane face of a lofty square tower when we are standing not very far from the base. A photograph of the tower taken from the same spot would exhibit a painful convergency upwards, which is not seen by the eye;" but, as I have proved, may be detected in a moment by means of a plummet held at a short distance from the eye. And it must be so, for the whole of perspective is based upon the simple fact that all bodies appear to diminish in size as they recede, and the top of a building being more distant than the base, the side must narrow as it rises. I am at present residing in a rather lofty house offering tolerable facilities for trying this question. Before the pane of a window raking a street I hung a plummet, and the sides of the houses in "parallel perspective" converged as required. That the so-called horizontal lines, excepting *the* horizontal line, rose or dipped was too evident to need experimental verifying. The side of the house well represents the side of a square tower, and a plummet at a suitable distance (a sketching distance) showed very clearly the same thing. Mr. Proctor's demonstration begged the whole question. Of course, we all know the glass plate will show the rays in the cone or pyramid of vision to be vertical if they start vertical, and that is just what is denied by the anti-Laputans. As for "the rules of perspective being deductions from observations made upon the glass plate," that is sheer nonsense. Perspective rules were acted upon before a sheet of glass was made; and what is more, I very much doubt whether anybody ever did use a sheet of glass to verify or exemplify the rules. The fact is, the only true and pleasing perspective is oblique perspective. So much for lines; now let us take figures. Draw a number of people in a market place; let the picture embrace an angle of about 45°. I maintain, then, even on the same horizontal line the figures should differ in height, and any rifleman will see that at once; for as the figures at the point of sight must be nearer they must be bigger, a little, certainly, but still perceptibly bigger, or your picture will not look true. An angular measurement would show that they are so. For convenience, however, in parallel perspective we must in most cases disregard convergency, although when wishing to convey the appearance of great height I strongly advise it.

Now as to the compromise question. There is no illusion better known than that respecting the slope of mountains, and few people who look at steep mountain sides are aware how much less the inclination is than it appears to be. In painting mountain scenes the artist is justified in giving the apparent and not the real slope. Then as to colour: it is absolutely impossible to imitate the colours seen in nature, for they are the children of light, and we have only a dark surface for our brightest light, and dirty paints for the colours of the spectrum. If we can match a colour tolerably well, we must not do it, because to match one and not all would be to introduce a false note. Having no light, no decent colours, and what is still worse, never the true complementary colours, we can only produce something suggesting what is seen in nature by never representing any one thing very truthfully. Whenever this rule is forgotten, we receive a shock to our pictorial nerves, as we do when an artist paints to the "life" a cold round of beef on a tablecloth spread upon "suggested" grass. M. Paris.

[The above letter was in type before the note at foot of let. 4605, p. 489, appeared.]

UPWARD DEFLECTION OF BULLETS, &c.

[4624.]—None of your correspondents appear to have hit the nail on the head. I, therefore, send the following extract from a work by General Hay:—

"There is another point of great importance with regard to the range of elongated projectiles. It is asserted by Sir W. Armstrong and others that at certain low elevations the range of an elongated projectile is greater in the atmosphere than in vacuo, and the following is the explanation given by the former of this apparent paradox: 'In a vacuum the trajectory would be the same whether the projectile were elongated or spherical, so long as the angle of elevation and the initial velocity were constant; but the presence of a resisting atmosphere makes this remarkable difference, that while it greatly shortens the range of the round shot, it actually prolongs that of the elongated shot, provided the angle of elevation does not exceed a certain limit—viz., about 6°. This appears at first very paradoxical, but it may be easily explained. The elongated shot, if properly formed, and having sufficient rotation, retains the same inclination to the horizontal plane throughout its flight, and consequently acquires a continually increasing obliquity to the curve of its flight. Now, the effect of this obliquity is that the projectile is in a measure sustained upon the air, just as a kite is supported by the current of air meeting the inclined surface, and the result is that its descent is retarded, so that it has time to reach to a greater distance.'" T. S. Usborne.

EDIBLE MUSHROOMS OF ITALY.

[4625.]—In England, though fungi are abundant and various, only two are used as articles of food, and these two are, perhaps, the least savoury of the edible mushrooms. The reason of this exclusiveness appears to depend principally on the ease with which the common and fairy-ring mushrooms can be distinguished from their poisonous congeners. On the Continent, and especially in Italy, various kinds of delicious mushrooms are constantly to be found in the market, and form a pièce de resistance in all the fare bills of the restaurants, be they of the better or of the lowest class. The best and most easily recognisable fungus is certainly the porcino (*Boletus edulis*), a very compact, full-flavoured, and nourishing mushroom. When full grown it is about 8in. in diameter, with a brown cap, and pale sulphur-coloured gills (resembling in texture fine brain coral). The stem is very firm, and measures 8in. in circumference. Raw, the smell is like cedar wood; cooked, the taste and smell are like the finest paté de foies gras. The usual mode of cooking is to slice the porcino very fine, stew for a short time in butter or oil, and then add parsley and garlic (chopped), salt and pepper, to liking. So "meaty" is the flavour of this mushroom that it serves to flavour potatoes, rice, &c., as well as a meat stew would do. The next in the order of culinary merit is the "reale" (*Amanita Cesarea*). This curious fungus at its first appearance on the ground looks exactly like an egg. In twenty-four hours the white top splits open and discloses the bright orange cap, which then presents the

FIG. 1

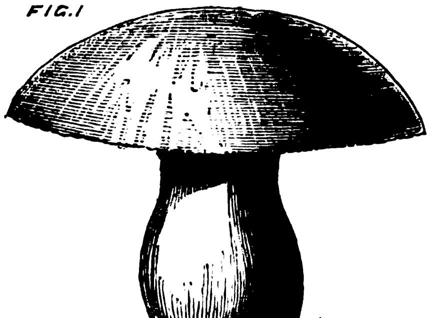


FIG. 4

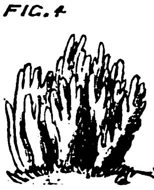


FIG. 2

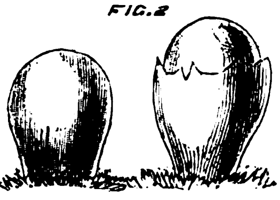
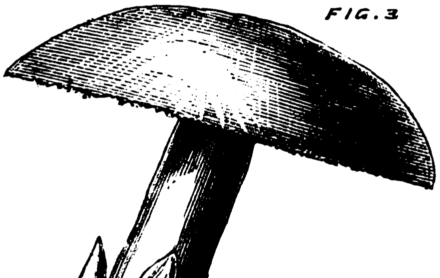


FIG. 3



appearance of the yolk of an egg (boiled hard) laying in its white. In another twenty-four hours the stalk has shot up, carrying with it the yellow cap, which expands until its diameter is about 6in. Fried, the taste of this singularly beautiful mushroom is almost indistinguishable from that of a good egg. Both this and the former are largely used in the manufacture of Italian pickles. They are also preserved for winter use by immersion in strong brine. Besides these, the common puff ball (*Lycoperdon*), the "fingers" (*Mannine*), are also much used.

Most of these are found in England. I have myself eaten the *Boletus edulis*, gathered at Wimbledon, in the strip of wooded land which now forms the Wimbledon Wood. Puff balls are also abundant there.

The annexed figures give an idea of the peculiar forms of these Italian fungii. Fig. 1 is the porcino; Fig. 2, the reale; Fig. 3, the same fully expanded; and Fig. 4, the *Mannine*. S. Bottone.

THE HARP.

[4626.]—Many beautiful things perish that it would be desirable to preserve. The piano, which, after all, is a harp in a box, in fact, an improved dulcimer in its best forms, is indeed a miracle of human ingenuity and ability. I do not at all purpose to set up the harp in opposition to it. I want the harp to live as well as the piano, and it has merits which commend it to that distinction. For the price of one good piano you may have, perhaps, a score of harps, gladdening as many families and as many performers. A well-made harp will last four times as long as a well-made piano. It can be carried about. It can be taken into the garden, or from one chamber to another. The harper begins by tuning his instrument, which, therefore, is always in tune when played upon. The pianoforte player, however, unhappily does not know how to tune his instrument. Fancy, then, the effect in a piece of music of even one string out of tune. But oftentimes there are many strings so; in the country or in a colony, therefore, the instrument (speaking of the piano) too often falls far short of being the comfort which it ought to be, which, under like circumstances, a harp would prove. But even in towns the piano is very often out of tune. The player, let us only reflect, is not taught to tune his instrument. In other respects tuners are not always at hand. Economy keeps many persons from sending for them, and learners are too often condemned to play on discordant instead of accordant instruments. The result is painful to the listener, and tends to injure the learner's ear, as no performance can possibly prove satisfactory on a tuneless or partially tuneless instrument; in fact, the money paid to pianoforte tuners, too often needed afresh when their backs are just turned, would do more than meet the interest on the money that a harp might cost. A good performance on a good piano in perfect order is, indeed, a treat. Nevertheless, its sister the harp, which I would bespeak in especial for dwellings which cannot afford a good piano—and any other is not worth having—is capable of yielding results which the piano, whatever may be its perfections otherwise, cannot realise.

On the thirty-six string harp the rule is to take the fifteenth string, counting from the top down, as the key-note, and make it G by means of a tuning fork. Lest the wires should not bear this tension in the upper octaves, the fourteenth string may be tuned as G in the first instance, thereby reducing the tension throughout. When the harp, however, is strung with sufficiently fine and well-tempered wire, it will bear the full concert pitch, the more so as I believe this pitch has of late been reduced. And I may here mention at once that the eight lowest strings consist of No. 18 wire, the next six of 20 wire, the next seven of 22 wire, the next seven of 24 wire, and all the rest of 25 wire brass or steel. The strings are secured at one end to a common turned perforated wire pin, with square shoulders to yield a purchase to the key, and a second pin with a notch on it to serve as a bridge, for all the world like an Erard harp, that may be seen in any music-shop window. The lower end of the wire, secured to a bit of wood about an inch long and a quarter inch wide, is first attached.

The advantage of taking the fifteenth string as the keynote is that the highest note at the top is G and the last note in the bass is also G. In some of Egan's improved harps, however, two additional strings below low G were added, making thirty-eight in all, and thus rendering the instrument more complete. I have one of Egan's harps. Egan himself is now no more, but I found one of his workmen in York-street, Dublin. His daughters were seamstresses, and this workman resided with them. He offered to supply a superior harp for £10. An equally effective but not so handsome an instrument may be constructed for a considerable less sum. By looking at the French harp a constructor might borrow many hints as to the pins and general arrangement. The wire strings at their lower ends are passed through holes which must either be made in a metal plate, else triangular bits of tin must be thrust into the wood above the aperture, to bear the immediate stress of the string. Apertures also must subsist in the back of the sounding box to permit the introduction of the hand and the proper adjustment, which is easily managed, of the lower end of the string.

The key of G with one sharp—viz., F♯, is the only key in which the Irish wire harp, in fact, is played. Possibly the Welsh arrangement of multiple strings might suit. I do not myself think it would suit, and, as for pedals, they are out of the question along with wire strings. In tuning the Irish or wire harp the octaves are first tuned in unison, beginning with G, fifteen strings down, then tuning the octaves up and down correctly. The fifths must then be arranged, then the thirds. The F♯, however, it must be recollected, only accords with the fifth below. But any tyro in the art of music and, *à fortiori*, any professor of music, can set this matter right. The music would have to be arranged for the key of G. Irish performers always play the treble with the left hand, the bass with the right. On the French harp the treble is played with the right hand, as on the piano. But this is of no particular moment. Any harp music in the key of G will suit the wire harp, and any professional man is competent to instruct players. The fingering, so far as I know, is the same in respect to all harps.

In regard to the Irish or wire-harp, the length of the pole or pillar is some 5ft. or so from base to summit. Its length depends on the length of the soundboard or box, and that again on the length and curvature of the comb. The lowest G string is 4ft. 6in. long, the next G is 3ft., the next G 1ft. 8in., the next G 10½in., the next G 7in., and the highest G 3in. The length of the soundbox is about 4ft., its breadth below 13in., and depth 7½in.; above its breadth is 3½in., its depth 2½in. The comb is 2ft. in direct length; but it has a vertical as well as lateral curvature or slew, which adds to the absolute length. Its depth is from 3½in. to 4in., and its thickness about 1½in. It is, furthermore, built in vertical sections, breaking-joint (say) of oak or mahogany, so as to add to its strength and permanence. The pillar may be of oak, the soundboard or box of pine. The soundbox is tapered from bottom to top, the front is rectangular, the back curved. But in the copy which I have of King Brian's harp, and which must have been jewelled at the end of the comb, the back is rectangular as well as the front. The whole, speaking of Brian's harp (the belly excepted), is richly carved, and all the harps have an ovolo or chamfer running along the upper edge on both sides. On the whole, the Irish or wire harp is capable of very sweet effects; of quick as well as slow music, diminuendo and crescendo passages alike; of shakes, arpeggios, and harmonics; and even in the key of G, that in which it is commonly (I might say always) played, it is capable of producing almost every sweet and gracious cadence fitted to cheer and solace, so far as music is fitted to do so, the heart of man. Ixion.

[4627.]—I may add to "Vertumnus's" reasons for the harp (ancient or modern) having fallen into disuse, the following:—A person having learnt to play on that instrument must either carry it over his shoulder or employ a man to convey it for him, if he ever wanted to exhibit his skill in other houses than his own. I began to learn the harp, but discontinued doing so for this reason, none of my friends possessed such an instrument, while no one was without a pianoforte. It's not "convaynient!" F. F. C.

AN IMPROVED BEEHIVE.

[4628.]—In continuation of my letter (4187, p. 251), and as a reply to our friend, E. T. Grays' letter (4371, p. 354), I herewith give answers to his questions, and comply with his desire as regards the promised honey-taking machine, accompanied by other small necessaries.

1. If the bees are in a hive, procure an empty straw hive or box, turn the hive with the bees in upside down, and place the empty one over; then by a continuous tapping or knocking on the undermost hive the bees will at once ascend into the upper one. As soon as this has taken place, and you are satisfied that the queen has ascended, remove the upper hive gently, at the same time putting a cloth over to avoid letting the bees out again. Set the hive in an upright position while you prepare as follows. If possible cut some of the combs out of the old hive, and as near as possible fit them into the new frames, then place six frames in the stock-room (three over and three under), procure a piece of oilcloth (say 2ft. by 3ft.), lay this on the ground close behind the new hive, then bring the hive or box with the bees in, and quickly and carefully remove the cloth, and in the same moment strike the hive sharp down on the oil-cloth, when all except a dozen or so will lay on the oil-cloth. Take hold of the two sides of the oil-cloth, and tumble the mass of bees into their new house. Place the window in its position and close the door; leave them to arrange themselves quietly, looking at them in about six hours' time to see that all is right, when you will most likely find them clustered and building new combs. When a swarm is obtained the proceedings are the same, only easier.

2. It might be an improvement, though not necessary, and would be more expensive; my bees have wintered over when there has been 10° below zero of frost, in hives of wood 1in. thick.

3. There is no advantage in having longer frames. In the improved hive there is ample space for brood; better have more hives in better order than larger ones in disorder.

4. As regards loss of heat, I have not noticed anything of this sort; but in Woodbury low, broad hives, I have had my bees destroyed, and lots of honey in the hive, the area having been too great for them to travel over in the severe cold. In the improved hive the partition boards being closed, and the honey-room filled with warm material, is sufficient.

The honey-taking machine will be easily understood by referring to drawing (Figs. 1 and 2), showing side and end elevation. A is a revolving, upright shaft, worked by means of the bevel wheels E, and handle D, or simply by handle F, where wheels cannot be procured; B is the can in which the honey is caught when driven out by the centrifugal force as shown. The can is 8in. deep. The frame, with comb and honey in, is laid flat on a perforated plate, which is supported by small angles of tin-plate, 2in. from the top of the can, as shown. The four distance-pieces pass through holes made to correspond, so that the comb rests flat on the perforated plate. The holes in the plate are five-sixteenths of an inch in diameter, and the seven-thirty-second part of an inch from centre to centre. C is a sliding weight to balance the can and honey on the pin or centre H; the dotted lines show the can in repose, when not revolving. The speed is about 100 to 150 revolutions for the can; this drains the combs thoroughly, and the frame and comb can at once be replaced in the hive to be filled again.

Figs. 3 and 4 show a contrivance I have, which may suit others, for diminishing or closing the entrance of hives as the winter approaches. I is a revolving square on the centre O', fixed the sliding door K, which is shown down, or covering to the entrance, except for one bee to pass at a time, when K is raised as high as the slots L will allow. I can be turned to suit any of the three sizes of opening, or in winter can be closed entirely, except the perforations. The dotted lines show the entrance behind K. This simple contrivance saves all trouble of narrowing the entrance by means of stones, sticks, &c., as one often sees, and to the great annoyance of the bees. The whole slide is of zinc, and is neat and effectual.

Figs. 5 and 6 show a frame fork for taking out and setting frames into the improved hive, and the mode of using will be easily understood by looking carefully at the sketches.

Fig. 7 is a very useful little tool. I call it a guide layer. It is used as follows:—Small pieces of clean wax are put in at P, until half full, it is then held over a candle or lamp at R until the wax is melted, when we take a frame and draw the nose S along the middle inside, thus leaving a small string of wax as a guide for the bees to build by. This I have found much simpler and better than gumming or glueing strips of old comb or wood as a guide inside frames, and the bees build much more accurate from this mode, and prefer frames with this sort of foundation. In a hive where I tried three frames (one prepared thus, a second with a strip of comb carefully glued on, and a third with a thin strip of wood one-sixteenth of an inch square glued on. On the first they built a beautiful comb at once; the second they did not rest until they had peeled every morsel off; and the third they took no notice of, and on removing the second and third, and giving them frames prepared by the guide layer, they commenced and built beautifully.

FIG. 1

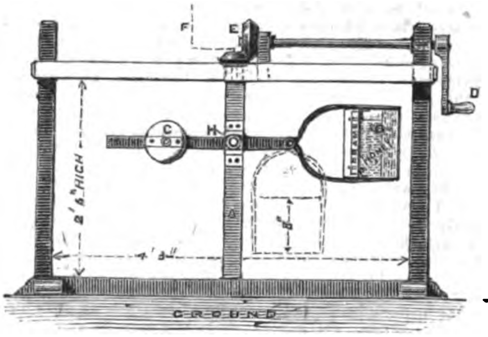


FIG. 2

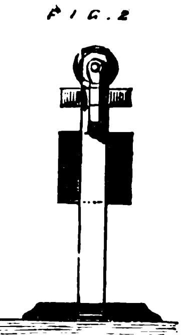


FIG. 7

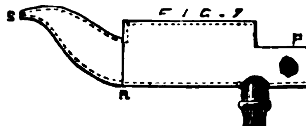


FIG. 5

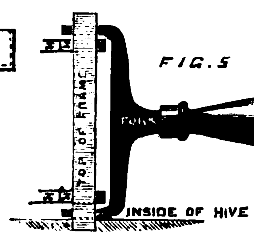


FIG. 3

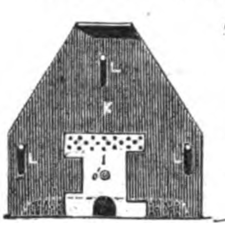


FIG. 4

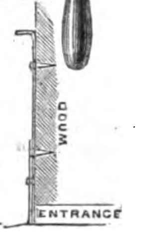
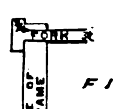


FIG. 6



It may interest some, and, perhaps, encourage others, who have a silent doubt about the improved hives, when I state that up to the middle of July there has been 95lb. of honey taken from one hive this year. I have little doubt that before the season is over the same hive will yield 10lb. more, and 25lb. will then be left for winter use. Thus the hive will in one season yield 105lb. saleable honey, or a total of 130lb. collected in one season.

It would be interesting if our friend Mr. Abbott would give us a few lines on the best mode of supefying bees by means of chloroform.

Also, can any bee-keeper say or explain why bees are so vicious at the time of collecting honey from buckwheat? At all other times I can tumble them about as I like, but while buckwheat is in season there is no going near them without a head-dress.

Nyborg, Denmark. Bee-Keeper.

LIGURIAN BEES.

[4629.]—Having become a reader of the English Mechanic, and finding that the subject of bee-keeping is widely interesting to your readers, I venture to give you an instance of success which to me is surprising.

Having kept black bees in Woodbury hives for four years with but indifferent results, as good, though, as I supposed our locality admitted of, I suddenly became ligurianised, and early in the spring applied to Mr. Abbott, of Hanwell, for a ligurian swarm. It arrived on April 28. Wretched weather followed, when I "tickled not their nostrums with a feather," as Tom Hood says, but their palates with "soothing syrup," of which they had about 4lb. to keep them in heart and hope till brighter times. As soon as fine weather returned, not wishing to pauperise the little community I left them to shift for themselves. It was not long before the hive was well filled, and they seemed to have an emigration scheme in contemplation which, however, was given up in consequence of some rising young bees, soon after I had placed on a Woodbury super, discovering that their house had a story more than the community generally supposed. This additional space was filled by about July 10, when the bees commenced hanging outside very thickly. On the 15th the super was removed, containing eight splendid combs, thick, white, and all sealed, and weighing 44lb. without the honey board. Tare about 4lb. I now tried the weight of the hive (straw Woodbury, but you may guess my dismay, not unmingled with satisfaction, at finding my weighing apparatus not equal to the occasion—60lb. being its limit, and my hive weighing more. No need to feed, clearly, and thinking that perhaps more could be done, a bell-glass, 7in. in diameter and 7in. high, was placed on next morning. This contained a good-sized piece of new but dirty empty comb. This super to-day (July 26) is filled with comb, all stored and nearly half-sealed. When finished it will weigh 10lb. net. The sweets of bee-keeping ought to be honey and sugar. If all swarms behaved like this one, bee-keepers would get a little of both.

Avenue House, Acton, W. F. Cheshire.

CO-OPERATIVE STORES.

[4630.]—Mr. R. R. Smith produces (in letter 4570, p. 465) excellent reasons, though not new to me, for calling things by their own names, and against calling them by other things' names, and against the endless mutual delusions, superstitions, and knaveries, and polluting debasements of soul thence bred. If a tenth of 3s. 8d. be assumed, as he assumes it to be, in this particular case, the just remuneration for the work described, then this neither denotes 10 per cent., nor 5, nor 15, nor any particular percentage to be more proper than another, or proper at all, to be charged "upon the cost price." It would simply denote, if his facts were a true average specimen of the business (which of course they are not), that a farthing *a parcel* was a shopman's just due—the same for a half-ounce parcel as for a half-stone, or half-quarter. Of course this is not the case, and whoever gets a parcel, large or small, from the shopman for a farthing over the wholesale value of its contents, robs him. But to be robbed is what one who reasons no better, and has no worthier aims, is made for; and what we must always, while he is such, hope and pray, for God's and man's sake, and soul's and bodies', and society's, and everything's sake, may continue to be his lot till its lesson is learnt.

As for his difficulty about coinage, if he could get and read an American pamphlet called "Equitable Commerce," or some others by its author, Josiah Warren, of Massachusetts, he would find that any coinage difficulty has been and would be soon solved, wherever there are labourers reasonably sober and in earnest, by their leaving the metal coin to those who desire it. None can make it necessary to commerce or life, where labourers are wise and in earnest. It is one of the grossest of superstitions, though taught even in universities, that coined money was either invented to facilitate, or ever did facilitate, exchanges. It was invented with no such aim, but solely for paying taxes; and its use in commerce anywhere has been purely accidental, secondary, and unneeded. The works of Mr. James Taylor, and even his small pamphlet entitled "Political Economy Illustrated by Sacred History" (Seeleys, 1852), establish this very clearly. Indeed, great commercial nations, as Egypt, Assyria, China, attained their highest refinement and power without using coin. The two former had no coin till their conquerors, the Persians (its first inventors), imposed it; and in all ancient lands it was the badge of conquest. The Old Testament *shekel* was a weight, and no coin to be reckoned by tale, till after the captivity.

While the most mischievous superstitions, as this of the utility of coin, are left untouched, attempts are made on every side to dub as "superstitions," and so to hide away, such damning and unalterable truths as the essential defilement in the touch of all "trade" as now understood; that is, all remuneration by percentages on anything, or rather, by *unfixed, unpublished* profits, instead of definite and publicly known fees or wages, a fixed fee for a fixed service. It is the height of at once absurdity and immorality to set forth (as I have seen the *Examiner* newspaper do) that there can be any trader, as the word is now taken, any of the class Adam Smith defined (Book I., chap. 6) as receiving "profits of stock," whether the poorest or the wealthiest in England, who is not a lower creature than any not so receiving—any professional man or labourer, the poorest. He is as essentially a lower order of creature, as a fox is lower than a S. Bernard's dog; nay, more so, because he is not, *quà* trader, a creature of God. The Creator has made men, maps them to be labourers, and professional men, and even, in a more limited sense, made kings, and with still more limitation we may say, slaves, slaveowners and even landowners; but He has made none a trader (*i.e.*, "profits-of-stock" receiver, or of *dead* stock, in the senses so carefully defined by Adam Smith in the above chapter), nor anywhere made it necessary there should be any such person; especially not any with dark receipt thereof—that is, in concealed or *unpublic* amounts, great or small. *That* is the black polluting element affecting the shop and all connected with it, the darkness of the opaque till, not transparent like the professional man's. The *choosing* of that opacity—choosing darkness rather than light—is what constitutes the "trader" essentially a baser being; not defiled by what entereth into the man, but by what cometh out of the man, his *choice*. This is why we have a degraded caste, not in the vaguer sense the word may be applied to the outwardly ragged, but degraded in soul, polluted and polluting—a truth it is worse than useless to hide, since it must survive and rule both the rise and destruction of twenty "nations of shopkeepers." And a degraded class means, observe, a class that *ought not to exist*—one whose existence all godly men must seek to make more and more difficult, till, by God's blessing, it is made *impossible*. This is why I hold, and have always held since being of an age to even look at Adam Smith's book or its subject, that combination against the trader class, and for the restraint of "trade" as now defined, is the only *religious* act possible to us English of these days, the only worship of the Almighty; because the only work really for, and *not against* His creatures. In all other so-called philanthropies, and godlinesses, and faiths old or new, from an "Order of S. Benedict" to one of Comte, the 85 "Christianities," the priesthoods, dumb on all living iniquity as bees alighted on honey, beating the air, and prodding only at dead Satans, I can see only the live Satan's laughing-stocks and very welcome allies. Show me a body of men that are making less "profits of stock" possible—an Antonio of whose acts a Shylock might complain "he doth bring down the rate of usance here in Venice," action that tends to a lessening the gross source of "Schedule D" income-tax, or, in short, makes but one penny of "profits of stock" grow where twopence grew before—and *there*, I hold, is Divine Service, but nowhere else in this many-altared land and day of ours. Every workman who is combining with no fellows to prepare any such union as I described in let. 3044 (No. 348), but looking to have always an "employer" (or worse, to *be* one), or lazily swallowing, as creed, respectability's fundamental assumption, that one man's capital must employ other men with none, and that employer and labourer must be two men, is by every day, whether of work or "strike," only riveting the chains of his brethren, and children if any, strengthening the hands of their devourers—*i.e.*, the enemies of mankind, "ghostly and bodily," as our catechism saith, and furthering, to the utmost that in him lies, the reign of all iniquity and misery. And every one, workman or not, who is combining with no others to supersede the butcher, the baker, and every adventure-shop in succession, by establishing shops and shopkeepers of their own (each the customers' own property and hired servant) in some such way as I described in let. 4080, is one who, hitherto, I hold, had better for mankind not have been born, even if he have given us more than Peabody.

God's servant Etienne Leclaire is gone, and according to the *Pall Mall Gazette* some officer from Versailles appointed to succeed him, and so the "Maison Leclaire," to be stereotyped, probably as a kind of almshouse, at the point to which he had brought it, with a permanent "Devil bribe" (let. 3044, rule 3) of 25 per cent. Now, of course, wherever there shall be a competition of divers Maisons Leclaire, which there must be in each trade or manufacture, in every place that is to become anything but a social hell and permanent trap-door to hell below—the first factory of men good enough to keep their capital together by a 20 per cent. bribe will undersell those that need 25, and thus, competition in righteousness, instead of in dark pelf-filching, will gradually bring down the "rate of usance," which means bringing down all evil, and advancing all good. The writer (let. 4570) complains of a wrong mode of competition making traders worse. Pray, who has *chosen the ground* of competition? E. L. G.

ARTIFICIAL MANURES.

[4631.]—I am much obliged to Mr. Allen (let. 4565, p. 465), for the notice he has taken of my letter on this subject (p. 381); but I beg to assure him that the "heresies" it contains were put forth for a purpose—a purpose which will be partly served, if I can obtain the attention of chemists and others, who may be able to experiment on the question whether plants require nitrogenous manures. I think one of the first "facts" in connection with agriculture which I learned to appreciate, was that the most valuable manures at present known are those containing nitrogen—and that for cheapness and ease of application the salts of ammonia were the best. Since then, however, many facts have been brought to my notice, which, though not exactly converting me from an opinion, the truth of which has been proved over and over again in practice, suggest the idea that by some means or other, yet to be discovered, plants may be made or induced to obtain all the nitrogen they require from the abundance of the atmosphere. An interesting article from the pen of Mr. G. E. Davis, on p. 400, of Vol. XIII., contains the particulars of some experiments in this connection and a clear statement of the hypothesis. I presume that he has been too busy of late to make further investigations, which must of necessity occupy much time. M. Deherian (see p. 314, *ante*) also propounds a theory to account for the fact that plants do contain more nitrogen than was contained in the manured earth; but Mr. Davis's paper is the more complete, and I commend it to the attention of Mr. Allen and others interested.

I expected to be severely censured for the heresies in my letter, but at present they seem to have fallen on unprepared ground. The one idea which underlies the vague notions I have hitherto formed, is that some "manure" may possibly be discovered, which will enable the plant to absorb nitrogen from the atmosphere; if any one can turn on a little "light" or knock the idea on the head, I shall be obliged.

In reply to Mr. J. M. Taylor (let. 4527, p. 438), I have had no experience with the manure obtained by Moule's system; but I have seen the extraordinary results obtained by the use of the sewage tank. Blood manure seems an excellent thing for roses, at all events. But I commend to his attention the article on p. 219 *ante* on the experiments at Blennerhassett farm, and the reports of those carried on by the public spirited enterprise of Mr. Lawes at Rothamsted. At the latter place, plots of ground have been fertilised with various manures, and crops of corn grown upon them for twenty-eight years in succession. In the table published in the *Gardeners' Chronicle* the average production for the last twenty years is given, together with the yield of last year (the 28th season). The weight of the grain per bushel is not a matter of much moment here, where space is an object, but it is worthy of note that the highest weight (60lb. per bushel) was obtained only from corn grown on land fertilised with farmyard manure (14 tons per acre). The best yield from *artificial* manures during the twenty years' average was obtained from a compound of the sulphates of potash, soda, magnesia (200lb., 100lb., 100lb.), 3½ cwt. of superphosphate, and 600lb. of ammonia-salts (sulphate and muriate equal parts), per acre. This manure produced on an average of twenty years 38¼ bushels of corn per acre, as opposed to 36¾ bushels obtained from a similar manure in which the 600lb. of ammonia-salts was replaced by 550lb. of nitrate of soda. The other ingredients of the two manures were exactly the same, be it understood, so that the ammonia manure gave 1½ bushel more than the nitrate of soda manure; but here it must be pointed out that the 550lb. of nitrate of soda is equivalent to only 400lb. of ammonia-salts, and on looking to the experiment in which only that quantity of ammonia-salts was employed (the other ingredients being the same), I find that the yield was only 35¼ bushels, or exactly 1½ bushel *less* than the soda manure. But now comes the clincher. In the 28th season the yield from the manure containing 400lb. of ammonia salts had fallen to 22¼, that from the 600lb. to 27⅛, while that from the nitrate of soda manure had only fallen to 34½ bushels, giving the latter an advantage of 12¼ bushels per acre (2lb. extra per bushel as well) over the manure containing an equal amount of nitrogen in the shape of 400lb. ammonia salts, and an advantage over even the 600lb. ammonia manure of 7 bushels. Nor is this all. The yield of straw which in the twenty years had shown an average of 35⅜ and 41⅜ cwts. per acre, for the 400lb. and 600lb. ammonia-salts, and 41½ for the 550lb. nitrate of soda manure, had fallen in the 28th season to 27½ and 35⅛ for the ammonia manures, but had actually increased to 43¾ for the nitrate of soda manure. Nor even is this all? When 550lb. of nitrate of soda *alone* was tried against its equivalent, as far as nitrogen is concerned, of 400lb. ammonia-salts alone, the yield was 26 bushels against 22¼ from the latter—the average result for twenty years; but when the 28th season is reached the nitrate of soda gives 17⅜ bushels to 10½ from the ammonia salts. On another plot, however, ammonia-salts (400lb.) equalled the 550lb. nitrate of soda (taking into consideration the weight of the grain) during the twenty years, but fell off to 10 bushels in the 28th season. The weight of straw produced by the nitrate of soda also had the advantage during the twenty years, and was about double that from the ammonia in the 28th season.

Those old-fashioned farmers who look to the manure heap for fertilising materials, and keep cattle in sufficient number, will "take heart again" when they find that the plot manured with "farm yard," at the rate of 14 tons per acre yielded 35¾ bushels (60lb.) per acre (¾ more than the compound containing 400lb. of ammonia salts), and was not merely the *only manure* which kept up its average to the 28th season, but stands out prominently as the one manure which gave an increase over the 20-year average, the figures being for last year 39 bushels of 60lb. corn with 40½ cwt. of straw. This letter is however, running to a greater length than the editor will like, but I must mention one thing that bears on my "heresy." One plot "unmanured continuously" for 28 years actually yielded last year 10½ bushels per acre, or *three-eighths of a bushel more* than the best of the two plots annually supplied with 400lb. of ammonia salts gave during the 28th season. The difference was actually greater, for the corn from the unmanured plot weighed 2lb. per bushel more than the other. To avoid misunderstandings, I mention again that the 28th season means last year, whilst the average has been struck for the 20 years ending 1871. I shall be glad of any information on the subject, but I have said enough for the present, and only wish to observe that my "heresy" has at least as good a foundation as many of the dogmas we have recently had in the English Mechanic.

Saul Rymea.

THE COMING STRUGGLE.

[4632.]—The editor of the *Meteorological Magazine* has just announced the fear that signs are impending of a "coming struggle" between the authorities of the observatories at Greenwich and Kew, which, if ripened into actual hostilities, would seriously impede the progress of Science! The Astronomer Royal has, it appears, pronounced the magnetical and meteorological observations at Greenwich to be "the best in the world;" while of the Kew observations the editor of the *Meteorological Magazine* remarks that "practically it has no published results by which it can be judged." If so great a disparity exists between the two observatories, we ask in the name of Science, where is there room for struggle? Will the younger sister seek to put a stop to the continuous and systematic course of meteorological observations carried on at the far older observatory, or will the elder sister seek to render nugatory the efforts of the more recent establishment? "To sum up the whole argument," says the editor of the *Meteorological Magazine*, "we consider the two observatories have essentially divergent objects: Greenwich, the continuity of observation and information respecting secular changes; Kew, the verification of instruments and original physical research."

The most important subject for consideration is the serious impediment to the progress of meteorological science likely to result from a struggle between the two observatories. May we not ask ourselves the following question: What if the authorities at Greenwich and Kew be at issue with each other, are we to consider that meteorology will suffer to the extent supposed? If Greenwich be the model meteorological establishment, which it undoubtedly is, can it supply the data, *except for one station*, for elucidating those questions in meteorology which have led to the appointment of the Meteorological Committee and the establishment of the Meteorological Office? The science of meteorology needs a broader basis than either the observations at Greenwich or Kew can supply; and even with regard to the secular changes which Greenwich from its long-continued series of observations is best able to elucidate it is necessary to remark that such elucidation can only have reference to the spot on the earth's surface on which the instruments are planted. With the machinery in daily work at the Meteorological Office the most splendid results may be realised. There may be and doubtless is room for great improvement, but if ever meteorology is elevated into a science of induction and prevision, as her elder sister astronomy, it must be by the employment of a large number of observers at distant stations forwarding their observations to head-quarters three or four times a day. So far as observation is concerned, an establishment of the nature of the Meteorological Office is better calculated for elucidating the meteorology of a country than an isolated series of observations at a single station. Nevertheless, for determining the numerical values of the meteorological elements the Greenwich observations are unrivalled. It is generally admitted that meteorology is but in its infancy. Now, an infant needs nursing, and it is a sorry sight to see the nurses leaving the infant to do the best it can while they settle their differences as to the best mode of nursing it. It is to be hoped that no difference will arise between two of the principal meteorological establishments of the country; but, to use a homely phrase, the Committee and the Office will give "a strong pull and a long pull, and will pull altogether," to advance the science which they cultivate.

W. R. Birt.

PIGS, RABBITS, AND SHELL-FISH.

[4633.]—I have been waiting with some degree of impatience, hoping to see this question taken up and exhaustively examined by some of your medical readers; but save the short reply of Mr. Bottoza, which gave what I may call the chemical view of the question, we have had nothing more than the hackneyed phrases which have been used almost from time immemorial in condemnation of pigs, rabbits, and shell-fish. I confess that I was slightly astonished when I read the remarks of "Sarah" on p. 283, because, although I had heard remarks in disparagement of rabbits and shell-fish, I had no idea that besides being "coarse and impure diet" they exercised a "vile and lowering influence on the mind," and consequently are the cause of much "crime and misery" among the lower orders. Looking through spectacles of a different tint to "Sarah's" one might be inclined to suspect that much of the "crime and misery" was originated by insufficient supplies of food, which cheap rabbits and shell-fish would go a long way to counteract. Be this as it may, however, "lobster" has had to answer for a great many evils shrewdly laid at its door, and so has the salmon, the king of fish; but how either of these articles of food can be capable of producing a lowering influence on the mind I do not understand, although I quite appreciate the force of Byron's lines—

> Who'd pique themselves on intellect, whose use
> Depends so much upon the gastric juice.

A great point seems to be made of the wisdom which forbad the Jews to partake of pork, while other specimens of the self-same wisdom seem to be utterly ignored—for instance, the blood question. But as a matter of fact, man was permitted to eat all kinds of animal food which he lusted after for some years before the laws detailed in Deuteronomy were promulgated; and besides, the pig is looked upon as an unclean animal unfit for human food by other Eastern nations (was this wisdom, too?), but was certainly used in Palestine for some purpose or other between B.C. and A.D. 29. But into this "wisdom" part of the question as affects the Jews I do not care to go. I imagine there may be climatic reasons why the pig is not suited for food in hot countries; for it is very certain that he is a favourite source of animal provender in northern and cold regions. The cause of this general favouritism is the very simple fact that of all domestic animals, the hog (*Sus scrofulosus*) is able to accommodate himself to circumstances, and to put up with the very "narrowest" of these without becoming thin and melancholy. He will live and thrive on all kinds of food, animal and vegetable; his stomach will digest what other and probably "choicer" animals cannot swallow without danger. He is very prolific, and readily fattens on good food; and from China to the western prairies of America he forms a girdle round the earth, and is eaten alike by the most refined and the most debased of nations. By what process a pig can turn barleymeal into unwholesome flesh is for his opponents to explain; for given a healthy pig fed on wholesome materials, and can any one say that he is more liable to disease than the domestic ox or sheep? (Will "Arotes" say what the "ravages" caused by a pork diet in the Crimean army were? I think the illness there was due to "short commons.") Of course the omnivorous disposition of a half-starved pig will lead him to partake of garbage which will do him no good; but I doubt whether piggy ever had a more deadly disease than rinderpest, pleuro-pneumonia, or foot-and-mouth, and even the Tænia does him less harm than "flukes" do sheep. But piggy is accused of causing consumption (!), skin-diseases, scrofula; he is said to furnish us with round and thread-worms, and the tape-worm—several correspondents writing as if there were but one species of Tænia. I do not feel compelled to offer evidence in refutation of the first three charges at present, because I think the boot is on the other leg, and evidence should first be offered in support. But as regards the charge relating to intestinal worms I beg to point out that a very unnecessary degree of alarm has been spread abroad—or more correctly, perhaps, a *highly necessary* degree, if the public will only make their alarm felt; for so long as pork is alone credited with the origin of "worms" the alarm is mischievous, but if all the likely sources of that and similar nuisances are taken into consideration it cannot fail to be productive of good. Many of your correspondents who would shudder at the idea of contracting tapeworm from eating pork, drink a glass of London water with gusto. But listen now, to what Dr. Cobbold says. He has been speaking of the Russian Cossacks, who to a man act as hosts to the *beef* tapeworm (*Tænia mediocanellata*), and he proceeds: "Fortunately, the adult parasite seldom does serious injury to the bearer; but the larvæ of some of these tapeworms are dangerous, and it is against them, therefore, that we should be especially on our guard. Thus, if you or I were to drink a glass of water containing two or three eggs of the *Tænia solium*, whose larvæ reside in the pig (and we might very well do that, for if there were 1,000 eggs in this tumbler of water you would not see the slightest trace of them with the naked eye) they would become transformed in our interior into cysticerci; and, as they have an awkward habit of betaking themselves to the vital organs, especially the brain, it necessarily follows that they would give rise to serious symptoms." Now, although the *T. solium* is a difficult guest to get rid of, I think I would prefer to play host to the adult, than be a developing-place for its eggs and the habitat of its larva. Besides the *T. solium* and *T. mediocanellata*, there is the *T. echinococcus* and *T. cœnurus*. The *T. echinococcus* resides in its adult state in the dog, but in its larval condition inhabits the ox, sheep, the deer tribe, the horse, the ass, and *man*, to whom it is really of *surpassing interest* (Dr. Cobbold), occasioning the death of some hundreds of our fellow subjects every year. "I take leave to assert, on evidence which I have been at some pains to obtain, that every year 200 or 300 persons die in England in consequence of their having swallowed the eggs of the *Tænia echinococcus*." (Dr. Cobbold).

The *T. cœnurus*, the larva of which is found in the brain of the "staggery" sheep, becomes adult in the alimentary canal of the dog, and is propagated by thousands. The rabbit also acts as host to the *cœnurus*. But enough is as good as a feast. I should not have devoted so much space to Mr. Pig, were it not for an announcement that large quantities of pork are coming from America, which will enable dealers to retail it at 6d. a pound, at which price it will doubtless meet with a large sale. To guard against parasitic worms—cook thoroughly; to guard against unwittingly hatching eggs, mix alcohol with that glass of pure (!) water drawn from any source into which sewage or the drainage water of fields can flow. Thus ends piggy: a great deal of bad meat can be found at market, but no more in proportion than of beef and mutton, and unless your readers can advance better reasons (?) than those already published, I think pork will still be an article of diet in this country.

But what shall we say of the rabbit? What has he done, or what can he do? Well, the rabbit is no worse off than the hare—though the *domestic* rabbit is, probably, like all other animals which man has brought into subjection, more liable to disease than the hare. The flesh of the rabbit is certainly digestible, and though I have heard that it is at times poisonous, in consequence of the animal eating some herb, I beg leave to doubt whether any serious results can be traced to the employment of rabbits as food.

Shell-fish are rightly or wrongly looked upon by many with suspicion; but large numbers of lobsters and crabs, and immense quantities of mussels and periwinkles, are annually consumed without the consumers exhibiting any ill effects. It is true that persons have been poisoned through eating the lungs of both crab and lobster; but surely that fact should not condemn their use as food, any more than an attempt to digest a bullock's hide would put a veto on beef. If the lobster is condemned, why not the shrimp? Mussels are also accused of causing dangerous illnesses, but it is very certain that millions of tons are consumed for food. Probably when spawning, in May, June, and July, they are unwholesome, and the byssus invariably should be removed. Oysters have been always looked upon as a delicate and nourishing food. Cockles are largely eaten, and so are whelks. Shell-fish live on wholesome food, and why their flesh should not be wholesome too I really do not know. The Italians call them the "fruit of the sea;" and, after all, the choice of fish to eat and to reject depends entirely on the flavour of the flesh. Salmon itself is unwholesome, if not positively deleterious, at one period of the year, although that has the requisite fins and scales which the eel (the most delicate-fleshed fish) is supposed not to possess. Why does not "Sarah" condemn the eel—especially the conger—as "vile and lowering?" What shall we say of the ordinary fowl, and the duck, the latter of which will eat almost any offal, and is very nice with green peas I think, "Sarah?" And yet let the duck have a "fishy" taste, and oh, what unwholesome "diet." Depend upon it, the human stomach is capable of extracting nourishment from other flesh and other fish and other fowl than we wot of. The French eat frogs and snails—and consider them delicacies. We eat crayfish and periwinkles. Tastes differ. That is all. SAUL RYMEA.

EYEPIECES.

[4634.]—WITH his accustomed kindness "F.R.A.S." has replied to my note on the subject of eyepieces. I beg to thank him, and at the same time to add somewhat to my query, the further to elucidate this important subject. I assume the image from a parabolic mirror to be truly ~~reflected from~~ the flat or prism; if this be received through the medium of a Huyghenian eyepiece, it will, I apprehend, be somewhat distorted, for the eyepiece is not aplanatic, *ergo*, the image is imperfect. If, however, the Huyghenian eyepiece is applied to the refractor, the object-glass, being imperfectly corrected, receives the necessary correction from this eyepiece, hence the comparatively admirable definition (minus secondary spectrum) of a Dallmeyer instrument. My idea of substituting a complete magnifying instrument in lieu of a non-achromatic eyepiece is not new, but I consider that it has never been efficiently tried.

To "F. R. A. S.'s" obvious objection of want of light, I submit that a wide-angled objective gives an extraordinary amount of light, in spite of the numerous surfaces (that is, six more than an ordinary eyepiece), and I fancied that if sufficient light came through a narrow slit and the numerous prisms of the spectroscopes from a second or third magnitude star, such a blazing object as the sun's corona or the moon would give sufficient. I alluded to the moon, as, if her details could be more effectually solved, we might gain some insight into the difficult subject of the early history of the sphere we live upon. Although I was aware of the law which renders her not the best subject for my purpose, the magnification of the atmosphere is a bar to all forms of eyepieces, and is, in my humble estimation, the fruitful cause of the many wonderful discoveries, spectroscopic and telescopic, we get in popular scientific papers. The late Mr. Ross was of opinion that an achromatic eyepiece was yet wanting to complete the microscope; this has not yet been attained, and I have, after numerous experiments, come to the same conclusion as Mr. Ross. For delicate observations I have long since discarded B, C, and D eyepieces, for I find the acute curves destroy the definition of the finest objectives utterly. I depend upon the A's and lengthened tube for amplification.

"F. R. A. S." will observe that these views are at variance with his observations as to the power Browning's mirrors will bear; he will not, I hope, consider this as a contradiction, but simply that my ideas of perfection are unreasonably beyond attainment at present. BETSY SUMMERCITY.

HEATING BY HOT AIR.

[4635.]—THE idea of heating plant houses by means of hot air is not by any means new, but I believe that Mr. Housman is the first who has carried out in a successful manner. He exhibited a model of his apparatus at the recent show at Birmingham, and has drawn renewed attention to the subject in a letter to the *Journal of Horticulture*. I send an extract in order that your readers may understand the principles of the system, and express their opinions on it.

Believing, he says, that the time has now arrived for a reconsideration of the question whether hot-air heating may not, in many instances, successfully compete with hot-water heating; and having during some years past practically succeeded with a method of air-heating, I was induced to exhibit a model of my system at the late Royal Horticultural Show at Birmingham. I have reason to think that it received some notice from persons well qualified to give an opinion on its merits, and I write this with a desire that the expression of such opinion should be elicited. I am far from claiming superiority in every case; in fact, where a "town" of glass has to be warmed from one source of heat, I see no likelihood of the agency of water being superseded. But for buildings placed in a range, or heated separately, I think from the hot-air system many advantages may be secured which are not obtainable, at least not readily obtainable, from the hot water.

Conceding that some equivalent must be found for the large heated surface of moderate temperature, which is an admitted necessity for successful culture, I submit that such an equivalent may be found in the cooling effects of rapid currents of moist air passing over a gill stove highly heated. It is when circumstances are favourable to the inducing of such rapid currents that I claim the balance of advantage for the hot-air system. If, after constructing a firebox in such a manner that the fire shall not impinge upon metal, we dome it over with a box of wrought iron 3ft. square, we shall have, in addition to the brickwork, a heating surface of 45 square feet. By adding gills, 12 on each side, and 3in. deep, we increase the surface to 185 square feet; and if we can subject this extended surface to the refrigerating effects of a moist current of air rushing over it with many times the velocity of the currents from the ordinary hot-water pipes, we have the means of effecting our object—viz., the delivery of large quantities of not too fervid air. This object once attained, advantages belonging to the system become apparent. The air flue, which, unlike the old smoke flue, requires no special care in its construction, delivers its heat through slides, which by a simple adjustment apportion the supply at will, or they can be made to shut it off altogether—no mean advantage when sun heat meets fire heat on a fickle day. The air so admitted is fresh air, bearing with it the healthful influences of the outer atmosphere, and causing, by the velocity of its incoming, the aërial perturbation so grateful to plant life, and for every gallon of fresh air admitted a like quantity is expelled; so, assuming the area of inlet to be 4 square feet, a like area of outlet will be required, and this is necessarily equivalent in a house 60ft. long to ½in. of top air always left on.

If this system can be brought into successful operation in a small way, it will be just the thing for amateurs growing stove-plants, or for service in the greenhouse on occasions. E. C. G.

"JACK OF ALL TRADES."

[4636.]—HAVING returned to old quarters, I think a letter of thanks is due to the many kind friends who have been so liberal with their donations to keep afloat a fast sinking craft, and have done their best to make me say "Jack's" alive again. I wish I could say "Jack's" himself again, but that is a question of time, and I here take the opportunity to say to all who have done so, May they find friends as kind in time of need! I cannot wish that it might be so, for that would be wishing them a vast amount of suffering for experimenting; but should they ever suffer any of these ills that flesh is heir to, I have every reason to believe the Smedley system recommendable both from its simplicity and efficacy, and should be glad to see it more largely introduced into our private life. I mean upon the self-help principle for assistance (see "Domestic Hydropathy," by T. Preston; Cassell, Petter, and Galpin). It could be arranged at little expense, and I should be glad to assist any who may feel disposed to go further into this treatment, and give my ideal plan of how this may be carried out. Not wishing to occupy too much of our valuable space, I again tender my grateful thanks to all my ENGLISH MECHANIC friends. JACK OF ALL TRADES.

NEW MATERIAL IN ORGAN BUILDING.

[4637.]—ENTHUSIAST to the utmost limit I will allow "Sucram" (let. 4579) to be; but it is cruel as well as useless to send amateurs on a wrong tack. How could a pipe of such material be tuned or voiced? "The Harmonious Blacksmith" long ago mooted the question that a cylinder of any other material than metal would answer. With all respect to him, I am a doubter: the different proportions of metal composition make all the difference in the ring of the pipe, and all the enthusiasm in the world won't bring that quality out of paper. You might get a medium as good as wood, but would it be worth the trouble? The cat may be as good as the king; but, with all the crowning of might and mystery, she still will be the cat. I have said before that pipe-making cannot be done by the ordinary run of amateurs; it must be learned at the bench, and there the amateur must go for his lessons. Perhaps it would be worth "Sucram's" while to try a metal top and foot to a wood cylinder. The question is, how will it work? The use of the cone must sooner or later interfere with it.

HENRY USSHER, B.A., M.B.

CONDENSATION OF STEAM IN PIPES.

[4638.]—MR. TURTON (let. 4542, p. 461) will find, on inquiry, that though the problem of converting high pressure steam into high pressure air is not fully solved, a very large percentage of usefulness is got out of compressed air, and by the ordinary compression pump suitably applied. For a pump to do next to nothing half its stroke is a serious defect, and how this defect should be inherent in every form of pump, I would like Mr. Turton to show. To solve the problem, Mr. Turton supposes as probable the application of the principle of the injector. But before "A. W. E." (let. 4457) tries this, or any other application in which steam has to be used with compressed air, I think something definite should be known as to how the two comport themselves when used together or mixed. How can this information be got? Will an answer to the following query lead to it? If so, perhaps some able correspondent will give it. There are two cylinders of the capacity of one cubic foot each, attached by an inch pipe, with a tap to connect them when required. One contains steam at 50lb. pressure, the other compressed air at 70lb. When the two are connected, what takes place? What change in the steam, the air, and the pressure? OHIO.

IS THE MOON SPHERICAL?—To MR. W. R. BIRT.

[4639.]—I SAY "No"—and pledge myself to prove it.

CH. RABACHE.

ANTIQUITY OF MAN.

[4640.]—I beg to inform "F.R.A.S." (let. 4405, p. 380) that I have no theory on the subject, but am simply looking for information. It is indifferent to me personally whether man has been 8,000 or 100,000 years upon the earth, but I should like to know which is nearest the truth. I have not Lyell's book by me for reference, but what I gathered from it was that he gave fair evidence from records of excavations in Switzerland and elsewhere for an antiquity, on a rough calculation which did not assume to be correct to within three or four centuries, of between 7,000 and 8,000 years. This is all I could find reasonably fair proof of. Anything further, as the conjectural period of 100,000 years or much more, was too much founded on guesses, theories, opinions, and too little upon actual evidence, to be relied on.

From the accounts I have read or received from scientific men of cave explorations in England, as for instance, those lately made at Settle, it seems as if the relics of the primitive cave men go to no great depth, evidencing no very long tenure of the cave to be measured by thousands of years, but soon cease and are succeeded below by bones of wild beasts alone without trace of human occupation. Of course, for all this goes to prove there may have been men in existence elsewhere, though not in these particular caves, many thousands of years ago; if so, let us have real proof of their existence, apart from conjecture and mere theory. I by no means affirm that the lower stratum of human remains in the Settle cave must have been those of the race destroyed by the Deluge; but I thought it well to direct "our" readers' notice to the coincidence which undoubtedly exists between the term assigned by calculation to the end of that primitive occupancy of the cave, and the date of the Deluge according to the older and probably truer version of the Mosaic account, that of the Septuagint. J. M. G. Brookwood.

THE ORGAN (EXPRESSION *A LA MAIN*).

[4641.]—In No. 328 I addressed to "Adept" a query (8291) concerning the probable consequences of carrying out my old crotchet of inclosing each pipe of an organ-rank in a separate swell-box, to be opened by the manuals for the above purpose. Considering it is now more than a year since the date of "Adept's" last contribution (in No. 322), perhaps some other "organic" expert will kindly afford me the required information; for, if practicable, it seems the least objectionable method of producing the greatly-to-be-desired effects.

I also addressed a query (8307) concerning the earliest known application of percussion to harmonium or other free reeds, to which a reply would confer an obligation on me.

The Harmonious Blacksmith.

ROTARY ENGINE.

[4642.]—I question whether the engine of Joseph William Fennell (let. 4552) would return a higher duty than the ordinary valveless rotary. There is the same defect in it as in all rotaries—viz., the packing, or rather the non-packing of the piston. In Joseph William Fennell's arrangement this could be altered, and the engine made as good as a reciprocating engine. For instance, for the packing of the rim of D there should be a square piece of brass $\frac{3}{8}$in. thick; this is to be forced up against the casing by means of a screw, and the same with the sides of piston D; two plates, same thickness, forced against sides by a left and right hand screw. These are all to move in guides; it would make a very effective water motor. P. W. H. J.

[4643.]—The engine described and illustrated (let. 4552, p. 462) is a revival of an old idea of mine. About five years ago I registered a similar invention to this, but gave up the idea of patenting it, as an engineer to whom I showed my sketch pointed out to me that the valves would make a most objectionable noise, and moreover would not stand the wear and tear. A practical rotary movement to the steam-engine is almost as illusory as perpetual motion and the philosopher's stone. Minds great and small have applied themselves to the solution of the difficulty, and some most ingenious contrivances have resulted, but nothing, however, which is likely to displace the piston movement.

Philip E. Masey.

ROUND SHOULDERS AND CURVED SPINES.

[4644.]—As the attention of your readers has recently been called to various contrivances for remedying the above defects, I send for insertion two photographs of a simple contrivance I have just brought out for a similar purpose. The photos. represent a back-board and spine-chair, for the use of children who have weak frames and round shoulders, contracted chests, and curved spines. This contrivance has for its object a perfectly plain and hard surface to rest the spine and shoulders upon, the head and seat being eased by a thin cushion. The trunk of the body, in these positions, grows straight and regular, and the weak muscles, that cannot give the necessary resistance in a vertical position, regain their wonted strength and prevent curvature, while the shoulders are pressed into their normal position, throwing the chest open, and free for the expansion of the lungs and organs of the chest. All children while growing should lie down some time daily, and more especially those that are weakly. It is the custom in some families and schools for the children to lie on a plain backboard, a little inclined, but with the plain board the lying becomes very trying. This irksome feeling is obviated in the above contrivance by the rest and resistance given to the spine; while lying, the child keeps its position, all weariness is relieved, and the whole body rests together. When the child is tired of lying on the back-board it can be raised into an inclined back-board chair. In this position, the rest it offers to any weakly frame is a luxury, the spine being relieved from the vertical position gets the rest it cannot get in a vertical chair. The body of the child being at ease, the mind can peruse its lessons without fatigue and restlessness. Some weakly children lie on stuffed cushions and mattresses. This should not be when there is no disease of the spine, because the prominent round shoulder would imbed itself in the mattress, and the child grows deformed while it lies; but in the case of diseased spines, where there must be no pressure, the same positions are necessary as with weak spines. A thin mattress to fit the back of the chair makes the contrivance valuable to all sufferers, child or adult, or it makes an excellent easy chair in ordinary household use.

The ancients paid more attention to muscular training and the lying on perfectly hard surfaces than we do. We, as a rule, lie on soft surfaces, which have a tendency to relax, instead of brace and consolidate the muscular structure.

As the contrivance I have offered for the information of your readers is one which has for its object the remedying of defects in the human structure, if I shall not be trespassing too much upon your space I would trace some of these effects to their cause. Those who are occupied with the affairs of everyday life, and scarcely see anything outside their own business, would scarcely credit the amount of decrepit humanity there is in the world, more especially among the youthful and infant members of our race. Children with curved and diseased spines, hip diseases, round shoulders, narrow chests, shrivelled and paralysed limbs, and undeveloped frames abound. Some of them, with fair medical and mechanical treatment, grow out of their afflictions; others are beyond the reach of human skill, and grow up burdens to themselves and their parents. One cannot be constantly coming in contact with such cases without tracing many of them to their origin. They arise from the following causes: Girls becoming mothers when not yet out of their teens; youths becoming fathers before their physical structure is matured; intermarrying of blood relations, from which follows idiotcy, imbecility, deformity; reckless lives of youth; drunkenness and gluttony in parents; bad nursing, artificial nursing; everything contrary to the common laws of our being, and to what God intended.

Many afflictions arise from no fault on the part of parents, but from hidden causes; while, on the other hand, the most healthy children have been rendered cripples for life, through carelessness; and thousands of children are annually rendered cripples by intrusting them to the care of nurse-girls, who cannot take care of themselves. Here, then, is a mighty evil that stares us in the face, and one which no Act of Parliament can grapple with, but which must be met by our individual selves.

Physical deformities are bad, but mental deformities are far worse. And if there was ever an age of mental deformity, this is one, in which the most valuable gifts of God to man—namely, health and common sense—are sacrificed to fashion. High heels and narrow boots—cramped feet, enlarged joints, weak ankles, and broken legs; unprotected heads, apologies for bonnets—neuralgia and diseases of the brain; tight lacing—contracted chest, diseased hearts, and sudden death; Grecian bends—pains in the stomach; nostrums for the skin, being made "beautiful for ever," going to parties undressed—asthma, pleurisy, consumption; poisoning and colouring the food to suit the eye, living to eat instead of eating to live. Both sexes are equally to blame. I think you will agree with me when I say the grandest science of our existence is to know our true selves and how to live.

James Gillingham.

THE FORCE OF GRAVITY AT OR NEAR TO THE SURFACE OF THE EARTH.

[4645.]—Taking 16,008,324ft., to one second of time, as the force at a certain latitude or point on the earth's surface by which heavy bodies freely fall, or are attracted. Turning the decimal fraction 0·008324 into the semi-transverse diameter of an ellipsis, by the addition of unity—thus, 1·008324, the logarithm of which equals 0·0036001, the application of this value will soon appear.

The force of gravity on the equator at or near to the surface is equal to the value of the logarithm 1·20276554 = 15·950178ft., and that on the pole is equal to the value of the logarithm 1·20710546, equal to 16·110369ft., which is the force in one second of time, by which bodies are attracted at or near to the surface on the polar point.

The two values, equatorial and polar, being added together, and the square root extracted thus, $1{\cdot}20276554 + 1{\cdot}20710546 = \sqrt{2{\cdot}4098710} = 1{\cdot}2049355 = 16{\cdot}03007$ feet. This is the force of gravity at a point very near to the latitude of 45°, equal to the tangent of 44° 56′ 46·35″. The force of gravity, as measured or calculated from the mean distance of the moon, is equal to the logarithm 1·2077201; which, being divided by the logarithm 0·0036001, thus, $\frac{1{\cdot}2077201}{0{\cdot}0036001} = 1{\cdot}2041200 = 16$ft., which is the force of gravity in one second of time, at a point on the earth's surface, precisely at 45° of latitude. And dividing the value, as found from the mean distance of the moon, thus, $\frac{1{\cdot}2077201}{1{\cdot}2049355} = 0{\cdot}0027846$, and $0{\cdot}0036001 - 0{\cdot}0027846 = 0{\cdot}0008155$, and $1{\cdot}2049355 - 0{\cdot}0008155 = 1{\cdot}2041200 = 16$ft. to one second of time, equal to the force of gravity on or near to the surface of the earth, "exactly" at latitude 45°.

It is clearly evident, from the foregoing calculation, that the force of gravity, being "less" than 16ft. in one second of time at the equator, and "more" than 16ft. at the pole in the same time, that somewhere between the points that force or attractive power must be 16ft. in one second of time, and that point is 45° latitude. Veritas.

CENTRIFUGAL FORCE.

[4646.]—With all due respect to your numerous correspondents who use the term, notwithstanding all the text-books in existence, at the risk of raising a sharp discussion, I, in conjunction with some of our most eminent professors, maintain that there exists no such force as "centrifugal force." Who can prove there is?

C. H. W. B.

THE BEARING-REIN.

[4647.]—I am glad to find that there are gentlemen not above being thought effeminate, as they undoubtedly will be, by those who countenance the use of this instrument of torture. I have never before seen it applied with such terrific severity as is now being done; and, if people had not become hardened and accustomed to the sight, I believe it would not be tolerated for a single week. I could introduce "Philo" to a different sight to that of London, where I think he would soon be convinced that the coachmen are the principal and almost the only offenders. I only this morning saw a young horse (and they are the greatest sufferers) in such a distressed state that I believe if it had been a poor man's he would have been mobbed. I called a friend's attention to it, who at once said, "I should not have noticed it, I was looking at the ladies; the fellow ought to have six weeks on the treadmill." I could show "Philo," in a day, about 150 hackney carriages, and not one of the horses attached to them wearing the torture-rein; about a dozen pairs of handsome animals drawing parties of the exclusive upper ten, all apparently happy together; then about 100 pairs very uncomfortably but not terrifically reined, reminding one of a man with his arm in a sling; then about 20 in such a state that one need not to be ashamed to weep for them. It verily is an unpardonable cruelty. Space forbids my alluding to the use of *blinders* I must call them, as they are now fitted so that a horse can scarcely know whether it is daylight or dark.

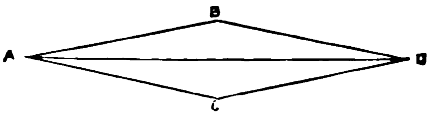
Old Ploughman.

REFLECTION.

[4648.]—It must be remembered that a piece of metal, or other reflecting surface, bent in the way suggested is only concave in one direction, and thus the image of a circular object produced at the focus is no longer circular, but a long oval, so that the light covers a much larger space, and is therefore less concentrated. Then, to correct this distortion and waste of light, it is proposed to use another cylindrical mirror or lens, which, if of similar power to the first, would just produce the result now obtained by a single mirror of spherical (or rather parabolic) surface, a waste of light and complication of apparatus without any corresponding advantage. The germ of good contained in "E. B. F.'s" suggestion (let. 4602, p. 488) has already been utilised in the Cassegrain reflecting telescope. In this, the rays reflected by the objective speculum are caught on a small convex mirror, and reflected back to the lenses constituting the eyepiece. In this construction the magnifying power is less than in the Gregorian or Newtonian telescopes; but the image is more distinct, as but one image is formed, and the two mirrors have a tendency to correct each other's spherical aberration. In fact, the Cassegrain telescope is among reflectors what the Galilean telescope or opera-glass is among refractors. Alfred H. Allen.

PARALLELOGRAM OF FORCES.

[4649.]—IF "F. R. A. S." and Mr. Proctor have not time to fully explain my difficulty, perhaps they will kindly indicate the direction our studies must take to fathom this puzzling subject. It cropped up thirty years ago in a Glasgow publication, since then I have seen nothing published to bridge over the difficulty. Some years ago I submitted it to one of the ablest professors in the Andersonian University, and in the opinion of all the class, including myself, he shirked it completely, telling us we had got beyond our depth, &c. If the lines A B, A C meet in a very acute angle, and represent two equal forces in magnitude and direction, then the diagonal A D will give the resultant in



direction and magnitude; therefore a body under the joint action of the two forces must reach D in the same time that it would have reached B or C under the action of a single force; but A D is nearly double of A B, therefore the body must go along A D with nearly a double velocity. But the theory of projectiles informs us that to produce a double velocity requires the expenditure of a fourfold force, but in this and similar cases we have a double velocity from a double force. If the parallelogram of forces and this law of quadruple force can be shown to be in harmony, it will be highly gratifying to many besides myself.

MARINE ENGINEER.

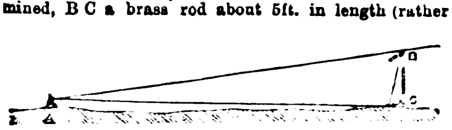
DRAINING MINES OF WATER.

[4650.]—IN 1869, at the time of the Exeter Meeting of the British Association, I met a French gentleman who submitted to the late Sir Charles Fox the plan of a new process for raising liquids to any height at a trifling cost. Though a number of engines are actually supplied according to this principle in France. Sir Charles Fox declined the communication. I understand that 2,000 gallons of water can be raised to the required height in half an hour's time by this means, at a cost of about 7 cubic feet of coal or petroleum gas. No engine is needed, only proper tanks and pipes.

A. J. DAYMAN.

JUDGING DISTANCES.

[3651.]—I OBSERVE that most, if not all, of our rifle matches take place at distances which have been previously ascertained, either by measurement or more likely by the aid of trigonometry. Most of our range measurers require two observations and a base line. In actual skirmishing the rifleman would require to judge the distance for himself, and to facilitate this object is the aim of judge of distance drill. Were it not for the resistance of the air a ball would pursue a parabolic path; the resistance of the air causes a higher trajectory to be described, as the velocity becomes less from atmospheric resistance, and the ball therefore falls more from the action of gravity in passing over a given distance than if it moved in vacuo. Considering, however, the case of a parabolic path, if the ball falls a distance of a inches in the first 100 yards, it will fall 4 a inches in the first 200 yards, 9 a in 300 yards, and so on—the fall under the influence of gravity varying as the square of the distance. Thus it will be seen that the error of mistaking 200 yards for 100, an error which I may observe is not likely to occur, is not so serious as mistaking 400 yards for 300. In the former case the ball would hit the target a inches too low so far as this error was concerned, in the latter it would hit it 16 a to 7 a or 9 a inches too low, and besides this, the latter mistake is one more likely to be made, and the object is more difficult to hit at 400 yards. In the case of artillery practice there is the great advantage that the gunner, seeing where the shot strikes, after a few shots succeeds in getting the range. I have heard of telescopes for judging the distances of objects looked at through them. I should like some information on this subject. I presume there is a micrometer in the focus of the eyeglass, or perhaps the principle of Monsieur de Rocon's telescope is used—viz., a piece of Iceland spar (this mineral has the property of double refraction) is slid along a wire in the axis of the telescope until the observed object, the size of which must be known, appears with the two images touching each other. Could the principle of the sextant be rendered available—viz., that a ray of light impinging on two plane mirrors, inclined at an angle A°, is diverged 2A° from its previous direction. Thus, let A be an object whose distance is to be determined, B C a brass rod about 5ft. in length (rather



more), having two mirrors, C and B, attached to it, inclined to each other at a very small angle, C being immovable; the half of B is silvered as in the sextant, and it must slide very steadily along the rod; the rod is graduated; a ray coming from A falls on the mirror C, and is reflected to the mirror B, and reflected again to the eye; the eye at B sees the object A, also through the unsilvered part of the mirror B; the mirror B is slid down along the rod until the two images coincide. Suppose A C 500 yards or 1,500ft., and B C 5ft., then angle B A C = $\frac{5}{1,500} = \frac{1}{300}$ nearly, referred to its circular measure, the unit of circular measure or an arc equal to the radius being about 57°, inclination of the mirrors equal half of angle B A C = $\frac{1}{600}$, or about the tenth of a degree. I should like the opinions of correspondents on this idea. Could the mirror B be made to slide so steadily on the rod as not to vary its inclination appreciably to the mirror A? This seems the practical difficulty.

PHILANTHROPIST.

GREATLY ELONGATED PROJECTILES FOR RIFLED GUNS.

[4652.]—As it is obvious the longer a projectile be made, whose weight remains the same, the smaller its diameter must become, and consequently the smaller the calibre of the gun from which it is expelled, it has occurred to me that it may be well worth while to inquire if a yet further saving both in the weight of the gun and the powder charge might not be effected by improving the form of the projectile so that the required range may be obtained without imparting to it so high a velocity.

The advantages of increase of range, at least in rifled muskets, are very questionable. The ranges of the better kinds now in use are so great that they enable "Christians" to "do good to those who (try to) despitefully use them" at 1,200 yards, a distance at which a man 6ft. high appears smaller than a peppercorn held 1ft. from the eye. There can, however, be no two opinions of the economy and military advantages of reducing the calibre and weight of the musket, also that of the powder charge, if that be possible without diminishing the velocity of the projectile at useful ranges, say up to 800 or 1,000 yards, and much, if it all, increasing the height of the trajectory.

It has occurred to me that these advantages might be obtained by exactly the same means by which we enable a given force to move a ship more rapidly through the water—viz., by making the thing to be moved of a form which is less resisted. No doubt a cylindriconoidal shot is much less resisted than a spherical bullet of the same weight, and a projectile five or seven diameters long, than one only 2½ or 3 times longer than the calibre, but a projectile of the former proportions is objectionable on the ground that its centre of gravity is not sufficiently forward, consequently its tendency to turn over and travel with its latter end foremost has to be resisted by making it spin with great velocity. This can only be done by augmenting the twist of the rifling, which certainly increases that obstruction all rifling must cause to the shot's expulsion from the gun.

FIG. 1

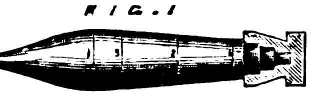
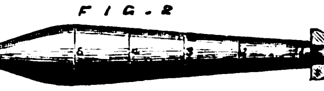


FIG. 2



I suspect Mr. John Scott Russell would have but little faith in a naval architect who proposed to build a boat in the form of a cylinder with one end pointed or rounded and its stern a flat disc, which is just the form of an ordinary rifle shot whose bows resemble a bluff Dutchman, and whose square "starn" must needs pull a good deal of water after it. A Thames wager boat, like those in which the Oxford and Cambridge crews compete, has not only a fine entrance, but also a fine run, the first to remove the water out of its path slowly, and consequently easily, the latter to leave the water behind without pulling much of it after the boat like one with a square "starn" does. I need hardly remark the cylindriconoidal shot is not exactly the "solid of least resistance;" for this we require both a fine entrance and a fine "run," such as I have drawn in the illustrations.

To keep a projectile like that represented in its proper position in the chase of the gun, it would seem that some means of temporarily supporting its latter end is needful. For this purpose I have designed the rather peculiar "sabot" shown in section. The use of any sabot, however light, is open to the objection that more powder must be burned than would be required if it were possible to do without it, for it is obvious you must burn enough to expel not only the shot, but also its shoe. Against this objection we have the advantage of the greatly diminished atmospheric resistance consequent on the fine run of the projectile, the consequence of which must be that, as its velocity will be much less reduced at long ranges, it can hardly be needful to impart to it so high a velocity before it leaves the gun, hence I expect that, notwithstanding we have to expel the sabot also, no more, perhaps even less, powder will be required.

If the specific gravity of the sabot be much less than that of the projectile, that difference, together with greater atmospheric resistance to the sabot caused by its form, will, I think, soon cause the latter to be left behind, the projectile, after separating from it, proceeding on its course unincumbered thereby. Were the recess in the sabot which receives the projectile a mere conical hole, I fear the latter would be jammed therein by the force of the explosion, and fail to become separated, so I have designed a series of cylindrical compartments, affording altogether, including the bottom of the smallest one, four surfaces at right angles with the axis of the projectile, and I think if rather thick paper washers be inserted at the bottom and between the annular surfaces to prevent contact adhesion will be prevented.

The best material for the sabot would be something at once sufficiently strong not to be destroyed by the explosion, which is as light as possible. Should metal be found necessary, probably aluminium would be best, it being very light, but I fear too costly. Every known kind of glass or earthenware would, I think, be too brittle. Bone, wood, or yet better, papier-mâché, which is far stronger than any wood of whose fibres it is composed, might serve if the explosion did not destroy it. That it would survive, I doubt, although the pressure of the gases would not be so great as usual, because, as less velocity would have to be imparted to the projectile, a smaller powder charge would suffice. Perhaps a yet further saving in the weight of powder might be effected by forming the periphery of the largest part of the projectile to fit the grooves of the rifling, a thing by no means difficult to effect with compressed leaden shot. I think this would save that small proportion of the powder whose force is now only employed in forcing the cylindrical surface of the projectile into the grooves, and thereby altering its form to fit them. This portion of the powder cannot assist the expulsion of the projectile, because its force has already been expended in doing other work, and it can't do its "work" twice. Were the work of shaping the projectile done before it was introduced into the gun, the whole force of the explosion would be available for expelling the projectile just as it is in great guns where projectiles have ribs cast on them to fit the rifling. I think it must be admitted that if you want to expel either a projectile from a gun or a fellow human being from your house, putting obstacles in his way is not the way to facilitate that process. Spiral grooves must needs be obstacles to expulsion, but are necessary to send him "spinning" on his way.

To those who have not realised the magnitude of what Cæsar calls the "impedimenta" of a modern army, the saving of, perhaps, 20 per cent. in the weight of the powder charge of a soldier's musket may seem of little importance. It represents, however, a good many tons in the weight to be carried, often over very inferior roads, and some not few thousands of pounds in military expenditure. I may further remark that (*cæteris paribus*) the more powder you burn before the shot is expelled from the gun the greater the recoil, a thing which—in the case of old "Brown Bess"—was "no joke," but, like the writer, "terribly in earnest," as our soldiers (and their bruised shoulders) could testify. Besides, if only four-fifths as much powder be burned, may we not hope to reduce the weight of the musket some 2lb., or even more, considering its calibre will be lessened, to the great comfort of the many muscular Christians whose rather unpleasant duty it is to carry it when the thermometer stands at 120° in the sunshine, doing which, like the venerable "Brown Bess" recoil, is no joke, I "kalkalate." Certainly, I don't know from experience, because, when a young man, being a man of peace, I listened not to the voice of the "charmer"—in the guise of a recruiting sergeant—when, quoting Shakespeare, that charmer said, "List, O list!" neither have I played at soldiering like most volunteers do. N.B.—Few of them do anything else in the military line than play. The play, however, greatly resembles hard work. Whether "Le jeu ne vaut pas la chandelle," is another question.

THE HARMONIOUS BLACKSMITH.

P.S.—May I take the liberty of inviting the criticisms of "Artillery Captain," and other experts on this my last shot, which I hope will not quite miss its mark. Perhaps it would be yet more likely to hit it if made more taper towards the first shoulder, or, yet better, if that could be dispersed with altogether, thereby reducing its diameter to something less than half the calibre at that part, also enabling us to extend the length of the hinder part to five diameters instead of 3½, and reducing the length of the sabot one-fourth. See Fig. 2. The proportions of this projectile being altered as above suggested, its centre of gravity would be so far forward that it could hardly turn over during its flight, even if the twist of the rifling, and its consequent velocity of rotation, were but small. Excessive twist is very objectionable, for it induces the stripping of soft leaden projectiles, but so long as these be made of equal diameter throughout, behind their heads, a great twist is a necessity to prevent them from turning over during their flights, and the longer they be made the more they resemble "Oliver Twist" in asking for more (twist).

THE HARMONIOUS BLACKSMITH.

Science and Art Department.—The examination of students' works has just been concluded. From 397 night classes 56,016 works have been received. From 114 Schools of Art 73,226 works have been sent up, making a grand total of 129,242 drawings, models, or paintings, executed in the year ending April last. This is an increase over 1871 of 19,051 works. These works were first submitted to a preliminary examination, each school being taken separately, by a Committee of Examiners who awarded 1,100 third grade prizes, and at the same time selected from the mass 1,208 of the best and most advanced works for reference to the national competition, in which all the Schools of Art in the country compete with one another. Ten gold, twenty-five silver, and sixty bronze medals have been awarded, together with a number of prizes of books. The prize works of this competition, together with as many of the other competing works as space could be found for, are now exhibited at the South Kensington Museum, where they will remain open to inspection until September.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[11554.]—**Pedestrian Tour.**—How to make a pair of comfortable waterproof shoes out of a pair of old trousers: Cut out of your old cloth as many pieces as you require for the thickness of your soles. Boil equal parts of resin and tallow together, and soak the pieces in them. Scrape the substance off the surface and join your soles together, pressing them with a hot iron. This will make them adhere together. Heels are made in like manner. Over your soles lay any kind of cloth or canvas you please, of the right dimensions. Screw it round the border of the soles with brass screws, and your shoes are made. They may be made to tie or button on, to taste. I have never been better shod than on this principle.—C. R.

[11632.]—**Debility.**—If "Cordwainer's" friend cannot procure the bean at the herbalist's, he can obtain the pills of most chemists. Sold under the appellation of Edward Douglas's nervous pills.—E. Parker.

[12002.]—**Aquarium.**—"H. O'B." says, "Don't collect eels or other running water animals, because such cannot be kept alive in still water." As far as my experience goes small eels live very well in aquariums, and I know that the finest specimens I have ever caught, or seen caught, were taken from ponds in which the water was certainly not running.—Saul Rymea.

[12054.]—**The Needle Lock.**—I am very glad that my note on this subject has produced a reply from "Q. Yorke," especially as the query appeared to be likely to join the "lost" in the unanswered column. I never said the needle lock was "unpickable"—probably no lock ever made really is, but the needle lock can only be "picked" with a key made for it. It is, too, *one* of the best locks ever made, from that very fact. "Force" does not enter into the question at all, for we do not employ locks to resist "force," but to prevent doors or boxes being opened by *every* curious or nefarious individual. I have yet to see the lock capable of resisting "force" when applied by the skilled hands of an accomplished thief. As a matter of fact gentlemen of this character do not waste time and ingenuity in picking locks; they either force them off or cut them out, unless silence happens to be a sine quâ non. The lock that does not yield to gentle force, very frequently has its fastenings removed by a well understood process, and if the exact position of these is not known a wide sweep is taken and the piece to which the lock is secured cut out. The needle lock will not bear rough treatment, but those I have seen have answered very well. Like all other locks it is not proof against the splendid tools (qua tools) which your first-class burglar uses. It is just a question of the insertion of a bar in the keyhole, a few turns of a nut on a screw, and the back of the lock, if not the whole of it, is forced off.—Saul Rymea.

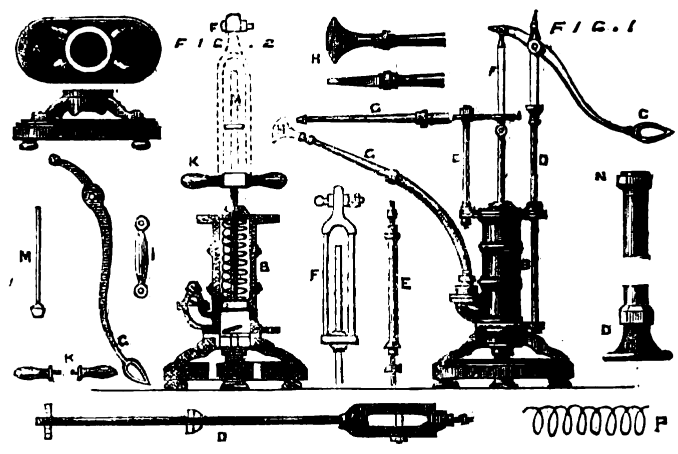
[12057.]—**Defective Sewing Machine** (U.Q.).—Make the recess in the hook deeper, that the spool may retain its position. Now, it gets hampered by dropping down between the shield and hook, and jams the thread.—Jack of All Trades.

[12063.]—**Tambour Frame** (U.Q.).—Make it the same as the ordinary sampler frame, either with two morticed rails and stiles with holes in for stretching, or four lathes with holes in and pins; or, if for large work, a square frame with a strip of canvas nailed upon the frame with webbing and snap-headed brass nails. To this the material upon which you wish to work is stretched and tacked, a reef being taken in to suit the size.—Jack of All Trades.

[12064.]—**Diameter of Screw** (U. Q.).—This is a query I cannot understand. Will J. A. Adams be more explicit?—Jack of All Trades.

[12067.]—**Portable Force Pump** (U. Q.).—Some time ago, when paying a visit to Dowgate Dock (Morewood & Co.'s old place), I saw just the thing that would suit "W. M." It was very portable, and consisted of a moderate-sized galvanized bucket, with a small pump fixed in the centre, furnished with brass fittings. Branch has plain flats, and rose with india-rubber hose, and at what I thought a very reasonable price.—Jack of All Trades.

[12067.]—**Portable Force Pump** (U. Q.).—This pump is convertible in case of fire, or for garden purposes. It will need but little explanation. I have shown in diagrams the connected and disconnected parts: by following the letters nothing can be misunderstood. It will be seen by reference that I have not introduced for garden purposes the ordinary rose for watering purposes, but one similar to a singeing apparatus, as used by farriers, as being the best-suited, so as not to destroy the most tender blossom of flowers or plants. The only letters I shall mention will be those marked M, arm of piston disconnected; N, hose and union joint or screw; O, bell-shaped nozzle at the end



of suction hose, or fastened by union joint to bottom of pump barrel. To render this pump compact, as well as portable and convertible, I have carefully arranged every part. The supply of water may be drawn from pond or portable cistern.—Joseph William Fennell.

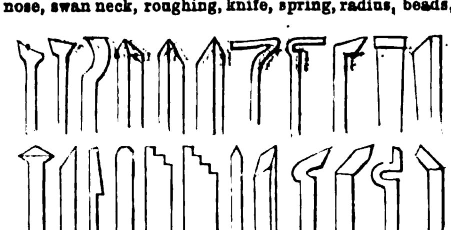
[12071.]—**American Drill Chuck** (U.Q.).—Tap the chuck to fit the lathe spindle.—P. W. H. J.

[12071.]—**American Drill Chuck** (U.Q.).—Yes; you may expand it over a gas-jet sufficient for that without injury.—Jack of All Trades.

[12075.]—**Fruit Syrups** (U.Q.).—There are various ways; some are chemicals coloured with cochineal, &c., while others are the pure juice, to every pint of which one pound of sugar is added. Some are boiled and clarified with eggs, while others are left to stand until clear, sugar being then added without boiling.—Jack of All Trades.

[12076.]—**Polishing Slate Clocks** (U.Q.).—Take a piece of flannel or list, with spirits of wine, and see whether it has been lacquered, if so wash the lacquer off and use copal varnish. Sometimes these are oiled before lacquering, which is the cause of it, and a mistake.—Jack of All Trades.

[12082.]—**Turning Tools used for Metals** (U. Q.).—These are hook tools, heel tools, diamond nose, side, L, three square skimmers, bolt head, planishers, for all classes of brass work, and filed for quirks, hollows, and beads of various sizes, for standard tools as well as gravers, chisel nose, round nose, all of which vary according to your work. Those are used for hand turning for slide-rest. They consist of round nose, swan neck, roughing, knife, spring, radius, beads,



hollows, &c. The sketch will give a general idea. Take them in rotation, as mentioned; the last is the Scotch, and is not to be beaten for rough work, and, in fact, general use for surfacing or boring tools; but though you may have the forms given, and make them, it is another thing to use them.—Jack of All Trades.

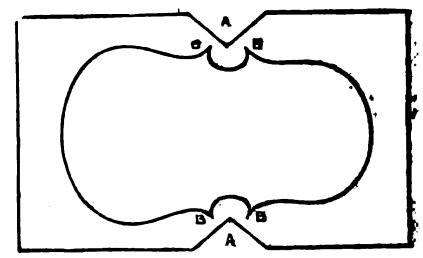
[12083.]—**Polishing the Edges of Glass** (U Q.)—This is done in many instances with a cork wheel, and fine or flour emery, putty powder, powdered pumice, or cowcup.—Jack of All Trades.

[12085.]—**Cricket Bats** (U. Q.).—A cricket bat requires no staining; age is the only seasoning which is serviceable. Polishing is a drawback, and makes it more of an ornamental than a useful toy. The face of a bat should on no account be polished, for then oil cannot penetrate, and no bat can be of much use for any length of time without constant oiling.—W. M. Colles.

[12085.]—**Cricket Bats** (U. Q.).—Can be stained with a weak solution of bichromate of potash, spirit, and turmeric, and polished with pale polish or a coating of bright.—Jack of All Trades.

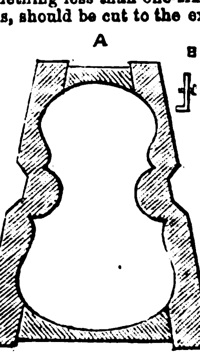
[12087.]—**Violin** (U.Q.).—Heat is the means of bending sides of violin. If the wood is wetted it is apt to recover its straight form on cooling. The violin makers use "curling tongs." For the amateur I suggest the following mode:—Heat a piece of round iron (an urn-heater will answer), nip the cooler in the vice, bend a piece of tin and put over the heated end. If the prepared slip of wood is held down upon the tin, shifting it as required, it may be carefully beat (dry) to the required shape, and will retain its form.—Suffolk Amateur.

[12087.]—**Violin** (U.Q.).—Get a piece of wood (pine will do) large enough to cut out the shape of your violin, and as thick as the depth, say 1¼in. Cut out the shape with a fret-saw, and you will then have a framework to begin with (see sketch), A A. Cut out so that you can use a hand-screw or small cramp to fetch up the block when glueing the sides. In cutting the frame cut the corners BBBB well in, and wide enough to take two pieces the thickness of the sides of the violin, but don't cut it too wide. Now get your sides and fit them in the frame. You can bend them to their shape on a round piece of iron made warm, not hot, and held in the vice. Now don't be in a hurry when bending the sides, because there is plenty of time, and if the iron gets cold you can warm it again. If the sides do not bend readily, wet the upper side a little, only don't try to bend it all at once; do it little by little, and it will gradually come to its proper place. When the sides are fit you can prepare the blocks, six in number, one for each corner, and one for each end. Be careful in fitting the blocks, and get them to bed well. When fit you may proceed to glue the sides in; block up two corners first, one at each side; when set do the others, and then the ends. See that the glue has not fastened the sides to the frame, or you will have a job to get it out. When the blocks are set, put some strips of wood at each edge inside; cut the strips in lengths to reach from block to block, and bend them in the same way as the sides over the iron. The strips are best made of split wood, you can then work them either way; they must be about ¼in. in depth, and



about one-sixteenth of an inch in thickness outside, and tapering off inside. When finished you taper them after fixing them in their places. Prepare one side of the strip, and fix it tightly into its place, each end just catching on a block; when they are all in and set finish off inside, making all perfectly smooth; level the edges and the blocks, and it is then ready for the back. If you don't understand this write again, and I will endeavour to explain, though I could have shown you all about it in less than one-half the time it has taken me to write this.—J. R. F.

[12087.]—**Violin** (U.Q.).—I will relate how the job was done by me with perfect success. A frame of deal is first made of the exact shape of the outline of the violin, out of two pieces of deal ⅝in. thick, fixed together face to face, with ⅛in. blocks between, so as to make the whole depth 1¼in., the usual depth of the ribs. The wood for the latter having been reduced to something less than one-sixteenth of an inch in thickness, should be cut to the exact lengths of each rib, and steeped in warm water for a short time, then bent on an Italian iron such as laundresses use—viz., an iron tube on a stand into which red-hot heaters are put from time to time to keep up the heat. To press down the strips on the iron use a piece of wood with the end hollowed to fit the curve of the iron; whilst the wood is still warm place it in the frame, and fix it in its place with small flat pieces of wood having a head at one end projecting at right angles; press the head tight to the rib so as to make it sit close to the frame, and drive a small tack through the flat part into the face of the frame, and when all the ribs are bent and secured in this way, set it aside to dry; afterwards glue a small block of wood into each angle of the ribs, and also some strips of deal, about ¼in. deep, and one-sixteenth of an inch thick, round the top and bottom edges of the ribs, to strengthen them. I inclose sketch of frame, &c. A, frame; B, wood clip.—Vexed Violinist.



[12087.]—**Violin** (U.Q.).—Boil them, and bend upon and between blocks.—Jack of All Trades.

[12088.]—**Cleaning Jewellery** (U.Q.).—Sal-ammoniac and urine are said to give the desired effect.—Jack of All Trades.

[12091.]—**Plums (U.Q.).**—Disease is said to be caused by the large roots getting down into hungry soil, more especially if your bottom is red gravel. I have seen trees treated thus: Undermine the roots and cut off the tap-root. Grub out if you can, with as little injury to the surface roots as possible, and fill in with old mortar, or, what is better, powdered oyster shells. The trees must be lopped in proportion. I have seen trees that have been served like this—which bore no fruit before, but plenty of bloom; and others that have borne fruit to a great extent, but which never came to perfection—cured and become splendid trees by this treatment—pears, plums, apples, walnuts, gooseberries, vines, &c. There is a nice little work called the "Cottager's Calendar," by Preston, price 3d.—JACK OF ALL TRADES.

[12103.]—**Staining Glass (U.Q.).**—These are plated glasses, that are only coloured on one side. This plated glass is acted upon by hydrofluoric acid upon the coloured side; in fact, it is etching upon glass, the acid dissolving the coloured glass and leaving the other clear for colours. See Indices for "Glass Painting," by "Sable."—JACK OF ALL TRADES.

[12107.]—**Recipe for Greasy Strapping (U.Q.).**—I know of nothing but hot water, which will drive the grease out.—JACK OF ALL TRADES.

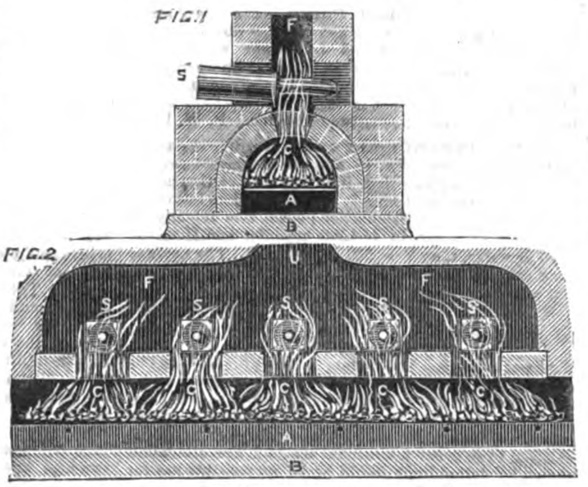
[12107.]—**Recipe for Greasy Strapping (U.Q.)**—When strapping gets so greasy as not to be pieced with the ordinary belt punch and lace, there is no help for it, it must be got rid of. Avoid all very greasy strappings, as they do not carry power well, and are apt to slip if the grease is in excess.—P. W. H. J.

[12109.]—**Old Locomotive Tubes (U.Q.).**—They are generally very brittle, and must be thoroughly cleansed inside and out, then heated very nearly red hot, and slacked in water. Fill them either with pitch, resin, or lead before bending.—JACK OF ALL TRADES.

[12095.]—**Hardening Steel Shafts (U. Q.)**—With a few fire-bricks build a furnace after the following sketch:—Fig. 1, end view; Fig. 2, section through A F; S S S, shafts; bricks are left out here and there in the crown of arch, and the same through flue F. At right angles place the ends of shafts through, and lute in with loam; rest the other ends upon trestles. Heat to a bright blood red, and slack in a good depth of water, at 80° or 90°, plunging them in perpendicularly, and let them remain until perfectly cold.—JACK OF ALL TRADES.

[12119.]—**Pump for Colliery (U.Q.).**—I should fancy a centrifugal pump would answer your purpose.—JACK OF ALL TRADES.

[12119.]—**Pump for Colliery.**—I don't exactly understand "One in Need." He says that he has to bring 500 galls. 200 yards, but does not say to what height it is to be raised. If it were on a level or on an incline downwards towards shaft there would be no need of a pump, so I am forced to the conclusion that it has to be raised. If this is only a few feet, a centrifugal pump would do best. It would only require a very small one for that quantity of water, in fact, if "One in Need" is anything of a mechanic, he could make one himself. The wheel could be entirely of brass, and casing of sheet iron. One of about 8in. diameter would do, of course a less one would do, but I think that that would be most serviceable. But I cannot say positively anything concerning it until I have further particulars. I want to know description of mine—whether it is driven in the side of the hill or not, or whether, if it has a shaft, it has a regular set of pumps. A plan and section of mine would make things clearer.—P. W. H. J.



[12155.]—**The Suspended Shilling.**—The statement that a suspended shilling will strike the hours can hardly be taken as a fact. I have cured one person of the fallacy by requesting him, instead of looking at the shilling and thereby, as it were, mesmerising himself, to watch his arm and observe that it does not move. I should expect that your correspondent is equally open to a cure.—SUFFOLK AMATEUR.

[12172.]—**Constipation.**—Let "H. S. A." try the following: 40 grains powdered rhubarb, 24 grains ipecacuanha made into 24 pills. One to be taken thrice daily with a little good exercise. Continue for two or three weeks. If no benefit arises the remedy is not hurtful.—SUFFOLK AMATEUR.

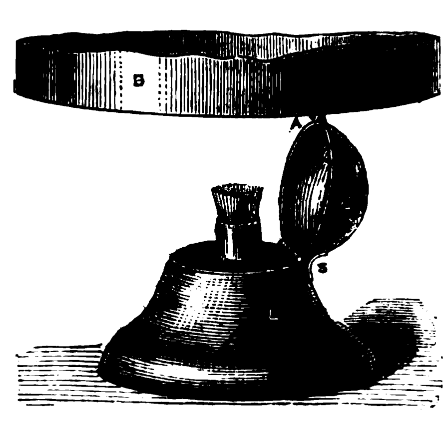
[12180.]—**Seasoning Pear Wood.**—If A. H. Cooke keeps his pear wood in a hay-loft he will find it soon spoilt. Choose a place which has a cool draught, the hay-loft is likely to be the exact reverse, strip the bark to allow the wood to dry. Pear wood is used for turning and cabinet work.—SUFFOLK AMATEUR.

[12184.]—**Brown Varnish for Baskets.**—Use "brown hard;" too cheap to make it profitably.—E. M.

[12187.]—**Repolishing Chimney-piece.**—Polish with Tripoli, and then with putty powder and felt; don't use too much water.—E. M.

[12205.]—**Double Rocket (Hesperis.)**—In answer to the above as to the best method of propagating the same, S. Bottone (page 415) says: "Best from seed sown in the autumn to bloom next year." I hope that S. Bottone will excuse my asking if he has raised the double rocket from seed himself, or if he speaks from the information of others. I have grown the double rocket for the last twenty years, and I never found it to produce a single seed. I have looked at several works on horticulture as to the method of propagating this plant, and find no mention made of seed. They give the usual method of propagating by division of the roots after the plants are done flowering or by cutting.—ABEL.

[12213.]—**Coffee.**—I have lately seen a self-acting apparatus like that described on page 416. In the one I saw, however, the two vessels (which were of earthen-



ware) instead of being above one another were placed at the extremities of a brass rod balanced like a see-saw. The chamber containing water, which I will call the boiler, is closed at the top with the exception of a hole which is plugged by a cork, and by which the boiler is filled. One end of a bent tube passes through the cork, and almost touches the bottom of the boiler; the other end, which is provided with a metal strainer like the rose of a watering-can, nearly reaches the bottom of the coffee chamber. The spirit-lamp L, which heats the water, has a lid E which acts as an extinguisher, and is closed by a spring S. When the boiler B is full, it is weighed down by the water, and a projection A on its bottom catches the extinguisher and holds it up. When the water boils, it is forced up the tube by the steam into the vessel containing the coffee, and the latter being now weighed down raises the boiler, and, by thus releasing the extinguisher, puts the lamp out; the steam in the boiler now condenses, and the coffee flows back to the boiler, and may be drawn from the latter by a tap. I inclose a sketch of the lamp, and bottom of boiler.—GLATTON.

[12215.]—**Fettling Materials.**—Marbella, blue billy, and ilmenite are merely impure oxides of iron. Ilmenite is titaniferous iron, blue billy is the refuse of the pyrites used in sulphuric acid making. I don't know the peculiarity of marbella.—J. B. C.

[12217.]—**Violin Tuning.**—I tune my second string to A by fork, then screw up the first until it chords in harmony with the second. W. M. Meek will easily hear when the E and A blend by the beauty of the tone; the third and fourth I tune in the same way, all off the second string; that is, I screw them up until I obtain the sweetest chord. It is nonsense to talk of tuning to a certain key, all scales are played off one tuning.—JOHN HOPKINS.

[12236.]—**Glowworms** should be found in plenty now. The beetle comes out fully developed rarely later than June. They are found in most country places in sheltered spots, where there is perpetual dampness, not wetness.—SAUL RYMEA.

[12244.]—**To Harden Lead or Zinc Type.**—It seems as if Mr. Sharpley would not obtain the information he requires. I know of no compound type-metal which is sufficiently fusible to cast in moulds and yet able to resist the heat of gas for hours. Surely, if Mr. Sharpley spoils a lead type every half-hour, brass *must* be cheaper. Why not try cast iron? or are the letters too small to get good types in this metal.—E. M.

[12249.]—**High Pressure Fire-Box Boiler.**—In reply to "495," the plates of the shell are to be $\frac{3}{8}$in. thick, double riveted, and best Staffordshire iron. The ends to be same kind of iron $\frac{3}{4}$in. thick, having two strengthening pieces $\frac{5}{8}$in. thick, and 5in. wide, riveted diagonally across from about the crown of the tube to the shell, and the stays mentioned in my first letter pass through shell and strengthening pieces and screwed up. By the use of Galloway's tubes you might make the boiler move over 40 h-p., but I think that it would be best to do without them, and add them afterwards as you find your power insufficient. Thus you will always be able to increase your power without putting an additional boiler down. If I had calculated for Galloway's tubes at first, I might have made the boiler considerably smaller. The tubes are to be set at an angle of 10° with the vertical line. There are to be 35 of them set in two parallel rows, at a distance of 1ft. from each other in the line; they are to be about 2in. wide at bottom and 4in. at top, internal, and about $\frac{3}{8}$in. thick with flanges. The bridge is to be a brick and a half thick at top, and two bricks at bottom. The firebars to be of cast iron. I need not particularise Hopkinson's valve, because, of course, you will obtain it direct from the maker. I would merely stipulate that the diameter of the top safety valve should be $6\frac{3}{4}$in. diameter.—P. W. H. J.

[12255.]—**Hair.**—The best wash is: Rose-water, 8oz.; glycerine, $\frac{1}{2}$oz., sulphur, 1drm., sugar of lead, $\frac{1}{2}$drm.: mix. To be used daily till the head is clean, and then occasionally. Proved.—M. W. G.

[12258.]—**Old Violin.**—The label "Chetianus Amates Camonensis, 1640," does not indicate value apart from its genuineness. I cannot find any mention of such a maker of violins. The Amatis of Cremona most known are Andreas, Hieronymus, Antonius and Nicolaus, to whom may be added Josephus of Bologna.—SUFFOLK AMATEUR.

[12267.]—**Cabinet for Birds' Eggs.**—"C. T. B." will find that a miniature chest of drawers will be the most suitable receptacle for specimens of eggs, &c.—W. M. COLLES.

[12293.]—**Lighthouses.**—Mr. Hey must apply to the Trinity Board, Tower-hill, E.C., when, if successful, he will have to go through a course of tuition on Blackwall Wharf, and finally pass an examination by the Trinity engineer.—LAND'S END.

[12299.]—**Tar Pavement.**—There are one or two points of importance in the construction of this kind of causeway that appear to have been overlooked in "Philo's" reply. One is, the regulation of the size of hard materials to mix with the gas-tar; and another, the necessity of securing perfect adhesion between them and the tar itself, so as to make the mass to a certain extent homogeneous and prevent its breaking up from any cause. In the process which I have watched, and which is very successfully adapted to provide for the heavy wear and tear of exposed railway platforms, the following particulars seemed noteworthy:—Firstly, the securing a perfectly firm foundation of hard-rammed chalk, building rubbish, or other "hard core," the thickness to be proportioned to the anticipated traffic and to the character of the soil beneath—*i. e.*, with regard to firmness or tendency *per contra* to "settle" under continued pressure. If the soil be of a very yielding character, it must be excavated to a sufficient depth and replaced by the foundation stuff, well rammed as aforesaid. The hard material for the path may consist of gravel stones or of shingle from the sea beach, broken stone, or anything similar; but it must be double riddled, so as to exclude all pieces above or below certain dimensions. The limit of useful size appears to be from $\frac{1}{2}$in. diameter as the minimum, up to 1in. or $1\frac{1}{2}$in. The next object is to thoroughly dry this material, so as to obtain perfect adhesion of the tar when applied to it. For this purpose the stone is carefully roasted, in this way: A thin layer of the stone is spread, and upon this a fire of cinders is lighted. When it is burning well a small quantity of the stone is scattered upon it; and when this is thoroughly hot more cinders, and again more stone, and so on, until the whole of your material forms an incandescent heap. When it has thus remained a sufficient time to have every particle of moisture expelled from it, it becomes (as may well be supposed), very "thirsty," and will suck in any fluid applied, so as thoroughly to incorporate it. But first the hot stuff must be again sifted to get rid of all the ashes and dust; and this must be done quickly, in order not to lose the benefit of the high temperature. As fast as it is sifted and thrown out of the sieve by one man, another pours upon it the prepared tar from a long ladle, and another rapidly turns the heap over and over, so that every scrap of stone gets a thoroughly good coating and soaking with the tar, but not in excess of the quantity required to secure adhesion and firm texture. These processes, it is obvious, must be carried on, not upon the site of the intended pathway, but at a short distance from it; and the tar, or mixture of tar and pitch, should be placed in a tub or half-cask sunk to a level with the ground in the vicinity of the roasting heaps, and thence may be conveniently ladled out as described. The tarred stone is then barrowed to the path, upon which it is evenly spread to a thickness of a couple of inches or so, the top being arranged with proper "pitch" for surface-drainage. It is then rolled with heavy rollers; and in corners or against walls, where the rollers cannot penetrate, it is thumped down with flat-bottomed rammers. After this, a surface coating of drying stuff, which may consist of coarse sand or lime rubbish, or, better still, the small chips and dust from a stone-mason's yard, must be sprinkled evenly over it, and the rolling and thumping repeated. If, from intense heat, or excess of tar, the latter should still tend to "sne" up on pressure, further coatings of the drying stuff may be applied from time to time as required. And, if not objectionable for any reason, a thin coating of the same may be left loose on the surface for a time, to prevent any possibility of damage to even the most delicate of "understandings" by direct contact with the tar. The peculiarity of paths well made on this principle is that—like

A woman, a dog, and a walnut tree,
The more you beat 'em the better they be.

They improve continuously with "wear and tear;" will stand a considerable amount of even rough usage; and, agreeably elastic at first, they finally settle down to a rock-like firmness. In making barn and other floors under cover in this way, a larger proportion of pitch, or of real asphalte, appears to be required; and the broken Derbyshire spar (crystalline sulphate of lime) is used with good effect and great advantage in establishing a firm and pleasant surface.—G. W. K. L.

[12311.]—**Hydraulic.**—The questions are easily answered. Pumps expel only the water which stands above the lower end of the pipe; never that which is under it. The action of the pump piston is to create a vacuum, which is immediately filled up by the descending liquid. The water flows in, not by "attraction" but by atmospheric pressure. This pressure is also called gravity, and incorrectly considered as centripetal. Hard water, being of greater density, occupies the bottom of the well; it cannot ascend, if not forced upwards, which it is not. On the contrary, the soft water ascends in proportion as a vacuum is produced under the piston: it descends first by atmospheric pressure acting on its surface. The place occupied by the pump is of no consequence whatever. It is always the upper water which descends to the pipe's mouth, in obedience to atmospheric pressure, and fills up the vacuum. Should not this take place, no water would ascend at all.—C. R.

[12329.]—**Practical Mechanics.**—What do the several correspondents who have written upon this subject require? Mr. Anderson's Cantor Lectures were given pretty fully, and at the present time the Rev. A. Rigg's Cantor Lectures are appearing just as fully. Both these series of lectures are upon the subject—Applied Mechanics. As for books upon the subject, I agree with your correspondent "Caer Glon" that they are unsatisfactory; but it is probable that before long something better will be published. Meanwhile, let me advise all students to follow some such plan as this: Get to see a machine at work, seek out the point where the power is applied, then see where this power is carried to, and how. If this be done, the student will soon feel himself progressing in knowledge. It would be rendering me personally an important service, and I believe many others also, if correspondents would state exactly where they are at fault, and what they desire to know in this subject of applied mechanics.—C. H. W. B.

[12341.]—**Moths.**—Finely ground white pepper dusted on the carpet and under will banish them, but may banish you, too, if your nose is much given to sneezing. Try snuff.—M. A. B.

[12344.]—**Disappearance of Art.**—If there be no remains of the mechanical arts found in Egypt, Assyria, &c., does it not argue that they never existed there? Imagine that in the course of time the power of England waned, and the mechanical arts were lost, what would become of the vast accumulations of that indestructible material, iron, existing in the form of ponderous bridges, cranes, girders, steam hammers, marine, loco, and land engines, &c.? Their debris at least (if not their actual forms) would last many thousand years. This query and 12374, "Ancient Wrought Iron," open out a field of very curious inquiry. Many thanks to S. Bottone and to "J. C. L." for their answers to 12188.—LXXXVIII.

[12346.]—**Gearing Waggon Wheels.**—In my reply to the above query (p. 469) there is a slight mistake. It ought to be thus—

25 : 2 : : 10 (arm
2
———
25) 20·0 (·8in., or $^8/_{10}$ of an in. out of straight line.
20 0

—Luffra.

[12347.]—**Stroke.**—The stroke of an engine is twice the radius of the circle described by crank-pin. It can be ascertained from an actual engine by turning the fly-wheel round until the piston-rod is as far in as it will go, and the engine is on the dead centres. Then tie a piece of string tightly round the piston-rod, close to the top of stuffing-box. Now turn the fly-wheel until the piston-rod is as far out as it will go, then measure distance between top of stuffing-box and string, which will be the length of stroke. The weight of fly-wheel for the Boulton and Watt engines as given by Watt, is found by this rule. Multiply the number of horse-power of the engine to which it is to be applied by 2,000, and divide the product by the square of the velocity of the circumference of the wheel in feet per second, the quotient is the weight of the wheel in cwts. Thus, the weight of a fly-wheel for an engine of 20 horse-power is 90·4 cwts., supposing it is 18ft. diameter, and to revolve 22 times per minute. The modern rule, as given in "Molesworth's" for weight of rim, is this: Let D = mean diameter of wheel in feet, P = total average pressure on piston in lb., and S = stroke in feet. Then W = weight of rim in cwts. $= \frac{P\ S}{45\ D}$, and sectional area of rim in sq. in. $= \frac{11{\cdot}42\ W}{D}$, and D = stroke × $3\frac{1}{2}$ or 4 generally. For engines with high expansion or irregular loads, multiply W, as found above, by 1·5. Some engineers have the diameter from 3 to 5 times stroke of engine, and from 6 to 8 cwt. per horse-power, ¼ of which weight is weight of boss and arms. This rule gives the fly-wheel about 3 to 6 times the average momentum of piston and other reciprocating parts.—P. W. H. J.

[12348.]—**Spanish Pronunciation.**—Erratum.—The word *blancho*, as given in the tenth line of my answer to "E. L. G." in our English Mechanic of July 19th, 1872, ought to be *blanco*: the error is typographical.—Wm. Wray.

[12351.]—**Underground Telegraph Wires in Cities.**—The soil is dug out to the proper depth, a bed is made at the bottom sufficiently large to receive the wires and allow of their being isolated. These wires are stretched out at proper distances by means of a disc of perforated sheet iron, through which they pass; three or four yards are drawn out at the time. When the wires are thus stretched out and fixed, melted bitumen, or common resin, is poured in so as to completely envelop and isolate them. This done the work is complete, and the earth is covered in. Such wires never need repair, and are free from all influence of atmospheric electric perturbation.—C. R.

[12352.]—**Centrifugal Pump.**—It appears to me that if "Rat-Tat" tried a pump constructed upon his idea, which is only a modification of the spray apparatus, he would find that if the aperture for the exit of the raised water were anywhere between the steam nozzle and surface of water that the air would rush in instead of the water coming up, and if the water is to pass nozzle as the smoke and air in locomotives does, the water would be blown into spray and the steam condensed instantly.—A., Liverpool.

[12352.]—**Centrifugal Pump.**—The plan mentioned in the latter part of answer of "Rat-Tat" has been tried and not found to answer as well as with the centrifugal. The reason is that to pump or eject a large body of water is attended by the condensation of the steam, if it is not in larger volume than would be required for a well-constructed engine.—P. W. H. J.

[12352.]—**Centrifugal Pump.**—I will first answer last part of query—viz., to find the number of revolutions. I shall suppose that it is Appold's or Gwynne's, as these are the most largely employed. The following is the formula for calculation:—Let V = velocity of periphery of pump in feet per minute, and H = the head of water, then V = 550 + 550 $\sqrt{H}$. The average head can be estimated at 9ft. Of course, this is not correct, but is near enough, and easy to deal with. Then V = (550 + 550 × 3) ft. = 2200ft. ∴ Number of revolutions per minute $= \frac{2200}{3{\cdot}1416 \times 2}$ = about 350 revolutions per minute. The leather belt mentioned would be exposed to a strain of 530lb. Theoretically, 8in. and a fraction would drive it well, but I think that it is an advantage to have one 10in. broad, as there would be much less danger of straps breaking, through not being exposed to so great a tensional strain. The alteration shown by dotted lines would be of no possible use for so short a length of strap. If it were a long strap, then it would be useful, on account of the weight of the strap increasing the adhesion, but even then it would hardly be worth while. The small pulley marked *c* on drawing (which, by the way, is not described) would increase the adhesion considerably, and so lessen risk of breakage. If "Teachable" had sent description of chain, it would have been possible to have seen whether it was really proportioned for the strain. Another way of getting over this difficulty is to increase the velocity of the pulley *c*, and lessening its diameter. This would have the effect of decreasing tensional strain on the chain. It would be the best and surest plan, but would entail considerable cost. Either diameter of spur-wheel *a* would have to be increased; or, what is much cheaper, if possible, the diameter of the pinion *b* would have to be diminished. At all events, try the strap first with present arrangements.—P. W. H. J.

[12352.]—**Centrifugal Pump.**—I have seen a woven leather belt (Hurn, patentee) driving a 16 horse-power engine and centrifugal pump to perfection. One of these woven belts has been driving the engine at the Royal Gas Factory, Woolwich Arsenal, upwards of three years to my knowledge. Inspect the belt and judge for yourself.—Mechanic.

[12366.]—**Pianofortes without Strings.**—If Mr. Fennessy will take the trouble to look into several articles lately printed, he will find pianos without strings are no novelty, a patent for one by Dr. Clegget dating 1788. They are now in rather common use, but were never extensively adopted, probably because the tones of most of them are very short, but this I believe to be only the result of the bad proportions of their forks or vibrating parts, for the sounds of a good tuning fork are anything but "short," certainly not so short as in Mr. Bottone's words to "require no dampers." Mr. Goldsworthy's—I should have written Goldsworthy Gurney's—piano was mentioned by me as being one of the best and simplest arrangements I have seen, and because it promises to obtain the greatest possible resonance any such instrument seems likely to get from a soundboard. Other varieties are rather numerous, as Mr. Fennessy will find by "reading up" "our" journal. Mr. Llewellyn informs me he constructed pianofortes whose sounds were obtained from steel wires coiled like a catherine wheel, the straight ends of which fitted tightly in a hole formed in the bridge on the soundboard. He tuned them by forming a screw on the straight part which projected above the bridge, and by means of a rather tight fitting nut (it was fitted rather tightly to avoid jarring) he tuned these springs, *à la* American clock "bells." To raise their pitches, he drew more of the straight parts through the bridge, thereby shortening the lengths of their vibrating portions. To flatten them the reverse operation served. I think very similar means have been employed for varying the pitches of harmonium reeds, and now are for organ reeds.—The Harmonious Blacksmith.

[12368.]—**Imitation Bronze.**—There is a practice that I condemn—viz., using corrosive sublimate for bronzing. It is, in the first place, very pernicious, and will make brass work as rotten as a biscuit. It, therefore, endangers the public safety if used in gas-fittings. Use sulphate of ammonia and sweat with acid.—Jack of All Trades.

[22368.]—**Imitation Bronze.**—Powder the corrosive sublimate; if it well blackens the brass that is sufficient.—W. Bolton.

[12374.]—**Ancient Wrought Iron.**—Is not the diameter of the base of this column a little overstated. 14ft. 4in. seems rather out of proportion for the base of a column probably not much longer than its visible portion, which is stated to be 48ft., and only 12in. diameter at top. Should it not have been $14^4/_{10}$in. at bottom. If this wrought (?) iron column be a mere relic of a past civilisation, like Cleopatra's needle, and no longer serves any useful purpose where it stands, although as a rule I abhor robbing ruins, I yet think it would be worth while to bring it to England, and if somewhat too large and heavy for the East India Museum, it might be sent to that interesting refuge for destitute curiosities, South Kensington Museum, and again subjected to the influence of (Henry) King Cole.—The Harmonious Blacksmith.

[12384.]—**Coppering Carbon.**—Place a piece of zinc in the porous pot, with one part of sulphuric acid and seven parts of water, and in the outer cell a saturated solution of sulphate of copper with a few extra crystals added to keep up the strength. Twist a piece of copper wire round the carbon, and connect to the zinc, allowing the carbon to dip in the copper solution as far as required. Metallic copper will shortly be deposited on the carbon, to which you can easily solder, using chloride of zinc, otherwise killed spirits of salts. I think this will also suit "D. J." (query 12453).—W. Bolton.

[12397.]—**Boat Building.**—Having built a small boat for my own amusement (though not a boat builder) it gives me pleasure to write what I know of it, in the hope of imparting some benefit to "W. S." and others. The kind of boat I wanted was such as one person could easily row for six or eight miles, and if necessary carry two or three persons. Having by visiting the quay decided on her dimensions—namely, 12ft. keel, 3ft. 9in. beam, and about 16in. deep amidships—to build one of these dimensions the following materials are required:—One piece of oak 12ft. by 3in. by 1½in. keel, one ditto 2ft. by 1ft. 4in. by ¾in. stern board, one ditto 2ft. 4in. by 3in. by 1½in. stern post, one ditto 2ft. 4in. by 4in. by 1½in. (curved) stem, two best quality yellow pine battens 14ft. by 7in. by 3in. free from shakes, or bad knots, and not dry—cut seven boards out of each; planking, twelve pieces green ash 5ft. by 1in. by ¾in. ribs, two pieces of ash 14ft. by 1½in. by 1¼in. gunwales, three dozen 1¼in. brass screws No. 14, 3lb. 1in. copper nails and washers, 5lb. or 6lb. paint. In addition to the ordinary tools used for planing and cutting timber when boat building, half a dozen pairs of what are termed tongs will be found very useful for gripping the planks together until shaped and secured. To make them, get two pieces of oak 18in. by 2in. by 1¼in., taper from 12in. back on outside at one end, and at the other taper them 6in. back, or inside, to give room for a wedge; strap together, secure each on a pivot, and by driving in a wedge at short end the jaws firmly hold the planks together. To build the boat, or rather the way I built it, was, having planed up the stuff, I half checked the stem and sternposts on keel, nailed on sternboard, rebated keel for edge of first board, placed this frame on a couple of stools about 20in. high, and stayed it securely in an upright position; cut one of the boards 14ft. long up the centre; these formed the first planks on each side; nailed three or four pieces 6in. by 3in. by ¾in. across keel to keep first planks horizontal amidships. While bending them into stem and sternposts, tapered planks on each edge to fit, painted rebate in keel and edges of planks, and secured them with copper nails; applied next plank, overlapping edge of first ¾in., gripped them together with tongs, tapered edge to fit, and reduced top edge at stem and stern, as at those points I had less space to cover than amidships, riveted planks and proceeded to third, which I had to cut and splice again to get it to assume a proper curve; a splice of 2½in. long, having a piece of brown paper painted on each side, and well nailed together, suited me. When the planks had been brought up to the required depth and shape of boat the gunwale was put in, and inside of boat painted two coats, a piece of ordinary 4in. down spout, stopped at one end, served me for steaming chest to soften and supple ribs, the sooner these were secured to planks after coming out of "chest" the better job; mine were put in 12in. apart; three seats 8in. by 1in., a flooring-board 14in. by ¾in. shaped to ribs, four coats of paint on outside; then a launch. It answers my purpose well.—H., Belfast.

[12417.]—**Hardening Spiral Springs.**—You have probably been using mild steel, such as pianoforte strings; it won't harden or temper to speak of. Get good cast steel, and you will certainly succeed.—T. S. USBORNE.

[12419.] — **Photography.** — Water alone. — S. BOTTONE.

[12427.]—**Entomological.**—The maggot is very like an ordinary cheese maggot, about ¼in. long, but stouter. It is found singly or by twos and threes in the sap-vessels of the leaf-stem or midrib of the leaves that are turning yellow in various species of Brassicæ. —MIMOSA.

[12428.]—**Air Vessel for Pump.**—The size, shape, and material are of no moment, so that they are big enough. It may be necessary to provide for the periodical supply of fresh air into a pressure pot. A vacuum pot will take care of itself.—T. S. USBORNE.

[12429.]—**An Engineering Inquiry.**—There is no royal road for a practical engineer to attain even a partial knowledge of his profession. At the same time, if J. A. P. Spence is in earnest, let him engage for two years in a marine engineer's erecting shop, but he must make up his mind to rough it, but "Dum spiro spero."—LUFFRA.

[12432.]—**Testing Beer and Spirits.**—Sykes' hydrometer as used by the Excise is the only reliable one for alcoholic strength, price, 15s. to 25s.—M. A. B.

[12439.] — **Working Plane Surfaces.** — R. Roberts asks for an impossibility. Theoretically, a perfect plane surface cannot be obtained; practically, Sir J. Whitworth first brought into fashion a means of getting a plane surface. Mr. Roberts should purchase a pair of Sir J. Whitworth's plane surfaces, of a size rather larger than he requires for his instrument. Then scrape a surface as true as he can on the face of his instrument, take one of the plane surfaces, cover with some colour which can be removed easily; on bringing this into contact with the scraped surface, the high parts will be covered with the colour whilst the low parts remain uncoloured; scrape away the high parts. Try again with the coloured plane surface, and so on, till the colour is distributed equally all over the surface. He will then have obtained as true a plane surface, as mechanics at present can make.— C. H. W. B.

[12439.]—**Working Plane Surfaces.**—Cannot R. Roberts use the method employed by the glass polishers? I will describe it. Two plates are employed rough, just as they come from the annealing furnace, one three or four times smaller than the other. The larger plate is imbedded in gypsum in a perfectly horizontal position upon the grinding bench, a table of about 2ft. high, resembling a billiard table. The smaller plate is fixed into the muller or upper stone, a movable box made heavy by weights, but in such a manner that the plates shall present opposite surfaces to each other, that is a rough (rolled) towards a smooth (from the casting plate) surface. When all is thus prepared, coarse sand and water is applied, and the upper stone is set in motion over the whole surface, round its axis, and backwards and forwards at the same time, either by the hand or machinery. When the sand has become too fine, the next size or number is applied (at Newhaus, in the Austrian States, seven kinds of sand, of different degrees of fineness, are employed), and this is continued until the grinding is finished—*i.e.*, until the ground plate exhibits a perfectly horizontal and plane surface. The process is then repeated with emery, which is renewed fifteen times at some places, gradually growing finer, until at last the glass becomes smooth as well as even, but is still dull and incapable of reflection. For this purpose it next requires polishing, which is done either by machine or by hand, the machine producing the best plane surface, but, nevertheless, it can be done by hand good enough. The powder employed is oxide of iron or crocus, also called colcothar (prepared by roasting green vitriol and washing). This is rubbed gently over the glass by means of a weighted board covered with woollen cloth. This process might easily be applied to metal, and I think with the same success.— P. W. H. J.

[12442.]—**Indigestion.**—Drink a tumbler of cold water containing a tablespoonful of lime water as you rise and go to bed. Eat brown bread made from the whole of the wheat ground, no bran being removed; avoid made dishes, spices, or sauces. Early to bed and early to rise. As much open-air exercise as possible. Never eat to repletion, but leave off whilst you could still eat a little more; no raw vegetables (salad, celery, &c.); avoid any vegetable that disagrees or causes flatulence. Indigestion is curable by proper diet, not by medicine.—M. A. B.

[12443.]—**The Tremolo.**—"Corelli" must have long practice to give that beautiful tremolo which he asks for; it is produced by the trembling or quivering of the single finger which stops the note. I was years before I could accomplish it properly, although I have scraped a fiddle for the past 22 years. Persevere, and you can accomplish great things; if a scraper, purchase Kreutch's Exercises (1s. 6d.), you will find many good exercises in it.—W. CLARKE.

[18443.]—**The Tremolo.**—It is difficult to explain, in writing, how the tremolo is produced, but, in a general way, it may be described as the shake, without removing the finger from the string, and this may be done by the fingers only, or by a free movement of the upper part of the hand in connection with the particular finger required.—F. F. C.

[12444.]—**Day and Night Telescope.**—The erecting eyepiece of most telescopes (spy-glasses) consists of four lenses, these are contained in the last draw of the instrument, two at one end in a small tube inside the draw and two at the other end; there is a stop in each of these inner tubes to cut off the wandering rays. To convert such a telescope into a night glass unscrew the first draw (the one nearest the eye), and unscrew from it the inner tube farthest from the eye and remove it; screw on the draw and focus again; the focus is much shorter; the object appears unveiled, but brighter, as it is not so much magnified, and besides, the loss of light incurred in passing through two lenses is avoided. Most small telescopes magnify greatly in proportion to the size of their object-glasses, and show darkly as day telescopes, and do not do well at night.—PHILANTHROPIST.

[12445.]—**Rotten Silk.**—Where dust is allowed to accumulate it breeds a species of fungus similar to mildew or must, which will very soon rot the best of fabrics.—JACK OF ALL TRADES.

[12447.]—**Employment for a Retired Tradesman.**—This all depends upon a person's taste. A good garden will afford you a vast fund of amusement. Mechanics are all very well; but some spend their life in such things without knowing, or being able to drive a nail properly. If "A Retired Tradesman" is determined to go in for mechanics, and has the means, get a good lathe, not less than 6in., with tools and slide-rest. Joiner's tools to consist of brace and bits; planes, smooth, jack, and trying; chisels, firmers from ⅛in. to 1½in., mortice tools from ⅛in. to ⅝in., beads, hollows, and moulding planes as you want them, bradawls and gimlets, a carpenter's bench, fret and circular saw, table for lathe, oval chuck, with other chucks; in fact, there is no knowing what you want until you start. I should recommend you to get the back numbers of the ENGLISH MECHANIC, in which all these things are treated on. If a start is made there is not the least doubt but that you will find by applying here that you will find plenty able and willing to give you tips. Never use a good lathe for grinding and polishing, but in some out-of-the-way place fit a temporary affair up for the purpose.—JACK OF ALL TRADES.

[12447.]—**Employment for a Retired Tradesman.**—A work-room with lathe and joiner's bench is all very well, but hardly enough for an active-minded man, accustomed to employment. A garden is a capital resource, so is an aquarium, especially if "A Retired Tradesman" has a microscope, he will find his aquarium almost as interesting as a Zoological Garden, he may be constantly finding something wonderful and strange. The study of some branch of natural history will be a more enduring pleasure than a tool bench. Geology is, perhaps, the most suitable for "A Retired Tradesman," but he cannot go wrong with any, if studied properly, not contenting himself, as many do, with learning merely the names (say) of the insects he collects; he must try to observe their manners and customs, to get all the good they can teach, which is a great deal. There is no need for a student of nature to travel far or incur much cost in finding objects of interest. They may be found everywhere by those who know where to look, and the habit of observing quickly increases the power of observation; those who have not acquired it, have little idea how much pleasure they miss. Many of the very commonest objects are, when properly examined, amongst the most wonderful; for instance, what fisherman's net is half as skilfully constructed as a spider's web; what building built with such economy of material as a honeycomb, and we shall be lucky indeed if "our" lifeboat is as complete a success as a gnat's egg-raft. —PHILO.

[12447.]—**Employment for a Retired Tradesman.**—I think photography would prove very interesting after the first difficulties of the art were surmounted, these are sometimes vexatious; and if necessary a few lessons might be taken from a professional photographer. Chemistry is a very interesting study, but some of its experiments are not devoid of danger; however, by far the greater portion of them are quite safe. Roscoe's "Chemistry" for study, and Francis' "Chemical Experiments" might suit.—PHILANTHROPIST.

[12450.]—**Beehives.**—The hive described in p. 806, Vol. XIV., is not the hive which I prefer above all others; but for those who prefer the Woodbury hive it is, in practice, the very best I know of, and with the improvements suggested at the end of the letter, and description, it will be perfect as a Woodbury hive. My objections to the Woodbury are described on p. 533, same volume, and my new hive is there roughly shadowed forth, and I have been promising to send an accurate description of all its parts ever since, but really cannot find the time to do it. However, I will endeavour to do so in time to enable bee-keepers to arrange for next year. But to return to "S. R. S. B. G." and p. 806. Fig. 1 shows ground plan. The blocks go down to within one-sixteenth of an inch of the bottom, and come up to within ⅛in. of top, and on them is laid ⅛in. deal to fill up the spaces, which said ⅛in. stuff is nailed in through both inner and outer skins of hive. The notches, as in the Woodbury, are cut into, and not through, the front and back inner skins only, which are of ⅜in. stuff for the purpose. My reply to first question makes it unnecessary to reply to the last one. As regards my new hive, results are bearing out all my anticipations. Swarms of this year are filling them, and the difference of the appearances at the entrances of them as compared with the Woodbury is most decidedly in their favour—no idling or outside clustering; no fanning at entrance, which is 9in. wide and ¾in. high; no difficulty about the ventilation, as the top board being in pieces, ventilation can be regulated to a nicety.—C. N. ABBOTT.

[12452.]—**Building on Sand.**—Sand is one of the best of foundations if properly drained. The first thing to be done would be to ascertain what is the nature of the stratum beneath; if it is at all soft, building should be proceeded with very cautiously. One of the worst situations for a sand foundation is at the side of a hill.—P. W. H. J.

[12452.]—**Building on Sand.**—If "Inquirer" wants a good job, by all means put in a concrete foundation; it is not only a better job, but it can be done for less money. A more powerful recommendation I cannot call to mind at present.—LUFFRA.

[12456.]—**Fuel for Steam-Engine.**—Use slack and coke in preference.—JACK OF ALL TRADES.

[12458.]—**Blowing Apparatus.**—The pressure required to force air through the syrup would be nearly 1½lb. A fan would not be able to force that pressure economically, though it would force it. The plan that I should recommend would be this: Get an iron or brass ring or tube ¾in. diameter, internal 16in. diameter, in which pierce fifty or sixty small holes that would let a knitting-needle go through them. This is to be fastened to the bottom of the cistern, and to have the straight portion of the pipe passing out at the side. This will do better than the Bessemer plan for a small thing like this, as in the former there would only be needless complication. There then wants a cylinder, 5in. stroke, and 3in. diameter. This is to be made like a double-action air-pump, and will require considerable care in its construction. It will be best made of brass. The air-vessel is to be a tin cylinder 10in. diameter, and the same high, which is to be connected with the ring by a pipe. To the piston-rod of the air-vessel there is to be fastened a lever-handle to work up and down like a pump. Instead of an air-pump, you might meet with an old engine-cylinder, second-hand, with slide-valve attached. This might be made into a pump by arranging so that the valve moves in opposite directions to the piston, by fixing the valve-rod to a pin on lever. An arrangement will be sent if desired.— P. W. H. J.

[12459.]—**Bending Laths.**—If you only want slight work, make saw cuts across your wood on concave side—one inch or less apart, and two-thirds of an inch through; and before bending wet the convex side only with hot water; but you must fix the ends in position permanently. If you want strong work you must give more particulars—viz., length of chord, rise of arch from chord, kind of wood, and hint of the purpose in view. I am supposing deal; but you can buy of a cooper a hoop of ash to make two much stronger and cheaper than you can make one.—CABINET MAKER.

[12459.]—**Bending Laths.**—If birch, beach, ash, &c., boil them and bend upon blocks. Oak, lime, poplar, willow, &c., will retain their shape. With the fir tribe it is a difficult job not to bend them, but to get them to retain their shape, unless put into a groove or fixed in some way.—JACK OF ALL TRADES.

[12461.]—**Threads in Gas-pipe.**—If "A Subscriber" will furnish himself with either Greenwood's or Martin's book upon "Screw Cutting," he will have all he wants, and will never have cause to regret the trifling outlay. They both advertise in "ours"—JACK OF ALL TRADES.

[12461.]—**Threads in Gas-pipe.**—1in. and upwards = 11; ¾in. and ⅝in. = 14; ⅜in. and ¼in. = 18; ⅛in. and all sizes of ordinary brass tube, 26.—W. BOLTON.

[12462.]—**Electrotyping.**—Copies can be taken off the plaster if it is properly prepared. They must first be dipped in melted wax and allowed to remain for a few minutes. After they are cool they are to be blackleaded with a soft brush. This wants to be done so that the blacklead is scarcely visible. They will then be ready for copying. They will return a fair medal, but there are many substances more suitable. Guttapercha serves the purpose admirably. The method adopted is to heat the guttapercha in boiling water, or in a chamber heated to the temperature of boiling water which makes it soft and pliable. The plaster casts are to be fitted with rims made of stout tin or pasteboard, bound round with wire. The guttapercha is then to be gently kneaded in and worked round until it has penetrated into the hollows of the plaster. They are then each to have weights loaded on the guttapercha and set aside until it is cool. Another plan is to place the plaster casts, if medals, or small ones, each at the bottom of a separate saucer, and surround it with well-kneaded clay flush with surface of medal, allow this to dry and press the guttapercha into it. To obtain a wax mould, the plaster cast is first brushed over with boiled linseed oil until it is perfectly saturated; this succeeds best when plaster is gently heated. Another plan is to saturate with water, and another with milk. To cast, the rim is to be ¼in. above medal, and before the wax is quite cool undo the rim or else it will stick to the wax. Care must be taken not to pour on the wax too hot, as that is one great cause of failure in getting good moulds, it should be poured on just as it is beginning to set in the dish. Put the medal and wax in a cool place, and in about an hour the two will separate easily; when they adhere, the cause is either that the plaster has not been properly prepared, or that the wax has been poured too hot.— P. W. H. J.

[12462.]—**Electrotyping.**—I should recommend the use of guttapercha in preference to wax, the latter being much more difficult to manipulate, on account of the formation of air bubbles, and other inconveniences. The guttapercha must be boiled in water until quite soft. The object to be copied, if plaster, should be slightly rubbed over with sweet oil, and should be provided with a rim of cardboard, or very thick drawing paper, allowing sufficient depth in the rim to hold a requisite quantity of the material. This may be conveniently secured with sealing-wax or strong gum. A rim of thin tin will answer the purpose very well if properly secured by means of a fine wire. To lay the plumbago on the mould, you need only to use a camel's-hair brush and rub on the plumbago (which must be very freely pulverised) in very small quantities, working round in circles, until the mould has acquired a metallic lustre. I have tried the above method, and have always found it to answer admirably.—W. H. H. C.

[12462.]—**Electrotyping.**—Take a piece of cardboard and tie round the edge of casts, either wetting or oiling before pouring the wax, or standing the whole in a little water in a saucer. To make the blacklead adhere evenly, wash the face with turps, and let dry; then apply the plumbago with a soft camel's-hair brush.—JACK OF ALL TRADES.

[12463.]—**Vision.**—There is another theory for the correction of the inverted image—viz., at the optic commissure or junction of the two optic nerves, there are three sets of fibres—decussating, non-decussating, and commissural. It is supposed that inverted vision is corrected here by the lower fibres passing upwards, and the upper downwards. A perfectly satisfactory reason, however, has never been given.—M. A. B.

[12463.]—**Vision.**—Perhaps visible direction has something to do with the inverted image, as evidently the eye receives the rays of light proceeding from an object above it in a direction slanting downwards, and we may thus be enabled to judge of the position of the object; a similar reasoning will apply to the case of objects situated below the eye.—PHILANTHROPIST.

[12463.]—**Vision.**—"H. Science" asks for the most probable cause of the inversion of images on the retina, but as the cause of that is nearly self-evident, I think he must mean to ask why do objects, the images of which are inverted on the retina, appear to us upright. The difficulty I feel in removing this difficulty, which many have, is in understanding what is the difficulty they find. We are entirely unconscious of the image which is formed on the retina; all that we learn by direct sensation is that we see when there is nothing between our eyes and objects giving off or reflecting light; that we see most distinctly the objects at which we direct our eyes, and that when we try to see parts of objects above or below, or at the side of that immediately in front, we have to turn our eyes upwards, downwards, or sideways respectively; and we have learned to do that just as we have learned to raise or depress our hands by the action of muscles, the action of which is quite unconscious to us, unless, indeed, the muscles are injured or fatigued so that their action gives us uneasiness. This is, I think, the most probable way in which the real position of objects seen by us is learned; but it may have been learnt, as it is now known to us, by our observing, as we often may without moving the eyes, that the part of the object the image of which is highest is nearest to the floor, which we know is below us. Thus, when we are lying down on (say) the right side, the lowest part of an object we look at forms its image on the part of the retina, where an object to our right would form its image if we were upright; but we find no difficulty in deciding its position with respect to ourselves, if we know our own position; nor should we find any difficulty by looking at objects when standing on our heads, and knew we were doing so.—PHILO.

[12470.]—**Separating Salts Produced from Kelp.**—The question put by "A Tyro" is one of those which it is difficult to answer, owing to their indefiniteness. The method to be pursued will depend very much upon the proportion of the salts contained. I should say that from a solution of potassium chloride, sodium carbonate, and sodium sulphate, if the proportion of the two latter be large, the best plan would be to concentrate by boiling. Upon cooling a crystalline mixture of sodium sulphate and carbonate would be obtained, such as sold by the name of grocers' soda crystals. From the mother liquor crude potassium chloride might be obtained by a second concentration and crystallisation. But I must confess that as I see no method by which they may be neatly separated, I think it would never pay unless the proportion of potassium chloride be large, in which case it might be crystallised out from the original liquor. I should advise the querist to concentrate some of the solution, and see of what the crystals obtained on cooling are composed, when he will have a better idea how to set about it.—ANALYST.

[12473.]—**Printers' Rollers.**—To mix composition for rollers: Summer use, 1½lb. best glue and 4lb. treacle; winter use, 1lb. best glue and 4lb. treacle. Soak the glue about one hour and a half if thick, if thin one hour. Take it out of the water, lay it on a board until next day, then melt down in proper melting-pot, or put it in a saucepan and place it in another containing water (be sure and not let the water run over into your glue; one great secret in roller casting is to have as little water in your glue as possible), then add treacle as above, let boil once, then keep it just under boiling point until cooked, which takes about two hours, more or less; pour out into moulds, well cleaned and greased; if left too long on the fire it will get thick and spoil. The above is sufficient for an 18in. roller; other sizes in proportion. From long experience I find the above is the best for both machine and press. Any further information to "A Tyro" I shall be happy to give. Perhaps the following may be of use to him and others. French compo. prevents damp rollers. For a 24in. roller, take ½oz. Russian isinglass, ½oz. gelatine, dissolve the two in ½ pint of water. When the usual composition is ready for pouring, add the above to it, let all boil ¼ hour longer, and cast in usual way.—W. CLARKE.

[12475.]—**Removing Whitewash.**—I should advise "S., Colombo, Ceylon," to try dilute hydrochloric acid for the removal of whitewash from stone and woodwork, subsequently washing with water.—ANALYST.

[12475.]—**Removing Whitewash.**—Take a bass scrubbing-brush and elbow grease. — JACK OF ALL TRADES.

[12482.]—**Integral and Differential Calculus.**—It would be difficult to mention any branch of science where the calculi are of no use, and it would really take up too much time and space to show where, when, and how used. The student, before commencing differential calculus, ought to have a good knowledge of trigonometry, and some knowledge of conics. Of course, a slight, yet useful, knowledge of this branch of mathematics may be obtained without so very extended acquaintance with the above subjects. (See Mr. Proctor's articles on the Calculus in Vol. XII.) I (personally) think Mr. Todhunter's books the best that any student can use. They are published by Macmillan, 10s. 6d. each. A book has lately been published by Messrs. Longmans, written by Professor Williamson, but I cannot say anything about it as I have not seen it.—C. H. W. B.

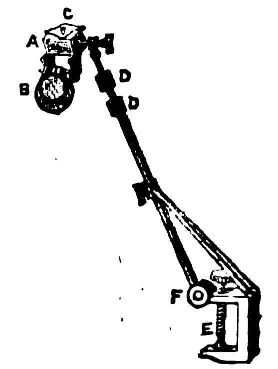
[12484.] — **Inorganic Chemistry.** — Get the "Science Directory" from South Kensington Museum. The syllabus for chemistry, first stage, second stage, and honours, will be found therein, also the books recommended by the examiner.—C. H. W. B.

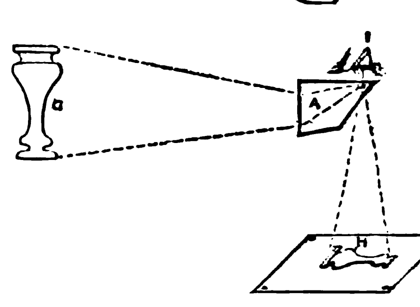
[12484.]—**Inorganic Chemistry.**—If "Science and Art" is ignorant of the science he desires to study, I should recommend him to begin by attending some regular course of lectures on chemistry, such as are given in most towns by certificated science teachers. If he prefers, or is compelled, to study privately, let him begin by reading Roscoe's "Science Primer," price 1s., published by Macmillan, carefully performing the experiments therein described. Then read Houghton Gill's "Chemistry for Schools," experimenting in the same way. If the student's object were to acquire a good knowledge of the science, I would then advise him to study Roscoe's "Elementary Chemistry," and the first two volumes of Miller's "Elements of Chemistry," but as his object is to pass the science and art examinations, he must read the book and master the chemical gymnastics of the examiner, Dr. Frankland. I am afraid "Science and Art" has fallen a victim to the intricacies of the "Science Directory" when he writes of wishing to pass "first-class in the third stage for honours." The lowest or elementary stage has two classes, first and second; so has the advanced stage; and so has the highest or "honours" stage. When obtained, the "honours" consist of a piece of brown card with your name written on it. There are very few honours to give away as the department has little to spare, its breaches of contract and "mistakes" being not unfrequent. The teachers of chemistry working under the department do their best, but their pay being dependent on "results," they are compelled to cram their pupils with the questionable theories of the examiner to the exclusion of much more valuable information and sound knowledge. If you want to learn chemistry for its own sake, and independently of the "honours," attend a class not connected with the department.—ALFRED H. ALLEN.

[12486.]—**Machine for Cleaning Boots.**—In reply to "S. J. R." first black your boots by hand, then polish with a revolving brush fixed to the head-stock of a lathe, or to cog-wheels, and a weight over pulley.—R. A. H.

[12504.]—**Sketching from Nature.**—Take a picture frame about 18in. square, or thereabouts, tie across the frame threads of cotton, both perpendicular and horizontal, about 2in. apart, like a gravel sieve; mount the whole upon a leg and fix it in the ground. Sit at a distance of 5ft. to 10ft., you will then see the place each object of the landscape occupies in relation to the cross lines, which serves to measure the position and space each require. The paper you sketch upon should be the same size as the frame, and should be attached to a board with pins. Dots at the end of the paper and across the top indicate the whereabouts of the threads on the frame; and the position each object must be placed in is easily found by the use of the T square, which serves, with the aid of the before-mentioned dots, to divide the paper into small squares in the same manner that the cotton threads divide the view of the landscape. This apparatus can be constructed for 1s. In sketching it is required to sit in one position until the outlines are taken. I would add a sketch as desired if I thought it necessary. You will probably understand it without, if not I will send sketch.—JOHN HOPKINS.

[12504.]—**Sketching from Nature.**—In answer to Thomas King (query 12504, p. 497), I do not think that anything better can be recommended for sketching from nature than the camera lucida; it can be obtained cheaply, and is certainly portable. I know people who have bought it second-hand for 12s., and as there is some exactness required, am inclined to think it would not be easy for ordinary persons to make. Both the camera obscura and the lucida have been tried by myself, and the palm belongs to the lucida for usefulness—but, "aye, there's the rub," it wants practice, and, possibly, a peculiar fitness of vision to use it. I am justified in saying this, because I know talented artists among my own acquaintance who cannot work with it. I have employed it for some years, find it a good servant, and therefore recommend it to others. Mine cost (new) £2 5s. The whole principle of the instrument lies in a nutshell: a prism, through which the images of the objects to be delineated are carried; these are seen reflected by the eye perpendicularly underneath the prism on a sheet of paper which is placed there. The eye then is held over the edge of glass, the hand with pencil delineates the outline of the landscape or object to be represented. The difficulty is in being able to see both the image of the object to be drawn and the pencil point at the same time—though some appear to surmount this vexatious trouble (for such it is), very quickly. After buying my lucida I laid it by in disgust for more than ten years, till a happy thought occurred to me to try it once more—and successfully. But for absolute truth I have more confidence in my own correct eye than in any optical appliance whatever. Many otherwise excellent photographs are notoriously distorted. The camera lucida has this fault, but with care it may be made to speak correctly. The following description, with reference to the diagrams, will explain it. A, prism; B, two eyepieces to assist defective vision; D, clamps to secure the elongating and telescopic rods, which thus increase or decrease size of image on paper; E, screw





for fastening on to edge of table or board; F is a pivot by which means the lengthening rod can be placed at any desired angle; C is a movable eyehole, of great advantage in confining the field of vision. The other diagram will show the principle still clearer. A, the prism; G, object to be drawn; H, image reflected; I, the eye. If Thomas King will turn to my answer to "Poloski" (12393), he will have the other requisite for sketching from nature.—A WORKING B.

[12511.]—**Gas.**—The following table will furnish "A., Liverpool," with the information he requires, and be useful to others. It is from the "Gas-Manager's Handbook." Wigan cannel and coal produce on an average:—

	Cannel		Coal
Gas	10,900	..	9,980 cubic feet
Illuminating power..	21·25	..	11·4 sperm candles
Coke	1,486	..	1,517lb.
Tar	17	..	11 gallons
Ammoniacal water ..	18	..	20 gallons

—SAUL RYMEA.

[12511.]—**Gas.**—In reply to "A., Liverpool," I learn that about 8,000 feet of really brilliant gas can be obtained from a ton of the best cannel coal; but if it is allowed to remain in the retort to be still further exhausted, then ten, twelve, and fourteen thousand feet of poorer stuff can be obtained, but the coke is then nearly unfit for household use. Ordinary coal, of course, will render a less and poorer quantity in proportion; but the larger the quantity of vapour obtained the greater is the profit the gas companies derive. It is a pity that our meters only register the quantity, without indicating the quality, so that we are now made to pay as much per thousand for the poorer stuff as the good, and are compelled to open our taps wider to burn a larger quantity, to obtain the light which a less quantity of the best gas would give. The complaints of poorness of light and increase of bills are getting so universal that it is time this subject was thoroughly ventilated.—R. A. H.

[12517.]—**Mathematical Machines and Tables.**—Babbage's extreme ambition unhappily did so overleap itself that the lesser of his proposed engines, the "Difference engine," a part of which was at South Kensington, is neither finished, nor, I believe, has yet produced any kind of table. The simpler of its purposes were meanwhile carried out by Scheutz, a Swede, whose machine was employed at Somerset House to calculate and print most of Dr. Farr's "English Life-Table," the volume mentioned in reply

12415, p. 495; and is now, I believe, manipulating the data of the 1871 census into a new edition of those tables. Babbage's complete design, the "Analytical Engine," which is to tabulate any function whatever, expressible by any algebraic formula, remains on paper only. Had he been content to execute either of them, as a first specimen, on a scale registering to ten decimal figures only, it seems he would have been enabled to carry out even this marvellous "Analytical Engine;" but he insisted on twenty figure results, as alone worthy of a national engine, and had to leave posterity to grow to his opinion. The little substitute of Scheutz was a quite independent invention; so admitted, I believe, by the philosopher, and without jealousy, welcomed and introduced to the country by him.—E. L. G.

[12520.]—**Fluid Lens for Photography.**—It would certainly be possible to construct a camera according to the diagram, but it possesses so many objections that no good could come of such an arrangement. 1. The loss of light by reflection from four mirrors would be very considerable. 2. The sulphuric acid would be constantly absorbing water, thus increasing its bulk, and altering its density and reflective power. 3. The water would rapidly evaporate from the proximity of the sulphuric acid. The focus would be best found by experiment with a piece of tissue paper or ground glass. It would vary with the distance of the object. Better buy a common sixpenny lens and fit it in a cigar box, than construct such an arrangement as in the diagram.—ALFRED H. ALLEN.

[12526.]—**Camera Lucida.**—The simplest so-called *camera lucida* for the microscope is Dr. Lionel Beale's neutral tint reflector. It consists of a piece of glass of a neutral tint inclined at 45° in front of the aperture in the cap of the eyepiece, and answers the purpose of Sömmerling's mirror or Wollaston's camera very satisfactorily. It may be purchased of any optician for a few shillings. The form introduced some years since by Mr. Collins is, in my opinion, the best. A substitute which will serve for rough work may be easily devised. Take a pill-box which will just slip on to the eyepiece in place of the usual cap, make an aperture in the bottom of the box the size of the eye-lens of the eyepiece, fix in a frame, which may be made of wood, cardboard or cork, two pieces of thin glass with a piece of thin tracing paper between them, or a little slightly coloured water may be run in in such fashion that the glasses shall be inclined at 45° to the face of the bottom of the pill-box. A piece of neutral tinted glass substituted for the thin glasses will, of course, form the orthodox article and may be very easily made by a person possessing very ordinary ingenuity at a trifling cost.—H. P. H.

[12567.]—**Chalk for Microscope.**—The plan I have adopted with very fair success is simple. I take a piece of the chalk I wish to examine, and immersing it in a small basin of water scrub it energetically with a tooth brush, or small nail brush, until the water has become tolerably turbid. I set the water aside until it has had time to allow the heavier particles to subside, when I pour off the water to about an inch of the bottom and fill up afresh with clean water. I then usually transfer the whole to a glass vessel, the better to see how things go on. This process of decanting and refilling must be repeated a score or more times, and the deposit after (say) the twentieth washing treated with soda, and then rewashed until all traces of soda are removed. The deposit, if now collected, will usually be found to consist of little else than foraminiferæ, coccoliths, &c. Another plan, which I sometimes follow, but do not like, is to pound the chalk tolerably fine, place it in a muslin bag and wash in water in the fashion a laundress "blues" her linen with the "blue bag," proceeding later as in the preceding plan.—H. P. H.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Jack of All Trades" has answered 12057, 12063, 12064, 12067, 12071, 12075, 12076, 12082, 12083, 12085, 12087, 12088, 12091, 12095, 12103, 12107, 12109, 12119; Joseph William Fennell, 12067; "P. W. H. J.," 12071, 12107; W. M. Colles, 12085; "Suffolk Amateur," 12087; "J. R. F.," 12087; "Vexed Violinist," 12087.

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12254 Aerostatics, 367

QUERIES.

[12537.]—**Compressing Air.**—If I take a cylindrical vessel—diameter a little over 13½in., so that the area of a piston moving in it is exactly one square foot, said vessel one foot deep—and press the piston downwards 6in., 7in., 8in., 9in., 10in. and 11in., what will be the work expended in compressing the above cubic foot of air—suppose at freezing temperature and 30in. of barometric pressure — into the corresponding new volumes indicated above—that is, ½, 5/12, ⅓, ¼, ⅙, and 1/12 of a cubic foot? The relative pressures in atmospheres will be 2, 3, 4, 5, 6, and 12, including the ordinary atmospheric pressure. At these particular volumes and corresponding pressures, what will be the temperature of the compressed air at the moment of compression, the sides of the cylinder being untraversable, or impermeable to heat either from without or from within, not taking into consideration the increase of elasticity of the confined air, which must inevitably take place by the heat generated? Again, supposing the length of the vessel is infinite, what will be the temperature of the air when the piston is raised 1ft.—which will, of course, double its volume—then 2ft., 4ft., 8ft., 16ft., 32ft., 64ft., 128ft., 256ft., and 492ft., then raised to infinity? Also, what would be the work expended in raising the piston to those various points? I know it will involve the use of the higher branches of mathematics, but I shall not be afraid of that. Will "E. L. G." kindly help me, or any other competent to do so?—MECHANICAL EQUIVALENT.

[12538.]—**Electrotyping.**—Will any experienced hand in this art tell me why I cannot get the deposit to take in the deep cavities of my moulds, but only on the flat or raised surfaces? It seems to thicken round the edges and branch out like rock coral.—DUPLEX.

[12539.]—**House Fly.**—Can the common house fly bite or sting?—GEO. A. AMES.

[12540.]—**Poultry.**—I should be thankful for the advice of any of our friends who have knowledge of the diseases of poultry and their remedy, in the following case. A cock bird has lately manifested great difficulty in swallowing, and, on examination, I discovered a white substance towards the root of the tongue. This substance continues to enlarge, and is now quite apparent through the sides of the beak, which the bird cannot perfectly close. I have tried various things which friends have advised, but none seem to do any good. The bird does not seem ill otherwise, inasmuch as he perseveres at the food, and with difficulty passes sopped bread and barleymeal. I should like to save him, as he is valuable.—H. G. W.

[12541.]—**Fish Culture.**—I live on the bank of a small river which is thinly stocked with trout. Would it be advisable and possible to introduce dace to the higher parts of the river; also the best way to do so? There are dace twelve miles lower down, which is as far as the tide comes.—GREEN DRAKE.

[12542.]—**Luminous Tubes.**—I extract the following from *Engineering*, of June 28, p. 435:—"Another curious discovery of Dr. Geissler was, that mercury, when shaken in a rarefied glass tube, would also become luminous, and emit a strong light, so that in a perfectly dark room all objects could be distinctly seen; the colour of the mercurial light could be modified by the presence of small traces of gases in tubes. A minimum of nitrogen shows an intense red, and hydrogen a yellow light. The capacity of mercury for producing light seems to depend on its purity, so much so that it was not luminous when it contained an admixture of tin, lead, zinc, or bismuth, but gold or silver did not affect it. It would be possible to utilise this peculiar quality of mercury for lighting up chambers filled with explosive gases, such as some parts of mines or powder magazines, instead of using the Davy lamp." I should like to know if any of "our" readers have ever made this tube in the form of an hour-glass, and with what result. In this way the mercury could be kept in motion for a considerable time, and for that time would, I conceive, be a self illuminating lamp.—PEGASUS.

[12543.]—**Light Shifting Hoist.**—Will any brother reader of our excellent journal kindly aid me in the following difficulty?—In the course of my work I have to lift a box 4ft. × 2ft., containing 36 bottles, in divisions, on to a slab 2ft. high. The bottles I fill with oil (2lb. in each), and have then to lift all down again on to a trolley to be wheeled away. The box, with bottles empty, weighs over 90lb., and when the latter are filled the weight is more than 160lb. I want some contrivance by which I can raise the box 2ft. 6in., push it forward, say 3ft. in a straight line, and, and bottles filled, vice versâ. Ceiling with strong joists, 9ft. high. A crane would be too much in the way, and the ordinary pulley blocks are inadequate, as with them one cannot well shift the load far enough from the point of suspension.—S. SELWYN.

[12544.]—**Taraxacum.**—I shall feel obliged if any one will inform me how to make taraxacum or dandelion coffee? I can't afford to buy it from the chemist.—WELSHMAN.

[12545.]—**Comet.**—I shall feel greatly obliged if any of "our" astronomical contributors will inform me when the next comet which will be visible to the naked eye is expected to appear in England.—GRAYSON GOLCAR.

[12546.]—**Protection for Steam Boilers.**—Would any of your correspondents inform me what is the best covering for steam boilers exposed to the air? I have seen a composition of manure, clay, &c., and should like to know the exact proportion of each, and how it is used.—WM. FELLOWS.

[12547.]—**Pasting Cloth to Maps.**—Will some one inform me how to paste cloth to maps? I have tried to do some and they crimp, the cloth runs in. I pasted both the paper and cloth. What sort of cloth should be used?—C. W. I.

[12548.]—**Flexible Black Varnish for Leather.**—I should be thankful for a recipe for making this. It is required for the folding head of a cabriolet. Brilliancy, flexibility, and resistance of wet are the desiderata.—LAMBDA.

[12549.]—**Field-glasses.**—To "F. R. A. S." or MR. OLDFIELD.—In looking through these on a blank light sky a darkened zone occupying the middle two-fourths of diameter of field of view is observable. Is this in the eye or field lenses? Is it a fault or a failing?—LAMBDA.

[12550.]—**Seaweeds.**—How can seaweeds be nicely dried for show?—B.

[12551.]—**Picture Framing.**—Would some practical person kindly inform me, through the medium of this paper, the simplest way and the neatest to cut and join the angles of picture frames, and it will greatly oblige—JIM.

[12552.]—**Aquarium.**—I am about making an aquarium, and if one of "our" ingenious subscribers would supply the following information, I should be glad. Size to be 2ft. × 1ft. 8in. × 1ft. 3in. What should be the material for bottom? What cement for fixing glass? What glass should be used? What fish would be best to stock it with when finished? Any other information which they may think necessary would oblige—W. R.

[12553.]—**Electro Magnetism.**—I have an electro-magnetic engine which is useful to me in doing light work, but the contact breaker is a constant source of annoyance, as the platinum points are continually burning or being oxidised. I have partly remedied the destructive effect of the spark by putting an extra coil of wire round the magnet and joining the ends of it together, thereby forming a complete circuit in itself. This, I suppose, acts as an induction coil does, and lessens the spark, but what I wish to know is, if the contact breaker known as the mercury and alcohol one, will be better than a platinum one. I should feel very much obliged if Mr. Sprague would describe minutely the action of one of these, and say how the oxide that is formed upon breaking contact is got rid of. A small sketch would, I think, interest many of your readers. I should also like to know how it is that my plan of an extra coil lessens the burning effect of the spark, and also if it lessens the power of the magnet at all.—CONTACT BREAKER.

[12554.]—**Graphite Battery.**—I should feel obliged if Mr. Sprague would inform me what purpose the glass tube is for in the graphite battery, described on p. 423, and whether to use acid or saline solution in the manganese cell?—WALTER WINNING.

[12555.]—**Packfong or Chinese White Copper.**—Can any follow reader inform me the composition of this alloy? I have some reason to suspect it contains nickel, and resembles the so-called albata or German silver in its composition and properties. Also, what articles do the Chinese construct with it, its specific gravity, and price?—THE HARMONIOUS BLACKSMITH.

[12556.]—**Soda-water.**—Would some of your readers inform us if soda-water be really a weakening beverage? My impression is it is a vulgar error.—A. B. C.

[12557.]—**Nickel Silver.**—There is advertised pure nickel silver, and nickel silver plated (spoons, teapots, &c.) What I want to know is, is it the pure metal nickel, or is it a mixture of nickel with other alloy—white metal, in fact?—NICKEL SILVER.

[12558.]—**Boot and Shoemaking.**—Thanks to the correspondents who replied to me on this painful subject. I have been directed to a more scientific man than I have met hitherto. He modelled my old lasts with leather to very near the pattern of my feet, and the boots made on them are an improvement, but not all I require. I find my problem is not so easily solved, for my foot, as I said, measures more at big toe joint than at instep, and if made sufficiently wide at former part to take off pressure from that tender spot, he says it would be impossible to get the last out of the boot when finished. I find the only boots I can wear without pain are a very old pair which have worked into the very cast of the sole, and in the same way the maker I refer to models his lasts, so that bulges on the sole will have a corresponding hollow in the insole of the boot, but then he cannot give me sufficient width in the upper. Can any one solve this problem for the shoemaker? Also, is there any remedy for swollen tender joints, besides taking the pressure off?—IRISH MECHANIC.

[12559.]—**Cleaning Oil Painting.**—I wish to clean an oil painting that is dirty with age, can any one give me a trustworthy recipe that has been proved?—SEMPER PARATUS.

[12560.]—**Varnish for Marbled Edges.**—I have marbled some book edges by the transfer process, but they are dull. Is there any varnish or gloss that will not stick them together?—SEMPER PARATUS.

[12561.]—**Curving Book Edges.**—Will some one inform me how to bend the fore edge of books, and at what stage of the process of bookbinding it should be done, as I cannot curve them well, they run in steps?—SEMPER PARATUS.

[12562.]—**Tar Pavement.**—Will "Philo" or any other correspondent of "ours" inform me the proportion of pitch to coal tar for making the tar pavement I intend boiling the coal tar. Would small sea shingle do instead of gravel, for our gravel is simply soft granite which works up pasty after a little wear and exposure to wet? The only objection to sea shingle is, its being salted would take the damp in changes of weather, but I do not know if it would do so if mixed with boiled coal tar and pitch. An answer much wanted.—HORTI.

[12563.]—**Rough Skin.**—I have for some months past been troubled with a roughness of the skin of my face, and have tried several would-be remedies, but without the desired effect. The skin of the cheeks and forehead is in a perpetual state of small white flakes or scales, and there is no soreness. I seldom eat salt meat and have never been a sea voyage. I should be glad of a recipe for this irregularity.—F. ACE.

[12564.]—**Photographic.**—Will some kind reader of "our" MECHANIC inform me the cause of my Carter negatives giving a dark shade on the faces of each person I take. Is it the want of proper knowledge of the arrangement of light on the sitter or some other defect? My negatives seem clean and sharp, but still the faces are dark, apparently dirty when printed.—J. H. WILLIAMS.

[12565.]—**Sticks.**—Can any reader tell me how to bend the handles of sticks? I want to use rough blackthorn to make sticks for "hockey," &c.—W. M. COLLES.

[12566.]—**Bees.**—If a swarm of bees take possession of an empty hive, does the swarm become the property of the owner of the hive?—W. M. COLLES.

[12567.]—**Brick and Tile Glazing.**—Can any of "our" readers inform me how the above named things are glazed for roof and flooring purposes?—For a Friend in the Colonies.

[12568.]—**Smoke and Light.**—How is it that tobacco smoke looks brown on a white background, and blue on a dark?—A. B. M.

[12569.]—**Consumption of Alcohol.**—Can any reader inform me what quantity of alcohol is yearly consumed in this country per head of the population?—Inquirer.

[12570.]—**Sunrise and Sunset.**—Will some kind correspondent give me the formula to calculate sunrise and sunset for any particular day? Will the same rule answer for the moon and planets? A short example will render great assistance to—Delta.

[12571.]—**Brake for Bicycle with Indiarubber Tires.**—Having just purchased a bicycle with indiarubber tires but without a brake, I am about to have one added. Will any correspondent kindly inform me if the ordinary wooden block wears out the rubber, and if the roller sometimes used has the same disadvantage?—E. B. Shaw.

[12572.]—**Piano Construction.**—Will the "Harmonious Blacksmith" please to enlighten me on the following points in his No. 8 Piano Action, given at p. 95, No. 368. 1. Are the hammer shanks there represented the proper length? 2. Would it be best to employ a metal rail for hammer butts to centre in, or wood, so that each hammer can be taken out singly? 3. Are the dowels which fasten on the slanting part of the hopper to be in a vertical or horizontal plane? If vertical, how is the wire spring to pass between them? If horizontal, how is it possible to get two dowels 5/32in. diameter with room for the wire spring to pass between them in ⅜in.? 4. In what manner is the hopper kept from sliding sideways from under the hammer butt? 5. Is the set off screw attached to the hammer butt, or as the hammer strikes the string, does it force the hopper from under the notch in the hammer butt by the set off screw coming in contact with the lower end of the hammer butt? 6. How is the forte pedal placed to lift the dampers from the wires? With respect to wire bridges, would it not be equally as well to make them in lengths for one note, to insure their being properly bedded?—Pianette.

[12573.]—**Hygrometer.**—Can any one describe an instrument called a hygrometer, invented by Sir John Leslie, by which mercury and water may be converted into ice?—C. T. E.

[12574.]—**Calculus.**—Will some kind correspondent solve the following question for me? A gentleman had a circular fishpond, the diameter of which was 100ft. He wished to inclose it by a fence in the form of an isosceles triangle, the sides of which shall be tangent to the circle. Required the length of the sides so as to inclose the least possible land.—W. H. H. C.

[12575.]—**Angles of Incidence and Reflection.**—Can any of your readers give me any information about the result of the discovery of the inequality of the angles of incidence and reflection? The author of this discovery, Mr. Brine, of King's College, Cambridge, had a machine made to test the thing, and thereby proved his assertion to be true. This machine was taken to the Nautical Office and examined, but no fault could be found with its construction. I should like to know what became of the discovery, if it is one.—R. P.

[12576.]—**Buffalo Pickers.**—Will any one oblige by describing the process how leather is tanned for these pickers?—Linum.

[12577.]—**The Iris or Rainbow.**—Will one of your astronomical or meteorological readers kindly inform me why it is that the rainbow appears of a circular shape? I have referred to many books on the subject, but can only find that the reason of the rainbow appearing as a segment, is in consequence of the refracted rays of light being only visible at certain determinate angles. This is by no means a lucid explanation to my mind, and hence my desire to obtain further information from some of your many talented contributors.—A Young Astronomer.

[12578.]—**Medical Coil.**—I have a medical coil which is worked by six Smee's cells, zinc plates 4½in. × 3in., the silver of one connected with the zinc of the next, and of course the extreme ends of the battery terminate in a silver at one end and a zinc at the other. The binding screw on the coil which connects the wire coming from the extreme silver is marked N, which I take for negative, and the other end P, which is positive. Now what I want to know is, if the electricity flows first from the zinc through the fluid to the copper, and from the copper to the zinc through the connecting wire above, how is it that the copper extreme is the negative? I suppose that all the electricity in the battery is given off into the coil from the zinc or positive end of the battery, and I cannot understand how it is that it is so, as from what I read I understand it quite the reverse. Perhaps I am mistaken in regard to the circulating electricity, as I suppose that when the body is placed in the circuit, it returns by negative pole back into the battery. I am using my machine for rheumatism of five years standing, and have not been able to work for over seven months. It is principally in my feet, and I am not able to stand long without a deal of pain. I have no pain when I am off my feet, and I feel anxious to know the most beneficial way to use my machine to bring about a cure. I might say that I apply the positive on the spine and the negative to my feet.—S. A. Z.

[12579.] —**Counting Envelopes.**—Is there any machine for counting envelopes? I know that there are many machines employed in making them. Would such a machine be useful?—Philanthropist.

[12580.]—**Photo-Lithography.**—Can any of your readers inform me of any process by which positive pictures can be used directly for reproduction by photolithography? As far as I can learn only negatives (photographic) are at present employed with the prepared stone or transfer paper. If any one can give me the formula for such process, or will indicate to me to what person or books I can apply, he would much oblige —Amateur Photo-Litho.

[12581.]—**Tests for Flour.**—I am much pleased with the alum test for bread flour, and request the favour of two more tests—viz., one for rice and one for china clay, as I have suspected some biscuits—sea biscuits commonly called—containing one or both these ingredients. —Ohio.

[12582.]—**Paper Clothes.**—The Japanese, it is well known, are the best paper makers in the world. They use paper advantageously in a thousand ways unknown to western civilisation, and I saw lately in an American paper, that paper suits, cool, light, waterproof, and not easily to be torn, are imported into New York, and sold there from half a dollar upwards. Can any American subscriber give any information about these paper clothes. We have done a good deal in England in the way of collars, curtains, and other articles in paper, and ought to be able to compete with the Japanese, or at any rate to be able to import some of their productions. Fancy the luxury of paper suits this weather! The thoughts of them almost tempt me to tear my black cloth coat into fifty pieces!—Kappa.

[12583.]—**Electro - Plating and Coppering.**—Will "Jack of All Trades," or some of our electro-plating friends, put me right in the following:—1st. I have some cutter-knives (steel blades), they have been plated, but the silver is worn off. I have placed them in the outer cell of Daniell's battery, and cannot copper them. Is this the right way to copper articles before plating them? 2nd. Is the cyanide solution the best for plating? I mix together 8oz. of cyanide to 1 quart of rain-water, and add ½oz. of nitrate of silver. Is this right?—Anxious.

[12584.]—**Bee-Keeping.**—"Phan" wishes to know whether she may continue to put on fresh super room after the drones are killed? The cottagers here, who all keep bees on the old burning principle, have a strong prejudice against supers, and argue that when the super-honey is taken the bees rob their neighbours' hives to replace what has been taken away from them. "Phan" would be glad of any remarks to prove the folly of this.

[12585.]—**Thermo-Electric Pile.**—I should esteem it a great favour if some practical correspondent will give me any information concerning the construction of the above. I have bismuth and antimony, and want to know (1) what size to make the bars? (2) In what mould, and how to cast them? (3) What solder, or how otherwise to unite the ends? Any other information respecting same or galvanometer.—Robert Knight.

[12586.]—**Magnetine or Improved Skeuasma.**—I wish some able correspondent would inform me how the above are made. What is their principle of action? What form should they take to be suitable for the various complaints they are intended to cure? Have they been patented; if so, when? Directions how to construct similar to that given for Pulvermacher's chain bands some time back would greatly oblige.—J. R. L.

[12587.]—**Lamp for Blow-pipe.**—I am a working jeweller, and am working in a small country town where there is no gas. Will any of your readers kindly recommend the best lamp to work by, and for the blowpipe?—Standstill.

[12588.]—**Railway Metals.**—I am informed that on a railway running north and south the rails wear most on the west side, while on a railway running east and west there is no perceptible difference. Can any of "our" correspondents say anything about this?—Luffra.

[12589.]—**Lapidary's Wheel.**—Could any reader give me a few hints as to size of lapidary's wheel for cutting and polishing stones, speed run at, &c.—A Subscriber.

[12590.]—**Glues.**—Will any of your numerous readers or correspondents inform me how it is that some glues after being used for a very little time in the glue-pot get frothy, and that others preserve the black colour as it is in the cake? I have got a supply of glue at present, but experience difficulty, or rather annoyance, in using it from its frothy nature; it clogs the brush, and does not work freely. Is there any cure for this? Or is the glue inferior in quality?—A Country Bookbinder.

[12591.]—**Harvest Moon.**—Can any one inform me why "the harvest moon," as it is called, looks larger than at other times?—A. S.

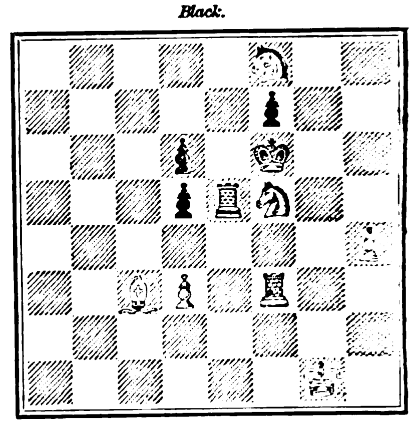
CHESS.

All communications intended for this department to be addressed to J. W. Abbott, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The "Chess Tournament," under the auspices of the British Chess Association, was held at the Crystal Palace, on July the 18th, 19th, and 20th inst., and met with all the success that was anticipated, and although the heat was excessive, and very much against the prosecution of a sedentary game like chess, the meeting was attended by a large assemblage of players and visitors from all parts of the country. The programme of the first day's proceedings consisted of blindfold, consultation, and simultaneous games. Blackburne conducted ten games at the same time blindfold, and actually succeeded in winning six, drawing three, and lost only one. Lowenthal played twenty-five simultaneous games against as many amateurs, winning seventeen, losing one and drawing the remainder. Two consultation games were played, the combatants being Steinitz and Tuckertort against De Vere and Wisker, while in the other Boden and Duffy were matched against Merchin and another. On Friday, Captain Kennedy gave a lecture on the "History and Antiquities of Chess." The discourse was interesting and seemed to be appreciated by the audience. On Saturday the programme was of a varied and attractive kind. Tuckertort conducted ten games blindfold, and although hardly so successful as Blackburne on the previous Thursday, he played the games with great precision and rapidity. The Telegraphic Match against the Clubs of Birmingham, Bristol, Hull, Glasgow, and Nottingham was highly interesting, and created much interest among the numerous visitors present. Unfortunately, owing to the lateness of the hour, but few of the games were finished. The Congress throughout has undoubtedly been of a successful character; the greatest harmony and good-will has pervaded the entire proceedings from first to last.

Problem IX.—By A. W. Cooper.

Black.



White.

White to play and mate in four moves.

Solution to Problem VIII.

White.	*Black.*
1. R to Kt 3	1. P to R 5
2. R to Kt 8	2. Anything
3. Kt or R mates acc.	

W. Nash (S. Neots).—Problems of five and six moves deep, and upwards, are appreciated only by enthusiasts, and such compositions are altogether out of place in a newspaper column. Many of our correspondents find *three* move problems quite difficult enough, and judging by the moves you send as the solution of W—'s problem, your advocacy in favour of more complicated positions is surely somewhat premature on your part.

R. S. (Edinburgh).—Look again attentively at Problem VII., and you will discover that the diagram is perfectly correct, as is the printed solution.

Inductorium.—Your problem is sound, but it is rather too easy for publicity.

G. J. Slater (Bolton).—Both the positions appear to be sound now, and they are accordingly marked for insertion.

Argo (Yarmouth).—We shall avail ourselves of one of your problems in due course.

J. C. S.—Correct, but too late for notice in the customary list.

Problems received with thanks from W. S. P—, B. Horwitz, A. W. Cooper, and C. W. (of Sunbury).

Correct solutions to Problem VII. (continued).—G. F. Grand (Gateshead); Argo (Yarmouth); Wiseaf (D—wich); G. J. Slater (Bolton); J. R. (Lincoln).

Correct solutions to Problem VIII. have been received from A. W. Cooper, R. A. Proctor, H. Cherry, and Beresford (Vauxhall). All others are wrong.

Experiments with Dynamite in Italy.—A series of trials of dynamite as a blasting agent were made during the past year at the Biassa tunnel, on the line of railway now in course of construction between Genoa and Spezzia, and which fully show the superiority of that substance over ordinary blasting powder, and especially when water is met with. Eastern end.—Compact limestone and hard dolomite. 1st. With ordinary blasting powder, 203 metres of tunnel driven 7·50 square metres in section in 200 days, or at the rate of 1·015 metres per day of 24 hours. 2nd. With dynamite, 300·80 metres run of equal section in 160 days, or at the rate of 1·88 per day of 24 hours, showing a superiority in favour of dynamite of 0·865 per day. Western end.—Rock, clayey schist, with beds of sandstone and abundant filtration water. 1st. With ordinary blasting powder, 80·75 metres run of tunnel, 7·050 square metres in section, driven in 190 days, or 0·425 per day of 24 hours. 2nd. With dynamite, 107·10 metres run of tunnel of the same section in 170 days, or 0·63 per day, showing 0·205 per day in favour of dynamite. From a careful estimate made as to the relative cost of blasting with gunpowder, as compared with dynamite, a saving of 4 francs per cubic metre was found to be obtained when the latter substance had been used.

THE ENGLISH MECHANIC LIFEBOAT FUND.

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Amount previously acknowledged	£339	8	3
Philo	1	1	0
	£340	9	3

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, July 30, and unacknowledged elsewhere:—

J. Redfern.—March and Pattison.—Street Bros.—W. Hallam.—J. Hamblin Smith.—T. S. Talbot.—Charles Woodman.—J. L. Thompson.—P. F. Nursey.—Edward Crawley.—J. Berry and Co.—Lieut.-Colonel Cotton.—J. Rickmore and Co.—Frances and Co.—Luffra.—E. L.—J. R. L.—H. Neal.—David Jacob.—D. Fernardo de Aramburn.—C. Buckley.—Jos. Wolstenholme.—Fred. Pratt.—Wm. Maullies.—J. W. Abbott.—W. R. Birt.—Geo. E. Aveline.—J. M. Garldine.—James Hill.—John Manning.—The Harmonious Blacksmith.—E. W. S.—W. B. B.—S. and Co.—R. Johnsons and Sons.—J. B. Dent.—W. B. Clarke.—R. A. Proctor.—A Satisfied Subscriber.—C. P. H.—Lands-end.—A Builder.—E. R.—W. B.—J. N.—S. S. C.—A. C. G.—A Subscriber from the Beginning.—Dabbler.—Thos. Hutton.—W. S. C.—Toivo.—Connection.—Xenophon.—W. Crisp.—Thomas Harding.—C. Gaudibert.—Hy. Clark.—Countryman.—Outgenious Whitesmith.—C. E. S.—Bedca.—H. S. P.—Thomas Burrows.—Dr. Morgan.—Mrs. Jack of All Trades.—Flamboyant.—E. T. G.—R. T. Smith.—W. C.—F. R. A. S.—Furner and Price.—W. Newton.—J. H. M.—Wm. Fergusson.—Gout.—Cocoa Nut.—J. B. Hopwood.—J. A. Chappell.—A Miller.—J. T. Lewis.—Optician.—Hy. Holland.—Electric.—Star Gazer.—P. J. Smith.—Maravilla.—Queen Mab.—Clinney.—G. W. Whittaker.—Wm. Kerslake, jun.—Tom-Tit.—T. M. D.—Philo.—Old Boots.—Opaline.—Rat-Tat.—Rugeley Inquirer.—W. Airey.—Tressilian.—Josiah Wilson.—C. N. W.—O.—T. C. E.—Francis Lewis.—Zoo Andra.—Optics.—Staines.—Frances.—F. Steward.—Paddler.—Veritas—Animals' Friend.—T. A.—J. Baxter.—W. C. C.—E. H.—A., Liverpool.—Aleph.—T. P. M.—F. Scot.—L. E. N.—J. M. Lawrence.—A.—W. H. Hey.—W. S. Stokes.—T. H.—Goy.—T. B.—W. H.—Musical Subscriber.—David Jacobs.—M. G. C.—E. O. S. Z.—W. H. Cash.—H. J. C.—Emigrant.—Thomas Buchanan.—Hy. Chapman.—Claudio.—C. Wray.—Excelsior.—W. H. H. Cooper.—W. H. Neal.—R. K. Jones.—A. Brown.—George Findley.—Fred. Garthwaite.—Alfred H. Allen.—Paddy.—W.—J. Cross.—Z. A.—C. H. Wingfield.—D. J. Bodkin.—W. Withers.—P. W. H. J.—Saul Rymea.—Wm. Tonkes.—J. T. E.—Jack of All Trades.—Young Telegraphist.—G. C. O.—T. Hucklebridge.—E. L. G.—C. C. C.—D. M.—Boatman.—Common Sense.—G. F. H.—Wm. Oldfield.—Webb.—A. T.—R. W.—T. W. S.—Disappointed.—A. W. H.—Glazier.—W. R.—G. R. R.—Industrious Will.—E. Woodward.—Philanthropist.—C. P. E.—Nathaniel Wetherall.—Stanley & Co.—J. Birmingham.—T. S. V.—C. Townley.

JETHRO FROST, New York, John Baynes, Manchester.—See "Hints to Correspondents," No. 4.

NON SCIENCE.—Your query is too vague. You must say more particularly for what purpose you require to raise water. See also back volumes.

Communications which can only appear as advertisements to hand from Shamrock, W. A. G., Athelstane, P. E. M., An Improver, R. M. M. S., One in the Trade.

THE DISTRESSED ONE, Rodger, F. R. C. P., John Smith, Banjo, F. R. L., Water, W. W., Esam, R. B., are referred to indices to back volumes.

DAVID JACOB.—See back volumes, if nothing there suits you write again and say plainly what you want. Your telegram was too ambiguously worded, and besides arrived to late. Your letter since to hand shall appear next week.

PRENTICE.—Build and try your steam carriage. When successful, write us again.

BENDING AMBER.—"Out of Pocket" writes that "Jack of All Trades'" plan for bending amber has proved a failure. The amber cracks under the process.

G. W. K. L.—Your wit is of the heaviest character, and we cannot spare space for the insertion of a letter which does nothing but "chaff," in a rather stupid mauner, one of our oldest contributors.

OUTGENIOUS WHITESMITH.—Never mind your compound medicine.

LINUM.—We do not think "J. K. P." would do what you ask. At any rate, your request cannot appear as a query. You might advertise your request and ask him to send you his address.

S. SEBASTIAN BAZLEY, M.A.—The book on turning to hand. Thanks.

CHINCHEY.—Our opinion is that Condy's fluid has been very much overrated.

J. D.—Your eighth paper on the organ next week.

E. WOODWARD.—No stamps inclosed.

GEO GILLUS.—See "Hints to Correspondents," No. 4.

L. S. (Dublin).—We cannot inform you.

HY. HORSMAN.—Recipes for making vesuvians were given in last volume, pp. 202, 207.

W. T. R.—The only way to prevent any one pirating your invention, is to patent it. That involves expense and will, till we have a reform of our patent laws.

F. CHESHIRE.—Such questions are no doubt asked both for exercise and to elicit information.

STELLA.—Do you want the skin of your face destroyed?

R. JOHNSON.—Your sketch and description are scarcely correct.

E. J. H., Paper Stainer, J. S. Wilson, and Bird Fancier.—Your queries are advertisements.

E. W. B.—An American paper.

J. M. G BROOKWOOD.—Your letter on Moses or Samuel is rather out of date, and rather too Biblical.

THE WELSH SHEPHERD says:—"Allow me to correct a printer's error in my last letter (4566, p. 465). In line 35 downwards: Not parallel to the glass plate must converge to the same point, &c., ought to be: to some point, &c."

HY. CLARK (Derby).—You speak of the brain as if its parts could be counted, measured, and separated like a box of dominoes. Be assured the brain of man is a much more mysterious thing than you and some other professed phrenologists think. We have frequently seen men who knew next to nothing of physiology or the properties of matter, or of vital forces, and who were profoundly ignorant of physical geography even, talk of the brain as if they understood the mysteries of existence; and we occasionally let one of these correspondents display his ignorance in our pages with the hope that some one who knows a little about mind and matter might enlighten him. But we suppose our chief correspondents think it would be a waste of their time and our space, and hence they let the subject pass. As Henry Clark speaks with great confidence, we will venture to give him a challenge; and we beg to suggest that he should *manipulate* the heads of ten men in the dark. The possessors of the heads should have decided intellectual biases. One should be a poet, another a farmer, another an engineer, another a musician, another a bricklayer, another a clergyman, another a mathematician, and so on; and we undertake to say that our friend the phrenologist would not be able, by feeling their heads, to distinguish one from the other. Will Henry Clark accept the challenge? If so we will do our best to assist him in trying the experiment.

MR. WM. TONKES writes to say that he is and has been for some time ill, and is "prohibited under medical advice from even reading." This is the reason of his late silence. He is, however, improving, "and hopes shortly to take his place once more in our columns." We heartily wish his health may be speedily restored.

THOMAS BUCHANAN has sent us the following in reply to our note last week, p. 499:—"Permit me to thank you for your editorial courtesy in having extracted a single sentence from my paper, and so produced it as to hold me up to 'inextinguishable laughter.' I shall not avail myself of your kind permission to ask 'F.R.A.S.' what those 'eternal fires' mean. The question of my lecture was merely a rhetorical *erotesis*, not needing an answer, since it was the mental soliloquy of the Chaldean shepherd 4,000 years ago, the expression of philosophic wonder, which, as I attempted to show, culminated in the apotheosis of humanity, in the Eleusinian mysteries and Freemasonry—to wit, the Deism which elaborates a religion apart from revelation. The last two topics I did not name, except so far as they are included in the Egyptian worship of Isis and Osiris—the Buddhism of India, and the parallel system of Confucius in China. But I merely glanced at the poetical aspect of the subject, which Byron has embellished, and which so long, as astrology, enthralled nations; and at the theory which represents the constellations as a panoramic picture, on which, in fiery etchings, the record of the Noachian deluge and the Ark were preserved." As we have given the whole of Mr. Buchanan this time he cannot complain of our only making an extract. We shall be glad to hear from Mr. Buchanan again on some less speculative subject.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JULY 23, 1872.

2132 D. Cunningham, Dundee, for improvements in the construction and working of caissons, which improvements are also applicable to movable bridges and the gates of docks and canal locks.

2133 H. A. Bonneville, Piccadilly, for improvements in the manufacture of imitations of tapestry. A communication.

2134 J. Ashwell, Highgate-road, Kentish Town, for improvements in the construction of furnaces, and in the arrangement of flues or passages for economising fuel therein.

2135 B. Brower, New York, U.S., for an improvement in card holders.

2136 J. B. Robertson, Manchester, for improvements in steam traps.

2137 J. Dale, Manchester, for improvements in the manufacture of oxylates of soda and potash.

2138 R. M. M. Alloway, Torquay, Devonshire, for an improved process for desiccating oak bark, flax, hemp, tobacco plat, mustard, and other substances by atmospheric evaporation.

2139 G. Newsome, Hunslet, Leeds, for improvements in machinery for lithographing and letter-press printing.

2140 B. Blair, Belfast, Dublin, for improvements in axles and axle-boxes for carriages and other vehicles.

2141 H. S. Copland, Duke-street, Strand, for an improved apparatus for mixing precipitating materials with sewage, and removing deposits, which apparatus is applicable also for other purposes.

2142 J. Imray, Southampton-buildings, for improvements in apparatus for supporting respiration and light in suffocating or explosive atmospheres. A communication.

2143 L. Bradley, Park-place, Regent's-park, and J. Speight, Leeds, for improvements in forming roads and other ways.

2144 S. S. Bateson, Bolton-street, Mayfair, for improvements in the treatment of hides and skins.

2145 M. A. Wier, Great Winchester-street, City, for an apparatus for registering and checking entries and exits to and tramway cars, omnibuses, or other carriages.

2146 E. Brooks, Birmingham, for improvements in brooms and brushes.

2147 H. Cheery, Handsworth, Staffordshire, for improvements in punching and shearing machines.

2148 W. Jenkins, Leamington, for improvements in machinery for rolling leather.

2149 J. Bidder, Islington, A. C. L. Lamb, Twickenham, and W. O. Scrivener, Westminster, for an improved clasp or fastener for necklaces and other personal ornaments and wearing apparel.

2150 W. E. Gedge, Wellington-street, Strand, for an improved machine for splitting wood and cutting it into lengths. A communication.

2151 C. J. Tiehoff and E. Voss, Holland, for improvements in apparatus for ventilating ships, railway carriages, houses, and other buildings.

2152 C. W. Siemens, Great George-street, Westminster, for improvements in regenerative gas furnaces for the manufacture of glass. A communication.

2153 W. Paterson, W. A. Sanderson, R. Sanderson, and J. Sanderson, Galashiels, Scotland, for improvements in the treatment of wool in process of manufacture, and in the preparation of materials therefor.

2154 C. G. Hill, Nottingham, for improvements in machinery for goffering, fluting, and crimping net and other fabrics.

2155 J. W. Melling, Wigan, for improvements in engines actuated by steam or other elastic fluid.

2156 F. J. Cheesbrough, Liverpool, for improvements in evaporating and concentrating sulphuric and other acids, also salt, sulphur, and other substances capable of evaporation, and in the apparatus to be used therein. A communication.

2157 G. D. Hughes, Nottingham, for improvements in steam-engine or other motive-power governors, and apparatus connected therewith.

2158 C. de Negri and G. Herrmann, Hornsey-road, and W. Guest, Great Saffron-hill, Middlesex, for improvements in machinery for braiding whips or other articles.

2159 J. G. Smeaton, Harwood-road, Walham-green, for an improved apparatus for the generation of steam and the circulation of heated water.

2160 W. N. Hutchinson, Wellesbourne, Devonshire, for improvements in railway engines, carriages, and vehicles, and in permanent way therefor.

2161 D. Timiriazeff, Southampton-buildings, for improvements in machinery for forming stereotype moulds or matrices.

2162 W. Linney, Bedworth, Warwickshire, for propelling looms, winding engines, and various other machines.

2163 J. Pullen, sen., and J. Pullen, jun., Camden-street, Walworth, for a new and improved method of casting and making lead D traps.

2164 R. Payne, Frome, for indicating the variations of heat in holds of vessels, rooms, or other places at a distance. A communication.

2165 H. Robinson, Skipton, Yorkshire, for improvements in the construction of railway waggons.

2166 W. Eades and W. T. Eades, Birmingham, for an improved tube cutter and wrench.

2167 J. Richardson, Lincolnshire, for improvements in arranging, actuating, and controlling cut-off slide valves of steam and other engines.

2168 J. Lake, Manchester, for improvements in steam boilers.

2169 M. Henry, Fleet-street, for improvements in apparatus for measuring and indicating time. A communication.

2170 J. Hopkinson, jun., Birmingham, for improvements in apparatus for giving motion to the revolving lights of lighthouses.

2171 J. Knott, Sheffield, for improvements in furnaces for economising fuel and preventing the generating of smoke. A communication.

2172 J. Knott, Sheffield, for an improved lubricator for machinery and axles. A communication.

2173 A. Krieger, Borough, Surrey, for a new or improved apparatus to be applied to street tramway carriages for facilitating the traffic.

2174 R. W. Eddison, Leeds, for improvements in platform lifts or hoists. A communication.

2175 F. Ayckbourn, North Brixton, for a new or improved arm for discharging or impelling missiles or projectiles for offensive, defensive, sporting, and other purposes.

2176 A. M. Clark, Chancery-lane, for a new or improved expansible pivot.

2177 L. C. Warneck, Paris, for a new or improved arrangement of shifting screw propeller.

2178 A. Ray, Guildford, for an improved mechanical mover. A communication.

2179 P. Love, Bedford, for improvements in machinery or apparatus for excavating, especially applicable for drainage purposes.

2180 P. R. Couron, Lewisham, for improvements in the washing and stirring apparatus employed in brewing, distilling, and other like processes.

2181 J. Robey, Manchester, for improvements in the manufacture of a substitute for animal charcoal, to be used for purifying sewage and various other substances.

2182 G. Goold, Handsworth, Birmingham, for improvements in apparatus for regulating the draught in the chimneys of fireplaces, stoves, or ranges, also applicable for other purposes.

2183 T. N. Palmer, Dalston, for an improved catamenial belt, which may also be used for other purposes. A communication.

2184 R. Hutton, Sheffield, for improvements in steam boiler and other furnaces.

2185 W. R. Lake, Southampton-buildings, for improvements in hoists or elevators. A communication.

2186 J. Thom, Chorley, Lancashire, and J. Stenhouse, Pentonville, London, for improvements in treating fatty substances containing colouring matters, and in obtaining useful products therefrom.

2187 A. M. Clark, Chancery-lane, for improvements in the manufacture of ornamental tiles or slabs. A communication.

2188 W. R. Lake, Southampton-buildings, for improvements in apparatus for raising liquids, grain, and other materials, parts of which improvements are applicable to the construction of rotary engines. A communication.

PATENTS SEALED.

187 S. R. Smyth, for a new self-acting machine or apparatus for working sewing or other similar machines that are worked by foot treadles or by hand, or by other power.

191 E. T. Hughes, for improvements in the preparation of wool, either pure or mixed with other fibrous materials, intended to be spun into threads or yarns to be used for weaving.

203 Count di Tergolina, for improvements in the construction of bits for horses and animals.

210 W. Bradburn, for a new application of the gases and vapours or fumes resulting from the burning of pyrites, cinders, and of the acid liquid produced by the absorption thereof.

211 A. Wood, for improvements in cleaning tramways and in apparatus employed therefor.

212 R. J. Wood, for improvements in sweeping streets or roads and in the machinery or apparatus employed therefor.

213 A. Wood, for improvements in tramway cars.

232 H. Jones, for a new or improved moustache protector and trainer.

235 A. Budenberg, for improvements in sugar refining and in the centrifugal machines employed therein.

247 R. J. Bills and G. Dobson, for an improved composition for preventing incrustation and corrosion in steam boilers and other apparatus for generating steam.

258 J. L. Tonkys, for an improvement in lamps for burning hydrocarbon spirit or oils.

259 W. Walton, for improvements in the manufacture of wire cards.

277 J. E. T. Woods, for improvements in reverberatory and other furnaces for chemical purposes.

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WOULD any kind reader give me the ADDRESS of MAKERS of best kind of hand ladder for general purposes in a large house?—G. W. WHITAKER, Helmshore, near Manchester.

ADDRESS WANTED "TYNE ENGINEER," re Tannate of Soda reply.—W. M., Post-office Seaforth, near Liverpool.

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The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 9, 1872.

ARTICLES.

THE DETECTION OF ADULTERATION OF ARTICLES OF FOOD.

By Alfred H. Allen, F.C.S.,
Lecturer on Chemistry at the Sheffield School of Medicine.

THE adulteration of food is a subject which has been written on by many, and the public are now pretty well aware what articles of food are most subject to admixture. But most writers on adulteration have been content with stating their results, without describing the methods used in detecting admixture. Even those who do describe their processes do so in most cases in such a manner as will only be understood by scientific men, omitting the minute precautions, the observance of which will alone enable a beginner to obtain satisfactory results.

Many articles of food are used but in small quantity, and the fee to a professional analyst for the examination of a sample would often exceed the saving that would result from the use of a purer article, and in many cases the only satisfaction the consumer would obtain would be the knowledge that the article he was accustomed to purchase was grossly impure, while he would have no certainty of procuring a superior quality by changing his shop. If the detection of admixture were more readily effected, and more generally understood, there are many who would be only too glad to examine their purchases. It is usual to assume the necessity of employing complex chemical tests and a powerful microscope in detecting adulteration, and although there are certainly many admixtures which can only be recognised by these means in the hands of an expert operator, there are, on the other hand, many adulterations which can be readily detected by any intelligent person who possesses a small microscope and a dozen or two of bottles, with reagents.

It is my intention in this article to describe minutely the simple methods of detecting the adulteration of food, avoiding, as far as possible, the employment of technical terms, and I hope in this manner to place the readers of the English Mechanic in a position to examine many articles for themselves, and so learn which are the best shops to make their purchases, while at the same time I give them the results obtained by myself in the examination of a considerable number of specimens.

Adulterations of Mustard.

Mustard is a condiment very commonly adulterated with wheaten flour or starch, turmeric, cayenne, &c. Ground mustard seeds give a somewhat pasty flour, owing to the large quantity of oil present. To prevent the tendency to cake, flour or starch is added, 10 or 12 per cent. being amply sufficient, though the quantity is often increased to 50 or 60 per cent. In the best quality of mustard prepared by one of the best-known makers, no starch is used, the tendency to cake being got over by the extraction of a large proportion of the fixed oil. The presence of *flour or starch may be detected* by boiling a small quantity of the mustard with water, and gradually adding to the thick liquid a solution of iodine in alcohol (or in water to which iodide of potassium has been added). A blue or violet colour will be produced if starch or flour be present, as it almost invariably is. Genuine mustard seed contains no appreciable quantity of starch, and does *not* give a blue colour with solution of iodine.* The presence of starch or flour can also be readily ascertained by the microscope, the granules of starch being readily recognisable; they are turned blue by addition of iodine solution. The shape and size of the starch granules, as seen under the microscope, indicate the kind of starch employed for adulteration. Wheat flour is commonly used, but I have also found potato starch.

Turmeric is seen under the microscope of a bright yellow colour and characteristic structure. It may be detected with certainty by the following test, even when present in very small quantity. Shake half a teaspoonful of the mustard in the cold with two or three times its bulk of methylated spirits. Filter the solution and evaporate one-half of the liquid to dryness at a steam heat in a porcelain basin, in which is placed a piece of filter paper about the size of a penny. When all the alcohol has been driven off, moisten the paper with a strong aqueous solution of boracic acid, and again evaporate completely.* In presence of turmeric the paper will acquire a reddish colour; but, as a further proof, drop on it some solution of caustic potash or soda, which will produce a very beautiful series of colours, in which green and purple are most evident. On then adding hydrochloric acid, a red colour will be produced, which can be again turned green and blue by addition of excess of alkali. The colours are very vivid and characteristic, pure mustard giving no such result. Turmeric is very frequently added to mustard to give it that bright yellow colour which the public seem to expect, but which is not natural to pure mustard. Turmeric is not injurious, and is not generally used in quantities sufficiently large to appreciably affect the weight of the article.

Gamboge is said to be sometimes used for colouring mustard. Its employment is highly reprehensible, as it is a violent purgative. It may be detected in the same way as turmeric, but gives a bright red instead of a green or blue colour on treatment with caustic soda, and on adding excess of hydrochloric acid the paper becomes merely yellow instead of the orange red colour produced in presence of turmeric.

Cayenne Pepper, or Capsicum, is often added to mustard to increase its pungency. It is best detected by evaporating to dryness the other portion of the spirituous solution used for testing for turmeric. On heating the residue in a porcelain dish very pungent fumes are evolved, which irresistibly compel coughing, and produce a sense of heat in the lungs.

Charlock Seeds are sometimes used for mixing with mustard. The charlock is very closely allied to the mustard, its botanical name being *Sinapis arvensis*, while white and black mustard are respectively *Sinapis alba* and *Sinapis nigra*. The charlock grows in corn-fields, and bears a large yellow flower. The taste of the seed is not so pungent as that of the true mustard, but agreeable and somewhat similar. There exists at present no means of detecting its presence in manufactured mustard, but admixture with it is by no means so reprehensible as most adulterations.

Plaster of Paris is said to have been used in adulterating mustard, but I never met with an instance. It could only be used to increase the weight, and, therefore, would be employed in some quantity, so that a sample of the mustard would leave an excessive proportion of ash after ignition. Mustard usually leaves about 3 per cent. of ash, and any proportion exceeding 5 per cent. may be looked upon as indicating adulteration by mineral matter.

Chalk, if present, would be at once detected by addition of an acid (hydrochloric) to some of the mustard, when effervescence would be produced.

The recent examination of seven samples of mustard, purchased in Sheffield, has given me the following results:—

No. 1.—Price, 6d. per ¼lb. canister. Free from starch, flour, and turmeric, but cayenne was present, and a sensible quantity of husk. The taste was extremely pungent—far more so than the other samples.

No. 2.—Price, 2oz. for 1½d. Contained *no* cayenne, and but very little turmeric. Potato starch was present in some quantity.

No. 3.—Price, 1½d. an ounce. Contained starch or flour, turmeric, and cayenne.

No. 4.—Price, 1½d. an ounce. "Warranted free from all impurities and adulterations." Contained starch or flour, turmeric, and cayenne.

No. 5.—Price, 1d. an ounce. Contained much starch, turmeric, and cayenne.

No. 6.—Price, 1d. an ounce. Contained starch or flour, turmeric, and cayenne.

No. 7.—Price, 1d. an ounce. Contained starch or flour, cayenne, and a little turmeric.

From these results it will be seen that all seven samples contained admixture of some kind. All but No. 1 had their strength materially reduced by admixture with starch or flour. All but one contained cayenne. All except No. 1 had more or less turmeric in them. It may be thought that the addition of flour, or starch, to mustard is of a very excusable nature, but the admixture of excessive quantities not only cheats the consumer by selling him flour at the price of mustard, but is highly reprehensible in a medical point of view. Suppose a child poisons itself, and while the medical man is on his way a dose of mustard and water is given to produce sickness, but in consequence of the adulteration of the mustard the emetic refuses to act and the child dies; who is to blame here, and can the admixture of flour with mustard be considered legitimate? Undoubtedly the consumer will do well to purchase his mustard free from starch or flour, with which he can easily mix it for himself, if he fancies it too strong or too dear. When one well-known firm sells five or six different qualities of mustard it is evident they are not all likely to be the pure article. In this, as in other cases, the best is the cheapest.

Adulterations of Ginger.

The additions to ground ginger are very similar to those of mustard. Turmeric may be detected by the microscope, or as described under "Mustard." Cayenne *must* be searched for by the microscope. As ginger naturally contains a large proportion of starch the iodine test is inapplicable, and the addition of the various farinas can only be ascertained by careful microscopic examination.

Adulterations of Vinegar.

Vinegar is an article very often adulterated, the more common impurities being sulphuric and hydrochloric acids, and cayenne, with accidental contamination by zinc, copper, and lead. Oxalic and tartaric acids are also said to be occasionally present. Vinegar is essentially a weak, impure, acetic acid, of very variable strength. Its strength may be ascertained by the usual processes of acidimetry. A more simple but less exact method is to weigh carefully a small, dry, white lump of marble, and place it in a known weight or measure (500 grains) of the vinegar until effervescence has entirely ceased. (In presence of sulphuric acid a little barium chloride should first be added.) The marble is then rinsed, dried, and re-weighed, when every five grains of loss indicates the presence of six grains of real acetic acid in the sample of vinegar. The vinegar of commerce is either fermented or distilled vinegar; the latter variety is obtained by the distillation of wood, and the former derived from either sugar, malt, or wine. The percentage of real acetic acid in vinegar varies from 2·38 to 5·66 per cent. Very weak vinegars should be rejected, as they are unable to prevent the decomposition of meat and vegetables, while the extremely pungent varieties are open to the suspicion of containing cayenne or sulphuric acid. One part in a thousand of sulphuric acid may be legally added to vinegar to increase its keeping properties, but this proportion is often greatly exceeded. If addition of solution of barium chloride occasions more than a very slight cloud, the presence of free sulphuric acid may be suspected, and searched for by the following tests:—

1. Write letters with the vinegar on white paper by means of a clean quill pen or splinter of wood. On strongly drying the paper before a fire the letters will become charred if sulphuric acid was present in the vinegar to the extent of 2 per cent.

2. Dissolve a lump of white sugar in thirty parts of water, and dip into the solution a porcelain capsule or basin, so that it remains wet. Then dry by placing on a vessel containing boiling water, and while in this position allow a drop of the vinegar to fall upon the porcelain, and let it dry up completely. If sulphuric acid was present only to the extent of a 300th part of the vinegar, a black spot will be produced on the basin where the vinegar fell. With very minute quantities of sulphuric acid the spot has a green colour.

* In a recent trial in America, a Dr. Doremus stated that genuine mustard contained starch, and that the iodine reaction failed, owing to the presence of the essential oil of mustard. But the intentional addition of a very small quantity of starch to a sample of genuine mustard is readily detected by the blue colour produced on gradual addition of the iodine solution in sufficient quantity, though the first few drops produce no effect. The starch in mustard would also be discerned by the microscope, if really present. A *few* scattered granules are alone visible in the genuine substance.

* A solution of borax mixed with hydrochloric acid may be employed in place of the boracic acid, but is scarcely so satisfactory. The test detailed in the text is there published in a new form, and is the only one by which turmeric can be readily and certainly detected without the aid of the microscope.

3. If it be desired to determine the free sulphuric acid, 8oz. of the vinegar are concentrated, the liquid mixed with twice its bulk of alcohol, filtered, acidified with hydrochloric acid, and precipitated with barium chloride. 233 grains of the ignited precipitate correspond to 98 parts of concentrated sulphuric acid.

The other adulterations of vinegar may be detected in the following manner:—Boil down 4 ounces of the sample to about an ounce, and divide into four portions, Nos. 1, 2, 3, and 4.

1. Evaporate nearly to dryness, add methylated spirits, stir well, and filter. Evaporate the clear alcoholic solution to dryness and heat. Very pungent fumes, which produce irresistible coughing and sense of heat in the lungs, indicate the *presence of cayenne*. (Ginger, which is occasionally present in vinegar, gives a similar result. The only way of distinguishing it from cayenne is to carefully neutralise the vinegar with sodium carbonate, when the *taste* of the liquid will generally settle the question.)

2. Add a strong solution of potassium carbonate, then more of the original vinegar (so that the reaction is strongly acid), and stir with a glass rod. A white crystalline precipitate, giving streaks on the sides of the vessel in the track of the glass rod, indicates the *presence of tartaric acid*. Vinegars obtained from wine contain tartaric acid as a normal constituent.

3. Evaporate to complete dryness, and ignite the residue in a porcelain crucible till no longer black. (The ignition may be greatly expedited by addition of a crystal or two of potassium chlorate.) Boil the ignited residue with a little nitric acid, add water, and filter. To the clear solution add excess of ammonia and carbonate of ammonium, boil and filter. If the filtered liquid has a blue tint, *copper is present*. To the hot liquid add a solution of ferro-cyanide of potassium, when the production of a white precipitate shows the *presence of zinc*. Pour acetic acid on the filter containing the precipitate produced by ammonia and ammonium carbonate, and to the liquid which runs through add chromate of potassium. A chrome-yellow precipitate will be produced if *lead is present*.

4. Dilute with water, and add a solution of calcium sulphate (plaster of Paris.) A white turbidity shows the *presence of oxalic acid*.

If the original vinegar gives more than a slight milkiness with a solution of nitrate of silver, the *presence of hydrochloric acid* is indicated.

I have recently examined four samples of vinegar by the above method, with the following results:—

No. 1.—Price, 8d. a quart. Adulterated with cayenne.

No. 2.—Price, 4d. a quart. Contained cayenne and a small quantity of free sulphuric acid.

No. 3.—Price, 5d. a quart. Contained cayenne, and small quantity of free sulphuric acid. A suspicious precipitate with nitrate of silver.

No. 4.—Price, 8d. a quart. Unadulterated.

Adulterations of Pepper.

Dr. Hassall found pepper adulterated with wheat and pea-flour, ground rice, ground mustard seeds, linseed meal, and pepper dust. The examination cannot be made satisfactorily without a good microscope, and then requires care and skill to successfully detect the admixture of the various starches, &c. I do not believe that actual dust or dirt is ever intentionally mixed with pepper, its adulterations being the above farinas, &c., added as make-weights. As pepper naturally contains a large quantity of starch the iodine test cannot be used for detecting admixture. Four samples of black pepper recently purchased in Sheffield have proved free from foreign admixture.

Adulterations of Cayenne Pepper.

Cayenne pepper (ground capsicums) is sometimes adulterated with common salt, various kinds of starch, sawdust, turmeric, red ochre, red lead, and vermilion. The addition of salt gives cayenne a bright red colour, and renders it less liable to fade on exposure to light. Salt is sometimes present in very considerable amount, and is used to cover other additions. The above adulterations may be detected in the following manner:—Boil some of the cayenne pepper in water, *decant* some of the liquid from the undissolved portion, and test the solution for starch by means of iodine solution. A blue or violet colour indicates the *presence of starch*. The particular kind of starch present can only be ascertained by the microscope. Filter the remainder of the water in which the cayenne has been boiled, and to the clear liquid add some silver nitrate. A white curdy precipitate, not dissolved on adding nitric acid, is produced if *common salt is present*. Boil some of the cayenne in strong hydrochloric acid for some minutes, then add a a few drops of nitric acid, and boil again. Dilute the acid liquid with some water,* filter, and divide the clear liquid into three portions, which test in the following manner:—

1. Add potassium ferro-cyanide. A Prussian blue precipitate indicates the *presence of iron*. Traces of iron are naturally present in cayenne, but a distinct precipitate proves adulteration by red ochre, rouge, or other ferruginous matter.

2. Add ammonia till alkaline. Then acidify with acetic acid, and add chromate of potassium. A chrome-yellow precipitate proves the *presence of lead*, probably as red lead, in which case the original solid particles will be darkened on moistening with dilute nitric acid.

3. Pour the liquid on a clean penny or piece of copper, and after standing some minutes wash the metal and polish with a cloth. If *vermilion* was present in the cayenne the copper will appear white and amalgamated.

Sawdust and turmeric are best detected by the microscope, or the latter addition may be readily discovered by the method described under "Mustard."

Four recent examinations of cayenne pepper resulted in the detection of salt and a small quantity of starch in two, the other samples being genuine. Dr. Hassall found only four genuine specimens in a series of twenty-eight, one half of which contained one of the poisonous metals—lead or mercury.

(*To be continued.*)

* If the insoluble residue has a reddish colour which is persistent after ignition, *the presence of brick-dust* may be assumed.

TECHNOLOGICAL EXAMINATIONS.

THE Society of Arts has formulated a programme of work which, even if the results fail to come up to the sanguine expectations of many, cannot but be productive of much good as far as the manufacturing interests of this country are concerned; for if it is backed up, as it should be, by those who are in possession of the requisite means, and can impart the needed stimulus, it will go a great way towards enabling us to retain the supremacy in the industrial world which we at present look upon almost as our birthright, and even if neglected and left out in the cold will still assist in a measure to keep what may be termed the science of manufacture and the necessity of a knowledge of it prominently before the public. The scheme, which may be considered to have been fairly started at the recent Conference of the Society of Arts, under the patronage of the most distinguished notabilities, had its origin in a proposal of Major Donnelly, R.E., that the Society should undertake the examination of artisans in the scientific principles which underlie the various industries in which they are engaged or are likely to be engaged, and award certificates of proficiency and prizes for those found to be accomplished. These certificates will be of three grades, and will probably be divided into first and second class, and the degrees of proficiency, or grades, will be apportioned, and certificates awarded as follows:—No. 1 will be the elementary grade, or what may be termed the ordinary "workman's" certificate; 2, the advanced, or "foreman's" certificate; and 3 the honours grade, or "manager's" certificate, which may be assumed to imply that the holder has been examined and found to be acquainted with all that is known of the scientific principles on which his special art or manufacture is founded. The first of these "technical examinations" is proposed (we hope soon to be enabled to state that the scheme has passed this stage) to be held in May, 1873, and to take up two of the most important manufactures—viz., cotton and paper, the idea being to follow as closely as possible the line taken by the annual International Exhibitions. It would be premature to speak of the minor rules and regulations which will govern the working of these examinations, but the committee appointed to shape a programme for the proposed examinations of artisans employed in the cotton manufacture was read at the conference, and the following will convey an idea of what is required of the candidates. The examination, then, will be divided into three parts, the first of which will be concerned with those branches of science a knowledge of which may be considered necessary as a foundation for sound technical instruction, regard being had to the acknowledged difficulties of obtaining a scientific education. The second part will be concerned with the "technology" of the manufacture, or the special application of the different branches of science to it. The third will be concerned with the practical skill shown in the manufacture itself. The knowledge of the candidates will be tested, as far as concerns Part I., general science, by the ordinary May examinations of the Science and Art Department; and as concerns Part II., technology, by special papers, set immediately afterwards; while the qualifications of the candidates as regards Part III., practical skill, will be judged by the returns of their employment in cotton mills. The outline of the scheme as applied to the cotton manufacture may be taken as a rough guide as to what will be required in the technical examinations connected with other industries, but special subjects, will of course, be introduced to suit the requirements and peculiarities of other trades or professions. The committee consider that the following subjects are more or less connected with or involved in the manufacture of cotton: practical plane or solid geometry, machine construction and drawing, building construction, pure mathematics, theoretical mechanics, applied mechanics, vegetable anatomy and physiology, and steam. To obtain the elementary grade, or "workman's," certificate, the candidate will be required to "pass" in practical geometry and the elements of mechanics: he may then count marks in any of the other subjects above mentioned. For the advanced or "foreman's" certificate the candidate will be required to have obtained at least a "first-class" in the elementary stage of practical geometry, machine construction and drawing, elementary mathematics, and applied mechanics or steam, and when he has qualified in these he will be allowed to count marks in any of the other subjects. For "honours" the candidate must evince a higher knowledge of the various "necessary" subjects, and will then be allowed to count marks in the others. The "technological" portion of the examination requires a knowledge of the nature and properties of the raw materials, of the methods of preparing them, and of the machines by which the various operations of the manufacture are performed. A knowledge of the "stiffening and weighting" processes will also be required, as well as of the numerous articles or kinds of woven cotton fabrics. These particulars will give a fair notion of what may be expected to be required for the different technical examinations, although the "paper" examination will, judging from the report of the committee, require a knowledge of a greater variety of subjects than the "cotton."

We can only hope that the requirements of the examiners will be supplied by the candidates; and with the nine hours' movement spreading gradually there is just a minimum chance that workmen will find the requisite time to devote to study. We are, of course, presuming that what is termed "obtaining a first-class," really means a sound and thorough knowledge of the various subjects constituting the elementary stage; but we do not know at what point the standard will be fixed. If placed too high working men will be discouraged; if too low the object of the society will not be served so well as it might be if the "happy medium" should be chosen. We observe that in the special competition for prizes the candidate must "come up" in all the subjects in which he wishes to count marks; but for the certificates he will be allowed to take the subjects in successive years—the latter a very necessary regulation, for it is useless to suppose that a workman could acquire a knowledge of all the subjects in the limited time at his disposal, and until the primary education of the masses is lifted above its present level the numbers who will go in for the "exam." will not come up to the expectations of the founders of the scheme. The Society of Arts' certificates, we have reason to believe, are highly valued by both employers and employed, and Mr. Lawton said at the conference that applicants for situations in the cotton mills and warehouses of Lancashire who could produce one of these certificates, generally obtained the preference. Similar results would doubtless follow the establishment of "technical" examinations in manufactures, and in course of time employers would look upon these certificates of proficiency as a guarantee of the ability of the applicant to perform the work he desired to obtain. If the proposals of the committee are carried out, and the programme adhered to, the advanced or "foreman's" certificate will be evidence that its holder is an educated man; for the "foreman" of a paper-mill will have a "first-class" knowledge of practical geometry, machine construction and drawing, pure mathematics, mechanics, steam, acoustics, light and heat, and inorganic chemistry or vegetable physiology, besides an acquaintance more or less extensive with magnetism and electricity, organic chemistry, and systematic and economic botany. In other words he will be, as the phrase goes, a "well educated" man, possessed of more solid information than many of his predecessors in office ever dreamt of. We shall probably return to this subject at a future time. The scheme should not be allowed to fail, now it is once formulated, and be the results much or little, if properly worked it cannot fail to improve the rising generations of artisans, who, as children, it is to be hoped, will soon be taught the rudiments of science at school just as they are now taught the A B C. Till, however, primary education is immensely improved it is useless to hope that a sufficient number of workmen will "qualify" to leaven the whole mass and elevate technology to the high position it ought to occupy in a manufacturing country like Great Britain. In the mean time we cannot but regret that the Society has determined to discontinue the ordinary examinations, which for seventeen years have been tolerably successful. We hope the new "technological" examinations will meet with a greater measure of success.

PERSPECTIVE.*

THIS simple, excellent, and most intelligible little work appears *a propos* with regard to a discussion which has for a good many weeks been carried on in our own columns; and we would refer the disputants, with some considerable amount of confidence, to it, for a perspicuous solution of the leading points of difficulty mooted in the course of the debate.

There is one observation of our author's, the simplicity of which impresses us with an idea that it must be trite; but the truth of which may be well laid to heart by all who aspire to sketch correctly. It is this: "The most frequent cause of failure in attempts both in drawing and colouring is — not knowing how." We are only doing Mr. Collins bare justice when we say that a careful perusal of his book must certainly remove this particular deficiency, so far as the knowledge of perspective is concerned; inasmuch as, beginning at the very beginning, he enunciates and explains its leading principles with a degree of lucidity which must render them apprehensible by any one who will follow his explanations with the most ordinary care. Moreover, essentially mathematical as the whole subject is in its fundamentals, there is a marked absence, in the work under notice, of anything in the shape of mathematics which cannot be easily followed by any one who can use a pencil and ruler, and knows what an angle is.

Beginning with plain definitions of the few technical terms to be afterwards employed, the author goes on to explain the nature of sight, and to tell us what the "projection" of a picture means. He then proceeds to exhibit the difference between perspective and orthographic projection, and to exemplify the nature of isometric and stereographic drawing. All this is done in a way which a child might comprehend, by very moderate application. Then the subject of perspective is treated in full detail, and a typical and somewhat elaborate view of the interior of an old hall is taken, and instructions given, step by step, for drawing every item in it. As the particular example selected presents several points of difficulty, it is scarcely too much to say that the student who will follow the author's teaching, pencil and sketch-book in hand, and reproduce his frontispiece by the aid of the principles which he so clearly enunciates, ought, hereafter, to meet with no difficulty whatever in delineating any object which ordinarily occupies the amateur, in correct perspective.

The work concludes with notices of "false pictures," the hanging of pictures, the reflection of the moon in water, complementary colours, the colour of the sky, and the effect of mixed pigments; subjects all more or less cognate with the main one of the book, that of "the art of drawing what one sees."

Thirty-eight carefully-executed woodcuts (in addition to the frontispiece) illustrate the work, one of them (Fig. 19) dealing expressly with the point concerning which the concluding part of a sustained argument appears in letters on our 489th and 599th pages.

Briefly, then, we would commend this little book to all such of our readers as may sketch from nature; and counsel them to include it with their drawing materials, when packing up their travelling bags this summer.

* "Perspective, or the Art of Drawing what One Sees," &c. By Lieut. W. H. COLLINS, R.E., F.R.A.S. London: Longmans.

THE "FALLACIES" OF DARWINISM.*

PROBABLY the name of no writer on scientific subjects is better known throughout the world at the present time than that of the author of the "Origin of Species" and the "Descent of Man." Not merely because his books deal mainly with the animals which are joint inhabitants with ourselves of the earth, and are replete with entertaining anecdote and narrative, but also because they contain an hypothesis which is calculated to disturb in no slight degree the self-satisfied and complacent frame of mind with which we regard the inferior or brute creation, conscious of the superiority which, for all we *know* to the contrary, is our birthright. It might be expected that any one who should publish a statement that man's immediate ancestor was in all probability an ape—and what is worse show incontestably that he had some grounds for the opinion—would meet with a storm of opposition from the great mass of humanity, and even from a very large number of those specialists who from their acquirements and intelligence were best capable of weighing the evidence placed before them. As a matter of course, when Darwin published his hypothesis the outraged feelings of the community found vent in an avalanche of wordy pamphlets containing much of the *odium theologicum*, little argument, and no facts. But against the storm Mr. Darwin showed a bold front, and now numbers a very large following. It is only natural that it should be so; for Mr. Darwin brings great scientific attainments, laborious collection of facts, and undoubted honesty of purpose to bear upon the statements he has to advance on the side of his theory. One by one his opponents, if not completely defeated, have at least failed to demolish his hypothesis, and a similar fate would appear to be in store for Dr. Bree, who considers the time "opportune for a review of the whole subject, and in venturing upon the task, proposes to treat it in a spirit of pure scientific investigation." But so far from being a "pure scientific" examination of the Darwinian hypothesis, Dr. Bree's exposition of its "fallacies" covers a far wider field, and argues "the subject in reference to an issue ten times more important than the knowledge of man's biological history." Perhaps it is impossible to dispute the propositions of Mr. Darwin in their full bearing without bringing Revelation into the controversy; and a writer who does this well and does it fairly will be sure to obtain a wide circle of readers for his book. Whether this will be the case with the volume issued by Dr. Bree remains to be seen; but in venturing to doubt it we can offer reasons which are furnished by the book itself. On the very first page we find it stated that Dr. Hooker, in the well-known address to the British Association at Norwich in 1868, asserted that "so far from 'natural selection' being a thing of the past, it is an accepted doctrine with every philosophical naturalist." This statement Dr. Bree characterises as a "sweeping assertion," and proceeds to point out its inaccuracy. Now it is in the highest degree necessary that any attempted "exposition" of Darwin's fallacies should be based on facts; but so far from this being the case with Dr. Bree's work we find at the very outset a "misquotation," and several pages devoted to the correction of an error which only exists in the imagination of the author. Most persons would have thought that before occupying several pages in refuting a statement made by Dr. Hooker, Dr. Bree would have at least taken the pains to see that he had not made a mistake, even if he could not generously credit Dr. Hooker with truthfulness. So far from saying "every philosophical naturalist," according to the authorised report Dr. Hooker said "almost every philosophical naturalist"—a qualification which brings the assertion of the ex-president within the confines of fact, and renders worse than useless the pages Dr. Bree devotes to the correction of the supposed error; for even in these he misquotes or misunderstands Mr. St. George Mivart, making the talented author of the "Genesis of Species" say the direct contrary of what he really did say. Blunders of so stupid a nature as these inevitably create a suspicion in the minds of unbiased readers, and lead them to look upon the arguments of the author with distrust.

Dr. Bree divides his subject under the different heads of the "physical," the "physico-psychical," and the "variation and natural selection" arguments, and though possibly, standing on the ground he occupies, he has the advantage of Mr. Darwin, he has certainly not used his advantage in the best or most conclusive manner. He furnishes us with a frontispiece showing in an illustrative form the "Descent of man after Darwin's theory," in which we find the protozoa of the unknown past as derived from "inferential protoplasm," or from the meteoric "mass" of Sir William Thomson, which he brackets as "very inferential." From this protozoa the diagram takes us to the ascidian-like larva which is Darwin's starting point (an inferred organism) and then the "Descent" goes from the Amphioxus or Lancelet, the first "so-called vertebrate," through the Sturgeon to the Lepidosiren—or amphibious reptile. We then come to the first break, for here we have to "infer" a line of reptiles ending in another "inferred organism"—an early implacental mammal which carries on the "descent" to the Ornithorynchus and the Kangaroo; but here two organisms are wanting—the "implacental progenitor of the first placental mammal, and "man's ancient ancestor, with cocked ears and tail, prehensile feet, both sexes bearded and hirsute, males with great canine teeth." Surely "man's ancestor" is out of place here; for the descent continues through the lemur, the Simiadæ and the old-world monkeys to the "so-called man-like ape." Here the great break occurs which separates the lowest type of man from the highest animal—a link in the chain, which has to be supplied by an "ape-like man" before Mr. Darwin's theory can connect man with the apes. On this point Dr. Bree says, "It must be obvious to the most superficial observer what an enormous amount of mere guessing is made use of in such a pedigree. Still more clear is the fact that, even supposing the present state of science justified apparent plausibility in the indicated line, the science of to-morrow may send such guesses into a totally different direction. [It may also prove the correctness of Darwin's hypothesis.] Mr. Darwin starts with guess No. 1; he then jumps over almost the whole class of vertebrate animals, to arrive at what he calls the first vertebrate animal—a form which has very little in common with the sub-kingdom it is placed in, but naturalists do not, in fact, know what to do with it. He then passes through cartilaginous fishes to guesses Nos. 2 and 3, as regards the amphibia and reptiles. Then an animal new to science, the early progenitor of implacental mammals, forms guess 4. He cannot keep the platypus nor the kangaroo in the direct line, but he makes them minister to guess 5, in being the lines to the implacental forefather of lemurs, leaving out the great class of birds. He then jumps to the Lemuridæ at a bound, leaving all the principal families of mammals out of the line altogether. Here he makes enormous guess No. 6, about man's early progenitor, who had cocked ears, a tail, prehensile feet, both sexes covered with hair and wearing beards. From the lemurs he passes to the Simiadæ, and follows the Catarrhine (or old world) group of monkeys, and has to make another huge guess (No. 7) in order to get into the line an imaginary creature he calls an 'ape-like man,' who leads him to the summit of existence—man. Nothing displays more the real ignorance of science, or the extreme baldness and improbabilities of Mr. Darwin's hypothesis, than a table like this." Dr. Bree has not omitted any of the defects of the theory, and it is very probable that "intelligent thinkers and men of education and high mental culture" will shake their heads and become disbelievers in natural science founded upon such a basis. "The chance of [the remains of] some of these variations being found in the different gravels or fresh-water formations above the tertiaries must be very great. And yet not one single variation, not one single specimen of a being between a monkey and a man has ever been found. Neither in the gravel, nor the drift-clay, nor the fresh-water beds, nor in the tertiaries

* An Exposition of the Fallacies in the Hypothesis of Mr. Darwin, by C. R. BREE, M.D., F.Z.S. London: Longmans.

below them, has there ever been discovered the remains of any member of the missing families between the monkey and the man, as *assumed* to have existed by Mr. Darwin. . . . The celebrated Neanderthal skull belongs confessedly to this remote period (the bronze and stone ages), and yet presents, although it may have been the skull of an idiot, immense differences from the highest known anthropomorphous ape." These intermediate forms, too, must have been in great numbers, and the changes which the ape's skull must have undergone would alone have taken a vast time; it is strange, therefore, if the Darwinian hypothesis has any foundation in fact, that remains of these intermediate forms have not been discovered. Dr. Bree also examines the various points in the hypothesis, and step by step refutes them, as he considers; but it is, of course, on the main point referred to above that his position is strongest. He quotes largely from the numerous articles published against the hypothesis, and devotes a chapter to the principle of "least action" as propounded by Dr. Haughton in lectures which will be found in Vol. XIII. It is needless to say that he makes use of every fact that bears in any way against the hypothesis, but into even a few of these fragments of his argument we cannot here follow him. And yet this is not the book to counteract the Darwinian tendencies of the majority of scientific men, nor a safe and trustworthy guide or exponent of the "fallacies" of "natural selection" suited to the requirements of the general public. If Dr. Bree had confined himself to the main points and defects of the theory, his work might have been accepted as a popular exposition of some of the so-called "fallacies," but even then it would have been necessary to avoid misquotation and misconception. As it is, his book teems with errors. Speaking of Mr. Mivart's doctrine of evolution we are told that it is offered "as a means of reconciling scientific and religious thought, and of bringing together the two lines which, Mr. Spencer remarks, *are running parallel and gradually approaching each other*." This extraordinary statement is illustrated by a diagram—two lines nearer at one end than the other, but certainly not parallel. Speaking of the vivid colours of birds, Dr. Bree says they are produced by striæ of pigments which "decompose the light and enable the feathers to *absorb* the most brilliant rays" and so commingle them as to yield the most beautiful tints. In an appendix Dr. Bree reproduces a large portion of M. Flourens's criticism of Darwin's "Origin of Species," but appears to have forgotten the replies to it—notably Professor Huxley's in the *Naturalists' Magazine*.

Many minds have been unsettled by the hypothesis of Darwin, and the acceptance it has met with in scientific circles in different countries, but we cannot think that Dr. Bree's book will do much to quiet those who have been disturbed by the "suggestion" that their reason and their intellect have been derived from a monkey—however far back in time it may be when the gap which now separates man from the ape was bridged over. They are already aware of the great defects in the hypothesis, but the minor points and details upon which Mr. Darwin has built are not to be set aside so easily, and if the connecting links should ever be discovered, few, indeed, would be his opponents, and weaker still their arguments. In the mean time, Mr. Darwin has been refused admission to the French Academy as a foreign correspondent, because, according to a correspondent of *Les Mondes*, "the science of those of his books which have made his chief title to fame—the 'Origin of Species,' and still more the 'Descent of Man'—is not science, but a mass of assertions and absolutely gratuitous hypotheses, often evidently fallacious. This kind of publication and these theories are a bad example, which a body which respects itself cannot encourage."

IMPROVED TURNING TOOLS.

An improved form of cutter or die for turning shafting and similar articles has been recently patented by Mr. J. Fensom, of Toronto, in Canada, and in conjunction therewith he constructs the bed of the lathe in a peculiar manner, when employed for turning such articles. The improvement in the cutter or die consists, according to the inventor, in making the front cutting edge like a chaser or screw-cutter, the thread of which gradually diminishes in depth until it runs completely out, leaving the back portion a broad cutting edge, which is in the same plane as the innermost part of the first thread. In this manner the thread, which is commenced by the first cutting edge, is utilised or caused to operate as a feeder for the cutter, but is gradually cut away as the threads in the cutter become less deep, and is completely removed by the back cutting edge. The effect produced by a cutter of this kind is that of distributing the cutting points, and thereby reducing the friction upon them, while at the same time the cutter is self-feeding.

The improvement in the bed of the lathe consists in making it of the shape of a trough, without the ordinary heads, the spindles fitting

FIG. 1

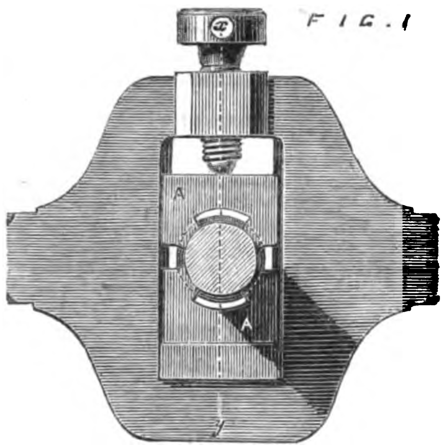


FIG. 2 FIG. 3

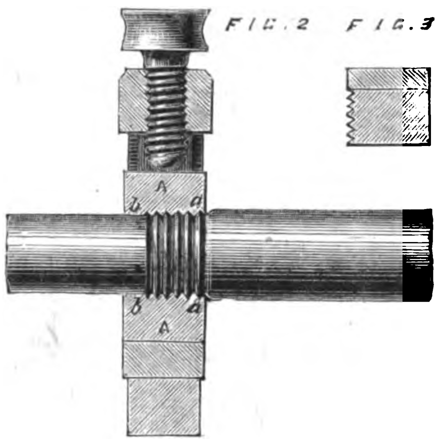
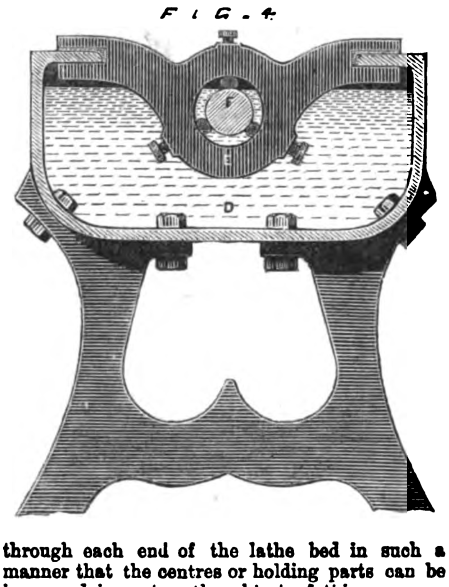


FIG. 4



through each end of the lathe bed in such a manner that the centres or holding parts can be immersed in water, the object of this arrangement being to keep the iron well lubricated and cool while under the operation of turning.

In the engravings, Fig. 1 is a front view of an ordinary blacksmith's stock holding a pair of the cutters or dies, and Fig. 2 is a transverse vertical section of the same on the line x y. A shows the cutters or dies, which in Fig. 2 are represented as performing the operation of turning a piece of shafting. It will be seen that the front part a of the cutter A commences with a full thread, which gradually becomes less deep until it runs completely out, and leaves the back part b a broad cutting edge, which entirely removes the thread produced by the front part a, and leaves the shafting plain and smooth, and reduced in diameter, as shown at C. Blacksmiths and others who do not usually possess machinery for turning can with these dies or cutters utilise the ordinary stock for that purpose. The cutters may be applied in various ways, either singly or in any number, to common or bolt-cutting lathes, either with or without the usual feeding gear as may be required. Fig. 3 shows an ordinary screw cutting die connected to a cutter, which will answer in a rough way the purpose of the cutter or die A.

Fig. 4 is a transverse vertical section, showing the improvement in the bed of the lathe mentioned above. It will be understood that the revolving spindle passes through the end of the bed D, which is, of course, fitted with proper journal boxes and requisite bearings. The tool-rest E must also be shaped so as to admit of the shafting or other iron under operation being held in the position shown at F, that is, immersed in the water contained in the trough-shaped bed D. Both the bed D and the tool-rest E may, of course, be varied in form.

IRRADIATION.

If two circles of equal diameter, one white on a black ground, the other black on a white ground, are looked at together, the white one appears larger than the black. This is the phenomenon called irradiation. The apparent magnitude of the stars when we look at them is doubtless affected by it; and its influence is very well observed in the appearance of the moon when only a few days old, the bright crescent apparently extending beyond the darker portion of the disc, and holding it in its grasp.

Plateau has assigned a physiological cause to irradiation, saying that the impression produced on the retina extends beyond the outline of the image. Welcker and others assert the cause is a physical one—viz., the dispersion of light. In support of the latter view it is urged that irradiation increases with faulty accommodation in the eye, and that by the use of proper glasses it may be removed. It is not only light objects on a dark ground that irradiate, the opposite also occurs. A simple way of proving this is to draw on fine white paper two equal thin dark lines, meeting at an angle of 1° to 2°. Look at these and note the point at which the breadth of the lines seems to be equal to the distance between them. Check this next by careful measurement, and it is found that at the point fixed upon the distance between the lines is considerably greater than their breadth, showing that the dark lines had appeared to broaden at the expense of the white space. This is only perceived, however, when the dark objects are very small.

Dr. Volkmann, of Halle, has experimented carefully on irradiation. He used an instrument which he called a macroscope. This is no other than a telescope tube with only the object-glass left in it. He looked through it at broad parallel bands (of black or white), which thus gave a diminished image. If the breadth of the lines did not appear equal to the distance between them their distance from the lens was altered till this took place. The following are some of the results that were arrived at:—The amount of irradiation varies with the size of the image on the retina: the smaller the image the greater the irradiation. Two parallel white lines 1mm. broad, and which could be made to approach each other, were placed at eight different distances, successively, from the lens, giving eight different images. It was observed in each case at what distance from each other they had to be placed in order that their breadth should be equal to their apparent distance, and the above result was obtained.

White lines on a black ground irradiate more strongly than black lines on a white ground. The surface of a board was half covered with white paper, and half with black. Two black parallel lines were drawn on the white half, and two white on the black. They were each 2mm. thick, and each pair 6mm. from each other. The distance from the lens at which each pair had to be put in order to their distance from each other being equal to their breadth was noted. This was much greater for the one pair of lines than for the other.

The amount of irradiation is dependent on the difference in light intensity between the object and its ground. An experiment was made with white objects on a black ground, the source of light being placed at various distances successively, and the result was that the irradiation was greater in proportion as the light was further removed—that is, as the light contrast between object and ground was less. Another mode of experiment, however, gives a somewhat different result (which the law must be made to include.) If we have four equal discs, one white and and one gray on a black ground, one black and one gray on a white ground—then the white looks larger than the gray on the black ground, and the black looks smaller than the gray on the dark ground.

The amount of irradiation further varies with the dispersion of light; it varies in different individuals; it is increased through the slightest fatigue of the eyes; and the reflection of light trom the field of vision external to object and ground has also an influence on it. A. B. M.

THE WATCH, AND HOW TO REPAIR IT.

By "Seconds' Practical Watchmaker."

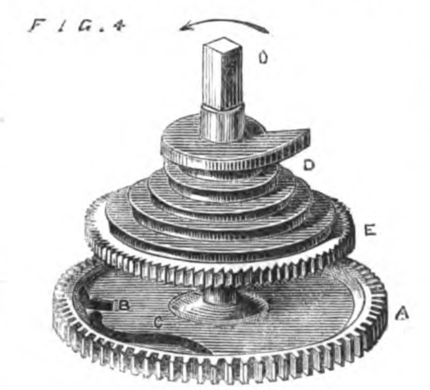
(Continued from page 503.)

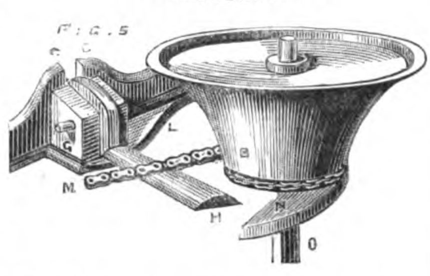
The Adjustment of the Mainspring.

To commence. Place the barrel A and the fusee B in the frame, and secure the upper plate by pins, which pass through the four pillars; place the hook of the chain (1) into the hole at the top of barrel, and then wind the chain on it; fix the hook (4) into the notch of fusee, and then wind on the barrel by the endless screw, or by the click and ratchet method—both these terms are familiar to the amateur as well as to the workman—say half a turn. Fix on the fusee-square the adjusting-rod, which had better be described before proceeding further. This rod (or tool) is formed of a piece of moderate sized round steel wire, nearly 12in. long. At one end it has a very small screw-vice attached, and by unscrewing a small thumb-screw belonging to it it can be secured to any size of watch fusee-square. Upon the wire of this rod there are two brass weights which pass up and down freely, and by their screws may be made secure at any part of it. Supposing that the rod is firmly fixed to the fusee-square, and the frame held in the left hand with its edge upward, the right will be at liberty, and thus the rod may be turned to wind the chain from the barrel, and thereby fill the grooves of the fusee. When fully wound up, the adjustment can be tested, and then so arrange the frame by the hand holding it that the rod can be easily turned. The movable weights on the rod will be on it below the fusee-square, and be very similar to the ordinary steel-yard. Allow the weighted end of rod to rise, and so place the weights that it will only just rise. Allow it to turn: observe the next turn whether the weights go over with the same or less power than the first one; continue till all the turns-over of the rod are accomplished. Generally the adjusting-rod will scarcely rise at the last-but-one turn, and at the last there is no force apparently left. In such a case set the spring up more—that is, turn the ratchet and click, or endless screw, another quarter of a turn more, making, with the half-turn first started with, three-quarters of a turn, then try again in the same way. Should the result be an improvement, proceed two or three clicks more, and repeat the trial. If the rod passes over equally except the last turn, hesitate whether any further alteration should be made for this reason. The whole turn of the fusee may correspond in value of time only five hours, and then by removing the adjusting-rod and fixing just on the opposite side of the fusee-square, the power by which the rod is lifted may be judged by the value of from two to three hours; therefore, it can with safety be so left, because no watch is supposed to continue going till quite down. Again, should the rod turn over more freely toward, and at the last turn, the mainspring is set up too much. But if the greatest force is evident at or about the middle of fusee's motion, it is evident that that fusee is too large thereabout; and if the watch under trial be of superior quality, remove the mainspring, apply another, and repeat the trial. It is customary with manufacturers and examiners of superior work to have the cutting of the fusee tested before it is delivered from their place of business, and therefore rather doubt the quality of the mainspring than the form of the fusee.

Having left the power equalised by which the train of wheel-work is kept in motion, we have to consider, in the next place, in what way the watch is made to tick. Below the fusee D is a wheel A—in old watches similar to that represented in Fig. 4, generally having fifty-five or sixty teeth cut thereon. The wheel A has to remain stationary during the time of winding up the watch; we will therefore describe in what manner this is effected. This wheel A represents the first wheel of the train, and detached from the fusee D in order to illustrate more fully the consequent action when both fusee and its wheel are connected. This wheel A is represented lower than the fusee, to show that at the lowest part of the fusee saw-like teeth are formed, E, termed "ratchet-teeth," and also that the centre portion of the wheel is hollowed to allow the ratchet portion of the fusee's base to lie within it so as to come in connection with the click B, it being a small hook and movable. The piece marked C is a piece of brass so secured to the inner part of the great wheel that it forms a spring so as to press the click B toward the centre of the wheel, and when the ratchet-teeth part of the fusee E lies within the wheel A, a click-and-ratchet action is formed. The watch-key being placed on the squared arbor of fusee O, and turned, will wind the chain from the barrel on to the fusee until the grooves are filled; then an arrangement gets into action, and prevents the over-winding of the watch. (See Fig. 5.)

By inspecting Fig. 4 it will be readily seen that the key must be turned in the direction of the arrow, and that the saw-like teeth at the bottom of the fusee will raise the click C, which, when it has arrived at the highest point of the ratchet-





tooth, falls from it, and is pressed to the base of the succeeding one, and by the flat face of the preceding tooth being presented to the point of the click, prevents the fusee being turned in the opposite direction. This click rising and falling causes the clicking noise heard when winding the watch. Thus, both fusee and its wheel are carried together, and caused to follow the inclination of the mainspring's force, the result of which is that the chain is uncoiled, and when all the chain has left the fusee the watch is then down, and must be rewound before it will again tick.

Having thus far become acquainted with the office of the mainspring, barrel, fusee, and great wheel, our attention must now be directed to another diagram, Fig. 5, in order that we may understand the simple but effective means employed to prevent the watch being over-wound. In Fig. 1 we see that the stop-stud G is the fixture in which the stop is placed, also that a small spring L, which is secured at one end by a screw, passes underneath that stop. The office of this spring L is to press the stop upward, in order that when the watch has been fully wound up an automatic action shall follow in connection with this stop, as the chain uncoils from the fusee.

By inspecting Fig. 5, B, we may readily recognise the fusee, as in Figs. 2 and 4, although the grooves are not represented, one turn of the chain being sufficient for our present purpose; and the mind's eye may be assisted in following the means whereby the stop acts at the termination of winding up the watch, and also in what manner the parts forming the stop-work get out of action again, and so allow the fusee to continue its motion without obstruction. This stop-stud G is a piece of brass securely riveted into the upper-plate, and across which a notch is made with a thin saw; into this notch the thin blade of the stop is placed, and therein secured by a small pin passing through the stud and stop, which are so arranged that the stop moves freely in the stud notch as well as on the pin. Underneath the stop, close to the stud, the spring L passes, and is so bent that it forces the stop upward, and thus remains until the winding-up of the watch.

We will now consider in what way the stop becomes useful. When the winding key is applied to the fusee-square O, for the purpose of winding up the watch, it is quite clear that the chain is wound from the barrel on to the fusee. It therefore happens that when the last turn of the key is about to be completed the chain has to fill the last groove of the fusee, and as the chain passes across the stop H, in the direction M (toward the barrel), it presses it toward the upper-plate; therefore, when the point N of the fusee-cap has advanced to its completion of winding, the flat end of the stop H is presented to it, and the key cannot be turned further. This, then, is the stopping of the winding, because the key cannot then be turned beyond that point. This simple arrangement is termed by watchmakers the stop-work. When the fusee has made one revolution after the watch has been fully wound up, by being moved in the opposite direction, the point N of the fusee-cap has passed under the stop H, which is brought about by the spring L pressing upward this stop, thus allowing freedom for the passing of the cap of fusee, and thus the chain is again transferred from the fusee to the barrel.

Our next consideration is that of the train, or wheels constituting the watch. Every watch is made up of four portions or divisions, that is to say, the barrel, fusee, and stop-work are termed "the great work," the three wheels following are known by the term "the small wheels," the last wheel, with the rest of the parts constituting the escapement, is recognised as the "escapement," and the two wheels and one pinion under the face is known as "the motion-work." Each section or portion will be referred to separately, and therefore we proceed to consider that portion of the watch which immediately follows, from the fusee-wheel including, which is termed the train.

We can, then, understand that the term train has for its signification those wheels and pinions forming that part of the watch until they become connected with the escapement. When the term wheel is made use of it refers to circular pieces of metal, usually brass, with teeth formed on their circumference. When the term pinion is made use of we refer to the small steel wheels into which the leading and succeeding wheels act. The five wheels of a watch are fixed on steel spindles (or arbors which terminate in two small ends) or pivots, and turn in holes made in the frame. When we refer to the teeth of wheels we understand by that term the notches formed on their circumference; but when we refer to those teeth which form the pinion we term them leaves; therefore, as the two terms will be frequently employed, it has been thought advisable to mention the distinction.

As the fusee continues its action by the mainspring's force, the train of wheels are put in motion, and, as we have stated, would have moved so rapidly that in a very short time would have ceased to move were it not for the arrangement just referred to as the third portion of the watch, termed the escapement, the object of which is that the wheels shall be permitted to perform their revolutions in such periods of duration as may be assigned to them by the medium of its intervention, and by which the mainspring is permitted slowly to uncoil after it has been coiled up in its box by the process of winding up the watch. Thus the term escapement at once suggests to the mind that means by which the power, after it has been concentrated in the barrel, is permitted to escape; and hence it will be seen that at each tick of the watch a portion of the mainspring's force has been disposed of.

SUNSTROKE.

Dr. Horatio C. Wood, jun., has recently published in America an excellent paper on the subject of sunstroke, founded upon some observations and experiments undertaken by him with the view of elucidating the phenomena. After showing that in cases of sunstroke the blood undergoes no primary changes in its physiological or chemical properties, Dr. Wood's next step was to ascertain why the heart and muscles are found so rigid after death from sunstroke, and what it is that really kills in this affection. By subjecting myosine to different temperatures, he found that this substance coagulated with great rapidity from 108° to 115° Fahr., and the temperature of the body in cases of sunstroke often reaches 110° Fahr. at the time of death. But the heart is found to continue to beat in animals dead of sunstroke—at any rate, dead in the sense that they had ceased to respire. The rigidity of the cardiac muscles, then, is a post- and not an ante mortem phenomenon. As some experiments by Dr. Wood proved that heat applied to a nerve trunk would not destroy its conducting power, his further investigation was directed to the action of heat on the nerve centres. By some ingenious appliances, hot water was made to circulate over the surface of an animal's head, and it was found that sudden insensibility, and ultimately death from asphyxia, could always be induced at certain temperatures. A brain temperature of from 112° to 114° was fatal to a cat, and one of 114° to 117° to a rabbit. Owing to the possession of a more highly organised brain, it is probable that in man a less degree of heat would produce the same set of symptoms. The mechanism of an attack of sunstroke then, according to Dr. Wood, is that "under the influence of external heat the temperature of the body rises until at last a point is reached at which the heat paralyses, by over-stimulation, the controlling centre regulating animal heat; then a sudden additional rise of temperature, with a corresponding increase in the severity of the symptoms, occurs." Of course cold is the remedy, and cold water the readiest way of applying it. It is a great mistake, says the *Lancet*, to suppose that these cases are commonly due to the action of the direct rays of the sun, for in India, as in America, attacks are very frequent at night. One of the main things to be attended to is, as we have said before, the function of the skin by the daily use of the bath.

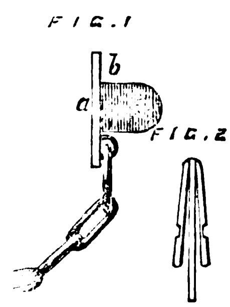
TEA, COFFEE, COCOA, AND ALCOHOL.

THE remarks of Dr. Arlidge, which we printed on p. 269, appear to have led to further investigations of the properties of tea and other beverages, and we extract from the *British Medical Journal* the conclusions of a French physician who has been experimenting in this direction:—

Apropos of the recent grave discussions concerning the abandoned class of persons stigmatised by learned writers as "tea-drunkards," it may be interesting to state the conclusions of an elaborate research by Dr. Angel Marvaud, which has recently attracted much attention in France, on the physiological and therapeutical effects of coffee, tea, coca, maté or guaraná (Paraguay tea), and alcohol, which he classes together as aliments of economy, or anti-waste foods. He considers their influence on nutrition from two points of view: as stimulants to the nervous system; as anti-waste foods, or anti-assimilators. Alcohol acts directly on the sensory apparatus of the spinal cord, and indirectly on the motor apparatus. Coca acts directly on the motor apparatus, which it excites in the same manner as strychnine. Coffee, tea, and maté act principally on the brain. Alcohol and coca excite the exercise of the muscles; coffee, tea, and maté, the exercise of thought. Further, by lessening the waste of the tissues, counteracting organic oxidation, and diminishing loss by means of the secretions, they all act as aliments of economy. In this way is explained their action in stimulating to work in the evening, in partly supplying the want of solid food, and in moderating vital combustion. Hence arises their increasing consumption, and their more general use as articles of daily régime; hence, too, their utility in alimentation, and their important place in hygiene. The abuse of these aliments has, it is true, two principal inconveniences. In the first place, the excitement of the nervous system which they cause is liable to be followed by fatigue, weakness, and even inertia. In the second place, by their interference with and reduction of the processes—indispensably necessary to life—of combination, transmutation, and decomposition, they may cause arrest, suspension, or even complete suppression of the nutritive changes in the cellular elements, and may produce as results, torpor, atony, fatty degeneration, and necrobiosis of the tissues. Thus are explained alcoholism, coffeeism, theinism, and cocoaism. The therapeutic properties of these substances result from their physiological effects. Medicine is capable of deriving great power from them as stimulants of the nervous system, as anti-calorifics, and as retarders of waste. They ought to find a place in materia medica among the medicaments that excite the function of the nerves of relative life, and depress those of organic life. The second of these properties may be regarded as a consequence of the first, if the mode of action of the nervous system be considered. Those centres which preside over nutrition and its principal phenomena (assimilation and decomposition) act with less energy in proportion as the centres which regulate the intellectual, sensory, and motor powers are subjected to a more lively and lasting stimulation.

FASTENINGS FOR WATCH-CHAINS.

A METHOD of securing watch-chains to the waistcoat in a reliable, and at the same time ornamental, manner, has been patented by a Mr. Dolby, of London. The device is applicable to Albert and Victoria chains or guards, which are generally secured to the waistcoat by means of a bar on the end of the chain, which bar is passed through one of the button-holes of the waistcoat. This mode of attachment, while giving little or no scope for ornament, is very inconvenient on account of the difficulty in getting the bar through the hole, and in afterwards passing the button through the same hole. Victoria chains worn by ladies are generally attached at their upper end to a hook on a brooch or on the dress itself, an insecure mode of attachment. To obviate these inconveniences, and provide a reliable fastening, the inventor employs a plate, key, shield, or ornament of any kind, provided at the back with a shank to pass through a button-hole or through a small hole made for the purpose, the shank being secured inside the waistcoat or dress by a spring bolt. The chain is attached to the plate, key, shield, or other ornament, or to the shank, and remains entirely outside the waistcoat or dress, together with the plate or other ornament. The general idea will be readily understood from the engravings, which represent one form of the "invention," which is, of course, capable of great modification. Fig. 1 shows the plate *a*, which may be ornamented to any desired extent; and *b* the shank which is passed through the hole in the waistcoat, and secured by means of the bolt shown in Fig. 2.



COAL AND DOMESTIC ECONOMY.

A FRIEND of Sir William Bodkin's has offered to the Society of Arts the sum of £500 to be awarded in prizes "or otherwise" for the invention of stoves, adapted for ordinary sitting-rooms and kitchens, which shall as far as possible consume the smoke and insure "the most perfect and judicious use of the coal to be consumed." This is, indeed, a timely offer, and the Society has thankfully accepted it, and appointed a committee to report on the best manner of taking action in the matter.

THE MANCHESTER STEAM USERS' ASSOCIATION.

THE last ordinary monthly meeting of the executive committee of this association was held at the offices, 41, Corporation-street, Manchester, on Tuesday, July 30th, 1872, Sir William Fairbairn, Bart., C.E., F.R.S., LL.D., &c., president, in the chair, when it appeared from the report of Mr. L. G. Fletcher, chief engineer, that during the past month 673 visits of inspection had been made, and 679 boilers examined, 406 externally, 6 internally, 6 in the flues, and 261 entirely, while, in addition, 6 new boilers were tested by hydraulic pressure, as well as specially examined both as regards their construction and complement of fittings, before leaving the maker's yard. The following defects had been met with:—Furnaces out of shape, 1; fractures, 12; blistered plates, 4; internal corrosion, 12 (1 dangerous); external ditto, 8; internal grooving, 5; external ditto, 13; water gauges out of order, 4 (2 dangerous); safety valves ditto, 4 (2 dangerous); pressure gauges ditto, 6: total, 69 defects (5 dangerous).

During the month two explosions had arisen from boilers not under the inspection of the association, injuring eight persons, though fortunately not fatally. The cause of one of these explosions, which had been investigated by an officer of the association, was found to be the same as that so frequently met with on previous occasions—viz., the use of an old worn-out boiler, the plates along the bottom, where resting on the brickwork, having been reduced by external corrosion till they had become as thin as a sheet of paper. This corrosion was greatly accelerated by the fact that the boiler was not set upon suitable seating blocks, but let down on to the solid brickwork with wide seatings, which harboured moisture, and thus promoted the corrosion. The entire boiler had been thrown from its seat, and a considerable portion of it hurled across a deep ravine to a distance of 120 yards. The roof of the boiler house had been blown up and the slates scattered in all directions. It was a wonder that no loss of life resulted. Competent inspection would have prevented this explosion.

ATMOSPHERIC GEOLOGY.

A PAPER was recently read by Professor J. Wise before the meteorological section of the Franklin Institute, under the somewhat fanciful title of the "Geology of the Atmosphere."* We are assured, however, that this is no fancy misnomer, but is as much a matter of scientific fact as is the geology of our planet's crust. Indeed, while the geology of the earth's crust confines our positive observation within the limits of one or two thousand feet beneath its surface, that of the atmosphere allows us a practical scope of examination of 30,000ft. above its surface, and of that portion of it most interesting to our welfare and study. Now, whatever the condition of terra firma may be beyond the point of certain examination in regard to its crust and internal structure, whether solid to its centre, or hollow like a geode, or whether filled with plutonic lava as some physicists maintain, we do know that the geology of the atmosphere proves itself to be a stratified elastic substantive shell to the distance of as many miles outward as you choose to count it under the law of geometrical diminution of density, which brings it so near to a nonentity at forty-five or fifty miles above the earth's surface that the atmosphere philosophers have placed its ultimatum at about that limit, but they forget to tell us what begins where the atmosphere ends, leaving us in a sort of philosophical quandary, and so we may as well come down into the shell of our subject, for shell it is, as certain as is the shell on the embryotic egg of the animal.

True it is that we shall not find it nearly so difficult of penetration through its strata as the granitic layers of its correlative basement, or even the liquid shelves of hot and cold brine on which it mainly rests, but we shall nevertheless find it possessed with counterparts as interesting to contemplate as are the old red sandstones and primitive serpentines of the nether geology.

Viewed from afar off, as we might see it from a standpoint on Mars or Venus, we should in all reasonable probability find the semi-transparent geology of our atmosphere to present us with a field of view similar to the belted Jupiter or striated Mars, since we have such well-defined lands in the torrid, the temperate, and the frigid zones that must of necessity give aspects in accordance to their temperatures, their reflections, their underlaid water bases, liquid and frozen, and its persistent equatorial cloud-belt that shifts itself in accordance with the earth's declination to the plane of its orbit.

While the gravity of our earth, by which all the other planets are weighed, at best is hypothetical, the weight of its atmosphere can hardly be questioned, as demonstrated by the Torricellian balance. That instrument tells us that our atmosphere is equal in weight to a shell of water 34ft. thick, encompassing the whole world; so you see we have a positive data of its weight, and have a good foundation to start on in the investigation of its geology. Now, as it may safely be alleged that the general stratification of the atmosphere is constantly liable to slides, and heaves, and avalanches, and shiftings, as compared to the geology of the more solid crust of the earth, the difference is only as to time. While the one is liable to changes in short periods of time, the other is just as liable to changes in long periods of time; and in the one case, as in the other, the relation they bear to that infinite eternity is all the same as regards the computation of time and change.

That the atmosphere has its fixed geological strata is manifest in various indisputable conditions of constant recurrence, well known to the seafaring and airfaring man, and he knows them as well in their courses as does the engineering landsman know the valleys of the Mississippi and the Amazon, or the ranges of the Cordilleras. The trade winds were for a long time only studied and understood as related to ship sailing voyages, as the squirrel understands and practices the art of crossing rivers, as a failure of the nut-crop makes it a necessity to migrate from one side to the other. Now, since we are a little more advanced from the ancestry which Darwin gives us, we are prone to look a little higher, and that, in accordance with the law of progress, leads us to study the higher strata of the atmosphere, with a view, if not to make ourselves wings to fly with, at all events floats to sail with, that bring us face to face with aërial highways, mountains and valleys, streams and counter streams, tides and storms, layers of clouds, warm and cold, just as we find stratifications, tides and gulf streams, in the more crude form here below; and thus we behold that unity of force and law in nature that moves and vitalises all things with its providential life and motion recognisable in the multifarious forms of matter springing out of it. You will not object to the term highway, as applied to this upper ocean, when I tell you that great processions of the thistle-seed, with its tiny silken chariot carrying it along, may be seen high above the second stratum of clouds, as is seen the gulf-grass moving with the current of the nether ocean. So with the pollen, the impregnating principle of the vegetable king-

* We are indebted to an unknown correspondent for a copy of the paper from which these lines have been extracted.

dom, which may be seen in these moving strata in the form of faintly outlined nebulous clouds, in their mission of destiny fulfilling the works of nature.

That great centrifugal furnace — our equator, with its seething band of heated and volatilised vapour, that is pumped up, as it were, by a tremendous irrigating engine, as if made expressly to send heat and moisture to the uttermost parts of the earth, is of itself a grand and interesting study, before which the heaving fires of Vesuvius are comparatively tame. That is the stratum which has not yet received its full share of consideration in the cosmogony of our planet, but rather neglected and left to the unimaginative sailor, who conjures it up into "calm belts" and "horse latitudes," and into "doldrums" and "crossings of the line," &c.

Owing to the configuration of the globe in its continents in connection with the motion of the earth, and the gulf streams that are projected from this huge steam generator, the mariner tracks out his roads and byeways as definitely as does the civil engineer his glades and valleys in his surveys. And while this great engine is moving the waters of the sea it is just as diligently at work in moving the great ocean of vapour over our heads above, presenting the grand conjunction of the trade winds rushing into this equatorial vortex from the northward and the southward, only to be raised and conducted outward, freighted with its life-giving materials, to be distributed over the land in the mechanism of its ways, as constantly as is the blood of the animal in its peculiar economy.

Old "Probabilities" — I mean the original one, Joseph Henry—gave me a lesson in this weather prediction fifteen years ago. With his weather map before him, and a telegram from S. Louis describing a storm then and there in action, he began to trace it by sticking pins into the map. As we had been discussing the nature of storms and the upper trade winds the evening before, I remarked, "You ought to be able to tell when that storm will reach the meridian of Washington," and he did predict it truthfully! He further remarked, "You know the snowstorms always commence in the west, and whenever I get a telegram from S. Louis of a snowstorm raging there, I can tell about what time it will reach the Atlantic seaboard." It is only when the east wind of winter forms a conjunction, and an atmospheric node with the west wind, that a deposition of snow takes place; and this winter node of snow, rain, or sleet, always travels eastward. Our weather signal service is mainly indebted to the early experiments of Henry; for as soon as a general system of telegraphy was established, the western predictions were an accomplished science, and he pressed the matter as a necessary and economical action of the Government for the benefit of seamen and agriculturists.

Such is the use of the study of the geology of the atmosphere, and while it would be too prolix for an evening essay to attempt the details of arrears of high and low barometer, and the exact tracing of isobarometric lines indicative of the course of the storm, it is in order to say that high and low barometer is only an effect of the storm motion—that is to say, the condensation of the atmosphere, caused by its pushing forward, makes the mercury rise, while its dilation, following in the wake, causes the mercury to fall.

The heat and force that actuates all our storms comes from the intertropical belt of our planet, and they ever take their rise from the vapour that is pumped up by the great centrifugal engine of the equator, and from thence sent north and south in the form of cyclones, and from the offshoots of these come our more northern gusts and storms, never so great and grand in the temperate zone as in the tropical. It does not belong to the solid earth alone to develop the stratification of horizontal and inclined layers, since we find the atmosphere presenting a similar condition. We often see the stratum of clouds with their feather-edged outlines as clearly defined as any stratification in the solid crust of the earth, and when the setting sun throws her golden sheen over them their forms and figures require no vivid imagination to trace the geology of the atmosphere. We also find an expressive counterpart of the upheaving earthquake and lava-projecting volcano in the downheaving waterspout and fire-projecting thunderbolt.

The great balance of nature is vibrating all the time with exact rhythmical motion—the earthquakes, cyclones, and volcanos are but bars and semiquavers in the harmony of the universe, and we, short-sighted creatures, often look upon them as catastrophes, and, with the uneducated, as the visitations of an offended Deity.

The shell of atmosphere that enfolds the solid earth is full of life and full of uses. One of its uses is yet to come. When man shall have studied more fully its matter and its condition; its highways and its byeways; its mountains and its valleys; its tide of flux and reflux; its capacity to float ships of copper or iron (a balloon made of copper plate, weighing a pound per square foot, and of 100ft. diameter, will float in the air), then shall we also appropriate the knowledge of the atmosphere's geology to our use as a means of devising fleet and pleasant travel.

The individual who nowadays neglects to look at "Probability's" enunciation in the morning papers—especially when he says are a of low barometer will pass over you to-day—and determines to leave out his hay for the morrow, or goes out on the day's excursion without his umbrella, deserves to have his hat sopped with rain, and his garments soaked with an admonitory moisture.

A more advanced theory of the geology of the atmosphere will teach us to predict earthquakes, as it is already more than surmised that the elastic shell of the atmosphere pumps up a bubble in the shell of the earth, and then lets it sink again, as does the indiarubber ball the water when we press the ball, and then suffer it suddenly to expand.

COAL-CUTTING BY COMPRESSED AIR.

At the recent meeting of the Institution of Mechanical Engineers, a description of a machine for getting coal was read by Mr. Winstanley, and as the subject has more than usual importance at the present time we reproduce it almost in extenso. Mr. Winstanley said that at no time in the history of the coal trade had a greater want been felt than at the present for the substitution of machinery for manual labour in the working of coal, and never, since the year 1761, when Michael Menzies made one of the earliest attempts on record to construct coal-cutting machines, had the difficulties experienced by coal proprietors been greater than now—a time when it is almost impossible to make production keep pace with the demand, and when the difficulty is further increased by the lessened output or production which accompanies a high rate of wages. Any improvement, therefore, in the working of coal mines which would increase the quantity of coal got and diminish the cost of production, and at the same time relieve the miner of the most laborious and dangerous part of his work, must be a benefit, not only to those immediately interested in the work, but also to the consumer generally. The object of the paper was to describe a machine which had been worked daily or nightly for the last two years at the Platt-lane Colliery of the Wigan and Whiston Coal Company, in a seam of coal known by the name of the "Pemberton Little Coal." The coal is about 2ft. 4in. in thickness, and is notoriously hard, so much so, that it was with the utmost difficulty men were obtained to work it, and at one time the seam stood idle for some time, because colliers could not be got to work in it, whilst the proprietors had always to pay a higher rate for getting it than for any other seam coal they work. The cutter, which is the invention of the writer and Mr. Barker, is, like most others, driven by compressed air, which is conveyed down the shaft and along the main roads in iron pipes, and from the end of the drawing-road to the machine in indiarubber hose pipe, 2in. in diameter. The coal is cut by a spur wheel fitted with teeth, this wheel being 3ft. 6in. in diameter. The wheel cuts its way into the coal without any previous "holing," and the depth of the "holing" made by the wheel can be varied at will. The machine is drawn along the face of the coal as it "holes" or cuts its way, throwing out the small coal or slack between the tram rails upon which the machine runs. The chief advantages of the machine are the following: 1. What may be called the "swivel movement," by which means the cutter "holes" its own way into the coal, cutting, in fact, from nothing up to 3ft., and for bringing the cutter back underneath the framework of the machine when not at work, and in this position the machine can be taken through any narrow roads or portions of the mine without the necessity of removing the wheel from the machine. Another advantage is that of applying the power to drive the cutting-wheel directly on the periphery of the wheel; whilst the mode of gearing also allows the small pieces of coal or slack to fall through to the bottom, so as not to lock or clog the teeth of the machine. The average rate of holing by the machine is from 25 to 30 yards per hour, according to the material the machine is holing in; but this, the writer said, was, after all, a matter of no great importance, as the great points to be considered were the amount of work the machine would do, and how it would do it. The machine in question had frequently cut the whole length of the face of 120 yards in a night, or between 7 p.m. and 4 a.m. This, however, included all stoppages, such as meal times, changing cutters, &c. In the same mine five yards per day is much above the average work for one man with the pick; and under ordinary circumstances it is considered the work done by the machine would be equal to that of forty men. The machine works in the night time, the coal being removed by ordinary manual labour in the day. No powder is used, the coal falling by its own weight after it is holed by the machine. For over six months the machine had had little or no repairs, and the practical advantages found in its workings are, the writer said—first, that without the cutter they could not get men to hole this particular coal on account of its thickness: second, that when the seam was worked by manual labour the proportion of coals and slack was as three of coal to one of slack, and with the machine it is eight of coal to one of slack; third, that work is done independently of the men, who could not be got to work regularly, and consequently the production is more certain with the machine. The actual cost of getting the coal by the machine and by hand labour had been found, from the payments made during a period of six weeks at the Platt-lane Colliery, to be as follows:—Hand labour, 3s. 6½d. per ton; machine labour, 3s. 1½d. per ton, showing a saving of 5d. per ton by the machine. This profit however, was considered to be absorbed by the expense of compressing the air for the machine, and by interest on outlay, and wear and tear. The increased value of the produce, in consequence of less slack being made by the machine than by hand labour, was estimated as follows:—By hand labour, 3 tons of coal at 11s. per ton, and 1 ton of slack at 7s. 3d. per ton = 40s. 3d., or an average value of 10s. 0¾d. per ton; by the machine, 8 tons of coal at 11s. per ton, and 1 ton of slack at 7s. 3d. = 95s. 3d., or an average value of 10s. 7d. per ton, being an increase of 6¼d. per ton in the value of the coal when worked by the machine. In a seam of coal a few inches thicker than that of the Platt-lane Colliery, and under more favourable circumstances, it was considered there would be a saving over manual labour of from 25 to 30 per cent. The cost of getting the coal by the machine, given at 3s. 1½d. per ton, could not, however, be taken as a correct representation of the cost, the one at the Platt-lane Colliery being the first that was put to work, and, as a commencement, a liberal rate of pay was given to the man attending it, as an inducement to give it a fair trial. The same man has now been working the machine on contract for the last fourteen or fifteen months, and now earns more than three times as much per day with the machine as he previously did with the pick.

The President (Mr. Siemens) said:—According to the paper, there is an economy in working by the machine; and another advantage which every one will appreciate is, that the machine, I presume, does not strike, and that men, to superintend its working, will be more readily got than men picking at the coal itself.

Mr. Fidler, who has the machine at work, said it now had had a fair trial, and, he thought, must make its way. The machine in question, however, had not sufficient ground to work upon, or they could by its use effect a greater saving than 5d. per ton in getting the coal.

Mr. Lawrence said it was not the all-important point to compare the cost of the machine with the wages paid to the miner, because, if it worked in a seam of coal which could not be worked economically by men, he thought it would prove of sufficient value without any comparison as to the cost of manual labour. It seemed to him, however, that there were some classes of coal in which the machine would not work well, and that with soft coal it would very soon jam itself up. He would like to know what depth of coal was left below the holing, and whether the wheel was not likely to be jammed by the coal coming down.

Mr. Winstanley said the depth of the coal below the holing was about 7in. in this instance. As to the question in respect to the coal falling, the man who worked the machine had wooden wedges which he inserted behind the machine to prevent the coal coming down. In this seam the coal was very firm indeed; and it very seldom happened that it came down and jammed the wheel. They had not had any experience yet in a very soft coal, but he thought cutting machines would not be required where the coal was soft, because it could be cut easily enough by hand.

Mr. Fidler, in reply to a question, said they did not take any coal out before they started the machine, as it worked its way in itself. In reply to another question, he said the machine was not stopped once a month in consequence of the teeth of the cutter getting out of order.

Mr. Menelaus said he had paid much attention to the question of cutting coal by machinery, but for their purposes in their district he had never seen a machine which he thought could possibly compete with colliers' labour, and he was very sorry for it. He found that the holing was about one-tenth of the whole labour of the collier, and in his district there was really very little of it, owing to the soft nature of the coal; so that the whole economy they could get was a saving upon 10 per cent. of the labour of the collier. What the increased price of and difficulty in managing, labour, might yet bring them to he did not know, but he confessed he had given up as hopeless the introduction of coal-cutting by a machine of that kind in his district. He had seen and paid attention to every machine, and he could say that if Mr. Winstanley's was not the best, it was one of the best; and if any machine would succeed in effecting its object this one was as likely as any he had seen. He could easily understand that for thin veins and hard coal it might be introduced with very great economy, but for soft coals and thick veins it was not likely to be of much use. He was hopeful that it might be introduced, and if they had seams in the Dowlais district which he thought it would work he should be very glad to give it a trial.

The President, in proposing a vote of thanks to Mr. Winstanley for his paper, said he was certainly disappointed to hear a man of so large an experience as Mr. Menelaus speak in faint praise of the machine. He was quite sure, however, he would be the first man to change his opinion, if the inventor could prove there was an advantage to be obtained even in soft coal; but, in regard to hard coal, all seemed to agree that considerable advantage might be derived from the use of this machine.

CUT-NAIL WORKS AT MIDDLESBROUGH.

MESSRS. JONES, BROTHERS, & CO., of the Ayrton Rolling Mills, have inaugurated a new branch of industry in Middlesbrough. On about an acre of ground adjoining their mills they have erected thirty nail-cutting machines, three shears for cross-cutting, a number of grindstones, lathes, and drilling-machines, requisite for making tools and keeping them in order. The cut nail trade is a special branch of a number of trades included in the term nail-making. The nails are made out of sheets or strips of Cleveland iron, and the thickness of the sheet varies according to the length of the nail required. The sheets are cut into strips transversely, the width of the strip being identical with the length of the nail. A youth "feeds" the machine with strip, which is seized by a "clamm," and turned over at each cut, the nails being produced at the rate of from two to three per second. The machines are constructed by the firm of Messrs. J. Rice and Co., of Birmingham, and embrace the latest improvements in nail-cutting machines. The machines are driven by a horizontal engine, the steam power being derived from two horizontal boilers, which are fixed outside of the building. Foundations are put in for another engine, to be coupled to the one already erected, when additional machines are laid down. Provision is also made for the erection of half a dozen "washer" machines. The sheets from which the nails are made are manufactured in the adjoining mill belonging to the firm, and an interesting system of three-high sheet rolling has been introduced for the purpose of turning out those sheets more rapidly, and with a better surface than is done by the old process. Generally, cut nails are made in Birmingham, Leeds, Manchester, and Gateshead. At present, the price of cut nails, from 3in. to 6in., is £22 per ton. There is no place in the United Kingdom where cut nails can be manufactured cheaper than at Middlesbrough. The town is also favourably situated for the London and Scotch markets. The works are producing rose, clasp, and clout nails, joiner's sprigs, ceiling brads, floor brads, lath nails, colliery plate nails, and any other class of cut nail not less than 1in. in length. The machinery is capable of making about forty tons per week, but the works are laid out for ultimately turning out about 100 tons of cut nails per week. The building is erected with the view of giving as much light as possible to the interior, and for this purpose a good portion of the roof is constructed of glass.

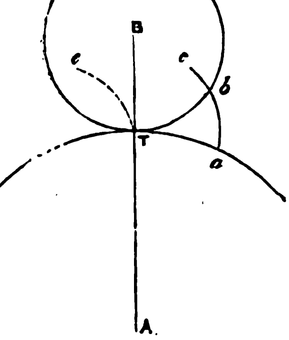
MECHANISM.*

(Continued from p. 507.)

THERE are four recognised modes in which a near approach may be made to a faithful reproduction of rolling contact by a process of sliding.

In Fig. 13, suppose that A and B are the centres of two shafts, then A B will be the line of which we have so frequently spoken as that in which is the pathway for the communication of motion from one wheel to the other. If the point T, at which that motion is communicated from one to the other is invariable, then the relations between the velocities of the two shafts will also be invariable.

FIG. 13

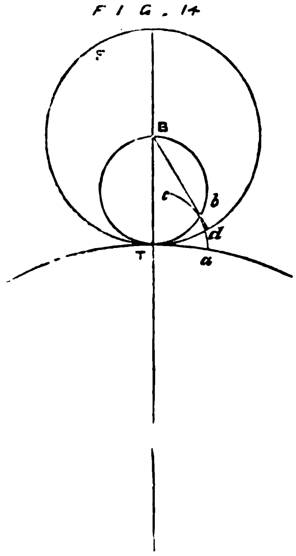


Suppose the circle and portions of circle to be the wheels keyed on the shafts, then one mode of determining the form of a contrivance for conveying motion from A to B by sliding, similar to that conveyed by rolling, is thus: Let there be at b, in the rim of the circle round B, a pencil-point, and suppose a sheet of paper to be gummed on the back of the wheel round A. Then, with the pencil-point at b resting on the paper, and b being at a, and the circle round B be rolled freely like a wheel up the hill from (a) to T, then the pencil-point will trace the line $a\ b\ c$. Now, suppose a piece of wood to be shaped like $a\ b\ c$, and to be attached by an arm to move round A, and suppose an arm to be fastened to move round B, and to have a pin in it where the pencil b was. If, now, the arm with the curve ($a\ b\ c$) be placed so that a is at T, and if the arm with the pin b be placed so that b is also at T, then if the arm with ($a\ b\ c$) be moved, pressing forward the pin b, it will be found that the pin will so slide up the curve $a\ b\ c$, as to reach "by sliding" the exact point b, which it would have reached, had the circular wheels "rolled" truly upon each other.

If, now, we increase the number of these curved arms and pins, or if we remove the rolling circles and put on others, which, not touching, carry curved arms and pins, then the one will be a wheel with the requisite number of teeth, each curved as ($a\ b\ c$) and the other will be a pin or lantern wheel, such as has been previously referred to. These pins are well and good for producing motion, but they are very much like a steam-engine which looks very well and very pretty so long as it has no work to do, but as soon as you put it to work there is a breakdown. If you put work upon these pins on wheels they will very soon break down. Prior, however, to a rejection of a scheme of teeth and pins, which has some very commendable features, the mechanic endeavours to avail himself of the labours of the mathematician, by strengthening the pins by means of end framings. Thus the pin-wheel becomes a "lantern" or "trundle" wheel. (See Fig. 6.) It is, however, desirable to try if we can find some substitute for the pin, or some other contrivance. Hence the mechanic has again to apply to the mathematician. The mechanic says, "I want something stronger than a pin;" and the mathematician says, "then you must put a line there." He adopts a process which Fig. 14 may serve to illustrate as a second stage of development.

Assuming the explanation which has been given with the former figure, instead of the circle round B rolling as a wheel on that round A, let a circle whose diameter, T B, is the same as the radius of the former circle, B, roll up a T, the curve traced on the paper will be the one ($a\ b\ c$). Putting the curve ($a\ b\ c$), as before, to an arm moveable about A, the mathematician could easily show that if this arm has to produce the same effect on the circle, F, as in the former case was produced upon the circle round B, it will be requisite to do away with the point or pin, and instead thereof to put a straight arm (B b d). With such an arrangement the mathematician informs us that the sliding of the curve along or touching the straight arm (B b d), in the passage of the wheel on A from T to a, will communicate the same motion to the shaft, B, as though the two wheels on A and B, in Fig. 14, had rolled perfectly on each other.

FIG. 14

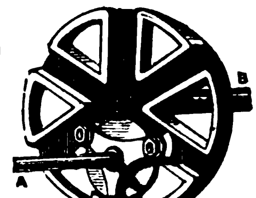


Here (referring to a model) are two wheels constructed upon this principle, and it is easy to see that what are usually called teeth are, in the one wheel, radial straight lines, and in the other, the curve of which we have been speaking, the motion is free and satisfactory, and it possesses a peculiar property in reference to the numbers of arms and teeth, as this model illustrates.

Recognising, as all must do who consider a general audience, that mathematical demonstrations, however divested of technicalities and complexities, appear "dull, stale, flat, and unprofitable," no apology is needful for interrupting the sequence of reasoning on which the true forms of teeth on wheels have been developed. Let us do so to turn to this interesting model possessing peculiarities which these demonstrations explain.

The wheel on the shaft B, Fig. 15, has on its face six radial grooves; on the shaft A is a smooth-faced pulley, having three pins at equal circumferential distances on a circle whose diameter is equal to the radius of the grooved pulley on B. On each of these pins is a small roller, fitting or nearly fitting the grooves. If now the shaft A be rotated, you may notice that each roller slides backwards and forwards in its diametrical pathway, and it is interesting to watch how equable is the motion and how neatly it is transferred to the grooved wheel and shaft B A, from roller after roller.

FIG. 15



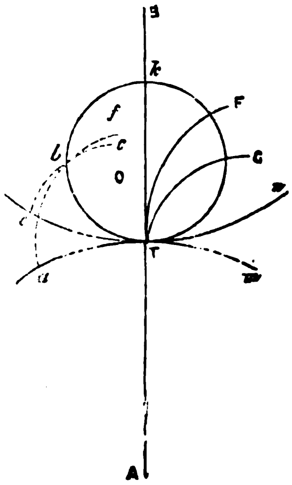
The velocity ratios are such that A makes two revolutions whilst B makes one. Four radial grooves and two pins produce the same velocity ratios.

Two applications of this motion may be named. One is to compel a polished bead placed on the top of one of the pins to describe a straight line. This bead thus moving causes a reflected light, as that from a candle, to appear as a straight line. Thus from two or more lights are formed two or more straight lines. Hence the intensities of the lights can be compared, and the instrument becomes a photometer. Another use of this motion is to obtain what, by a misnomer, must be called "a parallel motion;" the end of a piston being attached to one of the pins will, of course, be guided in a rectilineal path.

It will be observed that the two methods already suggested for making available the principle of sliding to accomplish the results of pure rolling, are applicable only to wheels of the sizes for which the calculations have been made, and working in one direction only. It is very desirable that rotation in either direction may be communicated, and that either one wheel or the other may be the driver, and that they may run freely when geared with different sizes. If, then, the mathematician cannot provide for the mechanician and the mechanic some principle of more varied application, and enable him to use wheels with teeth made so that of an extended set any two may be put in working gear—if this cannot be done, the complexities of wheel-work would almost be a bar to the use of it.

These considerations led to a generalising of the principle hitherto described. In Fig. 16 (T b k) the circle which rolls upon (a T m) is taken of a diameter smaller than the radius T B. Let it roll on (a T m) from T to m, and describe the curve T C. Instead now, of taking either a pin or a radial line, let the same circle (T b k), roll in the inside of (n T e), then will the point, T, describe the curve T F. If, now, these curves be the shapes attached respectively to the shafts, A and B, they will (mathematicians tell us) communicate the required motions, even though the sizes of the wheels on A and B be variable. This gives that extensive generality to the construction which enables mechanics to keep wheel patterns and wheels within a moderate number.

FIG. 16



The previous explanation of the principle upon which the most accurate system of teeth for a specific purpose can be formed, admits of only a slight deviation from perfect workmanship. There is another plan very generally adopted, which proceeds upon a different view of the relations between the driving and the driven wheel. Fig. 17 is intended to explain this method. The dotted circles touching at T represent what would be the circles if perfection of rolling were practicable. D H and E F represent other smaller circles or wheels. Through T draw E T D a common tangent to D H and E F. Let us suppose T D to be a piece of string having a pencil at T, and we proceed to wrap T D round the rim of D H, the pencil would trace the curve, K T H. Transfer the pencil to the end, T, of E T, and wrap round the rim of E F, then will the curve F T G be traced. Teeth formed with these curves, and placed upon wheels fixed to the axles A and B, would cause these axles to move as though moved by the one dotted circle rolling on the other. Wheels formed upon the curve named in the first two methods (Figs. 13, 14) are said to have epicyclic teeth; those in the third method (Fig. 16) are called epicyclic and hypocyclic teeth; and those upon the last method (Fig. 17) are called involute teeth.

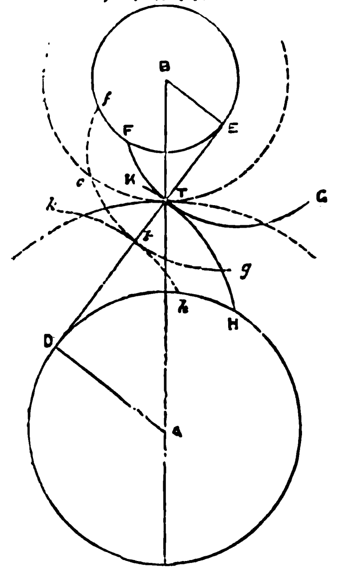
The explanation now given will to many appear deficient. For example, it is wanting in any attempt

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

to show that the line in which these sliding surfaces transmit the motion is a line which always passes through the point T. To show this involves a property of the curves used, and, as mechanicians or mechanics only, we must accept the mathematician's statement that it does so. Should any one present desire to follow out the inquiry, he may refer to Professor Willis's "Principles of Mechanism," or to Professor Goodeve's "Elements of Mechanism," both published by Messrs. Longmans.

One difference between teeth formed upon the epicyclic and involute principles may, however, be stated. The action of epicyclic teeth when crossing the line of centres A B, and therefore when in the act of transferring motion, is always, at T, perpendicular to this line of centres, A B, whereas the action of involute teeth is always in the direction of the common tangent, as D T E, Fig. 17. Hence,

FIG. 17



owing to the great strain this oblique pressure puts upon the shafts to which the wheels are keyed, the latter (viz., involute teeth) are not adapted for the transmission of pressure or the communication of power. For modifying motion, or the simple communication of velocity, involute teeth are valuable. They have, too, this further advantage, the tooth of one wheel may be made to touch both back and front of the other. Suppose two wheels thus perfectly made, then, by a very slight increase of distance of the centres, there will be a sufficient space and clearance, and so that which is sometimes wrongly called "backlash," will be reduced to a minimum. Hence, too, with involute teeth, what the microscopist calls "loss of time," is not a serious inconvenience to these workers in a field of science where "time" is so valuable that none can be spared for the tolerance of what the mechanic generally considers to be necessary, safe, and inconsiderable.

Such being the principles which govern the formation of teeth in general use, and as wheels are employed in all extremes of varying velocity, an inquiry naturally arose at a very early date—what is the size of the smallest wheels in any system which shall insure that a second tooth is coming into position before the acting or driving tooth has quit contact, and thus that jarring or shaking be obviated which occurs when there is a sudden transfer of the source of motion? Such, in fact, as may be illustrated by the periodic brightening of a gas-flame when the mechanism of a gas-meter is not well arranged and balanced. The mathematician answers the inquiry thus:—

The least numbers which can be safely employed

Of involute teeth are	25
Of epicyclic teeth	12
Of cylindric teeth, or pins	6

Pin-wheels, as deduced in Fig. 13, ought always to be followers and never drivers. The reason is very simple, and may be illustrated in this way. If you take a stick and draw it backwards, with the end resting on the ground, you can do so easily, but if you attempt to push the stick in front of you it is continually being shaken or stopped. In other words, if the stick be drawn towards the side on which it makes an acute angle, the following is smooth and easy. If the motion is towards the obtuse angle, such is not the case. It is the same with a pin in a wheel.

In Fig. 13, suppose B is driving A, then the pin would come in contact with the tooth (*c b a*), and in order to turn the wheel, A, it would have, as it were, to rise up the hill, from *b* to *a*, of this tooth. It would have to do with the tooth, practically, what you have to do with the stick when you push it forward over the rough ground, and the resistance so met would produce a constant jarring; whereas, if the pin slides down the tooth, as when A drives B, there is that sliding motion which is characteristic of toothed wheels, enabling the engineer to attain to perfection of rolling contact.

So much for the teeth of wheels. Those teeth slide on each other, and we have therefore a motion communicated by sliding only.

ON MEASURING TEMPERATURES BY ELECTRICITY.*

THE truth revealed to us by one of the younger branches of physical science, which has been cultivated and expounded nowhere more effectually than within these walls, has divested heat and electricity of their mysterious character, and has taught us to regard them simply as "modes of motion." Light also has been shown to be identical in its nature with heat, and the only remaining physical agency, "chemical affinity," has been recognised as a force differing only in "quality of action" from the others. According to these views, force, in whichever type of action it presents itself, is as indestructible as matter itself, and is, therefore, capable of being stored up and measured with the same certainty of result. We have a unit of force or the foot-pound, and a unit of heat, or the heat necessary to raise the temperature of 1lb. of water through 1 degree Fahr., and it has been already proved that 772 units of force are the equivalent value of one unit of heat. Again, the chemical force residing in 1lb. pure coal is equal to about 14,000 heat units, or 14,000 × 772 = 10,808,000 foot-pounds = 4,825 tons lifted 1ft. high.

Questions regarding the quantitative effects of heat present themselves, however, much less frequently for our consideration than questions regarding its intensity, upon which depends the nature of the phenomena surrounding us at every step, both in science and in ordinary life. The instrument at our command for determining moderate intensities or temperatures, the mercury thermometer, leaves little to be desired for ordinary use; but when we ascend in the scale of intensity, we soon approach a point when mercury boils, and from that point upward we are left without a reliable guide. The result is that we find in scientific books on chemical processes statements to the effect that such or such reaction takes place at a dull red heat, such another at a bright red, a cherry red, a blood red, or a white heat—expressions which remind one rather of the days of alchemy than of chemical science of the present day. There are pyrometers, it is true, but these are either of a complex nature, or little reliance can be placed on them.

FIG. 2 FIG. 1

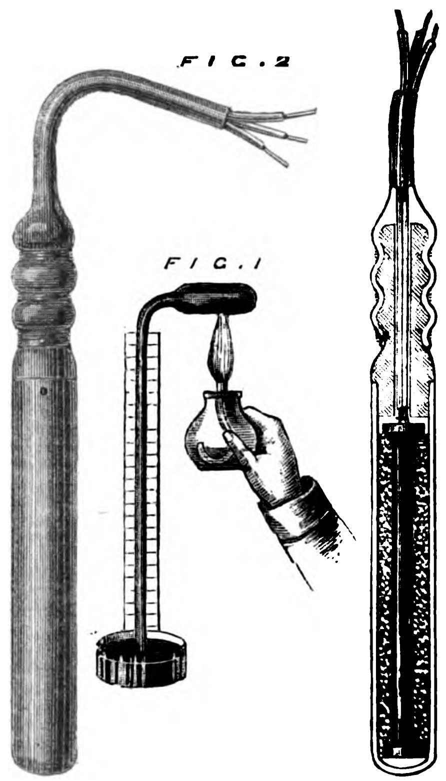
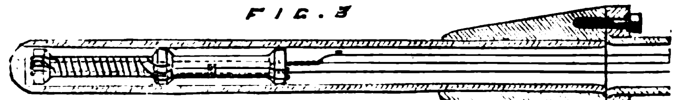


FIG. 3



It is my purpose this evening to place before you an instrument by which I hope to fill up to some extent the existing gap. It is the result of occasional experimental research, spread over several years, and it aims at the accomplishment of a double purpose, that of measuring high temperatures, and of measuring with accuracy the temperatures of inaccessible or distant places.

But before entering upon the details of my subject, I propose to place before you an instrument which fulfils, in principle, all the conditions essentially necessary in thermometry, and is at the same time the very first instrument that was ever proposed for measuring temperatures. I speak of the air thermometer by Galileo! It can be shown on theoretical grounds that the expansion of a permanent gas at constant pressure is the most perfect index of temperature. It is, in fact, the degree of energy of the atomical motion in an elastic fluid which determines its volume, and which constitutes at the same time its temperature.

The air thermometer consists simply of a bulb of glass with a long tubular stem, open to the atmosphere at its extremity. If I heat the bulb (by dipping it, for instance, into boiling water), and put it into a holder, with the hollow stem reaching downward into a cup of mercury, the air within the bulb will no longer communicate directly with the atmosphere, because the mercury is interposed. If now I cool the air within the bulb, by the external application or iced water, its heat motion will diminish, and its volume would be reduced proportionally, if the external atmosphere could enter freely to fill up the vacancy thus created. But inasmuch as the external air cannot enter, a reduction of pressure will take place, which, according to the law of elasticity by Boyle, must be proportionate to the reduction of volume at constant pressure. The difference of pressure thus created between the bulb and the external atmosphere will be balanced by the column of mercury rising up into the tube, and the elevation to which the mercury attains is a true index of the temperature to which the air in the bulb had been previously heated. This is true with regard to all temperatures, from the lowest to the highest, and the instrument may be termed a universal thermometer. If the bulb could be cooled down to 273° Cent. below the zero point it would follow by the law of Charles that the elastic pressure of air would be reduced to nothing, that is to say, the motion of the particles of air, which we call heat, would have ceased, and we should have reached the point of absolute zero, a point which has been theoretically established also by other means.

Practically, such an instrument would be most inconvenient; its indications would have to be corrected by calculation for barometrical variations; the capacity of the descending tube, which contains air not subjected to variation of temperature, would have to be taken into account, and no reliable observations could be arrived at without taking special precautions, such as are only within reach of the experimental physicist.

[The other known methods of measuring ordinary and furnace temperatures were here passed in review, and the limits of their application pointed out. They were classified into:—Thermometers, by expansion of liquids; thermometers, by the expansion of solids; pyrometers, by chemical decomposition of solids, comprising Wedgwood's and Deville's pyrometers; pyrometers, by observing the melting point of metals; pyrometers, by thermo-electricity; pyrometers, by exposing a copper or platinum ball of known heat capacity to the heat to be ascertained, and of quenching it in a measured quantity of water.]

The instrument which forms the subject matter of my discourse presents many points of analogy with the air thermometer, if we substitute "electrical resistance in conductors" for "expansion of gases." Both these effects are functions of temperature, increasing with the temperature according to progressive laws, which in the case of the gases we call the law of Charles, and in the case of conductors the law of "increase of electrical resistance with temperature." The latter law, which is of recent origin, had already been partially developed by Arndsen, Swanberg, Lenz, and Werner Siemens, when my attention was directed, in 1860, towards an application of the same to the measurement of temperatures at places inaccessible to the ordinary thermometer. By means of the contrivance which I shall describe presently, I was enabled to tell, in the testing cabin of a cable ship, the increasing temperature of the interior of the mass cable in the hold, and to prove the necessity of transhipment of the same into a vessel fitted with water-tight tanks, which have been resorted to ever since, to avoid the danger of softening the guttapercha covering.

* Read at the Royal Institution, by Mr. C. W. Siemens, F.R.S.

I have arranged an apparatus for proving to you, in the first instance, that the conductivity of a wire of platinum or other metal is greatly influenced by its temperature; for this purpose I direct the current of a galvanic battery at will through two branches of equal resistance, each branch comprising a free spiral wire of platinum, and one of the coils of a differential galvanometer. By throwing the powerful light of an electric lamp upon the face of the differential galvanometer, and by throwing the image by means of a mirror and lens upon the screen, the audience will see any movement of the needle to the right or the left that may take place when I complete the battery connection. The resistance of both branch circuits being the same, no deflection of the needle is observable on depressing the key, but when I pass the flame of the spirit lamp under the one platinum coil the needle is thrown immediately over to the right, because the electrical resistance of the heated wire is increased, and consequently a larger proportion of the current is passing through the cooler circuit, exercising a preponderating influence upon the galvanic needle. When I withdraw the spirit flame from the wire the needle rapidly returns to its zero position, but in passing it under the other spiral wire the needle immediately deflects in the opposite direction.

If instead of using the open spirals I were to wind thin insulated wire of any pure metal upon two small cylindrical pieces of wood, and were to inclose the tiny spirals in small silver casings, as shown in view and in section by Fig. 2, taking care that the extremities of the spiral wires were soldered to thicker insulated wires leading respectively to the battery and differential galvanometer before mentioned, it follows that no deflection of the needle ensues when both the protected and equal spirals are dropped into a jar containing iced water. But if I take one of the spirals from the water and place it, for instance, by his kind permission, into the hand of our president without disconnecting the same from its leading wires, the balance of resistance will no longer take place, and a deflection of the needle to the right actually takes place. I will now endeavour, however, to re-establish the equilibrium by adding warm water to the iced water surrounding the comparison coil near me until no deflection of the needle is observable. This result being obtained, it follows that the temperature of the water surrounding the one coil must be identical with the temperature of our president's hand, and the delicate mercury thermometer which I have placed in my solution must give me the temperature of the distant place which I intended to measure. The temperature here observed is 89·5° Fahr., which is at this moment that of Sir Henry Holland's hands. This result is independent of the ratio in which the electrical resistance increases with temperature in the similar coils, and considering that the silver casings containing the coils are not larger than small pencil-cases, this method might be advantageously employed in physiological research. The one coil would only have to be placed within the cavity to be measured to enable the observer to read the temperature from time to time, without disturbing the patient, with the accuracy of which the mercury or spirit of wine thermometer employed is capable. But the same method is applicable for measuring the temperatures of distant or inaccessible places, such as the interior of stores or cargoes of materials liable to spontaneous combustion; of points elevated above the surface of the ground, or of great depths below for meteorological purposes, or for measuring the temperature of the sea continuously in attaching such a coil to the mariner's sounding lead. An error would in such cases arise, however, through the uncertainty of the resistance of long leading wires, if a complete remedy of error from such a course had not suggested itself. This consists in uniting three separate insulated leading wires into a cable by which the distant coil is connected with the measuring instrument. One galvanic circuit passes from the battery through one of the leading wires, through the distant spiral and back again through the second leading wire to the differential galvanometer and the battery, and the second passes from the same battery through the near coil, and through the third leading wire up to the distant coil without traversing the same, and back again through the second leading wire to the galvanometer and battery. Thus both galvanic circuits comprise the leading wires up to the distant coil, and all variations of resistance by temperature to which the leading wires may be subjected affect both sides of the balance equally. In constructing coils for measuring deep sea temperatures a large quantity of insulated copper or iron wire is wound upon a metallic tube open at both ends to admit the sea-water freely in order to impart its temperature to the innermost layers of the insulated wire. The coil of wire is protected externally by drawing a tube of vulcanised indiarubber over it, which in its turn is bound round by a close spiral layer of copper wire, whereby the sea-water is effectually excluded from the sensitive coil. By these arrangements the temperature of distant or otherwise inaccessible places can be accurately ascertained; but the method is limited to the range of temperature which can be obtained and measured in the comparison bath. In order to realise a pyrometer by electrical resistance, it is necessary to rely upon the absolute measurement of the electrical resistance of a coil of wire which must be made to resist intense heats without deteriorating through fusion or oxidation. Platinum is the only suitable metal for such an application, but even platinum wire deteriorates if exposed to the direct action of the flame of a furnace, and requires an external protection. The platinum wire used has, moreover, to be insulated and supported by a material which is not fused or rendered conductive at intense heats, and the disturbing influence of leading wires had in this case also to be neutralised. These various conditions are very fully realised by the arrangement represented on the following diagram, Fig. 3.

Thin platinum wire is coiled upon a cylinder of hard-baked porcelain, upon the surface of which a double-threaded helical groove is formed for its reception, so as to prevent contact between the coils of wire. The porcelain cylinder is pierced twice longitudinally for the passage of two thick platinum leading wires, which are connected to the thin spiral wire at the end. In the upper portion of the porcelain cylinder the two spiral wires are formed into a longitudinal loop, and are connected crossways by means of a platinum binding-screw, which admits of being moved up or down for the purpose of adjustment of the electrical resistance at the zero of Centigrade scale. The porcelain cylinder is provided with projecting rims, which separate the spiral wire from the surrounding protecting tube of platinum, which is joined to a longer tube of wrought iron, serving the purpose of a handle for moving the instrument. If the temperatures to be measured do not exceed a moderate white heat, or say, 1,300° Cent. = 2,372° Fahr., it suffices to make the lower protecting tube also of wrought iron, to save expense. This lower portion only, up to the conical enlargement or boss of iron, is exposed to the heat to be measured. Three leading wires of insulated copper united into a light cable connect the pyrometer with the measuring instrument, which may be at a distance of some hundred yards from the same. They are connected by means of binding-screws at the end of the tube to three thick platinum wires passing down the tube to the spiral of thin platinum wire. Here two of the leading wires are united, whereas the third traverses the spiral, and joins itself likewise to one of the two former, which forms the return wire for two electrical circuits, the one comprising the spiral of thin wire, and the other returning immediately in front of the same, but traversing in its stead a comparison coil of constant resistance. The measuring instrument may consist of a differential galvanometer as before, if to the constant resistance a variable resistance is added. If the pyrometer coil were to be put into a vessel containing snow and water, the balance of resistance between the two battery circuits would be obtained without adding variable resistance to the coil of constant resistance, and the needle of the differential galvanometer would remain at zero when the current is established. But on exposing the pyrometer to an elevated temperature the resistance of its platinum coil would be increased, and resistance to the same amount would have to be added to the constant resistance of the measuring instrument, in order to re-establish the electrical balance. This additional resistance would be the measure of the increase of temperature, if only the ratio in which platinum wire increases in electrical resistance with temperature is once for all established. This is a question which I shall revert to after having completed the description of the pyrometric instrument.

(To be concluded.)

THE PROPERTIES OF CAST IRON.*

THERE are few things more interesting to one who is accustomed to watch the onward movements of natural and physical science than to observe the evidence of progression which has marked every process in the treatment and manipulation of cast iron. New efforts at improvement and economy are seen and heard of on every hand. Ingenious contrivances completed, or on trial, to diminish the cost of its production, or improve its quality, are strikingly manifested in the growing number of inventions under the stimulus of increasing competition. The progress of knowledge forbids us to cling pertinaciously to old opinions or old processes, or to pronounce improvements to be impossible, because we cannot at once discover the right mode of making them. The application of scientific principles to new mechanical contrivances, and a stricter attention to the properties of this material, may redeem us from reproach, and enable us to anticipate a time, and be destined to witness greater results and improvements than the most sanguine of us has ever dreamed of or ever hoped to see realised. To emulate and excel is a maxim and creed so excellent and useful that we should be the last to sneer at any exhibition of earnestness. I shall not attempt to foreshadow the results of the many attempts, chemical and otherwise, which have been made from time to time to improve the quality or increase the tensile strength of cast iron by rendering its fibres more dense, and its composition more uniform in texture. Whether this may be accomplished by chemical agency in the separation and absorption of impure and foreign substance, or by the union or mixture of other metals or substances, one of your members (Mr. Galloway) has made some efforts to explain. He has brought out and placed before you a proposal to combine lead with iron, so as to increase its homogeneity and strength. Although, as I believe, Mr. Galloway was somewhat cavalierly treated in discussion, I by no means join in the opposition to his suggestions and efforts. It is well known to chemists, and is, indeed, one of the deductions of the atomic theory, that metals and other elementary substances combine with each other by ordinary chemical affinity, and it has been accurately demonstrated by analysis that their combinations invariably take place in certain definite proportions, in fact, in simple multiples of those proportions. The numbers which represent those simple proportions represent also the relative weight of the atoms to each other. Definite chemical action and union can only exist when these conditions are present, and exist in the combination of two or more metals when joined by a state of fusion. For example, our mixtures of two metals, composed of copper and tin, or copper and zinc, known as gun-metal and brass, are not composed of the two metals in their atomic weights and equivalents. No chemical combination exists between them, but the simple condition of a state of mechanical suspension of their particles in contact with each other, without any definite or existing chemical union. Hence, the trouble and inconvenience so well known and often experienced by our brass founders, arising from the permeating action of copper and its constant tendency to separate itself from the tin by reason of its greater specific gravity, and the higher temperature at which it is fusible.

I do not know in what proportions Mr. Galloway proposes to mix the two ingredients, iron or lead, or for what special purposes he anticipates the compound metal will be best adapted; but, for a mixture to produce chemical combination, and insure the conditions I have just referred to, the relative atomic weights of the two metals would be, for the iron 28·0, lead 103·7. Specular metal, one of the hardest and most dense mixtures, although extremely fragile and brittle, is composed of copper and tin, in the proportions of about two of tin to one of copper. The atomic proportions begin nearly in those of the atomic weights, or for tin 59·0, copper 31·7; but, since this metal was known and in use before the discovery of the atomic theory, its discovery must have been the result of chance or experiment. As, however, a great deal of valuable information may yet be acquired respecting the properties of metals in combination with each other, by a careful study of the atomic theory in its relation to metals and their compounds, I recommend it to your consideration in its more exact and extended aspect and form.

Time will not permit that I should further pursue the investigation of this part of my subject, and I shall proceed to direct your attention to that which has high claims on our consideration at the present time, and is forced on our notice by the advocates of high engineering in their importunate demands for extreme pressures and great expansions. The advantages or disadvantages of extreme pressures with great expansions are eminently controversial points, but as the use of high pressed steam involves a high temperature, it is a vital question as to how far cast iron is capable of sustaining those pressures for any great length of time, under such conditions as those we have referred to. By way of illustration, let me refer to the case of a cylinder of the moderate dimensions of 30in., filled with steam, say of 200lb., a pressure which is said to be actually in use, and giving good results both as regards economy and performance. The area of such a cylinder would contain about 706in., which, multiplied by 200, would equal a pressure inside it of about 141,200lb. acting against the two ends and around its internal circumference, in a line parallel to its axis, and tending to produce rupture in a tangential direction. To contend against this force, we have the resisting power of some 94in. contained in its circumference, assuming our metal to be 1in. thick. Now, if we divide 141,200 by 94, we shall have a quotient of 1,396, equal to three-quarters of a ton of strain per square inch. The mean of many experiments shows that the average tensile strength of cast iron is nearly 7 tons to the square inch of section. Therefore, we may assume the force exerted by the steam on the inside surface of the cylinder would be about one-tenth of its breaking or bursting strain. We may consider this a very safe and moderate margin on the right side of security. I am by no means insensible to the modification this extreme strain would undergo from the accomplishment of motion by the performance of work, but this favourable condition would be considerably diminished from the constant and repeated blows from the steam entering the cylinder, and its repellant and expand-

* Abstract of a paper read by Mr. Laird at a recent meeting of the Association of Foremen Engineers.

ing action on the piston and the ends of the cylinder. But steam of 200lb. pressure has a temperature of 387° Fahr., and we must now introduce and deal with the irresistible forces produced by the high temperature of such extreme pressures. For, although the experiences of our workshop practice show that the results of cold inducing straining from compression, are oftentimes far more destructive in its effects on cast iron than heat causing expansion, it is found that increments of heat, by extending and stretching the particles of cast iron, always causes a diminution of strength.

According to the experiments of Professor Daniel the elongation of a bar of cast iron due to 75° is ·000416. Now, 75° is contained in 387° five times, therefore five times ·00046 = ·00233, about 1/500 of its length. The compressibility of cast iron is greater than that of wrought iron, and a ton per square inch is capable of compressing through 1/6000 of its length, and as the above expansion was nearly 1/3000, the power exerted must be nearly 2½ tons per square inch. Now, although danger might not perhaps be apprehended from simple pressure, yet, when these pressures are accompanied by motion, and that of an intermittent kind, there might be some risk of a strain being produced by accumulation, far greater in amount, and being sometimes forward and sometimes backward, far more destructive in its effects than simple pressure. From these considerations, it becomes a question of some importance, and one requiring attention, as to how far or to what extent the elasticity of cast iron is capable of sustaining expansion when it is subjected to high temperature, and when the expansion is very considerable from that cause. It is to be regretted that the limits of this paper will not permit us to enter into the experimental details and subsidiary inquiries connected with this extensive and laborious investigation, the details of which are always ingenious and instructive; this consideration will amply repay the minute study of the mechanical student and workman. It is principally by the collection of facts and accurately recorded statistics that we can gather data for the solution of such questions. Perhaps, at the present time, no mechanical question has more claims on our attention than that which relates to the numerous instances of failure amongst the cylinders of the marine engines in the British Navy. The causes of these are mostly of a preventible nature, but there is so much confusion prevailing over the whole subject that the disposition to attribute such results to metal, to contraction, or some other equally indefinite cause, points to a want of a clear apprehension of the exact points wherein those cylinders fail. If we separate the forces of expansion into two groups, which shall include the strains produced both by the agency of steam itself, and likewise that which is due to expansion of the metal arising from the temperature of the steam. The interior surface of the cylinder will be understood to be exposed to two strains, each one acting at right angles to the other; and now, if fracture occur, it will certainly be in the line of those forces. In some cylinders, however, from a want of judgment on the part of their designers, or from oversight at the proper moment, those forces are entirely ignored, and disaster follows inevitably.

The remedy for all this unsatisfactory designing and practice lies in the investigation and adoption of the principles upon which endurance depends. In other words, we must wisely follow, as our guide, those groups of forces in all their radial and longitudinal directions, and observe the various appendages that are cast on and surround the tubes of cylinders in a practical light.

Nearly allied to this section of our subject, there is yet to be dealt with what constitutes the gigantic and imperial question as to the suitableness of cast iron as a material for ordnance. This is a point of most intense interest and importance, for, although we are warned that cast iron, from its low tensile resistance and strength, is totally unsuited and unsafe for the requirements of ordnance of large calibre and power, we yet believe there is a successful future in store for the advocates of its use. With the example and practice of the Americans before us, with their manner of casting, and then of cooling their guns by means of a hollow, spiral tube, and streams of water flowing through it until the casting is in a condition for the lathe, we ought to grow wiser. Cast iron treated in this manner has thrice its previous strength. The astonishing superiority of such guns has been proved to be due, in a great measure, to the effectual manner in which the cooling is thus made to take place. In fact, rapidity in cooling a casting improves the quality and strength of the iron, by imparting to it closeness and density.

We have long believed, and recent circumstances have added to the strength of our conviction, that better results would be obtained in casting our heavy ordnance, if external longitudinal ribs, intersected by rings, were made to surround the circumference, the principal bands covering the seat of the cartridge and of the shot or shell behind the trunnions, the ribs gradually tapering off towards the chase and muzzle of the gun.

As the bursting energy and power of gunpowder is said to be 33 tons per square inch, or some five times greater than the tensile strength of ordinary cast iron, we are enabled to suggest and determine upon a section of sufficient, but yet moderate area, which would secure a given resistance to the explosive force of the powder, whilst insuring a margin of safety. This may be done without having recourse to those ponderous yet graceful forms so familiar to all of us in the Dahlgren, Parrot, and Rodman ordnance of the Americans, which, however, do not add to their strength, but which make them look heavy and unwieldy. Without wishing to annihilate your patience by the recital of what is speculative and uncertain, I cannot but avail myself of this opportunity of reminding you, that although cast iron from its low tensile strength seems inferior to malleable iron or steel, yet that its cheap and easy construction, and the quick and ready manner in which cast ordnance can be produced, will at all times entitle this material to consideration. The history of scientific discovery teems with proofs that it is very unsafe to predicate that no progress will be made in a direction which we may think to be a wrong one. Transatlantic steam navigation was pronounced by a very distinguished savant to be an impossibility—how many voyages are now made to prove that prediction a false one? When, therefore, we hear any one assert that cast iron is unsuitable for the purpose of producing trustworthy ordnance, and pronounce its doom as certain, if not already accomplished, and that no improvement is to be effected, and no progress is to be made in this direction, such remarks are not without their value, and they will not assuredly shake our faith in the ultimate triumph of cast iron over its detractors.

We now propose to glance for a moment at the indirect claims of our subject—to use a popular and political phrase of the day—and to notice the products of the modern school of engineering design and construction.

Those ponderous mechanical incongruities which we sometimes observe, and which are designated as steam-engines, suggest, in the exuberance of their malformation, notions of specimens of the extinct species of the pre-adamite world. But even as contemporaneous man dwelt then in tents of skins, with curtains hung round about them, and his descendants build palaces of alabaster, so may the descendants of the present race of engineers and machinists produce eventually works that shall combine strength with graceful outline and form—the utility of the modern, with the philosophic grandeur and beauty of the ancient style. It is to be deplored that with the exception of a few of the leading firms of this country, as certain agricultural implement-makers and small machinists, for example, no efforts seem to be made to introduce expression into the construction of engines, or to combine the maximum of strength with the minimum quantity of material. Our prodigality of material, indeed, seems only to be equalled by that of our fuel. There really exists, as a general rule, but little connection or affinity between the proportion and strength of a structure and the mass of material of which it is composed, or in the general outline and disposition of its parts. It is common to specify for an unnecessary margin of strength, apparently only with a view to meet the chances of mistake on the part of the designer. But why allow the incompetency of the designer, or the fancy of the overseer, to supersede mathematical precision or the cause of good taste and order? The ancient Greeks owed their superiority in architecture and sculpture to this characteristic. Thus, in columns, for instance, the details of mouldings and parts were multiples of diameters, whilst in figures they copied and reproduced everything with just scientific proportion and accuracy. Why should the details and parts of a steam-engine not be made conformable to some such plan? Upon what principles of mechanical science should unreasonable variations be allowed to exist? We find in the practice of wheel work wide differences in the arrangements of several firms and individuals. The proportion of the length of teeth to the pitch ranges from seven-eighths to five eighths of the latter.

Why should not something like uniformity of design, regularity of proportion, and ratio of material, be conditions subsisting between all the parts of an engine or piece of mechanism? That it is not so arises primarily from the want of purpose and of uniformity in technical education and scientific culture. Were it otherwise, economy of material would be secured and safety enhanced. Notwithstanding the importance of this subject, it is rarely mastered by the ordinary race of draughtsmen and mechanics in a way to influence their practice beneficially.

In the discussion which followed, Mr. Stabler said, as regarded the systems of ordnance, which from time to time had been started, he remembered the elaborate experiments and explanations given on the subject by Mr. Keyte, at the Woolwich Arsenal, about ten years ago. The endurance of cast-iron guns, hooped on Sir William Armstrong's principle, was at that time a vexed question, and Mr. Keyte had had much experience on the subject. It was then that the tensile strength of the several pieces of ordnance underwent severe testing, and the cast-iron gun with its cumbersome fittings sustained, nevertheless, a considerable explosive force. As to the best mode of casting cylinders there was much variety of opinion on the subject. As the author of the paper had pointed out, our incapacity of designing proportions that shall render the castings at once ornamental and safe was undoubted; but it might be shown, on the contrary, that the outline of a casting had really little to do with its intrinsic value. Mr. Laird had touched upon the chemical affinity which existed between certain constituents; it had even been shown that the influence of the earth's magnetism could not be disregarded with impunity, and the entire question had received and deserved great consideration at the hands of engineers, but the problem of good castings was far from being solved, although often the most palpable mistakes were made from sheer ignorance of first principles. The complex form of cannons had given way to a more simple pattern; sharp angles and corners which are perfectly useless, if not dangerous, have in many instances been abolished. It is the perfection of the gun, as an instrument, that must be aimed at; and, however plain it may look—to the really educated eye—such a piece of ordnance will ever command the greatest consideration. In the casting of large cylinders the most elaborate precautions had often failed to insure the desired success. Disintegration of the component parts is mainly caused by unequal and unsatisfactory cooling. However, a great deal might be done in bringing about more satisfactory results. Mr. Stabler then described a plan according to which the metal is more equally divided, and better disposed for the purpose of cooling. In the absence of a diagram the explanation was difficult to understand, but the casting is, as it were, honeycombed, cups at regular intervals being inserted, thus creating an almost uniform thickness of material all through. He went on to speak of the merits of steam-jackets, high pressure steam cylinders, and the employment of steel in casting cylinders. The substance in that case might be considerably reduced in thickness, but to all intents and purposes it was his opinion that for engine cylinders cast iron would hold its ground against all other materials.

Mr. Briggs briefly reviewed what had been advanced on the subjects of tensile and compressive strength, power to resist impact or shock, modulus of elasticity or stiffness, but he regretted that internal strains had hitherto received but little attention. He proposed to those who were able to take the matter up to construct cylinders of 2, 3, 4, 5, &c., inches substance, to burst them experimentally, and thus to ascertain a ratio which might be approximately correct.

Attention being drawn to the effect of rings placed outside of the cylinders, Mr. Bragg, who was understood in the main to corroborate Mr. Briggs, thought that there was one point which must not be lost sight of in accounting for the bursting of cylinders—viz., that there is more elasticity outside than inside. He demonstrated the fact simply and clearly by assuming that two beams, one 18in. long, and another 3ft. long, were stretched at the same time. He need not say what the result would be, but that clearly established the relation between the inside and the outside of a cylinder. He further said that as a matter of experience if a cylinder split lengthwise, the bottom remaining intact (which, by the bye, it did in one case out of a hundred), the line of fracture passed through the vent hole.

Mr. Jordan, who spoke from practical experience in the matter of hydraulic cylinders, thought that that was not difficult to account for. By drilling into the body of the cylinder a wedge is actually made for its splitting. There could, however, be no difficulty in avoiding these consequences. The drilling should not touch the body of a cylinder at all, it should be kept outside, and that was done by having a boss at the proper place.

Mr. Briggs replied that the boss itself would hardly offer a guarantee against fracture, that might take place right through boss and all.

Mr. Jordan thought that would undoubtedly occur where the engineer neglected his duty, and that was to see that the metal was properly mixed, and the moulders were prevented from having it all their own way. As to the question of rings, he had no doubt whatever upon the matter. Practically, they were of the greatest use in insuring the strength of the cylinder, but they were additions which people simply declined paying for. There could further be no question as to the possibility of fusing cast with wrought iron.

The Panama Canal.—According to the latest intelligence from the Isthmus of Panama new hopes are entertained about making a ship canal across that obstruction. After failing to discover a promising line for the excavation in the narrower portions of the neck, the American surveyors have gone back to Nicaragua, and now report a favourable place towards the north of the Isthmus, where they believe the enterprise can and should be accomplished. It cannot be doubted, however, that much greater difficulties stand in the way of this canal than in the case of that of Suez.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

263 P. XVIII. AQUILÆ—EYEPIECES—CENTRIFUGAL "FORCE"—PARALLELOGRAM OF FORCES — COMET — FIELD-GLASSES — SUNRISE AND SUNSET—AND THE HARVEST MOON.

[4653.]—IN compliance with the request preferred by "Epsilon" (let. 4588, p. 485), I have looked at the star 263 P. XVIII. Aquilæ, but confess that I should not have recognised it from his description. Webb's directions for finding this object are perfectly correct; and if "Epsilon" will get his namesake in Aquila at the bottom, or north, of the field of an eyepiece of the magnifying power he specifies, or perhaps of a rather lower one, he will see the star he seeks almost south of it, and on the other side of the centre of the field—in fact, after ε, it is the most conspicuous object in it. Now, however, comes the curious part of the matter, 263 P. *is*, I see, triple—*i.e.*, it has a second faint, and considerably more distant companion than the one whose position angle and distance Webb gives (from Smyth). Unquestionably, however, the position angle of—what we may call—the original companion is almost precisely 289°, while that of the more remote one is much nearer 20° than 110°, at which latter angle no star whatever is visible in my instrument. Moreover, the comes now under discussion is a good deal farther off than 14" from its primary. It is too faint to bear the illumination necessary to measure its position angle and distance micrometrically; but, at all events, the whole asterism by no means corresponds with "Epsilon's" description of the object he picked up, and which I have quite failed to identify. Should my querist be the possessor of an equatoreal, in proper adjustment, he ought, by taking the R.A. of 263 P. XVIII. Aquilæ as 18h. 54m. 9s., and its north declination as 14° 44·2', and setting his circles accordingly, to get it almost centrally in his field of view.

There is a tacit assumption contained on the letter (4634) of "Betsy Summercity" on p. 513, which it is necessary in the outset to correct. It is this, that the image formed by a properly-constructed achromatic object-glass is less perfect than one produced by a parabolic mirror. Now, disregarding the small and scarcely appreciable secondary spectrum, I assert, quite confidently, that one of Dallmeyer's object-glasses transmits an image in every way as optically perfect as the finest mirror ever ground, and that the Huyghenian eyepiece produces no more effect upon the one than it does upon the other. If we construct one of these eyepieces with two lenses of the same material, so placed that the distance between them is an arithmetical mean between their focal lengths, the combination is *ex necessitate* achromatic—*i.e.*, it magnifies the rays of all colours precisely alike, and shows a white image white, a green image green, and so on. A properly made Huyghenian would, in no shape or way, give "the necessary correction" to an "imperfectly corrected" object-glass; on the contrary, were the latter under-corrected, we should have the ultimate transmitted image fringed with red and yellow; and were it, on the other hand, over-corrected, such image would be edged with deep blue. As for curing spherical aberration, the Huygenian eyepiece would not do that either, because the kind of distortion which takes place in it merely produces the result of rendering equal angular intervals in different parts of the field non-correspondent with equal divisions of a micrometer covering it. Any object in a definite part (say the middle) of such field is sensibly free from distortion. Besides, Sir George Airy's formula enables the optician to eliminate the greater part even of this defect of aplanicity. I rather fancy, from internal evidence, that "Betsy" has been reading the description of the Huyghenian eyepiece as applied to the microscope, written originally by the late Andrew Ross in the "Penny Cyclopædia," and reproduced by Quekett in his work on the "Microscope," p. 167, *et seq.* I was quite aware that "B. S.'s" notion of employing a microscope as an eyepiece was not new. Our greatest living spectroscopist, Dr. Huggins, F.R.S., &c., used his Ross binocular in this way as far back as the year 1861, in order to obtain *quasi*-stereoscopic images of celestial objects. Nothing, however, ever came of it. Reverting for a moment, before concluding, to the subject of the secondary spectrum, I may reiterate, what I have before mentioned in these columns, that I saw last autumn an object-glass by Wray in which this was for all practical purposes cured, in fact, which was sensibly aplanatic. It had an aperture of 3·75 inches only, but exhibited the colours of Jupiter's belts marvellously; in fact, I question exceedingly whether any 6in. mirror could or would have shown this phenomenon much better.

I would join "C. H. W. B." (let. 4646, p. 514) in deprecation of such a term as "centrifugal *force*," the centrifugal tendency merely has its origin in the first law of motion.

It is something fresh for me to learn from "Marine Engineer" (let. 4649, p. 515) that ". . . to produce a double velocity requires the expenditure of a fourfold force;" because I have always hitherto been taught, and have believed, that a double force applied to the same body produces a double velocity in a unit of time, a triple force a triple velocity, a sextuple force a sextuple velocity . . . and so on to *n* terms. For example, let us conceive an iron ball to be dropped from a height, then at the end of one second, it will have acquired a velocity of 32ft. 2in.; but, having started with a velocity of O, will have fallen through 16·1ft. Let us now, though, further imagine that a magnet placed underneath our supposed ball begins to act upon it at the same instant as gravity does, and with exactly the same force, then, as that alone would impart a velocity to it at the end of the first second of 32ft. 2in., the combination of the two forces will induce one of 32ft. 2in. + 32ft. 2in., or 64ft. 4in.; and, inasmuch as the ball started from a state of rest, at the expiration of the second it will have fallen just 32ft. 2in., or exactly twice as far as it would have done if acted upon by either of the two equal forces alone. How "Marine Engineer" has mixed up "the theory of projectiles," with the simple and obvious law which I have attempted to illustrate it is not for me even to attempt to guess.

I can only say in reply to Mr. Grayson Golcar's query (12545, p. 521) that I don't know. I may perhaps add that I think it probable that this reply will be echoed by the rest of "our astronomical contributors."

It is practically impossible to answer such a question as that put by "Lambda" (query 12549, p. 521) without seeing the glasses of which he complains; but I should say that the appearance which he describes almost certainly has its origin at the eye-end of his field-glasses, and *may* possibly be a diffraction phenomenon, having its seat in the stops bounding the field of view. It might even be a spectral appearance, arising from fatigued retinæ; but, as I have implied before, it is idle to theorise in the absence of the offending instrument.

I trust that the following formula and example will enable "Delta" (query 12570, p. 522) to calculate the time of sunrise and sunset for himself. It is abundantly accurate for all ordinary purposes. Let us call the co-latitude of his place of observation ψ, the zenith distance of the sun z, and his North Polar distance d, and let us call $z + d + \psi$, 2 S, and the hour-angle from the meridian when the sun is on the horizon H. Then—

$$\text{Sin.}\ \tfrac{1}{2}\,\text{H} = \sqrt{\frac{\sin.\ (\text{S} - \psi)\ \sin.\ (\text{S} - d)}{\sin.\ \psi\ \sin.\ d.}}$$

By the aid of an example, we will put this into figures. At what hour will the sun rise and set, in lat. 51° 30', on August 10, 1872?

Here we have—

Co-lat. ψ	38° 30'
Sun's N.P.D. d	74° 35'
Sun's Z.D. z	90° 50'
2	203° 55'
S	101° 57'
S − ψ	63° 27'
S − d	27° 22'

Sin. (S − ψ)	63° 27' =	9·9516020
Sin. (S − d)	27° 22' =	9·6624586
Co-sec. ψ	38° 30' =	0·2058504
Co-sec. d	74° 35' =	0·0159148
	2)	19·8358258
Sin. ½ H =	55° 52' 15"	9·9179129
	2	

H = 111° 44' 30", and this in
Time = 7h. 26m. 58s.

Now the sun is on the meridian on the 10th at 0h. 5m. 8s., and if from this we take 7h. 26m. 58s. we get 4h. 38m. 5s. for the time of his rising, and adding the same quantity, 7h. 32m. 1s. for that of his setting. It must, however, be borne in mind that this is not rigidly accurate, since at his rising his north polar distance will be less, and at his setting greater, than the quantity we have assumed. This change in declination, which in the case of the moon is very rapid, added, moreover, to her perceptible parallax, renders the accurate calculation of moon rise, &c., a very complicated matter indeed, and one, the explanation of which would demand very much more space and many more figures than I feel at all disposed to ask you to grant me, or to print. May I advise "Delta" to compute a table of semidiurnal arcs for his own latitude? He will find the simple formula, and an example worked out, on page 461 of your thirteenth volume. (I must, by-the-way, ask him to correct the misprint of "T" for D on lines 12 and 23.) Such a table would be very useful to him on many occasions.

I will, after the Scottish fashion, answer the question (12591) of "A. S.," on page 552, by another. *Does* the harvest moon appear larger than at other times? I see that another of your correspondents, "M. A." (let. 4622, p. 509), appears to labour under the same hallucination as "A. S.," and to imagine that she does. I suspect the fact to be that people hear that the harvest moon rises, about the full, nearly at the same hour for some nights, and so look out for her on the horizon. Were they to watch her rising at other times, they would see that she would appear just of the same diameter as she does at that particular one. The question of the apparent increase of size of bodies as they approach the horizon is a very curious one, though. It is very marked in the case of a descending balloon; albeit, it may actually be travelling away from the spectator. This question has been mooted in "our" columns before, but I have no time just now to wade through the indices.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

PERSPECTIVE.

[4654.]—IN my first endeavour to introduce a glimmer through the wondrous Chinese sun-screen of M. Paris on this matter, some three months ago, I had sketched, but did not think of asking you to engrave, the diagram now given in Mr. Proctor's letter (4621, p. 509). I could not conceive any one requiring a figure to realise my simple remark that the top and bottom of the tower's picture were at distances from the eye just as different as those of the tower itself. Now, referring to the diagram, does M. Paris mean to deny that *ab* is "optically less" than *cd* in the exact ratio that AB is less than CD? It is marvellous that others, as "Bobo" (let. 4605, p. 489), will repeat that the reason "artists draw all vertical objects" without convergence because the upward convergence is "slight." It is neither slighter nor anywise less sensible than horizontal convergence in a street. It is simply that the pictured lines *must* be parallel *in order to converge rightly* in the eye. Similarly the "figures in a market-place" of M. Paris's last letter (p. 510), if standing in a rank parallel with the picture plane, must all be drawn of equal height, *in order that* the lateral ones may (in the eye) be duly diminished; and M. Paris, by making the latter shorter in his picture, would simply falsify the *drawing*, which branch of art (apart from *painting*) is matter of rigorous science, no more admitting of "compromises" than geodesy or arithmetic admits of compromises. It is true, as I have pointed out, there are a few trifling details wherein a picture to ornament a wall, and so to be viewed from various directions, away from the point of sight, should differ from a "cosmorama," *i.e.*, peep-show or stereoscope slide. These, however, only apply to artificially regular objects, as architecture and furniture; and the chief is, that the scene should not embrace above 40° or 50° of the horizon, though it may have far more range vertically for the reason I explained. The next, and perhaps only farther modification is that horizontal circles, as the caps and bases of columns or turrets, however near the sides of picture, should have the major axis of their ellipse horizontal, instead of rising toward the side, as rigorous drawing requires it. Again, the sun, moon, or a full fronting clock-face, however far from the picture's centre, should be circular, not elliptical, as strict perspective (or photography) would make them; but indeed the ellipticity would hardly be sensible except at greater distances from the point of sight than any picture is likely to place them.

These might be called "*gallery* compromises," *i.e.*, between the strict truth of a projection for one defined point of view, and one whose spectators are supposed to move. But none such will apply at all to a cosmorama, nor to a book illustration, or anything having a supposed single definite place for the eye; and any difference *of line* in "pictorial perspective" as distinct from "linear" in the phrase of "M. A.," p. 509, I must beg utterly to deny as sanctioned in any place or time pretending to real art. The sun's or moon's diameter in a picture must bear that relation to its architectural vanishing points that 32' or 34' bears to their real angular distances on the horizon. In no case can it be magnified without mere barbarism. One of Robert's views of the Pyramids grossly exaggerates the rising sun, to many degrees diameter. To make it true, the whole picture would have to represent the field of a telescope many miles from the objects; and in that case, of course the architectural vanishing-points would be perhaps as many yards out of the picture as they are inches. If any peculiarity of light or colour is held to convey to any eye an impression of greater size, let the painter so imitate the light or colour as to convey the same impression (or "illusion" if you will), but to falsify the size itself—to falsify *line*—is sheer blundering puerility; and there is no case of "compromise" in form yet described by "M. A." or M. Paris that is anything else, or that even Chinese would now (since the spread of photography) tolerate. As for the impressions given by a mountain slope in front view, and the picture of it, the latter, being vertical, cannot well avoid (except in a stereoscope) appearing the steeper of the two. I presume it would puzzle even M. Paris to give (p. 510) the "real slope" rather than "the apparent." If he means, however, that any one over-estimates the slope of outlines seen in profile, the same mind (not "eye") will equally over-estimate that of a *truly drawn* representation. The artist's business is to give the spectator the same means or *linear material* for judgment that Nature gives, and leave him to judge or misjudge accordingly. There are artifices in colour, or what "M. A." calls "pictorial perspective" (more properly "aërial perspective"), but the whole *form* or line system, and *every line* in a picture, is either true or false, just as each number in an almanac or a bank account-book is true or false; and cooked outlines are just as much or as little needed or tolerable in any world, artistic, "æsthetic," or what you will, as cooked accounts.

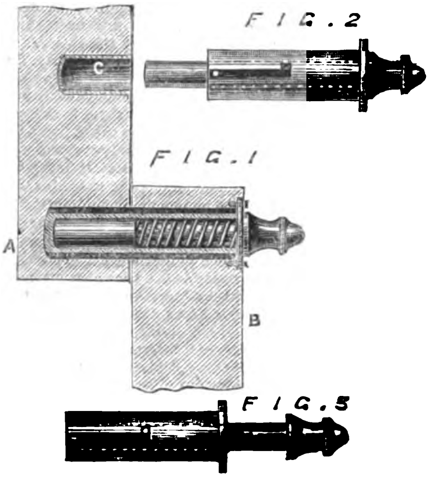
What Sir David Brewster cited a rectangular tower to illustrate was probably the straightness (as well as parallelism) that the eye, however near, attributes to the sides, though their images on the retina are decidedly curved, more so than the *entasis* of any column. If M. Paris would obtain for his stereoscope the Salisbury spire view that I long ago referred to, and which I find is marked "Sedgfield's English Scenery," No. 377, it would greatly enlighten him. It is perspective with *no* parallel lines, and with *three* vanishing points, the upper one or zenith probably the nearest of the three. It is a view, but not a picture, because the latter word implies a view projected on a *vertical* plane. A photograph of a tower, however near, taken on a vertical plane (as I have repeatedly told him), *cannot* have *any* upward convergence. Neither can a plummet, near or distant, detect any leaning in lines that do not really lean.

The optical corrections (so-called) in the Parthenon and other Greek buildings, are a wonderful evidence of refined art, but have really nothing to do with these perspective rudiments. It is quite certain those who contrived them would never have tolerated any outline-cooking such as M. Paris defends, in the representation of them or of anything else. Moreover, I doubt if many of them were "optical" in their object, so much as mechanical, or directed to high philosophic ideas of perfection. Thus the convergence of the axes of all the columns tended evidently to firmness, duration, and resistance to earthquakes. Their entasis was almost necessary if the workman (as Ruskin first remarked, I think) was on no account to cut *within* the straight line, any invasion within it being truly intolerable. Then the hyperbolic curves of the long courses must make them, from some central point, exactly fit the cone of rays from the sea horizon, evincing that they observed its dip, that Minerva's architects were no Hampdens of a poor nineteenth century, but were building on a globe of definite size, and knew it!

E. L. G.

NEW SASH FASTENERS.

[4655.]—THESE drawings almost speak for themselves. Fig. 1 shows the section of window closed; to open it to admit air you draw out the knob and throw



up the window, which will fasten itself at any height you may require. Figs. 2 and 3 show the bolt fastened and withdrawn. This is a perfect and simple fastener, and I am told does not readily get out of order. A and B in Fig. 1 represent the sashes, C hole made in them to admit bolt, which can be made at any height you require the window to open. J. W. RICHFORD.

ECONOMY IN USING COAL.

[4656.]—W. BROWNE (let. 4556, p. 468) very wisely suggests the use of fire-balls, made of coal slack and clay, as a substitute for coal, that has become and is becoming so very dear. These are used very successfully in South Wales, where they are made of culm (the small of anthracite coal) and wet clay, beaten together, and formed into larger or smaller balls, as a slower or quicker fire is desired. They make a very pleasant and economical fire for any weather, but more especially for warm weather, when a gentle fire for cooking only is needed. Some months ago you inserted the description of a mode for making these fire-balls impervious to wet, which I have tried to refer to without success. I think it was by dipping them into melted paraffin, but am not sure. The Welsh fire-balls being made of culm, containing little bitumen, burn with very little smoke or flame, the latter being chiefly that of carbonic oxide. Most of the heat produced by the flame is absorbed by the clay, and given off as radiant heat, less than usual being either conducted away by the grate or carried up the chimney—the way most of the heat of a common fire goes. Ordinary slack is not, I am told, so suitable for making fire-balls as culm is, but perhaps would be if some gas coke were added. Count Rumford recommended fire-balls to be made of equal parts of coal, charcoal in powder, and wet clay. He suggested that straw chaff or sawdust might be tried; also that balls, if to be used for lighting fires, might be dipped into a solution of nitre to make them burn easily. The clay in the fire-balls makes the ashes more dusty, but that is a slight inconvenience to set against the great economy. PHILO.

THE GULF STREAM.

[4657.]—I HAVE been much interested in perusing the article by R. A. Proctor on "Oceanic Circulation." I quite agree with him in retaining the term Gulf Stream, although I have long held the opinion that it does not all traverse the Gulf of Mexico; but what I wish more particularly to draw attention to is a method by which its presence may be traced which is not yet recognised by the scientific world. My idea is that it impinges on our west coasts at an angle much more nearly to a right angle than it is laid down in the chart which accompanies the article. I trace its effects on the coasts reaching from Brest to the North Cape, wherever they are exposed to the direct action of the Atlantic Ocean. A glance at the map will show a peculiar ruggedness of outline in contrast to the sandy shore of the Bay of Biscay. This characteristic marks the coast in the neighbourhood of Brest, the south-west coasts of Devonshire and Cornwall, the Bristol Channel to the Bay of Carnarvon, south-west and west coasts of Ireland, west coasts of Scotland, north of the latitude of Ireland, the Orkney, Shetland, and Faroe Islands, Iceland, and the coast of Norway to the north of the latitude of Scotland and the Orkneys. Whence this ruggedness of outline? It results from the absence of the protection of a sea-beach. If you observe a sloping sandy beach after an on-shore gale of wind, you will find that there has been a movement in a seaward direction, and probably the sand has moved seaward and left the gravel. This phenomenon admits of an easy explanation: an on-shore gale must necessarily raise the surface of the water in-shore. This, of course, creates a counter current in an opposite direction, and although this current may not have the power to move the sand when in a quiescent state, yet when the breaking wave stirs it up it will remove it in a seaward direction. A little reflection must convince us that the Gulf Stream must have a similar action on the shore as an on-shore gale, with this difference, that this action will be constant, not alternating with the change of wind from an on-shore to an off-shore breeze, as in the latter case there is nothing to counteract the natural action of the wave, which, taken *per se*, is always accumulative. I consider that the Gulf Stream is forced into its present position by the polar counter current which hugs the coast of America, but it must be evident that this was not always the case, as previous to the elevation of the Scandinavian peninsula, we have many proofs that this counter current came down the White Sea and along the Baltic, bringing the polar icebergs to this country, and when the land became too much elevated to allow of the icebergs drifting in our direction, we should still have the cold current and the thinner ice, keeping down the temperature of these islands so that glaciers would form on the hills. As to the geological period to which this change may be referred, I may remark that A. Geikie, in his "Scenery Geology of Scotland," p. 320, mentions a raised beach, about 40ft. above high-water mark, which contains Arctic shells, and thinks this elevation dates from the later part of the glacial period, which coincides with my view as being on the coast of Argyleshire and Inverness, consequently facing the Atlantic. If the Gulf Stream then ran in its present direction it would have removed this beach. He also mentions another beach about 20ft. to 25ft. above high water; but this only exists to the southward (page 323), where it is sheltered from the action of the Gulf Stream by Ireland. It is evident that the Glacial Period had passed at the time of this last elevation, as human implements have been found in it, showing that the climate was milder, and the island was inhabited—its absence to the north shows that the Gulf Stream had then changed its direction. I attribute the traditions we hear of the wasting away of the land on the south-west coast of England, in the neighbourhood of the Channel Islands, &c., to be a consequence of this change. J. WILSON.

AURORA.

[4658.]—AN aurora was seen here on Saturday last, the 27th July. At ten p.m. a bright diffused homogeneous light was visible over the northern horizon, from which at midnight shot up bright white streamers, which were well visible even in bright moonlight. This display seems to have been the conclusion of the hot and stormy period commencing on the 20th July. It is worthy of remark that the stormy period during January last was succeeded by the great auroræ of February 3 and 4, 1872. HERBERT INGALL.

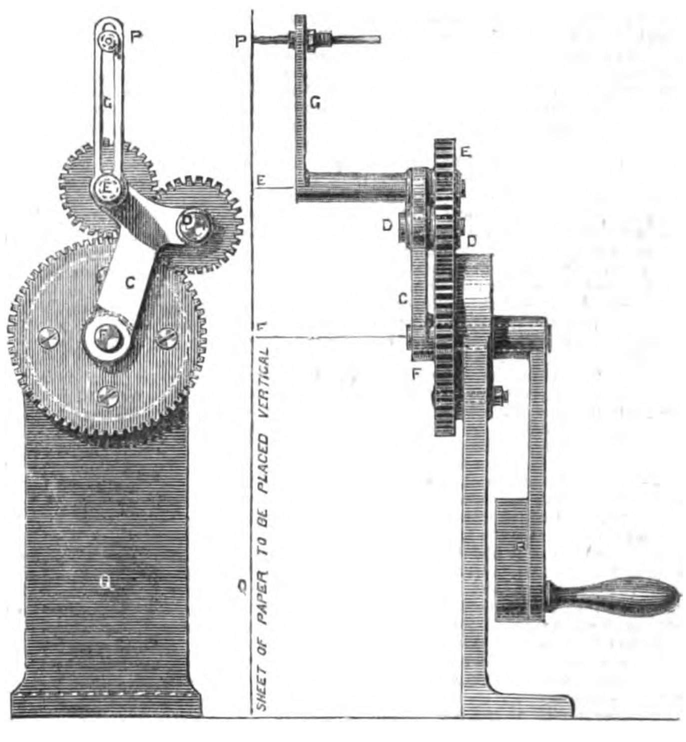
Champion-hill, S.E., August 1.

CHANGING RECIPROCATING INTO ROTARY MOTION (p. 484).

[4659.]—THIS appears to be a modification of a plan which I saw working a small steam-engine to turn a lathe, in the town of Lincoln, some years ago, and which made a very objectionable clatter in revolving, but was simpler than this, although neither are applicable to large engines, more especially sea-going ones, as the backlash of the cogs would be something awful to contemplate. In the engine to which I allude there was a cog-wheel with the teeth on the inside rim, which was attached to the standard H in the position of the dotted circle shown in diagram, the pinion revolved in end of arm C, and was fast to arm G, thus doing away with the intermediate wheel. Verdict: Cog-wheels not a practical arrangement for large engine cranks.

A., Liverpool.

[4660.]—THE so-called "new method of changing reciprocating into rotary motion" (described in letter 4578, p. 484) is fifty years old, and would have been employed had it been of any value. I send you a sketch of the apparatus we used in the drawing-office about 1848 for describing ellipses, &c., which is perhaps its best application. If any of your readers will take the trouble to make one it will afford them a month's amusement, as they can describe figures of marvellous extent and beauty, particularly if the proportions of the wheels E and F be slightly altered, the paper made to rotate, or motion endways communicated to it, &c. The intermediate wheel D should have two teeth less in number than the wheel E. The diameter of the wheel E is one-sixth, and the diameter of the wheel F is one-third, of the length of stroke required. The levers



C and G being of equal length, a pencil placed at the end of the lever G will describe a straight line equal to the length of stroke required. By moving the pencil inwards elliptical or oval figures are then produced. Wheels E and F are placed as near as possible to each other without being actually in gear.

REFERENCES.

P Q = length of stroke required.
E P = E F = one-fourth of ditto.
Diameter of wheel E = one-sixth of ditto.
Diameter of wheel F = one-third of ditto.
R balance-weight for levers C and G and wheels D and E.
Sheet of paper to be placed vertical.

JOHN H. KIDD.

WATCH REPAIRING.

[4661.]—I QUITE agree with an "Aberdeen Watch Jobber" that the method adopted by "Seconds' Practical Watchmaker" for bumping Geneva escape-wheels is far from being a safe one. I also think that of "A. W. J." defective, for if you allow a hammer (unless it be a brass one) to strike the crosses, it leaves a mark; besides, there is a risk of the pane of your hammer coming in contact with the teeth. My plan is as follows: I lay the wheel upon a leaden stake having a hole in its centre, to free the pinion, then with a punch (made of peg-wood) and hammer strike the cross required to be raised. The lead readily gives to the slightest blow of the hammer. I hope that "S. P. W." will give us jobbers some valuable wrinkles in his papers, taking care to avoid any of those connected with the "soft Tommy" argument.

JOHN MCKAY.

HINTS ON THE CONSTRUCTION OF GREENHOUSES.

[4662.]—I have for some time had an idea that if your horticultural readers were, figuratively speaking, to put their heads together, they might conjointly hit upon a design for a modest greenhouse which would suit the pocket of the average English mechanic, and yet be all that he could require. As the season is fast approaching when the greenhouse is in requisition, I hasten to lay before those whom it may concern a few notions on the subject, which, though doubtless crude, and maybe impracticable, will possibly load some of your readers of a more mechanical turn of mind than myself to lend their assistance in furtherance of the object. I need not say that a greenhouse affords healthful and pleasant amusement or recreation, as well as profitable occupation, and though at times requiring great and unremitting attention, there is ample reward even when the plants are not turned into money. The cost of a greenhouse, it is true, is considerable (comparatively speaking), but I scarcely think that is the only cause tending to prevent it becoming a more common appendage to a garden than it is. Few working men can consider themselves as permanently settled in any house in the suburbs of large towns, and unless the amateur floriculturist is a freeholder or leaseholder he is naturally chary of erecting a structure which he may be compelled to leave for the benefit of some one else. The difficulty of removing a greenhouse has something to do with this, and so has the law of fixtures; but the latter is obviated by erecting the house on a foundation of brick, when all that the law requires is that the bricks should be left, because they are "in the ground" and have become part of the "estate." That in a rough way is the law of fixtures as applied to greenhouses, and several manufacturers have taken advantage of it, and now supply houses which to all intents and purposes are "tenants' fixtures." But the cost of even these structures is rather heavy, the cheapest advertised being about £37 10s. for a span roof 20ft. by 12ft. This includes fixing and everything but the brickwork, the staging, and the heating apparatus. The framing and sashes are of red deal, the latter 2in. thick, glazed with 16oz. glass, with four coats of paint; the guttering, locks, and the requisite gearing for opening the ventilators being also supplied. It is obvious, however, that one-half of the sum stated is the price of the labour, and that if we estimate the cost without charging for our own handiwork, the amount will be considerably reduced, even allowing for the facilities of manufacture possessed by the seller, and for the lower cost to him of the materials. But as a matter of fact, few of the floriculturists contemplated by this letter would require a house of the dimensions specified; for besides being larger than most working men could spare time to attend to, it is naturally more expensive than a lean-to. The ideal house, therefore, with which I propose to start the subject, would be (say) 12ft. long, by 6ft. wide, and 8ft. high at the back, and about 5ft. or 5½ft. at the front. The brickwork would thus be, allowing a door 2ft. wide, 22ft. long by 3ft. high, so that 1,000 bricks laid half-brick thick would be ample for the wall and the fireplace, and enable piers a full brick thick to be built at intervals of a yard. The first two courses, full brick, might be laid *in* the ground, so that the front of the house above the ground level would be about 2½ft. brick and about 2½ft. wood and glass. Any tolerably sound old bricks would answer the purpose, and they would probably not cost more than 10s., including carting. Before starting with what may be called the foundation, it is highly necessary to settle the method of heating to be adopted, and also whether the floor of the house is to be on the ground-level or sunk about 2ft., more or less. Several advantages are claimed for a house thus sunk, and where lamps or gas are to afford the heat there can be no objection, but if hot water or the ordinary flue is intended to be used, my advice is emphatically build on the ground level, for with a fireplace it is absolutely necessary that the grate should be some distance below the level of the flue, and a similar arrangement will be necessary with a boiler, though in a greenhouse of the proposed dimensions hot water is scarcely a desirable or even economical heating medium. This part of the question, however, I will leave to another letter. Personally, I incline to the old-fashioned flue, and therefore proceed with my ideal house on the ground level; but independently of all considerations of heating arrangements I think a house far more convenient and pleasant when *on* the ground.

Before laying the bricks, then, it will be necessary to choose a site and mark out the plan on the ground. The best possible position for a greenhouse, then, is one in which the greatest surface of glass is presented to the south-east, for it is in or about this quarter of the heavens that the sun rises during those months of the year when his assistance is of the greatest importance to the inhabitants of the greenhouse, for the morning sun is the most beneficial to vegetation—why, I know not, but every one who has lived in walled town gardens running north and south has had ocular evidence of this fact. For obvious reasons, too, the greenhouse should be as near the dwelling-house as possible. The site being chosen, then, take out the soil to a depth of 6in. all over, and well ram along the line the bricks are to follow, except where you have determined to build the fireplace. In laying the bricks, when the course about 2½ft. high is reached, leave out one at intervals of a yard: these apertures are to be afterwards closed with wooden flaps which will act as ventilators when required. For the corner posts, 3in. quartering will be required, and these are to be connected by beams 2in. by 3in. with tenon and mortice joint, cramped together with bedscrews, dowel holes being cut in the 3in. posts, and dowels made to hide the screw heads when all is painted up. I propose that all the framing should be jointed in this way, which will present no insuperable difficulty and will enable us to take up our greenhouses and walk as easily as we do our bedsteads. In the 12ft. length three or four posts will be required to support the front beam, according to the sizes of the front sashes, and here I am slightly in a quandary as to the proposed dimensions, for my idea is to purchase second-hand or the machine-made sashes, but I do not know the sizes. However, these posts, be they three or four, will be stepped in the wall-plate of 3in. stuff bevelled off on the outside edge, and each sash should be hung by hinges at the top and fit fairly close against filleting nailed on the sides and bottom of the frame-work. The ends to be filled in with sashbar stuff (sold at 5s. the 100ft.), and the glass fitted in between each bar in one piece if possible. At the end at which the door is made, a post of 2in. stuff is to run up from the step to the sloping beam, and at a suitable height a cross beam will secure it firmly to the end post, while an iron rod will connect the door post to the front corner post, a similar rod being used to tie the other end together. I do not propose sashes for the roof, but fixed sashbars, let into the back and front beams and fixed by screws, so that the glass may lap over the front and be carried up to within 2in. of the back beam. The fillet or tongue of the sashbars is to be cleared off for the top 3in. to enable a board hinged to another screwed down to the back beam to fall close on the glass. This is to act as a ventilator, and would possibly be better in two or even three pieces, being made to open by small pulleys and strings from the inside. An iron rod, screwed at each end, should pass from one end beam to the other close under, and indeed, pressing against the rafter sashbars, being secured by a nut at either end. The glazing of the roof is a matter of some moment, and I unhesitatingly advise that the glass be in pieces, of uniform size, for convenience and economy of repairing, as well as to prevent scalding or scorching, which is very apt to occur under a hot sun when the glass is in single pieces for each pane. As to the best kind of glass—16oz. or 21oz.—I don't know what to say. It would seem natural that 21oz. is better able to resist hailstones than 16oz., the weight usually given by the makers for the lower priced houses, but a friend of mine assures me that 16oz. resists a hailstorm better than 21oz. as it "bends" and yields to the stones. If this is so the difference in price will settle the matter. With regard to fixing the glass, I think I should putty in all the vertical panes and fasten those in the roof with tacks or pins; but *chacun à son goût*. The whole of the framing should be exposed to the sun before painting, and when thoroughly dry four coats should be given, over and in all joints as well, for it can be rubbed off with sandpaper to make a fit afterwards, or the joints may be well dressed with raw oil. Now to the main point; I think all this may be done for about £5, according to locality, and a very cheap and serviceable house it will be; for, given a wall of the requisite height (if this is not to be had the difference must be made up with inch boards, which will keep out "cold" as well as 4½in. brick), shelves may be fitted all along, while ample height on the stage will be found for camellias and choice evergreens. The brickwork of the fireplace would, of course, be built in the house, with the ashpit and door in a hole outside, for by this means a very handy means of raising tender seeds is provided. It will be observed that I have confined myself to what is really a wooden house, for few amateurs understand working in iron, whereas many do in wood. I notice, however, that houses 30ft. by 12ft. span roof in metal are to be had for £35, but despite all that has been said to the contrary, I doubt whether they are more durable than wood, when it is *properly* worked. One well-known firm in the county of Essex supply galvanised structures at the following rate, 6ft. 4½in. long, 6ft. 3½in. wide, 7ft. 7½in. high at ridge, 4ft. 6in. at eaves, for £4 4s. 8d. This includes two glass ends and one door; the glass is cut up and a priming coat of paint on the wood. It will be understood that they are only made to certain sizes, so that the cost of the nearest approach to my ideal house would be £8 8s. 6d. without fixing, wall-plate, or brickwork. I should be glad if some one will correct my estimate. I make it somewhere as follows:

	£	s.	d.
Glass at 3d. foot	1	16	0
Two planks at 3s. 6d. 12ft. × 11in. × 3in.		7	0
200ft. sashbar at 5s.		10	0
Bricks, mortar, &c.	1	0	0
Wall-plate, a 3in. plank, cut longways		3	6
Front sashes, iron rods, screws, &c.	1	3	6
	£5	0	0

It will be seen that I have omitted to mention the paint, but I have allowed liberally for the other items, and at all events the cost is sufficiently near to be put at £5, at which price a greenhouse ought to pay for itself in a couple of years. But I have said enough at present, and shall be pleased to have the plan criticised.

Saul Rymea.

BLINKERS REMOVABLE.

[4663.]—I bought a five-year-old mare for gig and light work. She was blinkered, but I removed them safely and permanently. In a return journey, when the mare had expended her superfluous spirits, I took off her blinkers. This quickened her speed for a time. When she was fresh I put her blinkers on. This practice I continued for a few weeks; now she runs easily and freely without them. I have seen other instances of like character.

H. Clark.

ON COVERED STRINGS IN PIANOS; ALSO, WHERE AND HOW TO COMMENCE USING THEM.

[4664.]—In most of the best modern upright pianofortes not exceeding 4ft. 8in. high, it is usual to commence using covered strings at or about tenor C, in those 6in. shorter at D, and to make the first covered strings from one-sixth to one-eighth shorter than double the length of the uncovered strings which sound the octave above, according to the proportion the thickness of the steel under wire bears to that of the covering wire which is coiled around it; but, notwithstanding these comparatively large deductions from what would—were they uncovered—be their proper lengths, these strings are usually too tight to vibrate as freely as could be wished.

A very common defect is employing steel wire for the first covered strings many sizes smaller than that used for the lowest uncovered strings. Supposing the thickness of the copper covering wire to remain the same, it is obvious the thinner the steel under wire is, the more heavily it must be loaded in proportion to its tensile strength by coiling the same copper wire (say No. 1) around it; although (the length of each coil required to inclose a thinner steel wire necessarily being somewhat less than that needed for one of larger diameter) this evil is not quite so rapidly developed in practice as it would be if the same total weight of the coils on (say) No. 16 steel wire was equal to that on No. 20. The proportion of load to strength being, however, considerably greater in the instance of the thinner (No. 16) wire, we are compelled, to avoid the risk of breaking it, to make it shorter when employed to produce as sound of given pitch (say tenor C) than it need be, if covering wire of the same thickness were coiled on No. 20 steel.

As all pianoforte-makers well know that any great difference in the lengths of the last uncovered and the first covered strings causes a very sensible difference, not only in the loudness, but also in the timbre or quality of the sounds we obtain from them, they ordinarily make the first covered strings somewhat too long, thinking that they may thereby render less obvious that disagreeable "break" in the tone commonly induced by the substitution of covered for uncovered strings; but it is questionable if their second Devil is not worse than their first; for by making the first covered strings too long for the proportions of their covering and steel under wires, they are necessarily compelled to put too great a strain on the latter. In tuners' language, they don't "come up" readily, and when, by persistent pulling, they are compelled to come up, or rather are "dragged up," they are apt to be very stiff in their manners, in a word, too rigid to vibrate properly, not to mention that they then often fail to do good service for any long period, and they "crack up," and "go under," from which I infer that it is best to treat tenderly our slaves; and that "the merciful man who is merciful to his beast—even if that "beast" be his wife—will obtain by far the most profitable service.

It is a great mistake to suppose every increase of tension improves the tone of a pianoforte, at least below middle C. It is quite as possible for the base string of a pianoforte to be too "tight" as it is for its tuner to become so; and I can aver from experience, this is a condition of "things" which don't anyhow improve the voices of either of those "things;" certainly not the voice of the human "thing," for when "too tight," his voice is rather apt to be less clear than it normally is; and want of "clearness," both of thought and vocal utterance, is not so vary uncommon that we need hardly employ "tightness" to increase a natural imperfection, which is so remarkably common to many of us.

In many cottage pianos which have come under my observation, the last uncovered strings have been of Nos. 20 to 22 wire, and the steel under wires of the first covered strings only Nos. 16 to 18—a difference of from four to six sizes in two successive semitones; need we wonder a difference of length equal to about one-sixth was found necessary, or that the difference of timbre was most offensive, and the "break" so obvious, that I was tempted to "break" the covered strings which caused it. *Cæteris paribus*, the more nearly the lengths and thicknesses of the first covered approximate to those of the last uncovered ones—or rather to those of uncovered strings which are of the proper thickness and length for the sound one semitone below it—the less will the timbre of the sounds they produce differ from those of the lowest uncovered strings, because among other things the nearer will the bridge, which supports these strings on the soundboard, be to that which supports the former, consequently, I am far from being confident there ought to be any difference at all (certainly not more than one size, if any) between their thicknesses. Not having tried the effect of making them both of the same thickness when they were supported on different bridges, I cannot positively say they ought to be equally thick. Often, however, have I asked "ye practical men" why they use strings whose thicknesses differ; but the most "satisfactory" reply I have yet obtained is, "because it always has been done," which, no doubt, is quite conclusive if "whatever is, is right." Of course, a mere unpractical blacksmith (even if unable to swallow our poetical Pope's dogma) must be quite put out of court by such a reply as this, and if he (privately) presumes to think "whatever is is (occasionally) wrong," he had better—like all wicked heretics—keep his convictions to himself, lest he be further convicted of that mortal (original) sin ignorance, common to all; but he believes this word is also very commonly employed to designate incapacity to perceive the existence of alleged facts, which others think they know to be truths. Of course, such "incapacity" must be morally wrong; in fact, the very greatest of wickedness, quite deserving that everlasting "condemnation," which affords such great comfort to the piously benevolent.

However unpractical they may deem him, the "Blacksmith" probably has had, in this matter, rather more practical experience than some of "ye practical men" themselves, who afforded him the above very satisfactory reason for the faith that was in them which induced their employment of thin under wires for covered strings. In the course of some experiments carried out under his direction by the late "W. T.," it was found that when a No. 19 steel wire covered with No. 1 copper was substituted for the original No. 17 wire carrying the same covering, it not only "came up" much more readily than the latter did, but it vibrated very much more freely, and produced a sound of somewhat greater loudness, whose timbre differed much less from that of the sounds of the uncovered C♯ strings of No. 21 wire than those uttered by No. 17 wire did, C♯ being 45in., and the covered C strings 40in. long. On trying some further experiments on the monochord—not on the piano—we found No. 20 steel, covered with No. 0 copper, came up to tenor C, and vibrated pretty freely; its length was 44in., only 1in. shorter than the aforesaid C♯, but its tone was hardly so good as that yielded by No. 21 wire with the same covering, and both were surpassed by No. 21 when it was covered with only No. 00 copper, and its length made the same as that of the C♯ strings—*i.e.*, 45in., which is about 1/9th part shorter than double the length of middle C in that scale. Its vibrations were very free, the tone firm and powerful; and with such wire as is now produced, I have no doubt its pitch might have been raised at least four semitones without the least danger of its becoming broken for many years. After this, am I not justified in asking why use two bridges which are, unless firmly connected, *à la* Broadwood, almost certain to increase the "break" in the quality of the tone.

What is true of pianos 4ft. 8in. high, is no less true of those 4ft. 2in., or shorter. It is also equally true of those which are longer, yea, even of 8ft. 6in., and would be of concert grands 10ft. or 12ft. long, such as the late Robert Mott longed to construct for me—probably he thought this unusual longitudinal extension might match the ears of the writer, who, he doubtless believed possessed "more money than brains," which might have been very true without his possessing much of the former; but, happily, he did possess enough of the latter to avoid paying about £100 for some three additional feet of case, belly, and strings; the latter of which were even then quite long enough (in an instrument of the usual length) to produce sounds whose loudness well nigh drowned those of its treble strings. Years after I had a little experience of the "delights" (and expenses) of (amateur designed) grand pianoforte-making, and felt little or no temptation—after the experiments above detailed—to make even one or two covered notes any shorter than the lowest uncovered strings. On the contrary, I preferred stringing three more notes with uncovered wire, the first two *one* and the last one *two* sizes larger, which I found quite prevented the ear from detecting any want of firmness in the timbre of the sounds they produced. The long bridge and the short bass bridge were united by halving them together at about 8in. from the extreme end of the latter, which was tapered down to about ¼in. thick at its end; and that portion of the bass bridge which extended about 7in. to the right of the long bridge—*i.e.*, towards the bent side—was also tapered to about the same thickness at its end, which reached within a few inches of the rebate which supported the belly. I copied this method of connecting the two bridges from what I observed Messrs. Broadwoods had done in cottage pianofortes, perhaps nearly twenty years ago, and its advantages are, of course, not confined to pianos in which the first covered strings are as long as the last uncovered ones; for it is obvious the bass bridge may cross the long bridge—*i.e.*, be halved under it—at any distance desired up from its extreme end.

I have been told by "practical" men that it is objectionable to put two (unconnected) bridges on the same soundboard near each other, because when so posited, unless connected *à la* Broadwood, they mutually mute each other. If it be true that they do this objection can hardly apply to the bridges of my design for an improved upright grand cottage piano figured in No. 235 of the English Mechanic, for in that—and some other instruments of similar design which have been imported from America—the two bridges are quite far enough apart to be out of each others way. I have not a very strong faith in the mutual uniting power of contiguous bridges, but I do believe it conduces to the durability of the instrument to connect them *à la* Broadwood, for this is practically distributing the downward pressure of the strings over a larger proportion of the surface of the soundboard. If not an absolute necessity, it seems at least an error on the safe side.

When stringing my grand, had I been what an old workman of mine was accustomed to call me, to wit, "nasty nice," I might have shaded off the differences of the tensions of the last uncovered and the first covered strings by yet further reducing the weight of the load of covering wire coiled round the latter. Two methods of doing this are possible—using thinner wire or substituting some metallic material less heavy than copper or brass. Iron has been used, perhaps to advantage, and in this respect steel would be preferable to iron, for not only is its specific gravity less than that of copper or its alloys, but its tenacity is far greater. It follows as a matter of course that it can be used when thinner than copper, and yet be coiled tight enough on the steel under wire to adhere to its slightly roughened surface. Thus, the load of the under wire may be rendered less without much risk of breaking the covering wire by subjecting it to more tension than it can safely bear while it is being wrapped round the former. A really good method of doing this I greatly desiderate—*i.e.*, coiling very thick round comparatively thin steel wire (say) No. 40 or 42 copper or brass wire round No. 26 to 30 steel, without any risk of twisting the latter. I have been told such machines are made, but kept as trade secrets, indeed, I designed one myself, which I may contribute to "our" journal if its editor thinks it worth engraving, in which the under wire is securely held by clips only one-tenth of an inch apart, while the covering wire is being coiled around it, and consequently it is not subjected to any appreciable force tending to twist it, but the great practical difficulty seems to be communicating sufficient tensile force to the covering wire, when the latter is extremely thick, and consequently inconveniently rigid, to insure that it shall be coiled tightly enough on the thin under wire to prevent the string from becoming "false."

Besides using steel covering wire, which is said to deteriorate the quality of the tone produced by a covered string, I might have employed for the strings of a note only one semitone lower than the sounds of the last uncovered string, an open coil. What, in the—alas, long past!—days of my youth were termed "open" covered strings were common enough, in fact, few others were used. Now, it must be "obvious to the meanest capacity," that if the covering wire be wrapped round the under wire in the form of open coils (like a corkscrew or a bell spring extended) each of which are perhaps five times as wide apart as the diameter of the wire of which they are formed, only one-fifth as much covering wire will be coiled round the under wire as there would be if the coils were close to, or touched each other, as they usually do. At present I see no objection—excepting perhaps, prejudice, and the look of the thing, both of which have wonderful power over poor humanity—to the employment of open covered strings for the first two or three covered notes if it be possible to wrap the wire tight enough to prevent them from becoming "false." It is for ye string coverers—rather a prejudiced and therefore "conservative" race—to say if this is a difficulty. Query, might not the ends of the covering wire be soft soldered to the steel under wire if the latter be previously tinned, and the customer willing to find the "tin." I, for one, have great faith in the efficacy of "soft sawder," intelligently applied, for prolonging human and other "attachments," because it can be employed without sufficient "heat" to spoil, or even try the "temper" either of steel wire, or what are far less tender than that not very "soft" material, "married couples."

The Harmonious Blacksmith.

IN WHAT DIRECTIONS ARE SOUNDBOARDS MOVED BY THEIR STRINGS?

[4665.]—Mr. Schucht says the string of a piano moves its soundboard in the same direction that it would be moved by a lever, inserted vertically in its bridge, if that lever was pulled to and fro, alternately, in the direction of the string's length. How the string can move the bridge thus to any appreciable extent in that portion of the piano's compass which is near to and below tenor C (in which, from the longitudinal direction of the bridge forming a very acute angle with the string its resistance to motion in that direction must be enormous) I can hardly conceive, although I can very easily suppose it to do this to some small extent in the lower bass, where the bridge is nearly at a right angle with the strings. Were the string—instead of being extended beyond the bridge to the plate, as it usually is—attached to the bridge, its vibrations must rock the bridge to and fro just like the vibrations of a harp string alternately lifts its soundboard and—when the string again becomes straight—allows it to descend to its normal position.

From the fact that violin bridges are not in contact with the breast throughout their lengths, but have two legs, I infer the impulses communicated to them in reverse directions by the strings alternately depress each half of the soundboard, allowing each half to rise again before the string commences to move in the contrary direction, and depress the reverse side of the soundboard, just as the harp string allows its soundboard to descend when it becomes straight. The strings of a piano being struck in a direction vertical to its soundboard, naturally are at first compelled to vibrate in the same direction as that of their impelling force, at least, their earliest vibrations must be vertical to the plane of the soundboard, whatever directions they may afterwards assume during their continuance hence I infer that when the string descends or is driven backwards by the force of a blow delivered from above or in front of it, it carries the soundboard with it, and in the instance of a horizontal piano, whose hammers strike its strings from below upward, that the strings as they rise lift the soundboard.

That a harp string does lift its soundboard was demonstrated by Dr. Tyndall when lecturing on sound. He stretched a thick and long steel wire, one end of which was attached to what he termed the bottom of a wooden tray, but which was, however, for all practical purposes, a true soundboard or *table de harmonic*. On vibrating this string a very loud sound resulted, and he said that sound was a convincing proof that the direction of motion had been changed—*i.e.*, that the vibrating string pulled the bottom of the said wooden tray—which performed the function of a soundboard to it—every time it vibrated, and thereby compelled this wooden surface to vibrate synchronously with itself. "The Harmonious Blacksmith's" new violin, figured on p. 254, No. 374, is an exact copy of Dr. Tyndall's experiment, excepting that he prefers employing many connected soundboards to a single one, but this does not alter the principle of the contrivance one jot, neither "The Harmonious Blacksmith's" violin nor Dr. Tyndall's wooden tray bottom can be said to possess anything which can act the part of the bridge in stringed musical instruments, nor has the harp. Perhaps Mr. Schucht, "Fiddler," and other readers who are better versed in acoustics than the writer, and have experimentally investigated the action of soundboards, will enlighten, on this subject,

One who Desires to be Instructed.

A NEW MATERIAL IN ORGAN-BUILDING.

[4666.]—I do not know of any objection to the use of paper for organ pipes, as proposed by "Sucram," provided one is satisfied with the tone produced, but for one I should not be satisfied. Organs and organ pipes have been made of almost every conceivable material, from brass to paper. Most of us have heard of the celebrated organ erected in Winchester Cathedral in the early part of the tenth century, which had four hundred pipes of brass and ten keys, with a wind power produced by the united exertions of seventy men; and some have heard of an organ made by a French Abbé at the close of last century out of a pack of playing cards, which is said to have produced agreeable tones, although one would suppose not quite so powerful as the Winchester instrument. Twenty years ago I made some pipes of paper, with metal lips, and a wooden block or languid; but could not get any clear tone, and the smaller pipes seemed to be born with a violent attack of asthma, which was quite incurable by me. I would not, however, attempt to discourage others who would like to make the experiment, for it is not a costly one; but, for my own part, I should prefer to make a set of wooden pipes, as far as time and trouble are concerned, to the plan proposed by "Sucram;" the tone, also, would be greatly superior, and if a Scudamore arrangement of pipes is desired, let them be stained, say, the smaller pipes a very light shade and the large pipes in the back row a dark shade, then well varnished, and they will look quite as well as any wall-paper pipes. J. D.

[4667.]—Paper, or rather "papier mâché," has been used with great success in the construction of pipes by F. Besson, of the Euston-road, who, I feel confident, would willingly communicate the results of his experiments. S. Bottone.

[4668.]—I beg to inform "Sucram" (let. 4579, p. 481) that I have practically tested the adaptability of paper for circular organ pipes. I took the following plan:—An ordinary paper ruler of 7in. long, and fully ⅛in. in diameter, round which I wrapped four pieces of paper gummed, each 7in. by 9in.; I then formed a cone in the same manner, the block used being a piece of clay, shaped accordingly, but rather longer than necessary, so as to allow the insertion of the top piece. I then punched out a circular piece of card for the languid, cutting off a small piece so as to make it correspond with the top of the cone, which is a little flattened at one side, and nicked it as fine as possible. When perfectly dry they were taken off the blocks and glued together, having previously inserted the languid and cut out the necessary portions of the pipe. You may imagine my surprise when I blew into it. The sound came out quite clear. It is perfectly in unison with G in alto of stopped diapason. I am much pleased with its tone, being nice and soft. Perhaps I may not have been explicit enough with some parts of it, but will be glad to answer any questions on the subject. Opaline.

MUSICAL EDUCATION.

[4669.]—What "Fiddler" says in his letter about the scarcity of amateur players who consider music as a science is perfectly true, and it exactly confirms what I said in my last. It is because so many people, not naturally musical, learn to play that we have so many performers and so few musicians. Every young lady is expected to play, the consequence is that those who learn because it is a fashionable accomplishment do so merely for the sake of display, and the music which is easiest to rattle off, producing the greatest amount of noise and so-called "brilliancy" of effect, with the least expenditure of trouble, is what they prefer to all other. The first requirement is that a piece shall be easy, the rest is of but little moment. Ask these too common drawing-room musicians, as "Fiddler" says, to play one of Haydn's or Mozart's sonatas, and they will not—not always because they cannot, but because they are absolutely incapable of understanding its beauty. And all this strengthens what I said before about musical education, and the mistaken ideas of it entertained by most English parents. They will not see that music is not a matter of mere teaching, like the alphabet or the multiplication-table—that it cannot be driven into all alike, by so many lessons from Herr So-and-so, and so many hours' daily pounding upon the pianoforte. And so long as this is so, and one sex is taught indiscriminately, and the other left alone, without regard to the tastes and talents of each individual, which are the gifts of God (not by any means to be imparted by man), so long shall we see music at home in its present degraded condition—so long shall the music-sellers' shelves be loaded with stale dance-pieces and new, though far from original, "morceaux de salon"—so long shall the divine compositions of the great masters be neglected for the reams of spoiled paper which the publishers turn out, week by week, for the benefit of the amateurs of society.

Vertumnus.

ON CO-OPERATIVE STORES AND COINS.—To "E.L.G." AND OTHERS.

[4670.]—"E. L. G." (let. 4630) says coins were invented for "facilitating the payment of taxes." Whether for that purpose or not, there can be no doubt —as Bob Lowe could testify—the possession of abundance of coin does greatly facilitate that first duty of Britons. May be "coin is a badge of conquest," not necessarily in this case of oppression, for my small experience compels me to believe it is the means of liberty—*i.e.*, liberty to purchase what you desire. No doubt the shekel was a weight; but what, in the name of commen sense, is a coin but a certified given weight of gold or silver?—the fact that it is certified to be of given weight and fineness by legal authority saving us the trouble of weighing and assaying it, and thereby much oftener facilitating purchase than tax paying.

The utility of coin may be "a superstition," but it seems rather a well-founded one. I have found this "superstition" extremely convenient when I wanted to buy anything. No doubt the precious metals are not the only possible "medium of exchange." Iron in Sparta, leather—there is nothing like leather—in China, and paper promises to pay in Europe, from bank notes to assignats, Yankee greenbacks and shinplasters, have all served our turn. Indeed paper, which is issued under conditions preventing its value in exchange becoming depreciated—*i.e.*, convertible paper, not necessarily convertible into the precious metals—will in all probability become the common currency of the future in civilised countries. N.B.—One kind of "convertibility" I have stated at some length in No. 1 of the *British and Foreign Mechanic*—one of the many journals since absorbed by "our" "Aaron's serpent."

"E. L. G." says the trader is not, as such, a product of Providence. Possibly not; but I find it hard to conceive to what other productive energy we owe his existence. To me it seems he must be just as much the product of the "all Father" as his customers, be they kings, labourers, or the mighty middle class. Such questions as these I prefer not to discuss, because, as Matthew Arnold would say, it "ain't edifying," besides which, divine Providence not having condescended to reveal all things unto me, I am compelled humbly to acknowledge myself "ignoramus." Not having the honour of being personally acquainted with certain and sundry "live and dead Satans," I am also ignoramus in relation thereto, always assuming the aforesaid Satans really have any personal existence, and are not one of the many melancholy mental "crazes" of our clever correspondent "E. L. G."

A word in season on co-operative stores, so-called. How, in the name of the "thingummy"—who is, I suppose, nearly related to the Satans above mentioned —could co-operative stores (or, for that matter, any other machinery for distribution in any society in which community of property does not exist) work if we had no medium of exchange, not necessarily stamped, and thereby certified, gold and silver. Perhaps some modification of Robert Owen's "labour notes" might serve, or yet better, an undepreciable national paper currency, which would command rather more general confidence than either R. Owen's labour notes or any other merely local issue. Certes, it could not much facilitate exchanges if all purchasers were compelled to exchange one form of wealth—which especial form might not be in local demand—for another they needed. Sure-*ly* bank notes are better than barter, and it must be easier to carry a check on your banker in your waistcoat pocket than to carry your own (iron, leaden, or porcine) pigs to market.

THE HARMONIOUS BLACKSMITH.

SELENOGRAPHICAL.—GASSENDI.

[4671.]—IN answer to Mr. Birt's question (let. 4528, p. 487), I may say that the formation marked *a* in my sketch does appear very like an outpouring from the crater that, for some reason or other, with which elegance or descriptiveness has little to do, has been called "the spoon." Its outwardly curved outline seems to be such as a flow of molten matter would assume when arrested in its progress by cooling, and the re-entering angles that divide the outline into several curves would show where the discharge was held back by obstacles on the surface over which it moved. It is far otherwise with the formation *b*, which seems to overlie the former, and to have intruded on the spoon, dislocating and pressing inwards its southern rampart—that is, the spoon's rampart.

Mr. Brown (let. 4585, p. 485) discusses certain apparent evidences of recent change in the central hills of Gassendi, and compares Professor Phillips's sketch on the one hand with the sketches by M. Gaudibert and me on the other. It is seen, however, that although in our sketches we differ entirely from Professor Phillips, we agree with the old observer, Schröter; and it is not likely that the central hills, after suffering a complete transformation, would be restored just to their original state by subsequent disturbing forces. If we could believe that the view given by the Professor is not an inverted one like the others, the apparent discrepancy would be explained away at once.

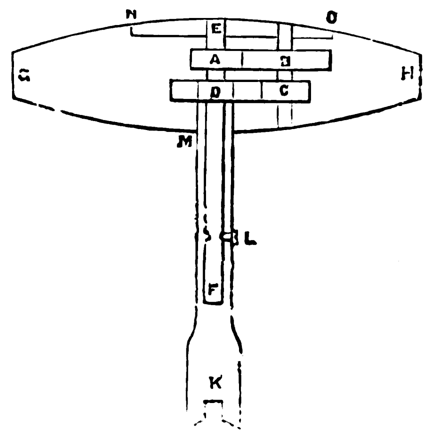
Among the several observers cited by Mr. Brown M. Gaudibert alone has correctly shown the curved figure of the east central mountain. He is also more correct than I in the southern boundary of Gassendi, which appears too much flattened in my sketch. I may say for myself, however, that I attempted no very general accuracy, as my purpose was principally to direct attention to the formations *a* and *b*.

J. BIRMINGHAM.

PIANOFORTE TUNING KEY.

[4672.]—IN response to the invitation of your talented correspondent "The Harmonious Blacksmith" (let. 4561, p. 463), I forward a rough sketch of a tuning-key I designed many years ago, but for want of appliances could not carry out. I trust it will answer its purpose.

The spindle E F, made with a square top at E, fitted into a square hole in the handle G H, to insure their turning together. On this spindle is fixed the pinion A. The wheel B and pinion C to be fixed on the same axle, and they turn together. The wheel D fixed on a square at the head of the key K, and they turn together. Through the centre of the wheel D is a round hole for the spindle E F to pass freely, and the head of the key K passes freely through a round hole in the handle at M. The screw L keeps the spindle E F in its place. If the pinions A and C have half the number of teeth as the wheels B and D, the handle



would turn round four times to the key once. If the wheels and pinions are made of steel and the handle of brass, the tool would bear the strain in tuning a piano. The above sketch shows the principle. In constructing it the wheels and pinions ought to be placed nearer in contact, that is, A and B nearer to D and C, to give room for the wheels in the handle. A movable cover N O, to take the form of the handle, would admit of the introduction of the works.

The expense of such a tool would be great, but few amateurs would object to this, considering the advantages it offers. The writer would be but too glad to purchase one if made.

BEDCA.

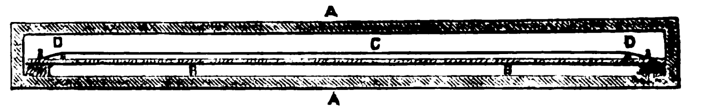
CHEAP SUPER FOR COTTAGE HIVES.

[4673.]—"PHILO" is evidently no beekeeper, or he would not write what he has done on p. 462, in the number for July 19. If the queen should go into the super, which is a very rare occurrence, she will certainly leave it before the drones are destroyed, and never should you take a super until the drones are annihilated, which will occur, to show that with them at least the swarming season is over. A diameter not over 2in. will keep the queen out after the drones are dead. Bees will certainly not eat putty; they like pudding better. Nevertheless, either paint or putty will destroy the hive. A friend of mine once painted his hive ridiculously, and the bees were all dead in three days.

H. B. E.

IMPROVED ÆOLIAN HARP.

[4674.]—SOME of "our" correspondents are showing the mistake which is so often made in musical instruments—*i.e.*, inclosing the soundboard so that the tone becomes necessarily choked and coffined. I send a drawing of an Æolian harp, which I have constructed; the usual mistake is rectified, and there undoubtedly is far more sweetness in the tones than I have ever heard expressed by the ordinary box-shaped instrument.



This improved harp consists of a strong rectangular box of oak with the sides open; the timber is about an inch thick, the sounding-board is placed about three-quarters of an inch above the bottom board of this box, and at a few inches on either side (which position should be practically determined) are placed the bridges (half an inch high), on which the strings, eight in number, rest. The tuning-pins are turned by inserting a suitable key through holes in the upper board or top of the box. On either side of the box, extending as far as the bridge, pieces of wood are placed, which give strength to the instrument, and cause the breeze to flow only over the strings. The tone and power of this contrivance might be further increased by improving the form and material of the soundboard; probably it would be a material benefit to cut it away in the centre.

REFERENCES.—AAAA, a rectangular box open at the sides; B, soundboard of thin pine; C, strings; DD tuning-pins.

E. B. FENNESSY.

HYDROPHOBIA.

[4675.]—SOME interesting information respecting this terrible disease appeared in "our" MECHANIC some time since in response to a letter from me which you inserted. Do any of your correspondents who then wrote know anything of the following remedies, an account of which I have met with in a Salopian paper?

M. Marochetti, an Italian surgeon of the hospital at Moscow, being in the Ukraine, was requested to give assistance to fifteen persons who had received the bite of a mad dog. Knowing the worthlessness of the professional treatment of this disease, he administered help to the unfortunate persons through a peasant, who, during several years, had acquired great reputation in curing hydrophobia, the peasant administering to fourteen of the persons confided to him in a peculiar way, while the fifteenth, a young girl of 15, was treated by M. Marochetti in the ordinary manner, for the purpose of proving the effect of both modes of treatment. To each of the fourteen the peasant gave daily one pound and a half of the decoction of the buds of yellow broom flowers, and he examined twice a day under the tongue the place where, according to his statement, little swellings were formed containing the virus of madness. These swellings rose on the third or ninth day, and were seen by M. Marochetti. Very soon after they appeared they were touched with a red hot needle, after which the patient gargled the part with the decoction of broom. The result of this treatment was that the fourteen patients were cured in six weeks, whilst the young girl, treated differently, died on the seventh day in the convulsions of madness. The same physician, a few years later, at Padolia, had a new opportunity of confirming this interesting discovery, curing twenty-six persons who had all been bitten by a rabid dog.

The other cure for this disease is given by Don Victores Aguilar, who has seen the medicine administered in the last paroxysms of the disease, in which it was never known to fail. It is as follows: Soak a rennet in a little more than half a tumbler of water for about five minutes. When this has been done, add of pulverised sevadilla—(*Hordeum causticum*), a species of veratrum—as much as may be taken up by the thumb and three finger; mix it thoroughly, and give it to the patient—that is, force it down his throat in an interval between the paroxysms. The patient is then to be put into the sun if possible, or placed near the fire, and well warmed. If the first dose tranquillise him after a short interval, no more is to be given; but if he continue furious, another dose must be administered, which will infallibly quiet him. A profound sleep, or rather a total loss of all power over the bodily and mental faculties, with a death-like stupor, without any symptom of animation, will succeed, which will last twenty-four or forty-eight hours, according to the strength of the patient's constitution, at the expiration of which time the effects of the mixture will arouse the patient, and its violent operation, as emetic and cathartic, will last ten or fifteen minutes (the attack lasting till the poison be entirely ejected), the fluid discharged from the stomach being black as charcoal, and offensive to the smell. He will then be restored to his senses, ask for food, and be perfectly cured, feeling nothing but the debility produced by the combined effects of the disease and the medicine.

KAPPA.

DISPERSION OF SEEDS BY THE WINDS.

[4676.]—IN *Nature* of June 27, there appears an article on "The Dispersion of Seeds by the Wind," over the signature "A. W. B.," in which the writer doubts the wind performing this important duty. In 1852, I made a balloon voyage from Zanesville, Ohio, and when I reached the heights above the first layer of clouds I found myriads of the thistle seed, with its tiny parachute, sailing along in the upper current, and these little air-floating vegetables had the seed with them. I have frequently noticed nebulæ of pollen floating along in the same way. In a paper read before the Franklin Institute on "Balloon Meteorology" several years ago, these facts were also mentioned. I mention this matter of fact for the benefit of science, believing that it is useful in the establishment of a great physiological question not yet thoroughly understood. The migration of certain portions of the vegetable kingdom is not more curious than the migration of certain portions of the animal kingdom. Motion is the prime law of nature, and when the seed-bearing float takes to the wind it does so from the force of circumstances, just as we do ourselves when we are moved to emigrate, and in this our migration we are after all as subservient to the universal law of motion as is the seed and the pollen, although we may stultify ourselves in the vain conceit that we may do, or may not do, the things that are done.

JOHN WISE.

Hall of the Franklin Institute, Philadelphia.

IS THE MOON SPHERICAL?

[4677.]—I SHALL be glad to see M. Rabache's proof. See let. 4683, No. 384, p. 518.

W. R. BIRT.

THE ORGAN BUILT.—VIII.

[4678.]—Having got the framework of the organ put together, it will be better to make the pedal soundboards. Get a set of cardboards the size of the Bourdon pipes, and divide them into two lots, taking every alternate one to form each lot—viz., CCC, DDD, EEE, FFF♯, &c., for one lot, and the alternate cards—viz., CCC♯ DDD♯, FFF, &c., to form the other lot, there will thus be thirteen in one lot and twelve in the other. Now lay the thirteen side by side, leaving a quarter of an inch between each, and get out a piece of inch pine 8in. wide, and the length of the row of cards; mark on the board the centre of each card, taking care that the largest card is on the end of the board that goes to the back of the organ. Now bore the holes for the wind; the hole for the CCC should be 2in. by 1in., and for the C ⅞in. in diameter. The channel for the largest pipe must be 1½in. wide and ⅞in. for the smallest; the depth of the channels to be 2in. Make the channels with bars, as previously described, only that each channel being exactly under its pipe, there will be a space like a wide channel between each real channel. Let the wind-chest be 4½in. deep and 6in. from the treble end; in each wind-chest cut a hole in the back 3½in. square for the wind-trunk to enter. No slides or stockboards are necessary for these, as the draw-stop acts upon a valve in the wind-trunk instead of the ordinary plan of slides; the pallets in these wind-chests are to be the full length of the channels. Over each hole in the soundboard a block of 1½in. pine is to be firmly glued, having a round hole bored in it, to receive the foot of the pipe; the hole for the largest should be 3in. in diameter, and for the smallest 1in. (See Fig 1.)

Before describing how to make the movement for the organ, it will be as well to explain a simple plan for preventing the noise often caused by wires working in holes in wood. Every hole in a piece of wood in which a wire works should be lined with cloth, and although apparently a very difficult job, it is in reality very easy. Bore a smooth hole in the wood ½in. in diameter, get a strip of cloth ⅜in. broad, and cut it into lengths of 1½in.; cut one end to a point, rub a little glue into the hole, and draw the cloth through the hole until the pointed part of the cloth is pulled through.

FIG. 1

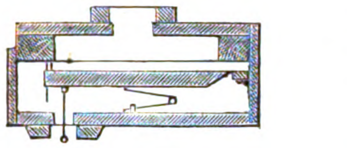
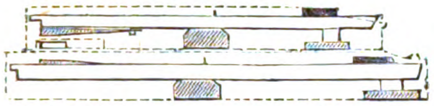


FIG. 2

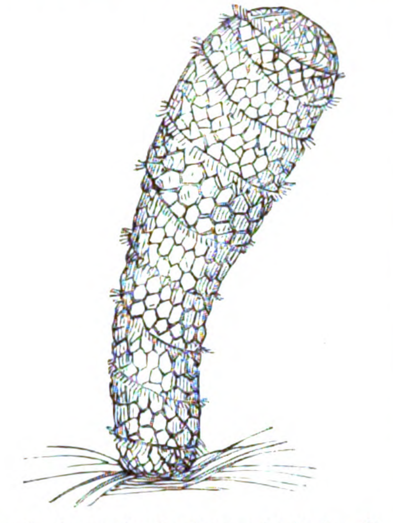
FIG. 3



Cut the cloth off close to the wood on each side, and push a small bradawl through the centre of the cloth to force it nicely round the hole; the holes which require bushing, as this lining is termed, are those in which the roller ends work, and the centre holes of backfalls and squares. Now get out the rails in which the backfalls are to work; two will require to be 4ft. long—viz., for great and swell organs—and one 2ft. 8in. long—for the coupler great to pedal, the width of each to be 3½in.; the rails are made of a thickness of mahogany and one of pine glued together, the mahogany 1in. and the pine 1½in. thick; while these rails are drying make the "coupler" swell to great; it is a rail of mahogany or oak 2½in. by 1¼in. The exact length between the ends of the keyboards to be left the full thickness, and a tenon 2in. long and ⅜in thick to be left at each end. (Fig 2.) The tenons slide in a groove cut in the frame of the swell keyboard; the rail is to slide 3in. backwards and forwards in this groove. In the rail bore a quarter-inch hole exactly over the centre of each key; great care must be taken to make these holes vertical. After making all the holes line them carefully with cloth, and afterwards get out a sufficient quantity of mahogany rod, round and smooth, of a size to slip easily through the holes after they are lined. The length required will be about ten feet. Next fix small wedge-shaped pieces of wood on the great organ keys, as shown in Fig. 3; they are to be 3in. long and the width of the key. Make similar pieces for the swell keys, but 5in. long, and fix them to the underside of the keys by a screw only at the thin edge of the wedge; at the other end of the wedge put a wire screw through the key, so as to adjust the wedge to the top of the coupler sticker, and then cut the mahogany rod into lengths to fit between the wedge-pieces on the keys. After getting the stickers the right length, blacklead them well to make them work easily. The dotted lines show the key frames and the groove for the coupler to work in; the coupler is shown in position when in action; to throw it out it merely requires to be drawn forward. It is advisable to cover the wedge-pieces with a piece of leather to prevent any noise; the smooth side of the leather to be outside and well coated with blacklead. J. D.

EUPLECTELLA.

[4679.]—Some time ago a query appeared in our paper respecting the *Euplectella spinosa*. No answer has been forthcoming, and as I have learned something about this creature since the date of the query, I feel



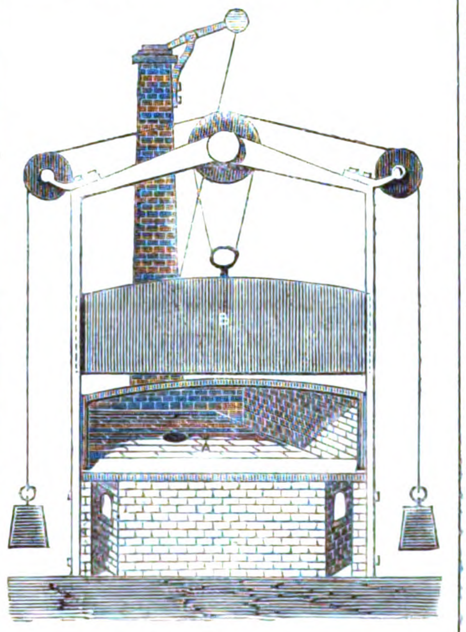
it incumbent on me to give the querist the benefit of that acquired knowledge. In the first place, the name given is not correct; it ought to have been *Euplectella speciosa*, "the beautiful euplectella," and not "spinosa," the thorny. The creature itself is a kind of sponge, which fixes itself by means of a lovely silky base to the sea bed. Until very lately it was thought to be extremely rare, and good specimens fetched from thirteen to fourteen guineas. Lately, however, its habitats have been discovered, and by means of a peculiar kind of drag, resembling a small but long-headed rake, considerable quantities have been raised, so that the price has fallen to 30s. for good specimens, and 12s. for those of commoner aspect. The peculiar shape, silky white lustre, and delicate texture of this remarkable sponge, will ever cause it to be a favourite with the lovers of the beautiful in nature. I inclose a rough sketch, which may serve to call attention to this "wonder of the deep." S. Bottone.

FENUGREEK.

[4680.]—Fenugreek powder as a cattle condiment. A friend told me a day or two since that he has in very many cases used this as a cattle restorative with very good effects. It has been tried recently on a donkey of mine that was going off his feed with equally good results, a small quantity only (about 1oz.) being daily mixed with a feed of chopped mangold and bran mash. Can any one state whether "Thorley's Condiment" is partly or chiefly composed of this substance, and if it is known to have any similar restorative effects on the human subject? Animals' Friend.

FURNACE FOR HEATING WHEEL TIRES, &c.

[4681.]—A new furnace for heating cart-wheel hoops, engine-wheel tires, spring plates, or any kind of article to nearly white heat. Black spot A is chimney-hole on



flat floor, where articles lie to be heated, B door to cover mouth of furnace fire holes at each side below floor; they run all the length on each side inside. Can be got to any heat quickly, from cold to melting point. Damper at top of chimney to regulate heat. Furnace door B should be li[ned] inside with fire-bricks. The furnace appears to ha[ve] one corner short, but all can be seen that is required.

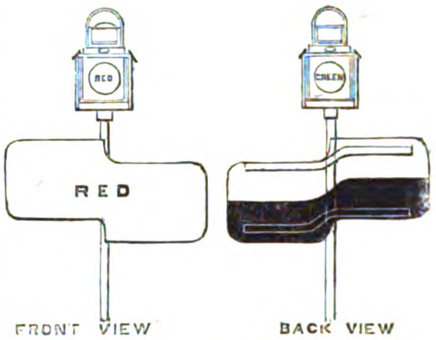
Outgenious Whitesmith.

FALL OF A BULLET.

[4682.]—With reference to the paragraph quoted by "Puzzled" (query 12377, p. 444) from Mr. Proctor's letter (4411, p. 381), I cannot see how it is "perfectly true that gravity draws down the most swiftly travelling bullet—fired horizontally—so that it reaches the ground as quickly as a ball dropped from rest from the same height," for would not a ball, if propelled swift enough, continue to revolve round and round the earth, yea, and even recede from it every revolution and part of a revolution, until at last the earth's gravitation would lose all control over it? And can we not conceive of a ball being propelled horizontally with such force as would make it revolve round the centre of the earth, but becoming nearer and nearer each revolution, until at last—after a period, we may say, of a century—it would reach the centre? And would not a ball dropped from rest from the same height have reached the centre long ago? What I hold is that this theory is not perfectly true, but nearly, and even then only on comparatively short distances. Francis Lewis.

ALTERATION OF DISTANT SIGNALS ON THE MIDLAND RAILWAY.

[4683.]—The distant signals on this line consist of an oblong board; when turned facing a train they are "on," when turned edgeways so as not to be seen they are "off." Great difficulty arose then to distinguish at a distance whether a signal was facing the train or whether it was simply the back of a signal belonging to the other set of rails. To remove this difficulty the right hand sides of the boards are to be lower than the other, so that at sight it will be seen to which line it applies. Some of the signals have already been altered to this pattern, and have been found to answer well. All new distant signals will be made of this pattern, and it will also be applied to the old signals as soon as possible. I think the "directions" will interest your readers.



With a view to increase the efficiency of the distant signal in use on the Midland Railway, by enabling drivers, on sighting a distant signal, to distinguish by the shape of the signal, as well as by the colour of it, whether it is applicable to the line on which they are running, or whether it is simply the back of the signal which is presented to them, it has been arranged that the form of the disc shall be altered, and shaped as shown below:—

It will be observed that the disc consists of a high side and a low one, and the signal will be so arranged that, when turned on against an approaching train, the high side will always show on the left-hand side of the post as drivers approach it, and the low side on the right-hand side of the post. Drivers will easily recollect that, as all semaphore signals are shown on the left-hand side of the post, so the elevated side of a distant signal shown on the left-hand side of the post indicates that the signal applies to the line on which they are running, whilst the low part of the signal appearing on the left-hand side of the post indicates that the back of the signal is towards them, and that it applies to the other line, and not to the one on which they are running.

When the signal is at "all right," the board is turned edgeways so as not to be seen, and the lamp shows a white light. C. E. S.

SEPARATE RAILWAYS FOR GOODS TRAFFIC.

[4684.]—Some twelve or eighteen months since a letter was published in one of the weekly professional journals pointing out the advantages of, and the necessity for, the making of entirely distinct lines of railway to be used for goods traffic solely. I do not know whether any action is being taken upon his suggestions, but I think it is an idea which ought not to be lost sight of, especially as some of the companies are now doubling their existing main lines in order to accommodate the increasing goods traffic thrown upon them. If this example be followed by the other companies, as it certainly will be to a considerable extent unless better means are provided, the result will be that when Government takes possession of the railways (which I think only a question of a few years' time), it will find a badly-arranged system—one made not for the general interest, but for that of each particular company—duplicate and even triplicate lines where one would have sufficed, and almost as much danger from accidents as at present, as the additional goods lines would have to cross on the level the numerous branches running into the main lines.

The existing canals might be utilised so as to form portions of main goods lines, and the position of the many large works erected on their banks being a fertile source of traffic ready to hand, would be a great argument for converting them; but unfortunately their courses are often so devious and winding that the distance would be greatly increased. I anticipate, however, that before many years have passed away they will, under Government control, be shortened by cutting off the windings. But this cannot be expected at present, and in the mean time the doubling process will go on. The writer above alluded to recommended a new railway to be made which would accommodate by one main line the midland counties, the potteries' district, and the whole of the north of England. Commencing at London by connections with the goods termini of the northern lines, it would run to about the neighbourhood of Leicester, where it would divide into two forks, the one passing up the Erewash Valley, near Sheffield and Barnsley, to the West Riding towns, whence it would be continued through the Durham coal-field to Newcastle: the other through the potteries to Liverpool and Manchester, with connections to all the Lancashire towns. To this might be added a branch from the neighbourhood of Market Harborough to Birmingham and South Staffordshire. Short junction lines should be made to each existing line, crossed in order to throw as much traffic as possible on the goods railway. There are several existing lines, which, being scarcely used except for goods traffic, might be utilised as portions of these lines, among which are the Chesterfield and Masborough branch of the Midland Railway, the Biddulph and Sandbach branches of the North Staffordshire Railway, and perhaps others.

I am aware of one great objection which will be urged against such a scheme as this. None of the existing companies would of themselves offer to make the line, because of the opposition they would be sure to receive at the hands of the companies whose territory they proposed to invade. But I think the difficulty would soon disappear were they all to unite together for the purpose, each contributing capital in the proportions to which they are interested in the traffic, or as nearly so as can be computed; pay interest on this capital at 5 per cent. (or a lower rate as might be arranged), and divide the surplus profits among the companies in the proportion to the amount of traffic conveyed, and which would in the ordinary course have been taken by each of them. Thus each company would receive the profit of its own traffic, and the only extra expense would be the interest on the capital employed in the construction of the line; against which should be set off the increased safety of the passenger lines and the consequent diminution of the large annual charge for compensation, in addition to the far greater scope given for developing the passenger traffic on lines almost altogether free from goods.

There is another point. On lines employed exclusively for goods traffic there would grow up in time a natural desire on the part of the residents in the districts through which it passed to avail themselves of it for passenger traffic. This would, of course, be a departure from the principle of separate goods lines; but in case of a sufficient amount of traffic from that source being likely, a third line might be laid down running by the side of the others until the nearest junction with a passenger line was reached, where the passengers would be handed over to the other company, who might indeed work such traffic themselves at a percentage of the gross receipts.

I am convinced that if this or a similar scheme were carried out it would reduce the chances of accident to a minimum, simplify the management, and eventually prove a great saving, not only to the companies but to the nation on whom the cost of all unnecessary works will ultimately fall.

Manchester. W. H.

WARMING RAILWAY CARRIAGES.

[4685.]—Having some time back in "our" Mechanic seen several letters on the warming of railway carriages, and having lately travelled in differeng parts of Germany, I found in operation four different systems of warming. Three have been described by several of my brother readers; but the best, in my opinion, is on the Berlin-Potsdam Railway. The carriages need little or no alteration. You take two pieces of chemically prepared charcoal the size of a brick, put them in a wire box similar to a rat-trap, set fire to it, and you have the carriage warm for eighteen to twenty hours without further attendance. I was lucky enough to obtain several pieces of Herr Ober, engineer's turner, in Potsdam. One piece I laid on the window-sill in a strong breeze: it gave no spark whatever. Another piece I lighted and put in a dish in the middle of a very small room, door and window shut, so as to exclude all ventilation for five hours. I was in the room working all the time, and I am still alive and kicking. What a boon for an infirm lady or gentleman, and many others who are obliged to travel in the rough, cold winter time to sit in a warm carriage. The coal is very cheap, about the London price of the best Welsh coals, which must induce the Railway Companies to adopt the system.

H. Menz,

Factor to the Westfälische Marmor-Werke, in Allagen by Soest.

A GIANT PLANET.

[4686.]—If "Hyrab Sen" will make his calculations as to the temperature of Jupiter's satellites in Centigrade instead of Fahrenheit degrees he will find that he will arrive at a temperature for them about seventeen times as great (according to his method of computation) as the one he gives. This alone ought to show him that there is some fatal fallacy in his reasoning, and that he has been counting his degrees Fahrenheit like a schoolboy counts marbles, as Mr. Proctor suggested he must have done before he demonstrated it by his last letter. T. H.

[4687.]—In "Hyrab Sen's" letter (4573) there are several grave mistakes. He supposes, in the first place, that 1200° Fahr. divided by 600 are equal to 2° Fahr. They are nothing of the kind, for let him work it out, using the Centigrade scale, for instance, and see what he will arrive at. 1200° Fahr. are equal to $648\frac{8}{9}$° Centigrade; this, divided by 600, equals, according to "Hyrab Sen's" method, $1\frac{11}{135}$°, which, if "Hyrab Sen's" method is correct, ought to equal 2° Fahr. But this is not the case, as it equals 1·96° Fahr., the reason why there is so small a discrepancy being that the zeros of the two scales are not far removed. Again, "Hyrab Sen's" method of finding how much the temperature of Jupiter's satellites would be influenced is incorrect—that depends solely upon the apparent diameter of the planet as seen from its satellites, and from its own surface. In the case of the furthest satellite, Jupiter has an apparent diameter of 21°–44′, while at the surface of the planet itself of course its apparent diameter is 180°. Leaving out the question of Jupiter's ellipticity, the amount of heat received from the planet at the furthest satellite bears the same proportion to the heat at the surface of the planet as the squares of the above quantities do to each other—viz., as ·0146 : 1·000; that is, the planet's temperature, if obtained solely from Jupiter, would be equal to ·0146 of that of the planet. Finally, "Hyrab Sen" asserts his belief in the theory that distance *per se* diminishes the brilliance of an object, and in support of his supposition he asks why the earth-lit surface of the moon should not look equally brilliant with the moon-lit surface of the earth. Just for the same reason that a lighted candle will appear black when held before the sun's disc, the intenser brilliancy of the sun-lit portion of the moon eclipsing the more feeble light from the remaining portion. Besides, if what he supposes were correct—viz., that distance diminishes brilliance—he will see that that would give a considerable advantage to Mr. Proctor's theory, as in order to shine as brightly as he does, Jupiter must be immensely more brilliant than he appears to us, and must therefore shine with considerably more than three or four times the brilliance that he would if merely reflecting the sun's light. G. F. H.

DOUBLE STARS.

[4688.]—The following double stars, found since the 20th July, 1872, are not in "Celestial Objects," &c., nor in Mr. Proctor's smaller atlas.

Ophiuchus.—12° N. of β, and 85′ preceding. Magnitudes 6, 8. P. 20°, D. 35″.

Ophiuchus.—A wide double, about 3° N. of β, and 20′ preceding. Magnitude of primary about 8. Prevented taking position of companion.

Ophiuchus.—A wide double, about 15′ N. of β, and 25′ preceding. P. 360°, D. 25″.

Ophiuchus.—A rather close double, 8′ N. of 73, same right ascension. Magnitude 8, 9. P. 140°, D. 1·2″. As this double is in the same field as 73, I dare say it has been noticed before.

In my letter 4589, Ophiuchus 2° 30′ N. of E, read N. of ϵ (epsilon).

Jumet-Hainaut. C. Gaudibert.

THE AUGUST METEORS, 1872.

[4689.]—I am desirous of directing the attention of your scientific readers to the meteoric display which may be expected to occur on the evenings of the 9th, 10th, and 11th inst., and would recommend all those who have the leisure and inclination to maintain a careful watch of the sky on the evenings I have mentioned, so that the details of the appearances, numbers, &c., of the meteors may be placed on record. By a reference to letter 2528 (Vol. XIII., p. 619), it will be seen that during the interval from August 9 to 11 last year I observed no less than 260 shooting-stars, and in a similar period, in 1869, 159 came under observation. In the latter year it was estimated that, on August 10, meteors appeared at the rate of 38 per hour, while on the following evening the number was 40 per hour. In 1871 there was a particularly grand display of the August meteors. Mr. W. Davenport, of Lancaster (see Vol. XIII., p. 644), in company with three friends, observed 42 meteors on August 10, between 11h. 30m. and 11h. 45m. Other observers have also published the results they obtained, and it would appear that meteors were very numerous in August of that year, particularly so on the 10th and 11th. On the former date three observers at York counted no less than 120 from 9h. 45m. to 12h. 0m., and on the following evening they saw no less than 47 in the two hours preceding midnight. From the observations made at various places, Professor A. S. Herschel was enabled to compute the heights of 20 shooting-stars. See *Quarterly Journal of the Meteorological Society* for November 15, 1871. He found that, at the first appearance, the average height, in British statute miles, was 86·1, while at disappearance the average elevation was 53·5; their velocity per second was 51·6, and the length of their paths 42·4. The average heights of some of the meteors, which had been previously seen, were as follow:—Of 16 meteors doubly observed in 1869 = 74·1 British statute miles at first appearance, 47·6 at disappearance; of 10 meteors seen in 1870 = 71·7, 54·4; of 20 meteors observed in August, 1863 = 81·6, 57·7. The above figures are given in the last "Report" of the British Association Committee on Luminous Meteors, which also contains particulars of all the large meteors that came under observation during the preceding year, and refers in detail to the progress made throughout the year in meteoric astronomy. Observers cannot, therefore, do better than send to one of the members of the committee the results they may obtain during the forthcoming display of meteors. The observations can then be compared and discussed, and in cases where the same shooting-star has been observed at two different stations, its height, length of path, and other particulars may be determined. Observers must, of course, be as accurate as possible in describing the paths of the meteors, and should also be careful to note their dimensions, times of appearance, radiant points, duration, and the like. If this were invariably done, our stock of knowledge in this department of astronomical science would soon be considerably augmented. William F. Denning.

Hollywood Lodge, Cotham Park, Bristol.

SPINNING TOPS AND GYROSCOPES.

[4690.]—An answer to the last question in "Gy's" letter (4581, p. 484) virtually answers all his questions. "Taking out of account friction and the resistance of the air," the velocity of the top or gyroscope would remain undiminished, the axis would maintain the same inclination to the vertical, and the speeds, both of rotation and of gyration, would remain unaltered.

I think "Sigma's" remark (let. 4592, p. 486) about the ball moving in a tangent to the earth's surface unnecessarily complicates the question. It would be tedious, although quite easy, to take the feature referred to into consideration; but the simpler plan is to restrict the conditions of the case first proposed by "A.," by assuming that the ball starts in a direction parallel to a horizontal plane, that gravity acts at right angles to that plane, and that the resistance of the air is absent.

"A.'s" letter (4594, p. 486) shows curious contradictions. He appears to see that it is the lever action which makes the centrifugal force act partly in raising the governor-balls, when he refers to J. M. Taylor's theory. When speaking, however, of the weight and cord, he says, "The cord has nothing to do with holding it up"! The fact is that the cord has everything to do with holding up the weight, for it acts precisely like the lever or link of the governor.

Glasgow, July 27. E. H.

[4691.]—Any one who reads "Sigma's" letter (4593) will see that he fully confirms my position instead of confuting it. That opinion is, that if a body be discharged or propelled with sufficient velocity—and mind you that this propelling power be kept up continuously—that said body would maintain a straight course in spite of gravitation. I suppose that no one will deny that if a cannon were pointed upwards and a ball fired from it with a continuous propelling apparatus attached thereto, that said shot would never return to poor gravity any more; and if this be true vertically, why not equally so horizontally? I never disputed the fact that a cannon-ball yields to the force of gravity as its velocity decreases, but do maintain that it cannot fall in the same time as the ball left to fall freely, and invite "Sigma" to controvert the following proposition: Take a light globe tied to a string, and run swiftly; it will follow in what is commonly termed a horizontal line as long as the speed is maintained. It is evident that the same would take place if it were a cannon-ball if sufficient speed was attained. Now, it cannot be said that the cord holds it up, as it only drags it along. I maintain that propelling it would have precisely the same effect as the cord has; and allow me to ask, oh where and oh where are poor gravity and the parallelogram of forces in this case?

A., Liverpool.

MONOLITHIC BUILDING.

[4692.]—In reply to "Epsilon" (let. 4576), I trust he will forgive me when I criticise his criticism. Were I or any other man—adopting our friend "The Harmonious Blacksmith's" word, monolithic, as distinctive of a concrete form of structure—to admit the presence of joints properly so-called, we should at once plead guilty to having employed a word the significance of which we did not understand or knowingly misapplied. "Epsilon" is perfectly right as to his theory of cementing surfaces, but wanders away into a consideration of the cementing process in ordinary brickwork. Now, I will not admit that any comparison can be made between a good concrete wall and a brick one; the first is a solid mass of matter, every particle of which is possessed of greater tenacity and resistance than brick itself, to say nothing of ½in. joints of mortar, in many cases not better than so much mud. Only fancy a brick wall put up in such weather as we are now experiencing, when the workman can hardly spread his mortar to get the brick in position. To talk of tenacity in such work is to insult the understanding of any reflecting mind. My comparison was drawn between stone and concrete, and in any discussion on the relative merits of building material I should decline to enter were brickwork, the only and sole merit of which is facility of construction, permitted to take a place. I certainly committed a slight *lapsus* when in my former letter I compared the joints of stonework and concrete as in the latter. The addition of a layer of material cannot be said to constitute a joint any more than the addition of a load of hay to a rick can be said to do so. Did "Epsilon" ever see a large work executed in plaster? and if so would he say that there were joints in it? I venture to say that if the work was well executed, not only would it be impossible to find any, but that absolute fracture would fail to show where the additions of material had been made; and so it should be with concrete—the frames should be raised and the work progress in such a manner that the surface is never permitted to bake, when, due care having been observed in proportioning and mixing the materials, a truly monolithic structure would result. We are as yet in the infancy of this matter. True, the ancients knew and practised the system, but the light brought to bear by science in the preparation of cements has rendered its application at once simple and effective, so that those who will take the trouble to inquire for themselves may look forward with confidence to the day when it will be generally adopted. That failures have happened, and will occur again, is only in the natural course of events, but so surely as truth ever overcomes prejudice, so surely will concrete building, whether truly monolithic or not, supersede brickwork. In the same number of "ours" as the letter of "Epsilon" I find a selected article from the *Aberdeen Journal* on concrete, but from the description there given of the process it is not properly named. It is a system of cement puddle or grout construction, and could never be depended upon as compared with true concrete, though doubtless for cottages as described it answers every purpose. M. G. C.

INEXPENSIVE AND SIMPLE STEAM ROAD-CRUSHER.

[4693.]—A CRUEL means of coercive restraint the bearing rein is, doubtless, most truly stated to be, and "Old Ploughman" (let. 4434, p. 384), deserves much credit for drawing attention to the evil. But there is yet another form of barbarity to which all our horses alike are subjected even against the will of their owners—namely, the custom of leaving the sharp macadam of a newly-repaired road to be gradually worked down in the course of public traffic by the horses' feet. This practice, although it has been much denounced and condemned, is yet everywhere prevalent, and the costly and cumbersome steam road crusher is, owing to its limited local application, not likely to find much general favour. A cheaper and more handy appliance is very much needed. Now, while recently looking over an illustrated description of a steam plough, in a magazine, the thought occurred to me that such a contrivance might be utilised on a common road by merely substituting a heavy stone or iron roller for the plough, all the other apparatus being retained without alteration. Movable barriers might be set up at (say) 200ft. or 300ft. apart, half across the section of road under the operation, the other half, as is usual, being retained for traffic. The roller might then be run by a stationary engine to and fro over the metal till crushed in. A small roller might trundle immediately behind the large one to act as a pawl to check recoil in case the rope should give way, which would be more particularly needful in ascending inclines. This simple apparatus might be promptly set up, and as easily removed in almost any locality (except on very steep inclines) at a small cost when compared to the ponderous machine which is occasionally and exceptionally brought out to do similar duty. I send the above suggestion for what it may be worth, and shall be very pleased if it may be found practically available to lessen needless animal suffering. ANIMALS' FRIEND.

"VERITAS" AND THE PENDULUM.

[4694.]—I CANNOT understand what "Veritas" is attempting or doing in letter 4606, page 489. Why does he multiply the seconds in a month by the seconds in a day? And why divide this by the number 330, and then the square root of the quotient by π, and by the n° to log. 0·00072332? What is the latter quantity, and what is he going to find?

The polar diameter is not 7900·18 miles. Neither is the mean diameter a geometrical mean between the equatorial and polar. It is twice as near to the former as to the latter, because the larger diameter applies to two dimensions, and the smaller to only one. Coming to his second letter (4645, page 514), he is wrong in placing the earth's mean diameter at latitude 45°. It is at 35° 16′, and is the mean of *three* extreme ones, the polar and *two* equatorial diameters, instead of one of each. The mean diameter is that which the earth would have if moulded into a sphere without change of bulk. It is not the mean between *only two*, the largest and smallest. He is right in placing *this* at 45°, but wrong in calling it "the mean diameter."

The strangest thing, however, is whence he has got his false data of the feet fallen in a second. These are half the velocity acquired in a second, and the latter is π^2 × the length of second's pendulum at the same place. Nothing has been more accurately measured than the pendulum at various latitudes. It is (according to Airy's work, referred to in his first letter, page 489) 39·01677 inches + ·20377 sin.² *lat.* This is for the sea-level, and shows that the longest pendulum possible, namely at the polar sea-level, would be 39·21704 inches; and the shortest possible at any sea level—namely, at the equator—is 39·01677 inches. Now, the latter multiplied by π^2 exceeds 32 feet. It gives 385·08 inches, or 32·09 feet. So that there is no latitude where the fall of bodies in a second, at the sea level, is so small as 16 feet. "Veritas" contradicts himself by saying—first, it is 16·03 feet, at a latitude within four miles of 45°, and afterwards that "somewhere" it is 16 feet, "and that point is 45° latitude." The real fall at 45° is 16·086, and at the equator 16·045. To get to a place where it is as little as 16 feet, we must either descend below any mine or ascend above any mountain yet climbed—namely, more than five miles, even at the equator. I lately remarked, on the metrical question, that if we were ever to adopt Sir J. Herschel's proposition of augmenting our inch and foot by one-thousandth, so that a cubic foot of water might be 1,000 ounces instead of 997, and his "module" of 50 new inches (or 50·05 present ones) be a decimal fraction of the polar axis; then the new foot would represent the quarter-second fall of bodies *somewhere*, at some accessible height on the Quito Andes; but it would still be a little short of the fall at any place inhabited. E. L. G.

P. S.—"Veritas" cannot deduce the mean fall here on earth from the moon's fall per second, as if the latter were known by some independent measure! Of course her distance (and hence her velocity) are only measured by her parallax and our measures of degrees on the earth, and the former can hardly be known to four figures; even the latter are uncertain beyond the fifth figure, while pendulum lengths are pretty certain to the seventh. The nearest miles to the earth's equatorial diameter are 7,926, but to the polar 7,899, and to the mean 7,917, instead of those he has found.

PROPOSAL FOR UNIVERSAL STANDARD MICROMETER EYEPIECE FOR MICROSCOPES, &c.

[4695.]—SOME of your readers may be interested in learning that I have calculated and completed a compound micrometer eyepiece which I think might be used as a standard one. I have had it in use for some months. It is not mere theory. I give a few reasons for considering it a standard:—

1. It magnifies just ten times of itself, which is an easy multiplier, and is not like any I can hear of.
2. It shows the magnifying power of any objective (simple or compound) at sight, by measuring the size of the image formed by the objective of a stage micrometer ruled to 100ths and 1000ths of an inch.
3. It shows the magnifying power of the combined objectives and eyepieces by multiplying the magnifying power of the objective by 10, its own power. If the objective be 10 ×, and the eyepiece (or ocular) be 10 ×: then 10 × 10 gives 100 = the magnifying power of the whole combination.
4. It will show the real size of the original object.
5. It will enable us to calculate easily the magnifying power of any other eyepiece used with the objective.
6. In the telescope it will show the real size of the image formed in the focus of the telescopic object lens or reflector.
7. It will measure the breadth of the pencil of light emergent through the eyepiece of a telescope, and show its magnifying power.
8. In the spectroscope: It shows at once the distance of the Fraunhofer lines in the spectrum formed in my (Browning's) spectroscope.
9. It will show the relative dispersive power of the prisms by the distance between the Fraunhofer lines.
10. It will give a rough measure of angular magnitude.
11. It makes the focus of any object for parallel rays easily calculable.
12. It verifies its own utterances as to magnifying, for any one can see it magnify by 10.

GEO. FINDLEY.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4696.]—IN reply to Mr. Oldfield and Mr. Vivian, I would take any amount of trouble to get my object-glass better corrected, if Mr. Oldfield will give the kind assistance proferred in his letter (4483, p. 412). The actual clear aperture of the object-glass as mounted in a plain screw-down brass cell, is 4 $^{8}/_{10}$in., the real diameter is 4$^{9}/_{10}$in. If Mr. Oldfield thinks 70in. long enough by his proportion for the above diameter, it would save some of my present work. There is one thing I am yet in doubt of. Is it possible that my flint lens is too thick in proportion to the crown? I will state the measurements in decimals of an inch, and perhaps matters may be improved in this respect. Crown in centre ·35, on edge ·13, flint in centre ·26, on edge ·35. With regard to the quality of the glass, I cannot see any veins or striæ, only a very small seed or air bubble, one in each lens, and in both cases close to the edge. In examining photographic lenses I have often seen these veins by holding the lens between the eye and a bright cloud or a lamp. As a certain distance is reached, they show very plainly. This test to my lens, with even the crown taken separately, did not reveal any.

I must now plead guilty to having given some wrong specific gravities of the glass. The fragments do not vary to the extent I gave in my letter (4389) on page 355. Perhaps it would be better to say nothing about a bad workman quarreling with his tools as an excuse, but I found that one of the knife edges of the balance was broken. Before going to work, according to Mr. Oldfield's directions to get an accurate specific gravity, I got the weights most carefully adjusted, and also the balance put in first-rate order. The water used was distilled, the temperature kept to 60° Fahr. A mean of one dozen results on the lenses and fragments included gave 2·5529 for the crown, and 3·6452 for the flint. A still more careful test of the object-glass itself last week gave, to my great satisfaction, exactly the same result even to the fourth figure, which I have no doubt is the real thing. I shall be very glad if Mr. Oldfield will set me to work with some new curves. Does the above agree with my refractive index given some time since—viz., ·638 for the flint, and ·529 for the crown, both of which I took some trouble over? W. H. CASH.

COMPARING ELECTROMOTIVE FORCES.

[4697.]—REFERRING to letter 4610, p. 490, I beg to assure "Pi" that the three equations contained in my letter (4475, p. 411), are quite correct. The term *gi* should, however, be preceded by the sign + in the second, and by − in the third equation, or *vice versâ*. Bearing this in mind, these equations hold generally, and not merely when the current in the galvanometer is *nil*. I derived them from the following consideration, that "the sum of all the products of the separate intensities and resistances in any closed circuit equals the sum of all the electromotive forces in the same circuit." This is a natural consequence of Ohm's law, by which the product of the intensity and resistance in any part of a circuit equals the fall of tension in that part.

The truth of these equations may be shown in another way. By considering E_1 alone to act, find the current it would cause in the galvanometer. Do the same with E_2, and the difference of these expressions must represent the actual current. It is:

$$i_3 = \frac{E_1(r+y) - E_2(R+x)}{(R+x)(r+y) + g(R+x+r+y)}.$$

Now, by eliminating i_1 and i_2 from my second and third equations, with the assistance of the first, the above expression is also arrived at, thus showing the accuracy of the equations. O.

BOAT BUILDING.

[4698.]—WOULD some practical boat-building correspondent kindly give me information on the following points—viz.: Wherein consists the superiority of diagonally-built boats over clincher-built ones? Are they more difficult to build? Are they lighter, with the same degree of strength? Are timbers required? Is the planking at and about the midships continued from gunwale to gunwale round the keel, or fixed to the keel as in ordinary clincher building?

I have frequently built small craft clincher fashion, and am thinking of building a small lifeboat to coast in, 14ft. long × 4ft. beam, with air-chambers, &c., and decked over, canoe fashion, and think it best to build it diagonally, time being no great object. I would therefore be glad of the above information, or any other ideas in connection with the matter. I should mention I am intending to build it of two ¼in. skins of white spruce or yellow pine, and would also wish to know if the timber would be suitable, and of sufficient strength. CANOEIST.

USEFUL AND SCIENTIFIC NOTES.

Whitworth Scholarships.—The following were the successful candidates in the competition for the Whitworth Scholarships, at the Science and Art Department of the Committee of Council on Education, South Kensington:—Robert H. Smith, aged 20, mechanical engineer, Edinburgh; Albert E. Seaton, 23, draughtsman, Hull; George W. Sutcliffe, 23, joiner, Bacup; John C. Jefferson, 21, mechanic, Leeds; Henry G. Willis, 24, student, Trimley, near Ipswich; Frederick H. Millington, 21, millwright, Worsley, near Manchester; Edwin G. Field, 20, engineer's apprentice, Wolverton; Robert Coey, 20, student, Belfast; John C. Fell, 20, mechanical engineer, London; William Firkin, 21, analytical chemist, Crewe.

Maine Power.—The State of Maine is in one sense the most powerful State in the world, although it contains only 30,000 square miles. It has about 1,800 lakes covering nearly 3,000 miles, nearly all of which lie at the head of rivers running to the sea, and their great altitude gives to the descending water an immense power. Rangely Lake is 1,500ft., and Lakes Umbagog and Moosehead are each over 1,000ft. above the level of the sea, and the whole surface of the State is, on an average, 600ft. in elevation, so that the waters of all the lakes and rivers must fall that distance. It is estimated that the total water-power of the State is equal to the combined working energy of 4,000,000 horses or 34,000,000 men labouring day and night all the year around, or, counting only that available, exceeds the actual working power of all the men in the United States, England, France, and Germany.

Submarine Photography. — According to the correspondence of the *New York Herald*, an ingenious plan has been adopted by Prof. Agassiz's expedition for determining how far the submarine regions are pervious to light. A plate prepared for photographic purposes is inclosed in a case so contrived as to be covered by a revolving lid in the space of forty minutes. The apparatus is sunk to the required depth, and at the expiration of the period stated is drawn up and developed in the ordinary way. It is said that evidence has thus been obtained of the operation of the actinic rays at much greater depths than hitherto supposed possible.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

[11589.]—**Dry Steam.**—Will "E. L. G." kindly refer to experimental proof that 30lb. steam suddenly relieved of half the confining pressure will at once expand to not only double but to nearly four times its volume. I do not remember to have seen this stated before, but that is no reason for denying its correctness, nor does it seem to be improbable, but I should like to see it proved. If it be so, the sudden expansion of compressed steam will cause more of the apparent loss of heat than I supposed to be caused by its expansion alone. "A., Liverpool," is mistaken in supposing that I attributed the increased pressure of superheated steam to the increased quantity of water in it. Its elasticity may be increased just as that of any gas may be, by increase of temperature alone; but when steam is heated in contact with water, its increased tension is caused chiefly, not exclusively, by the increased quantity of water in the form of vapour, and the increase of its tension is very great in proportion to its sensible increase of temperature. As before stated, I do not think the increased tension of dry steam is the chief reason of its advantage, but that the excess of heat allows some of it to be transmuted into power, without any steam being condensed into water. I do not know that this opinion is generally accepted, but it is, I believe, correct, or nearly so.—Philo.

[12103.]—**Staining Glass.**—"Clinchey's" reply (p. 491) confounds three perfectly distinct things, the making of coloured glass—(*i.e.*, tinging its ingredients in the manufacture), painting on panes of glass with vitrifiable enamels, and the staining the same yellow or orange, for these are the only two stains yet discovered. The "very fine red" he first copies is merely red enamel for porcelain, or such as we see on the old German glass beakers. Being "fine" only as an opaque paint or by reflection, it would, in a window merely adorn the outside, and have no more effect within than so much sealing-wax. The same applies to all the other recipes with which he favours the querist. The yellow stain he describes indeed, but with no hint how it is applied; and doubtless a green of some sort has sometimes been produced by this "yellow on one side and a blue on the other," but he describes no blue! Oxide of chrome has *not* "been employed to *stain* glass green," but only to make green glass—*i.e.*, to tinge it in the melting-pot, which copper, however, does more richly. The chrome green is used only for trinkets in which also gold and uranium are employed to tinge glass, but not that of windows. The other tinging metals in use for window glass, besides copper (which gives both the finest red and finest green) are only cobalt for blue, manganese for violet, antimony for orange, and silver for yellow. Of all these, the only colorant known to *stain* glass already made is silver, either alone or alloyed with antimony. The silver, to stain yellow, may be either metallic or in the form of Chloride, and being levigated with a cream of clay or ochre (merely as an inert diluting vehicle) is spread and dried on the glass, being afterwards scraped off any parts that are to be left unstained; and when it has been exposed to a red heat, the layer being scraped or washed off, can be used again. The parts covered by it are found to be as transparent as before, but tinged yellow to a depth of a fortieth or even twentieth of an inch. With the antimonial silver, a similar stain, but of a dull orange or sherry colour, far less valuable artistically, is produced, and even one miscalled "red." Antimony alone, or in excess, has no effect; nor have means of staining in any other colour been found, though these have been practised for at least five centuries. Panes thus stained yellow have even superseded, for use in windows, all glass manufactured of that colour in fusion. It is to be noted that when, as in the Munich style of glass painting, the same pane is to receive both enamel colours and either of these stains, the painting and stain must be on opposite sides, or they would run together in the burning, and spoil each other. In the golden age of this art, till the end of the thirteenth century, neither these stains nor any painting in colour was yet known, (the only enamel applied being shadow-colour) nor was even any glass that we should call white, producible! Those who made the glorious windows of the Cathedrals of Chartres, Bourges, the Sainte Chapelle, or the Trinity Chapel, Canterbury—works of art as impossible for modern man ever to replace as to build a new Parthenon, or paint a new Vatican—had no glass that we should deem good or colourless enough for the rudest penny drinking vessel or toy, or any outhouse window.—E. L. G.

[12140.]—**Chemical (U. Q.).**—In answer to Mr. J. S. Hoyles, it is my opinion that Professor Dolbear's method for making potassium is not dangerous. The explosive compound, which is formed in the ordinary process of manufacture, is a compound of potassium with carbon monoxide. Now, carbon dioxide is not present in Dolbear's method of manufacture, and from the ingredients used, I think it is impossible for an explosive combination to be formed. It remains now to be seen whether the process is commercially useful. Certainly the separation of the metal from the paraffin oil will be no hindrance to its introduction, it needs only to be poured away or filtered, for potassium is not soluble in that menstruum.—George E. Davis.

[12153.]—**Ant Hill Earth (U. Q.).**—I know nothing of the above, but if "Proven" will sift his Bath-brick fine, add one-third whiting, and wet with brine of common salt, not too strong, he may burn his moulds and blow them out clean with a bellows; but you must guard against exposing your moulds to the action of the atmosphere as they absorb it very rapidly, and in drying again are apt to explode; therefore, when once dried and burnt keep in stove or oven until wanted. The same material can be crushed, sifted, and used over and over again. These can be fired very hard and clean, making good sharp work. Paraffin I have found as good; in fact, to my fancy, better than wax.—Jack of All Trades.

[12167.]—**Dry Soap (U. Q.).**—I don't know much about it, but I started to repair some machinery at a dry soap works; they caught me looking at them, so they sent me off before I had got all particulars. They had a pair of rollers like those that grind clay in a pan, by means of which they ground soda, tallow, and some sort of whiting or clay—lots of soda, lots of clay, and little tallow. The heavy rollers are to well mix it. When they had well ground it they shovelled it out into low boxes about 4ft. square and 6in. deep. There they let it lay till it dried a little (it won't stand drying with steam or fire, it melts the tallow). Then they put it into a mill, something like a coffee mill, and knocked it about, and it ran out underneath, dry soap. There is a firm not quite a thousand miles from Bradford, in Yorkshire, where they make lard out of soap-suds, which they get from washing machines at factories; the residue makes tallow for dry soap.—Outgenious Whitesmith.

[12167.]—**Dry Soap (U. Q.).**—"An Old Weston Subscriber" has not, I see, obtained an answer to his query, so I will now do my best to help him. Dry soaps may be made in many ways. I know several manufacturers of them, and they all use different processes. This is one process: Boil 9 parts of soda-ash (containing from 8 to 12 per cent. of caustic) in 10 parts of water, and add 10 parts of fat of any kind; keep constantly stirred, and add 80 parts of soda-crystals; keep hot and well stirred until all the crystals have melted or dissolved in their water of crystallisation, then run out into shallow iron trays, and keep constantly raked about, with a very fine-toothed rake, until cold. The dry soap will then be in a powdery state, and ready for doing up into packets. Another process is to melt 80 parts of soda-crystals in their water of crystallisation, and add 15 parts of hard white soap until dissolved; it is then run out as before, raked into coarse lumps, and afterwards ground in a mill. A third process may let my readers into a practical exposition of the saying, "one-half of the world doesn't know how the other half lives." A dry soap is made by this process by a "a dry-soap maker" in one of the northern counties. A soap is made by the first process, but with only 20 parts of soda crystals instead of 80, and this is afterwards ground up with not a very definite quantity Glauber's salts. The following are analyses I made some time since of the first and last specimens:—

	First.	Second.
Fatty acids	10·000 ...	8·774
Sodium chloride	1·228 ...	1·046
Soda crystals	79·440 ...	14·936
Soda ash at 50 per cent.	8·510 ...	2·244
Glycerine and sodium sulphate	·822 ...	73·000
	100·000 ...	100·000

—George E. Davis.

[12170.]—**Dyeing (U. Q.).**—I know of no association for the chemistry of the above, but you might apply to Lockwood and Co.; I believe they publish a good work upon dyes in general.—Jack of All Trades.

[12172.]—**Constipation.**—I beg to inform "Saxum" I have used the enema daily, and still continue; as regards its continued use, that must depend upon circumstances. Mine was a bad case. I may explain: At two years of age had a fall, which resulted in a determination of blood to the head; at four years my parents were informed that by the age of fourteen I should be a confirmed idiot; at fourteen a capital head-piece, but very weak constitution; put to hard work and long hours; at twenty-one very costive and head-ache; twenty-three, a continuation, with great mental anxiety, piles, rheumatism, sickness after each meal, and considered physically broken down, and mental powers weakened; at twenty-nine gave up my doctors, took to scientific pursuits (as a recreation to divert the mind), with excellent results; had a great deal of out-door exercise, but bodily ailments still continued; at thirty-two cured myself of rheumatism with egg liniment (try it); at thirty-three operated on at S. Mark's for piles (a good cure, but in my case not permanent: given up as incurable); took to the enema at thirty-four, and in three months my old friends forsook me; at thirty-seven I have not taken a dose of medicine, nor needed one, for three years. A debility of the system to a slight degree is left, the effect of so severe a drilling. My experience shows me that I require a daily use of the enema, but in some cases every other day would do, where the lower gut has not been so much weakened. From a pint to a quart of plain tepid water can be used in winter, or quite cold in summer; the cold is useful when the vessels require constricting, or where actual piles are present. I should not use it without. As regards medicated water, that would only be used in urgent cases of illness, such as a soapy lather would act as an irritant, and the starch as a counter-irritant. The best form of instrument is an indiarubber one, which can be bought for not more than 6s. 6d. at any indiarubber shop. It is a hollow bulb, with about 18in. of tubing at each end. With such a one any quantity of water can be pumped; to any one a stranger to its use I would privately send instructions. Most good doctors know the value of it, but very few have experience of a continued use, because patients, as a rule, do not like any trouble; it is a good thing for medical men they do not. Even if a strict course of diet was ordered to a half-dead patient, it would be considered very hard to be obliged to restrict oneself, and for a doctor to act strictly conscientious means poverty to one struggling for a living. An old woman doctor (12172) recommends cabbages, turnips, carrots, &c., which are quite right for a person in good health, and digestive organs sound, but awfully flatulent for weak stomachs, and I now know numbers of costive persons who dare not eat them, in consequence of not being able to digest them: the remedy in that case is worse than the disease, and I know it to my cost. It appears to me from a long experience that the proper course is to eat food which easily and quickly digests; take no medicine to further weaken and irritate the mucous membrane, but empty the bowels by means of the enema, and in course of time the system will strengthen and allow you to eat green stuff as much as you like. That is precisely what has taken place with myself. I eat anything now, but continue the enema, through the lower gut, being still my weak part, although I have no piles.—J. W.

[12172.]—**Constipation.**—I fully indorse the views of "A Physician" on the above subject, as to the constant use of white bread aggravating, if not being the main cause in many cases, of confirmed constipation, though at the same time whole wheat or brown bread are not always suitable means of relieving it, as many weak stomachs and bowels cannot bear the irritating effects of such. Vegetables and fruit are much more suitable in such cases, with daily ablutions. Dr. E. Johnson's theory is "that nervous excitement is the cause of constipation—that is, the cause of the arrest of the alvine secretion. The cause of constipation, therefore, does not reside in the bowels themselves, but in the nervous system, and can only be cured by a remedy which has the power of allaying excitement, and strengthening the great nervous centres." He regards the hydropathic treatment as a great means of cure, as drugs of any kind only relieve for a time, leaving the system weak and more susceptible to a future attack. He also regards it a most unnatural practice when the bowels are sluggish to have recourse to the constant use of medicine, as in almost all cases the fæces has not been secreted, and the effect of the purgative is simply to force and expel that from the bowels that nature intended should be retained some time longer. He also holds that the entire of the food is taken up into the blood, except indigestible substances, which pass without undergoing any change, and that no part of it is expelled in stool or fæces till secreted from the blood into the bowels. Among other reasons, he gives the case of a patient kept alive by the daily injection of mutton broth, and the yolks of eggs, his bowels being regularly relieved every three or four days of a well formed and healthy stool, possessing all the properties of an ordinary ejection. Another instance: you daily administer medicine, and daily the bowels are opened, though no food is taken. Surely if the common-received notions were true that the stools are the residuum of the food it would be a matter of great wonder, since out of nothing assuredly nothing can come. There are thousands of individuals who are constitutionally relieved only once a week, and sometimes once a fortnight (of a spare habit of body, with good appetite), whereas others again are daily relieved. If the old medical theory is correct, what becomes of all the refuse accumulating in such individuals, the retention of which gives them no trouble whatever. I recommend the perusal of Dr. Johnson's pamphlet on constipation and indigestion to those of your readers suffering from such ailments. I could write much more on the subject, but fear I have already trespassed too much on your space; but the subject is one of such importance, no doubt, to many of your readers, more especially to those who are brain-workers, and those following sedentary occupations (the great sufferers from constipation), as the man labouring by the sweat of his brow, and whose sleep is sweet, seldom suffers.—T. L. V.

[12173.]—**Coloured Inks.**—The fault of many who make coloured inks from the aniline colours is, that they make them too strong. I have for a long time written with magenta crystals dissolved in water; for a red ink it is very brilliant, and I have never needed that it should be thickened with gum. I have never used sugar either; it might certainly increase the brilliancy, but my inks have always been as brilliant as I have cared to see them.—George E. Davis.

[12245.]—**Chemical (U. Q.).**—Mr. R. Terret does not say whether he wishes for a method for separating the illuminants from coal gas, on the analytical, or on the large scale. Presuming that he wishes to do it on the large scale, he has only to pass the coal gas through a small column filled with flints, down which highly concentrated oil of vitriol is poured in a continuous stream. The olefines will be absorbed, while the vitriol will only take up traces of the marsh gas.

If a eudiometrical analysis is required of the gas, the olefines must be absorbed by a ball of coke saturated with a solution of sulphur trioxide in hydrogen sulphate, and when the absorption is complete, to remove the acid fumes with a potash ball.—GEORGE E. DAVIS.

[12269.]—**Staining Leather.**—A solution of salt of tartar or common soda will stain leather brown. The gloss is put on by rubbing with a piece of hard wood.—E. M.

[12272.]—**Electrotyping.**—To W. H. H. C.—The objects I am trying to electrotype are wood engravings, the electrotype to be used to print from, instead of printing from the engraving. When I have obtained the thin shell of copper by the deposit, it is quite evident I must have something to mount it upon before being able to print from it; those used in the printing trade are upon type metal, how is this type metal made to stick to the copper? I have dusted the copper over with powdered rosin, and poured melted metal on, but it would not answer at all. I have seen some electros with very thin coatings of copper indeed, and which appeared to me as if the copper had been deposited upon the metal stereotype, instead of being deposited on a mould and filled up with metal at back; perhaps this is the right process after all in this department of electrotyping. Up to now all my moulds have been of guttapercha: I could not make wax moulds take a deposit anyhow. I see another correspondent (qy. 12485) is inquiring for information respecting electrotyping, for the same purpose—viz., electrotype blocks for printers.—ZOO ANDRA.

[12276.]—**Boiling under Pressure.**—"W. W." does not say at what temperature he wishes to boil his liquid. A Papin's digestor is the best thing to use, but any vessel strong enough in which the "lid" could be kept down would do.—E. M.

[12277.]—**Aniline Black.**—A. Muller gives the following formula for an aniline black which can be used for printing:—20 parts chlorate of potash, 40 parts sulphate of copper, 16 parts of chloride of ammonium, and 40 parts of aniline salt, are dissolved in 500 parts of water, and warmed to about 140° Fahr., then removed from the water bath upon which it has been heated. If black enough, it is to be exposed to the air for a day or two; if not, heat again before exposing. After being well washed the powder or paste is fit for use. There are other formulæ in use, but I think this will suit "W. W."—GEO. E. DAVIS.

[12278.]—**Mercury.**—The symptoms of mercurial poisoning are said to be unmistakable. A coppery taste in the mouth, loose teeth, and spongy gums, and so on. The remedies are the dilute sulphuric acid of the Pharmacopœia, lime or lemon juice, and saline aperients. For the throat, use a very weak gargle of chloride of lime. Don't follow this advice unless you *know* it is mercurial poisoning from which you are suffering; although you can't do any harm by using the remedies, you may be neglecting the "beginnings" of something else.—SAUL RYMEA.

[12280.]—**Winter's Machine.**—The "wire passing through the wooden ring" may be of brass—preferably so, in fact. I suppose it increases the length of spark by collecting more electricity.—E. M.

[12282.]—**Holes in Valve-Board of Harmonium.**—These are made long for convenience. You may make them round if you like, but you won't get them tighter then. It is not the shape of the holes that is at fault.—K. T. L.

[12288.]—**Radius of Object-Glass.**—I send "Amateur" a set of curves for the discs named. The flint glass must be ground to the following radii, or on the following tools:—Convex side of flint lens must be ground to the radius of 102in. and the concave side to 17in., ditto that of the crown must be ground to 17⁸/₁₀in. by 26in., both convex.—W. OLDFIELD.

[12302.]—**Stains in Oak Plank.**—Try oxalic acid and water, or weak muriatic acid and water. The first removes all ordinary stains from most woods.—E. M.

[12304.]—**Phrenology (and Electric Sparks.)**—I am quite sorry for "Sigma." I had no intention of hitting him so hard as from the tone of his letter at p. 492 it is evident I have done. This he will of course deny, but nothing short of extreme irritation can explain or excuse his ill-mannered reply, of which, however, I make no complaint, as bad language injures those only who use it. "Sigma," as is natural with a man of his temper, thinks that I, who doubt his infallibility, cannot know what I write about, but the proof he gives is in this instance a queer one, for he abandons the opinion he gave at p. 418, to adopt that I gave at p. 468, which is that all but universally held by all great writers on the subject. At p. 492 he asserts, as if he thought it was denied, that children from their birth have very different powers and dispositions; but allows that they know nothing they have not learned, which is exactly what the great writers taught, who, he says, were never more mistaken. He does not tell us what writers he did refer to, and says he does not know or much care whether John Locke held the opinion or no. If "Sigma" neither knows nor cares what opinions great writers do hold or do not hold, would it not be as well for him to hold his peace on the subject until he does know? Electric sparks seem to be a sore subject with "Sigma," so I will say no more about that; except to refer those who wish to see whether it was I or he that was dogmatic, to the letters, and that they may do so with little trouble, I have looked out the pages in which they appear—namely, 615 and 667 of Vol. XIV., and 42, 62, 119, and 256 of Vol. XV. I gave no opinion of my own at all, but merely stated a fact which I had been told and believed, which "Sigma" very rudely denied, but which turned out to be quite correct. "Sigma" says I am incapable of understanding what I either read or write, and proceeds to misrepresent what I did write by saying I appear to grumble when people laugh at me. If he will look again at p. 472 he will see that I said I would rather be laughed at than have no laughing at all, though I prefer laughing at others, especially at those who cannot bear the most gentle correction without their dignity being insulted.—PHILO.

[12308.]—**Iron Vats Leaking with One Liquid and Not with Another.**—If "R. J." would screw his vats together with sheet indiarubber between the flanges, instead of wood, I think that would stop, or reduce to a minimum, the leakage of which he complains. The reason the mixture leaks, and not the nitre (potash nitre), is that nitrate of potash is not deliquescent, whilst muriate of potash and also the nitrate of soda both are, and it is always found when operating upon the large scale that if there is any tendency to leaking that it always happens first with deliquescent compounds.—GEORGE E. DAVIS.

[12321.]—**Chess Player.**—"Zoo Andra," p. 492, thinks Kempelen's own neglect of this toy for so long after it had answered its end of amusing the Empress, was a "presumption in favour of the pretensions of this contrivance to be a masterpiece of mere mechanism." Without regarding it as any way remarkable for mechanism, I cannot but think his conduct very natural. The object was to outvie some magnetic "experiments" or paradoxes that had excited the Court's admiration. The mystery of the so-called "automaton" is not in a concealed player working the figure so as to make moves of the pieces, which any one must have known was easy by mechanical transmission; but in this unseen and unseeing director knowing what moves his antagonist has made. He is placed, I am told, under the board, which is thin, and has 64 little pendents of iron hung under the centres of the squares, each with a little play up and down. The antagonist's pieces each contain a magnet, and when the concealed director sees a pendent that is sticking to the board drop, and another that was hanging down jump up to the board, he knows that the piece which was over the former pendent has been moved and placed over the latter. Having a little pocket-book board and men in his hand, he accordingly registers this move of his opponent, then considers and registers his own, and then proceeds to execute it publicly by the mechanism. As most players, on first attacking the "automaton," tried the experiment how he could treat a false move, they gave him the opportunity of thumping the table, replacing their piece (or turning it off the board, I forget which), and proceeding to a fresh move of his own; no small advantage. The inventor evidently saw nothing to be proud of in the mere mechanism. The magnetic indication of the moves was the gist of the puzzle. After its revival, however, in 1781, the popular idea seems to have been that a real automatic player, *i.e.*, a self-directed chess-playing *machine*, was either made or pretended to be made. The exhibition travelled to every town in Europe, and in the beginning of this century, I believe, to every part of Asia and both Americas; the main question raised everywhere being whether its moves were or were not directed by a human mind! But the climax of the joke was that even when this had been settled, as probably all civilised men soon did settle it, (for mind applied to each move, not mind that had made a playing-machine once for all), the decision was on false grounds; and probably 99 in 100 of us even now fancy the bare idea of a chess-playing machine is absurd, or would involve creation of something. It involves nothing of the sort. It is not more certain that an engine can be made to count sovereigns, and sort them into two boxes, the light and heavy, without further interference of mind after it is once set going, than that machinery *might* be made, were there time for its study and execution, to play, and either win or draw the game with every human chess-player infallibly. The late Mr. Babbage is the only writer on the subject, I have heard of, who maintained this view; which being laughed at, he once, I believe, proposed to clear up the befogged vulgar mind upon it, by constructing an actual automatic player of "*naughts and crosses*," a child's game on nine squares, probably the simplest of the class to which draughts and chess belong. The fact is that all such games are a mere trial of who will make fewest mistakes; and a machine might therefore play them, and making *no* mistakes, must always either win or draw. Between two machines (or perfect players) there must always be a draw.—E. L. G.

[12344.]—**Disappearance of Art.**—The débris of iron "bridges, cranes, and girders," waning when unpainted, into "that indestructible material" rust, will not, I fear, after the "many thousand years" of Mr. "LXXXVIII." (p. 518) yield quite so much evidence of mechanical (to say nothing of "fine") arts as the sculptured alabaster, delicate bronzes, and pottery of Assyria; and stupendous masonry, surrounded by endless broken glass, pottery, and bricks, of Egypt, each alike truly "indestructible" materials; and in the latter climate even papyri and mummies nearly as much so. The chances, or rather certainty, in all present appearance, promise those old lands very decided monumental survival yet, after the "disappearance" of the arts of "girder" riveting and all pertaining thereto. Mechanical arts and manufactures must surely be displaced, superseded and vanish; that of papyrus-making for instance, which employed half Egypt's population, and now it is far more than 1000 years since a sheet has been made, or a plant grown. (Isa. XIX. 7). There is small mystery in such changes. As for "fine arts," they seem a blossoming into which no race or tribe blooms more than once, in a real genuine manner. Ornament and architecture have been slowest declining in India. After many centuries of steady fall, they seem even now no lower than ours under the Tudors, or even equal to the French of that date in all but its statuary. As the Mahommedan horror of idolatry has always at least equalled the very earliest Christian, these late Hindoo and the earlier Arab decorative arts abundantly disprove *that* theory. Besides, the decline of classic European arts began as early as Alexander, was far gone even before Christianity *appeared*, and was pretty well at its bottom by the time Constantine acknowledged the new religion, when alone it could begin to affect art generally.—E. L. G.

[12348.] — **Spanish Pronunciation.**—Thanks for Mr. Wray's very full particulars. Is he sure any other than *Blanco* is legitimate? Another point in which the grammars seem to differ from what I have heard spoken, is in defining the *j* as simply equivalent to a *g* preceding *e* or *i*. Are not *ja, jo, ju*, really equivalent to *gia, gio, giu*, the *j* being a double letter, sounding as *gi*, the German *ch* (or rather what Orientalists now express by *hh*) followed by short *i*? *Hijo, bajo*, = echhio, bachhio; *not* echho, bachho. I agree with him that the Spaniards, by their sensible philosophic reform of their spelling, have made their tongue, in this century, the most regular and easy in grammar, probably, in Europe. It is also, I think, the finest in sound; at least, excelling the Italian on that score, *longo intervallo*. Besides having due shares of all the vowels, or more of *o*, and less of the thin *e* and *i*, there is freedom from the doubled consonants, and indeed from all syllables ending in other consonants than the six best terminals *d, l, n, r, s*, and *theta*. (These, by the way, would be our only abundant word-closers in English, if we had not the wretched *k* and *t* as often.) Though Italian boasts of almost entire absence of consonants ending words, it perpetually ends a syllable with one, and even repeats it to begin the next, a defect as bad as any in our barbarous north. Spanish has not only, thus, more vowels to its consonants, but a rare subordination of the acute or harsh mutes, *p, t, k, f*, to the grave or soft, *b, d, g, v*. They make *acuto* into *agudo*. I think that admirable; a due proportion of such letters barely appearing in French, while in Italian, English, and above all German, they are swamped by the harsh mutes. Germans, who have not learnt some foreign language young, can hardly sound words like *hand, rub, dog*, without making the final letter acute. Both southern tongues happily lack our corrupt short dull northern vowels, and have hardly more variety of sounded than of written vowels, all distinct and full. But Italian, besides fewer vowel, has fewer consonant sounds (and hence fewer letters) than, I think, any other alphabet; whereas Spanish is singularly rich in choice of consonants. It keeps at once our *ch* and the German *ch*, French "*ll* mouillé," Italian *gn*, and the ð and θ that none others but we and the Greeks have. True, it singularly lacks both our *j* and the French *j*, and *b* and *v*, having only their intermediate, the Greek β and probably Latin B. Our *w*, the Latin V, they can express by *hu* or *gu*, according to its aspiration. Doubtless theirs is the tongue most like the Classics. Then, apart from sound, its grammar is most rational. It alone has the four distinct auxiliary verbs that we elsewhere smash up into two. A Spaniard must see that it is a barbarous defect our having only "to be" for *ser* and *estar*, and only "to have" for *haber* and *tener*. We are all as much behind Spain in this as the ancients were behind us in not having two articles, the Romans none; or as the French are in their odious use of *femme*. How absurd, again, that none of us out of Spain, writing a question, will distinguish it by the ? where most needed, to mark the beginning, but only the end!—E. L. G.

[12350.]—**Sulphuric Acid.**—I cannot say exactly how Dr. Ure compiled his percentage scale, but it may be done by taking a known weight of acid at a known density, precipitating with barium chloride, and calculating the acid from the sulphate collected. As to calculating the quantity of vitriol from the cubic feet, the following ready method is followed by some manufacturers:—It is taken that 1in. of vitriol at 120° Tw. (1·75 specific gravity) weighs 10lb. Then, if we have 40 cubic feet at 1720 specific gravity (144° Tw.) and x = the weight required

$$x = \frac{144 \times 12 \times 10 \times 40}{150} = 4608\text{lb.}$$

Now this method is incorrect, for in the first place an inch over a cubic foot does not weigh 10lb., and the quantity of the di-hydrated sulphuric acid ($H_2SO_4H_2O$) does not increase in proportion to the degree on Twaddle's hydrometer. Now, taking a cubic foot of water to weigh 1000oz., we shall get the weight of a cubic foot of vitriol from its specific gravity, thus a cubic foot at 1720 will weigh 172·0oz., and at 1750 it will weigh 175·0oz. 40 cubic feet of vitriol at 1720 will weigh 4300lb., and as vitriol at 1·720 specific gravity contains about 79 per cent of H_2SO_4, and at 1·750 contains 81·5 per cent., the following equation will give us the weight of vitriol at 1·750 which 40 cubic feet at 1·720 is equal to:—

$$x = \frac{4300 \times 79}{81 \cdot 5} = 4167\text{lb.}$$

Difference, error in first method 441lb. Now, the first method, which is so simple, requiring so few figures, may be brought very near the truth by taking the weight of an inch over a square foot to be 9·1lb., this brings—

$$x = \frac{144 \times 12 \times 9 \cdot 1 \times 40}{150} = 4193\text{lb.}$$

—GEORGE E. DAVIS.

[12358.]—**To "The Harmonious Blacksmith."**—On referring to my contribution to the early history of pianofortes printed on p. 435 of No. 381 you will find your question relating to the combination of organ pipes with pianoforte strings substantially answered. I have little to add to what I there wrote, but may just remark that if the same rank of keys be employed for both, the pianoforte "touch" must be utterly spoiled so far as capability of expression on that instrument is concerned, just as it is in some modern combinations of free or harmonium reeds with the piano. You are quite correct in supposing the main difficulty is preventing variation of the relative pitches of strings and pipes, which, although unisonous at the same temperature at which they were tuned, become dissonant by any increase or diminution of heat. I fear nothing but maintaining the temperature at which they were tuned can entirely prevent this evil, although something may be done by mechanical contrivances which vary the pitches of many reeds at once, or by the late General Perronet Thompson's contrivance, which he designated a (pitch) regulator, which was a system of adjustable shades. Some two years ago I got so "awfully" wigged for suggesting to blow the same pipe with varying pressures of wind that my, perhaps, rather long ears have hardly ceased smarting yet, for even donkeys can feel, although pachydermatous. Nevertheless, this so-called impossible thing was done long ago by S. Erard, with what results I can find no record. My other old suggestion to put each pipe of a solo rank into a separate swell box to be opened gradually by the further depression of the manual for the purpose of obtaining expression *à la main* in organs seems but a still-born child. Long ago, I requested our late able "Adept's" opinion of this crotchet, but he has made no sign since he promised to reply to this and some other queries. Considering his writings in "our" journal long ago proved him to be "hevery hinch a gentleman," I greatly fear his long continued silence is the consequence of serious sickness, if not something yet worse. Surely all us "crotchetty" correspondents cannot but regret the cessation of his most able, instructive, and practical papers on the organ.—THE HARMONIOUS BLACKSMITH.

[12371.]—**Truss.**—Have the metal work plated or covered with vulcanite as done by the instrument makers to some surgical instruments, and have the pads to unship. One of the ordinary kind for the land and one filled with horsehair only, and covered with macintosh for the water, and the same with padding for the springs. Highly dangerous to bathe without one.—D.

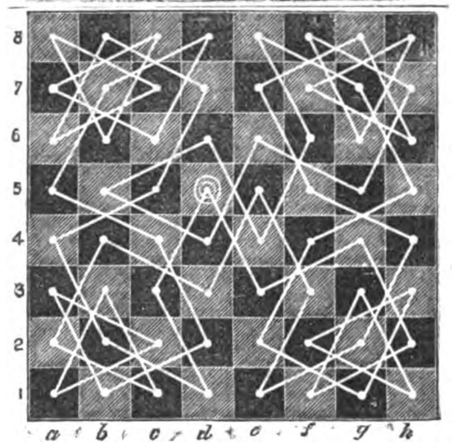
[12386.] — **The Prevention of Incrustation in Steam Boilers.**—Probably, "J. D. K.," with many other users of steam, has found by experience how little good accrues from the use of mineral compositions for boilers. Fuller's earth was once eagerly used until it was found to rapidly silt up the boilers. Tannic acid or tannate of soda is now having a good trial. Nearly any easily decomposed organic substance makes a good composition, the mineral matter becomes surrounded by the organic, which gets charred, when it forms a scale and allows the water to creep behind it. Bones form a good anti-incrustator.—GEORGE E. DAVIS.

[12387.] — **Amateur Organ Building.**—The sizes given are sufficient. If the bellows are to be worked by mechanical power or by hand double feeders will be better, but if occasionally by the foot of the performer a single feeder will be most useful. There is not any extra difficulty in making them of the dimensions proposed. The scale of the Bourdon is amply sufficient, viz., 6 × 5¼in. I very much prefer a moderate-sized pipe made to speak up well than a large pipe which is reduced so much. A small organ should be a minature church organ in tone.—J. D.

[12399.]—**Organ Building.**—The Viol d'Amour is a very small scale pipe of 8ft. pitch, it is half the diameter of the Dulciana, the mouth is one fifth of the circumference and as high as it is wide; the pipe has a sweet clear reedy tone, beautifully delicate and soft. There is no difference in shape between a Wald flute and Claribel flute, but the Wald has a higher mouth and is more reedy in tone. I would recommend the Bourdon to be mitred or elbowed and keep the pipes vertical.—J.D.

[12430.]—**Automaton Chess Player.**—1. For the article in German, with engraving, apply to Veit and Co., Leipzig, Germany, and order *Schachzeitung* of May, 1869, pp. 141 to 144. 2. For the article in Dutch, write to Dr. W. J. L. Verbeck, to Wijk bij Duurstede, Holland, and order *Sissa* of January, 1870, pp. 5 to 7. 3. For the article in English, with game and diagrams, write to Mr. Harrison, Merton House, Salisbury-Court, Fleet-street, London, and order *Gentleman's Journal*, supplement for March, 1870, pp. 105 and 106. 4. For a German notice in a Portuguese paper, apply to Mr. W. Spaythe, 66, Ludgate-hill, London, and order *Echo Americano* of October 27, 1871, p. 198. 5. For an English article on the *old* Automaton, apply to Trübner and Co., 60, Paternoster-row, London, and order *Chess World*, April and May, 1868, pp. 1 to 4 and 41 to 45. 6. See Professor C. Tomlinson's valuable work, "Amusements in Chess," pp. 87 to 113 (with 11 engravings and 4 games): London, J. W. Parker, West Strand, 1845. H. Meyer corresponds with Mr. Hooper, inventor of the figure at the Crystal Palace, and is willing to give further information.—H. MEYER, Sydenham.

[12438.]—**Chess.**—The following Knight's tour has no ends, therefore you can commence it on any of the 64 squares. There are several solutions to your question:—*d* 5, *e* 3, *g* 4, *h* 2, *f* 1, *g* 3, *h* 1, *f* 2, *h* 3, *g* 1, *e* 2 *f* 4, *h* 5, *g* 7, *e* 8, *f* 6, *e* 4, *d* 6, *b* 5, *d* 4, *e* 6, *g* 5, *h* 7, *f* 8 *g* 6, *h* 8, *f* 7, *h* 6, *g* 8, *e* 7, *f* 5, *h* 4, *g* 2, *e* 1, *f* 3, *e* 5, *d* 3,



b 4, *a* 2, *c* 1, *b* 3, *a* 1, *c* 2, *a* 3, *b* 1, *d* 2, *c* 4, *a* 5, *b* 7, *d* 8, *c* 5, *a* 7, *c* 8, *b* 6, *a* 8, *c* 7, *a* 6, *b* 8, *d* 7, *c* 5, *a* 4, *b* 2, *d* 1, *c* 3.—H. MEYER, Sydenham.

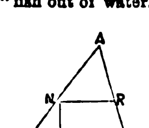
[F. Lewis and C. N. Abbott have also answered this query.—ED.]

[12439.] — **Working Plane Surfaces.** — Mr. Roberts, I think, may be able to grind plane surfaces if he gets two plane grinding tools, either planed flats or turned perfectly flat, and grind them together till all turning marks are removed with fine emery, and finish off with pounded pumice stone; after they are ground true together work the articles on either of them in the usual way of grinding and polishing true surfaces. This should answer for ordinary purposes, but if required in large pieces then Mr. Roberts will have to apply machinery, which Mr. Tydeman, I have no doubt, will explain according to promise.—WM. OLDFIELD.

[12444.]—**Day and Night Telescope.**—The day and night telescope is made with very large field of view, abundance of light, and only a moderate power, much less than that of other telescopes, which enables the seaman to see an object on a dark or dull night, when other telescopes would be useless on account of their higher powers.—W. O.

[12447.]—**Employment for a Retired Tradesman.**—Let a retired tradesman fit up a small printing-office; I warrant he will find plenty of amusement and interest in that; I shall be glad to give any information through the medium of the MECHANIC.—ZOO ANDRA.

[12447.]—**Employment for a Retired Tradesman.**—Being myself a "retired tradesman"—well, a retired manufacturer of remarkably "retiring" habits—I can fully appreciate my fellow correspondent's necessity, for he and most of his class (which has but few resources) are generally sadly in want of something useful to do, hence, nearly all retired tradesman, however pecuniarily rich, must of necessity be like "fish out of water."—THE HARMONIOUS BLACKSMITH.



[12457.]—**Geometry.**—Let A B C be the given triangle, and S the given given point. Draw S N parallel to A C (Euc. I.), and N R to B C. Then because N S is parallel to R C and N R to S C, ∴ N S C R is a rhombus inscribed in the triangle A B C.—P. W. H. J.

[12463.]—**Vision.**—"H. Science" puts two queries, the principal of which, I presume, is "How does the eye see an object erect when an inverted image is depicted on the retina?" I fear he will get little other explanation from scientific sources than he has himself indicated. The education theory seems to me to be a mere assumption. I hold to the common opinion, that the eye sees the outward object and not the inverted image. The proof is in the fact that objects appear in their natural position. Perhaps some of your able correspondents can tell us what amount of proof attaches to any scientific theory on the subject.—COMMON SENSE.

[12464.] —**Aquarium.**—From reading Mr. E. Fowler's query I am reminded of a young lady who kept some small trout in a glass globe. Mr. Fowler says "One day the water is nearly white; the next day, &c., to the end of the chapter where the tragedy occurs." Just what Mr. Fowler graphically depicts happened to the trout, from the young damsel fancying that one globe of water would do her much-prized fish for an indefinite time, but they were all "with the majority" next morning. Perhaps some spiritualist, who did not disdain such trifles, cast a spell over the imprisoned fry and sent them swimming through the narrow ocean of his fancy. At all events, the young lady's fish wandered round the globe no more, like some puny, discontented individuals, but lay "contented and still." She was then advised, if she wished to keep fish for the future, for their health and vivacity, to keep them supplied with a constant stream of fresh water. This was accomplished by forming a communication with a water-barrel outside by means of a small pipe and tap to regulate the supply. A small fountain was afterwards made to play through the glass globe by making some small holes in the top, and it formed a beautiful ornament with the lively fish inside. The water was carried away in an overflow pipe and conveyed to another barrel standing beside, but lower than the other.—RAT-TAT.

[12465.]—**Compound Eyepieces.**—In reply to "C. B.," the following is a good rule which will answer his purpose for the Huyghenian eyepiece with the proportion as 1 to 3; divide twice the product of the focal lengths of the field and eye-glass by their sum. Thus, if the focal lengths of the field and eye lens be 3 and 1, that of the equivalent lens is equal to $\frac{2 \times 3 \times 1}{4} = 1\frac{1}{2}$ or 1·5. The positive or Ramsden's is as follows:—The lens equivalent to an eyepiece of this description is found by dividing the products of the focal lengths of the lenses composing it, by their sum less the distance between the lenses; hence, if the focal length of each lens be 1·5, and the distance between them 1in., it will be as follows:— $\frac{1\cdot5 \times 1\cdot5}{3 - 1} = \frac{2\cdot25}{2} = 1\cdot125$ or nearly 1⅛in. focus; this method will, I have no doubt, suit "C. B.'s" requirements.—WM. OLDFIELD.

[12466.]—**The Harp.**—Although "The Blacksmith" is not the especial "Man at the Wheel," our "East-end Mechanic" asks his question "at," as Di Vernon expresses it, perhaps he will permit "The Harmonious Blacksmith" to inform him he can see some specimens of Irish harps at the present loan exhibition of ancient musical instruments in South Kensington Museum. Also—with the attendant policeman's permission (N.B.—Bobby is a very civil fellow whose temper is much tried by the genteel mob who will not keep their hands off what they don't know how to touch without great risk of injuring)—of measuring their strings. One of these harps, numbered 226 in catalogue, is strung with rather thick wire, but it looks very slack, I "rather guess" it 'aint "up to much," and certainly not "up to pitch." Another (No. 227) bears the date 1621, and yet another A.D. 1671, quite a juvenile. (N.B.—This "baby" in years is lent by a lord, consequently it is something to interest, and to be almost worshipped by such folks as blacksmiths and "East-end Mechanics.") Besides our ancient Hibernian friends, while "harping" on this subject, I may mention there are sundry Welsh harps, also one English ditto, said to have belonged to our most religious and moral King Charles II., of pious memory, to whose reign we are indebted for the Lord's-day Act, which don't shut up the publics in the East, but, by way of compensation, does shut up the Bethnal-green and many other museums on Sundays. (See the "Too Great Contrast" in *Punch*, of July 17.) Considering the "pious" memory of its royal owner, the harp must yet have an odour of sanctity far too powerful to be smelled on Sunday, at least by the "common people," although "King Cole" has occasionally admitted his "religious"—who are also "rich"—friends within the sacred precincts of science on that day. Of course, I need hardly add—for it is quite self-evident—that this would be so very dangerous to morality in so poor a locality as Bethnal-green that it could not be tolerated, so the police had orders to deprive of their tickets the wicked aristocratic visitors who "desecrated" the Sabbath by visiting our "East-end Mechanic's" local museum last Sunday. (See Mr. Goschen's statement in "the House.") There are also some French harps of the period of "Louis Carthorse," and later, but, to my humble judgment, not one of them is fit to hold the candle to a good performance on a modern double action Erard. This collection well repays the cost of a visit, for it is, perhaps, the most extensive collection of "ancyent instrvmentys of mvsick" ever brought together, and (as the little girl expressed the interesting fact) it may be seen "all for nothink" three days per week, and for "the ridiculously small sum" of sixpence you may get a "stuffed cat," I mean a catalogue "stuffed" with very interesting matter.—THE HARMONIOUS BLACKSMITH.

[12469.]—**Bees.**—F. J. Gooden will be lucky if his bees continue to hang out without swarming the second hive, for second swarms are always a mistake, much so when late in the season. I should recommend him to put a glass over the swarm and he will have a good take of honey next year. The plan he refers to, to turn up the stock hive and place another over it, I do not like. Will C. N. Abbott kindly forward his opinion and oblige —H. B. E.

[12473.]—**Printers' Rollers.**—Small rollers can be cast in an ordinary tin canister if it is perfectly round, care to be taken to let the composition set before drawing the roller out; the inside of the canister should be oiled to prevent its sticking. The best thing to clean a roller with is benzoline, the same as burnt in lamps; never wash a roller with lye (potash) as it ruins them; when out of use take as much ink off with paper as possible, and slightly oil with a little neatsfoot oil, and keep in a well ventilated cupboard or box. To make the roller take ink after being oiled go over it with a damp rag or piece of waste. By following the above directions a roller will be as good and tacky at the end of a twelve month as it was when first cast.—ZOO ANDRA.

[12474.] — **Machine for Making Aerated Drinks.**—I believe the gas and water is pumped into the condenser by means of a pump. The cost of the excellent machine producing from 30 to 700 siphons or from 700 to 1,500 bottles per day, is cheap mounted for use: £44 700 bottles, £69 1,500 bottles. I forgot to mention that the gas remaining in the machine after an operation can be used for the next, and will make an economy of about a third in the acid and whiting. I do not know if it could be worked by steam, but will endeavour to ascertain for "E. L. P. G."—H. B. E.

[12476.]—**Bee-Keeping.**—Perhaps some of the plans suggested by Mr. Abbott from time to time would be practicable in "B. H. J.'s" case, or he might try the methods recommended by me to "Willie Scarer" and "W. T. L." The bees seem to have formed a very desirable amalgamation, though very singular from the fact that after driving or fumigation bees are more inclined to rob the neighbouring hives. However, the order of procedure, as members of the law say, may have been reversed in "B. H. J.'s" case from some unexplained reason or circumstance. Perhaps two or three hives were fumigated the same day, which may account for the bees being bewildered and not knowing their own hives. "B. H. J." says that his bees have built the combs in his "Nyborg cabinet" diagonally, instead of straight with the frames. To prevent them building in any but the right direction, and in the right compartment, a few bits of comb from the old hive should be attached; by heating a little, along the tops of the bars, the bits of comb may be about two inches long, half an inch deep and the width of the frames.—RAT-TAT.

[12477.]—**Water-Glass.**—A simple form of water-glass may be made by cementing a circular piece of glass to one end of a wooden tube, the tube may be 6ft. long, and about 4in. in diameter; to use it the glass end is dipped some depth in the water, and the other end closely applied to the side of the face. It has, of course, no magnifying power. A similar one is used in Norway; if lenses were used the focus would be very much longer for water than for air, on account of the refractive index of water being considerable.—PHILANTHROPIST.

[12478.]—**Sour Ale.**—Rack it off, and put some bi-carbonate of soda and some hops, and bung up again for a week or two.—JACK OF ALL TRADES.

[12480.]—**Silk Working.**—No remedy but to be filed out and burnished again.—JACK OF ALL TRADES.

[12480.]—**Silk Working.**—Touch the males with hydrochloric acid, and the rust will soften and drop out with the working of the silk.—RAT-TAT.

[12481.]—**Wax Moth.**—Treat them while in the hive, or in a covered vessel, with tobacco smoke, or carbolic acid gas. If moths are about cover the entrance holes at night, and stand a shallow vessel containing a mixture of impure honey and iodide of potassium on the top of the hive, or on the stand. The moths and other insects will be attracted by the odour, and fall an easy prey.—RAT-TAT.

[12482.]—**Integral and Differential Calculus.**—This branch of mathematics is used in the higher branches of mathematics. In astronomical calculations, optical investigations, in calculating strength of materials, &c., it is the foundation of the higher mathematics. If a person knew Euclid and algebra, he could begin the calculus, but it is usual to study trigonometry also. There are some excellent rudimentary treatises in Weale's Series. Todhunter's Differential and Todhunter's Integral Calculus are read at Cambridge. They are expensive, 10s. 6d. each.—PHILANTHROPIST.

[12483.]—**Rewiring Old Piano.**—I rewired an old one about 12 years ago with as near the same size wires as I could judge, and it answered well. If you put stouter, the pins will not bear the strain required to tune it. I put all plain wire; you can get it in hanks from 1oz. If you want to know where, and will advertise address, I will send to you.—WEBB.

[12484.]—**Inorganic Chemistry.**—The "Science and Art Syllabus" mentions the following works for the advanced stage:—Chemistry, Inorganic and Organic, Bloxham; Manual of Elementary Chemistry, Fownes; Elements of Inorganic Chemistry, Miller; Chemistry for Students, Williamson; Chemistry for Schools, Houghton Gill; Qualitative Analysis, Galloway. Besides these works, the following are recommended for reading and working for honours:—Second Step in Chemistry, R. Galloway; Chemical Physics, W. A. Miller; Dictionary of Chemistry (4 Vols.), H. Watts; Elementary Treatise on Heat, Balfour Stewart; Heat as a Mode of Motion, Tyndall; Quantitative Analysis, Vacher's Fresenius. "Science and Art" wishes to know what "honours" consist of. This is asked by many, but having passed them myself, I can say that you have the honour of seeing your name printed upon a piece of paper called the results of the examinations. I think the Government should give something, even if it is only a printed card, as a mark for having passed through such a stiff examination as it usually is.—GEO. E. DAVIS.

[12485.] — **Electrotype Casting.**—Moulds for these are best made of either marine glue or gutta-percha, keeping the model in close contact by means of a weight until cold. Treat the face to a polish with a very soft brush and plumbago until it has a good metallic lustre. Use two small batteries and a decomposing trough.—JACK OF ALL TRADES.

[12486.]—**Machine for Cleaning Boots.**—I have somewhere seen a drawing of a machine brush, similar to those used in modern hairdressers' establishments, worked by the foot in the same way as a lathe or sewing machine. Why should there not be shops in London or elsewhere where you might go in and have your boots cleaned on your feet by an attendant with a revolving brush in his hands? Let some of your hair-dressing readers introduce this practice into their establishments. A few extra brushes and a longer band are all that are needed.—C. P. E.

[12486.]—**Machine for Cleaning Boots.**—If "S. J. R." will refer to reply 6739, p. 597, Vol. XII. of the ENGLISH MECHANIC, he will there find a sketch of a boot cleaning machine "driven by power or hand," which, "with only three brushes, cleans from 230 to 250 per morning."—THOMAS HUTTON.

[12486.]—**Machine for Cleaning Boots.** — Merely a machine like a scissors-grinder's barrow, substituting brushes for stones.—JACK OF ALL TRADES.

[12487.]—**Annealing Spring Steel.**—This is a new "kick" entirely, annealing steel for welding—at least to me. To anneal iron or steel, take small chalk, old mortar, or whiting will do, inclose it in that in a piece of tin or ball of clay, and make it red-hot. It will make it beautifully soft and free from pins, and if the operation is continued with care, cast iron or steel may be made so soft that you may cut it with an ordinary pen-knife like lead, and no detriment to the steel.—JACK OF ALL TRADES.

[12487.]—**Annealing Spring Steel.**—I don't know but to weld a spring plate as well as it can be done is to weld a piece of iron to it, then the other piece of steel to it same as cast steel. To temper any kind of springs, make red-hot all over, cool in soft water, then hold over bright fire, get a lump of tallow, grease all over, hold it till it blazes all over, let it cool out itself.—OUTGENIOUS WHITESMITH.

[12488.]—**Zinc for Hot-water Tanks.**—It must be very stout to be of any service, as it contracts and expands so much that it cracks at angles and joints, and soon becomes useless. Try galvanised tinned iron.—JACK OF ALL TRADES.

[12489.]—**Lacquering Brasswork.**—Yes, it is sometimes done, or attempted; it is not always that they succeed in making a job of it. The best way is to dip it quick.—JACK OF ALL TRADES.

[12489.] — **Lacquering Brasswork.** — Brass-finishers often give brasswork two or three coats of lacquer, and re-heat for each coat given.—W. O.

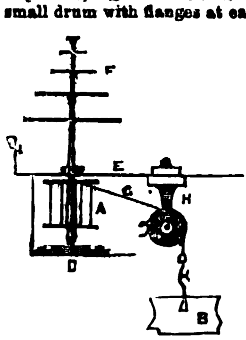
[12490.]—**Grape Culture.**—"Horatio" will find abundant information in a work composed by Thomas Mawe and John Abercrombie.—CLINCHEY.

[12490.]—**Grape Culture.** — "Hoare on the Vine" is an exhaustive treatise on the subject.—OLD BOOTS.

[12491.]—**Overgraining.**—Discard the beer. It should only be used for dead colours and show-boards. Use turps instead.—RAT-TAT.

[12491.]—**Overgraining.**—Use vinegar; when beer or size is used it has a habit of crawling and pealing off; by using the above you will get over the difficulty.—JACK OF ALL TRADES.

[12492.]—**Show Stand.**—To drive show stand, a small drum with flanges at each end, four straight pins for rope G to lap on to, riveted into flanges, H double eye with collar and nut to hold to floor boards for pulley C to work in, rope G works over attached to lump of stone B. I is shop front, F show stand, lowest end as a centre working on a piece of iron with a centre in it. E is supposed bottom of shop-front window. The reason for having a large stone or a bundle of bricks is that you can speed it yourself by knocking a lump off or putting a lump on. When you want to wind it up you catch hold of bottom wing of stand, and twine it the other way till weight comes close to pulley C. The drum A must be a small one.—OUTGENIOUS WHITESMITH.



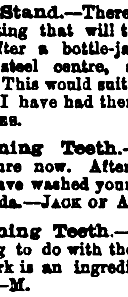
[12492.]—**Show Stand.**—There is a maker of a jack for meat roasting that will turn from 100lb. to 150lb., something after a bottle-jack. The foot of frame rests in a steel centre, and the affair is regulated by a fan. This would suit you. The maker's name I know not. I have had them under repairs.—JACK OF ALL TRADES.

[12494.]—**Hardening Teeth.**—It is the effect of the acid. No cure now. After taking the compound you should have washed your mouth and teeth with carbonate of soda.—JACK OF ALL TRADES.

[12494.]—**Hardening Teeth.**—I do not think quinine has anything to do with the breakage of the teeth. Cinchona bark is an ingredient of one of the best tooth powders.—M.

[12496.]—**Stained Scarlet Tunic.**—Well wash, and after rinse in salt and water, after in pure water.—JACK OF ALL TRADES.

[12499.]—**Trigonometrical.**—Draw DE perpendicular to AC.



$$\text{Tan. ACD} = \frac{\text{DE}}{\text{EC}} = \frac{\text{DE}}{\text{AE}} \cdot \frac{\text{AE}}{\text{EC}} = \frac{\text{BC}}{\text{AC}} \cdot \frac{\text{AD}}{\text{DB}} = \frac{a^2}{b^2}.$$

$$\text{Again, } \because \frac{\text{AE}}{\text{EC}} = \frac{\text{AD}}{\text{DB}} = \frac{a}{b}, \therefore \frac{\text{AE}}{\text{AE} + \text{EC}} = \frac{a}{a+b}.$$

$$\therefore \text{AE} = \frac{ab}{a+b}.$$

$$\text{Also CD} = \sqrt{\text{DE}^2 + \text{EC}^2} = \text{AE}\sqrt{\frac{\text{DE}^2}{\text{AE}^2} + \frac{\text{EC}^2}{\text{AE}^2}}$$

$$= \frac{ab}{a+b}\sqrt{\frac{a^2}{b^2} + \frac{b^2}{a^2}} = \frac{ab}{a+b} \cdot \frac{\sqrt{a^4 + b^4}}{ab} = \sqrt{\frac{a^4 + b^4}{a+b}}.$$

Q. E. D. Many solutions.—ALEPH.

[T. Hucklebridge and "Xenophon" have also answered this query.—ED.]

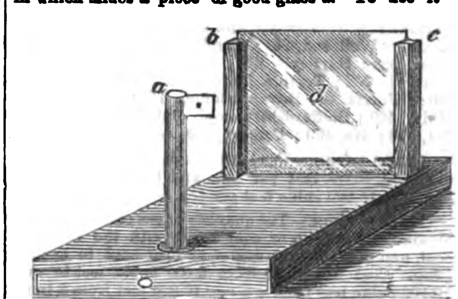
[12500.]—**Land Surveying.** — A land surveyor should be able to survey an estate and make a map of it; he should have also an elementary knowledge of civil engineering, and be able to make a road, &c.; he should be acquainted with drainage and irrigation. As to studies, a fair knowledge of elementary mathematics, such as Euclid, algebra, and trigonometry is necessary. Surveying should be studied theoretically and practically; drawing and mapping are very important. A practical acquaintance with the instruments used by the civil engineer should be attained; many moderate surveys have been made with the chain alone, as it saves the trouble of carrying other instruments, it is necessary, however, to understand the use of the theodolite, the level, the box sextant, prismatic compass, &c. I do not know the technical requirements demanded of the surveyor.—PHILANTHROPIST.

[12501.]—**A Cheap Gas.**—Your correspondent will find some valuable information in a book published by the late Mr. Weale. The following is the title:—"A Treatise on Gas-works and the practice of Manufacturing and Distributing Coal Gas." By Samuel Hughes, C.E. The nominal price of the book is 3s. Too much of your space would be occupied by giving extracts.—W. AIREY.

[12501.]—**A Cheap Gas.**—"A., Liverpool," does not say the quantity he wishes to make at once, nor the purpose he wishes to apply it to, but after stating that it need not be inflammable, we may suppose he does not wish to burn it. Coal gas costs more for making in some places than others. I know a place where cannel gas only costs 2s. 6d. per 1000ft. for making, and another where coal gas costs 3s. 2d. per 1000ft., so it depends upon the locality for one thing, which would have to be taken into consideration before a price was given. If "A." wishes to make it at Liverpool it would cost him about 2s. 10d.—GEORGE E. DAVIS.

[12503.] — **Testing Tartaric Acid.** — Make a clear solution in pure water, drop into it a little solution of chloride of barium, and a dense white precipitate will form; pour off the liquid, suspend the precipitate in a little water, and add nitric or hydrochloric acid; if any remain undissolved, there is, probably, a sulphate mixed with the tartaric acid, perhaps alum.—PHILO.

[12504.]—**Sketching from Nature.**—Let T. King get a piece of well seasoned wood, about 16in. by 10in., or even larger. At one end insert an upright centrally (*a*), in which is fixed a small piece of tin, card, or other material with a small neatly punched hole about the size of the letter "o" in the type with which this is printed; two more uprights *b* and *c* with grooves, in which slides a piece of good glass *d*. To use it—



wash over the glass a very thin solution of gum arabic and white sugar-candy, twenty parts of former to one of latter, let it dry; now set it up; look through the small hole to get the object or landscape subtended by the glass, and with a soft Paris Conté crayon outline the subject on the prepared surface; remove the glass and lay it over your sketch; if you require the outline you should have a second plate of glass, and trace over it the reverse way with charcoal, then lay your paper on, and a little gentle rubbing will transfer the outline. By adding a drawer to your board and screw holes for your uprights you may carry the apparatus about with ease.—OLD BOOTS.

[12504.]—**Sketching from Nature.**—Make a square or oblong frame of strips of wood 1in. wide by ½in. thick (6in. by 8in. would be a convenient size), stretch fine string or wire across each way to form about 1in. squares; suspend this in front of you and look through it at the object you want to sketch.—WEBB.

[12504.]—**Sketching from Nature.** — Let T. King provide himself with a frame of light wood of such dimensions as he would be satisfied to carry; let him divide this into a series of squares or oblongs by strings or wires stretched across the length and breadth of it. Let him rule the paper on which he means to sketch into a set of proportional divisions, by lightly marked dots or lines in pencil. Let him carry a walking-stick with a taper ferrule at one end, and a T top, each end of the top to have a screw-hole for attaching it to the frame; the double attachment will keep the frame from swinging. Having selected his view, he is to attach the stick to the frame and fix it upright in the ground, then taking up a suitable position behind it proceed to sketch the most marked objects in the centre division of the frame exactly in the same relative positions in the centre division of the paper. It would be well to have one or two test objects in the corners, or on the actual intersections, for during the progress of the drawing he will be sure to shift the position of his eye, and by bringing these test objects into their original place he will get right again. It is better to jot down the principal objects first, and afterwards fill in the connecting parts. The inconvenience of wires is their getting bent; of strings, their becoming slack; but most people know how to tighten a string. A plate of glass might be used in the frame on which the lines could not vary; but this would add to the weight, and glass is very sure to come to grief.—T. S. G.

[12506.]—**Power of Engine.**—The effective horse-power of Hecla engine, if it is high pressure, would be about 74, but as for nominal he can give it any name he likes.—H. T. P.

[12506.]—**Power of Engine.**—The nominal and effective horse-power of engine of the following dimensions:—Cylinder 20in. diameter, 18in. stroke, and 100 revolutions per minute (which is equal to 300ft. per minute; steam 40lb. pressure, and cut off at two-thirds of stroke (which is equal to 26·666lb. mean elastic force throughout the whole stroke). First I will find the nominal horse-power, which is merely a term in the buying and selling of engines, independent of locomotives. Rule, find the piston's area in square inches, multiply by its velocity in feet per minute and × by 7lb., which is always taken as a constant number; divide the product by 33,000, and the quotient is the expressed effect in nominal horse-power, which is 19·99.

$$20^2 = 400 \times \cdot 7854 = 314\cdot 16 \times 300 = 94248\cdot 00 \times 7 = \frac{659696}{33000} = 19\cdot 99 \text{ horse-power nominal.}$$

Or can be found by dividing the square of the diameter of piston in inches by 20, which answer is not far out of former one.

$$20^2 = 400 \div 20 = 20 \text{ horse-power, nominal.}$$

The effective force or working power of the same engine is—Rule, multiply the piston's area, in square inches, by the mean pressure or elastic force of steam per square inch, then by number of feet piston travels per minute, and divide product by 33,000, the quotient = the effective horse-power, which is 80·7.

$$20^2 = 400 \times \cdot 7854 = 314\cdot 16 \times 26\cdot 666 = 8377\cdot 39 \times 300 = \frac{2663217}{33000} = 80\cdot 7 \text{ effective horse-power.}$$

—G. Valentine.

[12511.]—**Gas.**—The following is the average quantity of gas obtained from one ton of Lancashire Cannel, 11,600 cubic feet; Wallsend, 10,300; Newcastle (Hartley's), 9,600; Temple Main, 8,100; Staffordshire (best), 6,400; Primrose Main, 6,200; Pembry, 4,200. The following is a table, showing the comparative qualities of coal, Scotch coal being estimated at 1,000:—Scotch Cannel, 1,0 0; Lancashire, 986; Yorkshire. 949; Bewicke and Craister's Wallsend, 875; Russell's Wallsend, 861; Tanfield Moor, 850; Heaton Moor, 822; Hartley's, 810; Killingworth Main, 792; Pontops, 762; Temple Main, 690; Manor Wallsend, 650; Forest of Dean Middle, Delf, 612; Eden Main, 562; Staffordshire coal, 1st, 546; 2nd, 514; 3rd, 492; 4th, 490; Pembry, 354.—William H. Hey.

[12511.]—**Gas.**—Newcastle coal yields from 9,500 to 10,000 cubic feet per ton, and Cannel yields from 11,500 to 15,000 cubic feet per ton.—W. Airey.

[12511.]—**Gas.**—The quantity of gas capable of being obtained from a ton of coal varies with the variety of coal, and also with the degree of heat used in carbonising. Coal will yield from 6,000 cubic feet to even 10,000 cubic feet from a ton. 10,000 feet from a ton of coal is a rarity, but it has been done. From 8,000 to 11,000ft. may be got from a ton of cannel coal, but if 10,000ft. are obtained from either Wigan or Bridgwater Cannel, it is not bad carbonising.—George E. Davis.

[12511.]—**Gas.**—Newcastle coal will give from 8,000 to 11,600 cubic feet of gas per ton. Cannel from 9,350ft. to 15,000ft.—Excelsior.

[12512.]—**Spotted Kid Gloves.**—Touch the spots with benzine collas.—Rat-Tat.

[14514.]—**Elder Flower Water.**—Take of fresh elder flowers 10lb. (or an equivalent quantity of the flowers preserved while fresh with common salt); water two gallons. Distil one gallon. This is according to British Pharmacopœia. For lavender water take of essence of lemon, essence of bergamotte, and essence of cedral, of each half an ounce; oil of cloves and oil of citronelle, of each half a drachm; otto of roses, three drops; and oil of lavender, half an ounce; spirits of wine, one pint; a few grains of musk may be added. It improves with age.—Opaline.

[12515.]—**Mowing Machine.**—There are various causes which will account for the frequent breakage of the knives of "A Countryman's" machine—viz., they may have been repaired with inferior iron, or are too long or too short, in either case breakage will occur. The finger beam and fingers may require setting and adjusting, this is a frequent cause of breakage. I don't think a short connecting-rod has much to do with it, although I decidedly prefer a machine with a long rod. I repaired a machine last week troubled with the same complaint as "C.'s"; in this case I found the crank shaft was crooked. But the best advice I can give him is never to allow any one but a thoroughly competent machinist to have anything to do with repairing his machine, he will find out what is wrong and remedy defects.—Toyo.

[12515.]—**Mowing Machine.**—I had a machine made by the same makers which worked very well until the third season, cutting about 100 acres each year, when several knives were broken before I found out the cause, which was from the pin and pinhole of crank having become worn; mine worked with a long rod, in consequence of this part having play the knife-bar is struck instead of being pushed. Any long iron bar will drop in two pieces if struck repeatedly on one place, with a small hammer.—Old Ploughman.

[12516.]—**Mathematical.**—To show that

$$\cdot\dot{1} = \frac{1}{9}$$

$$\begin{aligned} \cdot\dot{1} &= \cdot 1111 \ldots \text{ \&c. multiply by 10} \\ &= 1\cdot 1111 \ldots \text{ \&c. subtract } \cdot\dot{1} \\ &= \cdot 1111 \ldots \text{ \&c.} \\ \hline 1 &= 9 \text{ times } \cdot\dot{1} \\ \text{therefore } \cdot\dot{1} &= \frac{1}{9} \end{aligned}$$

See also Munn's "Theory of Arithmetic," p. 134.—C. H. W.

[12537.]—**Compressing Air.**—"Mechanical Equivalent" has miscalculated the pressures his air will have when confined to the 5in., 4in., or 3in. Instead of 3, 4 and 5 atmospheres at these three volumes, it will be 2·4, 3, and 4, inversely as the volumes themselves. The halving or doubling, Dalton found to raise or lower the temperature, if no heat were to escape, about 50° Fahr.; and for other ratios of compression or expansion, the heat being as the work exerted, and this being as the hyperbolic logarithm of the ratio of change of bulk, the rise or fall of temperature, if the act could be perfectly sudden, would be to 50° as the common logarithm of the ratio is to ·30103. Hence we have—

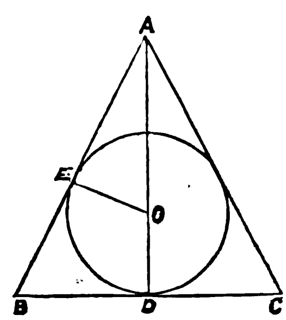
Log.	2	=	0·301030	∝	50	Fahr. temperature.
"	2·4	=	0·380211	∝	63·4	"
"	3	=	0·477121	∝	79·5	"
"	4	=	0·602060	∝	100	"
"	6	=	0·778151	∝	129·7	"
"	12	=	1·079181	∝	180	"

These would be the rise of temperature at the compressions into 6, 5, 4, 3, 2, and 1in.; and at expansion to 2ft. the fall would be 50°; to 4ft. 100°; to 8ft. 150°; to 16ft., 200°; to 32ft., 250°; to 64ft. 300°; to 128ft., 350°; to 256ft., 400°; and to 512ft. (if that is what the last figure means) 450°. As for "raising the piston to an infinite height," it is certain that, without receiving more heat, the air would not expand beyond a certain height, where it would become, in fact, a liquid, with an inelastic surface, as it must at the top of the atmosphere, at a temperature (as is supposed) of − 58°. At lower temperatures, it would not expand so far, and the absolute zero, where all fluids would lose elasticity, is probably about −490° Fhr. The work expended will be about 14·3 foot-pounds (or 183 5 times the air's weight) for each degree. To heat a pound of air 1 degree without change of volume requires 130 5 foot-pounds. To heat and also expand it, without change of pressure, requires 183·5 foot-pounds, the difference, or 53 foot-pounds, being the power exerted in expanding. It is questionable whether a heating of the whole upper half of the atmosphere to boiling or even red heat, so as to expand to several times its present height, would be perceptible to us otherwise than by slightly altering astronomical refraction, and very slightly lowering the barometer, by the gravity lost through increased distance of the upper layers from the earth's centre. All this heat would probably radiate into space before a very sensible portion could creep down to us here, four miles below, by conduction. The question has much bearing on the diluvial comet-fall.—E. L. G.

[12559.]—**Cleaning Oil Painting.**—I cannot give "Semper Paratus" a "trustworthy recipe which has been proved," or rather I could give him some half-dozen such, but, alas! not any single one which is the "universal medicine" or menstruum he requires, simply because different varnishes are used for pictures, and the solvent of mastic will not dissolve copal. Picture cleaning is an art not to be learned in one day, and before the operator can be safely trusted to go to work on any picture whose varnish has become discoloured by age, he must have had considerable experience. In its absence, no doubt you may "clean" a picture very effectively, so much so that it is often so thoroughly "cleaned" that it becomes so difficult to determine what the subject was that it is almost a necessity to make a copy beforehand to enable you to "restore" by repainting it all over. I am sorry to add many of the valuable productions of the old masters have been "restored" after this fashion by men who are neither old nor new masters—in a word, who have exhibited no "mastery" of the brush at all. I think I have replied to similar questions more than once before. See No. 293, p. 135 of our journal.—The Harmonious Blacksmith.

[12572.]—**Piano Construction.**—1. The engraving of action Fig. 3 is half the size of my drawing, consequently the hammer-shanks and other parts are double the dimensions shown therein. 2. A double brass rail may be employed if desired, but personally I greatly prefer being able to remove each hammer singly, consequently I most decidedly recommend a separate fork, or—if the butt be forked—a separate prong for each. 3. In my drawing only the round parts were shaded, consequently the positions of the dowels were very distinct. Probably my mere outline drawing was not sufficiently "artistic" for the wood chopper—I beg pardon, I mean engraver—so he (or rather, perhaps, the draughtsman) shaded all the parts "pretty considerable I guess," hence the positions of the two horizontal dowels in the hopper are difficult to see—they are but just visible when the dotted lines are carefully looked for. In my model the width of the hopper for the upper 1¼in. of its length is 7/16in. where the inclined part is glued on, and it is reduced to ⅜in. below when it is in the forked guiding socket. If "Pianette" prefers making the head of the hopper no wider than ⅜in., he must use thinner dowels, say ⅛in. or 1/10in. diameter. I believe the latter, if made of good English oak or hornbeam, would be strong enough; brass or copper wire rivets might be preferable. 4. For preventing the hopper from sliding sideways, probably the cheapest thing is a forked socket just like those used for the jacks or hoppers of ordinary grand pianofortes. In his patent, Mr. Molineux specifies a clothed mortice in the hopper, which is guided by an oval key-pin inserted in the rail behind it. This has the great advantage of enabling the side shake to be reduced to a minimum by partially turning the oval pin, just as we prevent the rattling of keys which have clothed front mortices and oval pins—a luxury well worth its trifling extra cost. The "rattle" of loose keys is to me a very unpleasant "plaything." 5. The set-off screw is in the hopper, which is reinforced—or left thicker—where it is screwed through it. This screw has a slot for the screw-driver at its front end. By the way, the front surface of the tail of the hammer-butt is erroneously represented "out of the square" with the inner end of this screw. Of course it should be parallel to the screw's hinder surface. 6. In all actions in which the dampers are attached to the hammer-butt, it is customary to take the dampers away from the strings by moving the action frame forward. If wire bridges be made only long enough to receive the strings of one note, unless secured by other means than the downward pressure of the strings on them, there is some risk of their falling out when the strings are taken off. In some respects I prefer studs to wire bridges. See article on improving the trebles of cottage pianos in No. 381. But I yet believe the tone is purer when the wire bridge is employed, especially if the lowest inch of the space between the strings and the wrestplank be well stuffed with felt or cloth, so as to prevent any audible vibration above the wire bridge.—The Harmonious Blacksmith.

[12574.]—**Calculus.**—Let ABC represent the required triangle. Join A with O (the centre), and produce AO to meet BC in the touching-point D. Join EO. Let angle BAD = α. Then AO = 50 co-sec. α, ∴ AD = 50 (co-sec. α + 1), and BD = 50 tan. α (co-sec. α + 1). If w = area of triangle, w = AD. BD = 2500 tan. α (co-sec. α + 1)². Differentiating and equating right member to zero $\frac{1}{\cos.^2 \alpha}\left(\frac{1}{\sin. \alpha} + 1\right)^2 -$



$\frac{2 \sin. \alpha}{\cos. \alpha}\left(\frac{1}{\sin. \alpha} + 1\right)\frac{\cos. \alpha}{\sin.^2 \alpha} = 0$. That is, $\left(\frac{1}{\sin. \alpha} + 1\right)$ $(1 + \sin. \alpha - 2 \cos.^2 \alpha) = 0$. From first factor, sin. α = − 1. From second factor, 1 + sin. α − 2 + 2 sin.² α = 0; ∴ sin. α = ½ or − 1; ∴ when w is a minimum, sin. α = ½; ∴ α = 30°; ∴ angle BAC = 60°; ∴ the required triangle is the equilateral circumscribing triangle. The side of this is easily found to be 100 $\sqrt{3}$.—Aleph.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last George E. Davis has answered 1214, 12167, 12245; "Jack of All Trades," 12153, 12170; "Ingenious Whitesmith," 12167.

12257	Milking Machines, p. 392
12259	Faulty Acetate of Soda Bath, 392
12371	Double Flageolet, 392
12281	Length of Electric Spark, 392
12289	Electric Bell, 392
12290	Hydrogen Lamp, 393
12291	Nature Printed Leaves, p 393
12298	Watch Springs, 393
12303	Small Castings, 393

QUERIES.

[12592.]—**Silk Solvents.**—Many months ago I inquired concerning this matter, and "Sigma" kindly suggested that instead of dissolving my better half's old silk dresses and trying to make them into new ones which did not seem to be a very promising scheme), that I should—no doubt he assumed I am or was a cockney—send her "ex cathedra" (I mean outside our metropolitan cathedral—*i.e.*, to S. Paul's Churchyard), and having presented her with a blank cheque, allow her to select as many new silk dresses (at a cost not exceeding the moderate rate of 15s. per lineal yard) as her æsthetic taste dictated. At the time I felt duly thankful for this "good advice," for which "small thanks is yet the market price;" but notwithstanding this powerful dose of the "cold water cure," I again beg to say I have a very distinct remembrance of reading that a French chemist had not only succeeded in making a solution of silk, but also in recovering it from the semi-fluid state in the form of cords, which, if I am not mistaken, he formed by forcing it through suitably-formed apertures (just as we make peppermint pipe or draining tiles), the aforesaid cords resembling the so-called "silkworm gut" of the angler. I opine such solid silk cords would not only form fishing lines without knots, but would make excellent first fiddle strings. They might also be at once far cheaper and preferable—inasmuch as we may expect them to be stronger, torsion considerably diminishing the effective strength of any rope—than the twisted silk lines made in France for deep sea soundings. Will any of our scientific correspondents let the light in on this matter?—The Harmonious Blacksmith.

[12593.]—**Lightning and Thunder.**—Will you kindly inform me whether lightning ever occurs without its being accompanied with thunder? And if so, the cause?—Paterfamilias.

[12594.]—**Varnish Cells.**—Will any reader inform me of the best substance for making varnish cells? Gold size and Brunswick black make good cells for dry mounting, but on the application of heat for balsam mounting, the varnish runs into the balsam, and so spoils the object. I want a varnish that will resist the heat when mounting in balsam.—Alf.

[12595.]—**Boats.**—I wish to construct a small pleasure boat about 14ft. long. Could "A., Liverpool," inform me of any book, and its price, that gives practical directions for building boats? I should also like to have lee-boards and sliding keels explained, and how the water is prevented from getting into the boat where they enter the water. In reply to query 12397, "A., Liverpool" says that it would take more room than the editor would allow to describe fully the art of boat-building. I think this subject is as worthy of attention as many others which appear weekly in the pages of "our" Mechanic. I am sure that articles on it would be warmly received by a number of subscribers, as I see from recent queries that many others like myself seek information in this branch.—J. E. D.

[We would manage to find space for a series of articles or letters on boatbuilding.]—Ed.

[12596.]—**Canoe.**—As there are doubtless many practised canoeists amongst your contributors, may I ask of them a few hints as regards the following:—I intend to take my holiday in the autumn, and to proceed down the Trent and Humber to Hull, then, if practicable, to go by sea to Filey or Scarborough. Is the canoe safe enough to do this in, or would it be better to go by rail from Hull. What is the best size for such a one, so as to enable me to feel perfectly at ease. I am practised with the paddle, but have not tried a sail. Would the use of one be safe without any practical instructions as to its management on such a trip?—Paddler.

[12597.]—**Waterwheel Floats.**—I wish to learn the most approved form and directions of the floats for an undershot waterwheel, for which little water will be available and economy very desirable.—D. J.

[12598.]—**Age of Trees.**—Would you oblige me by asking through your columns for authentic records of the extreme age of trees growing in Australia, Africa, and California?—Lignum Vitæ.

[12599.]—**Dimensions of Mail Boats.**—Can any of your readers give the chief dimensions of one of the Dublin Steam Packet Company's boats (and engines) carrying the Irish mails between Holyhead and Kingstown?—C. E. S.

[12600.]—**Hydraulic Explosion.**—I was making hydrogen gas by decomposing water with sodium the other day. I took a rather large (in fact too large) piece of sodium and held it under water by a gauze spoon. There was a violent (if I may use the term) decomposition at once, and I held a glass jar, which would hold about a quart, in the usual way to receive it, but alas! before the jar was half filled, there was a violent explosion, the jar and sundry bottles, &c., near, were smashed to atoms, and the pneumatic trough (tin) was knocked into a cocked hat. Now, would any correspondent of "ours" kindly explain, if he can, the cause of the explosion? I was once performing the same experiment, and with the same result, but used then a little flask with a narrow neck in which I forced the sodium wrapped in paper, and so held it under water, and I always thought the capacity of the flask was too small for the amount of sodium used; but this time the jar was not half filled when the explosion took place. I have thought that the hydrogen must by the great heat evolved have taken fire, but by this means I could not account for such a violent explosion. I have also wondered whether it was possible or not, there being such a rapid decomposition of the water, for the oxygen to be liberated as well, and the heat evolved to have recombined them. If this could be so, of course I could then understand the explosion.—Dabbler.

[12601.]—**Tuning Æolian Harp.**—I have one of these instruments strung with 14 strings. Will some of your musical correspondents tell me how to tune it? Is it tuned like a piano, or how?—Opaline.

[12602.]—**Extinction of Fires.**—Many gases are far more soluble in water than carbonic acid is. Would Mr. Bottone kindly inform me if a solution of some of the other gases, such as chlorine, &c., would not be more efficacious in extinguishing fires? Some are supporters of combustion, as sulphuretted hydrogen, &c., and others, perhaps, are too expensive; but could not some sort of salt be dissolved in the water which would generate gas by the action of heat when the water evaporated, the gas generated to be such as would extinguish fire. Of course, much less water is to be used in these engines than in ordinary ones.—Philanthropist.

[12603.]—**Acoustics.**—Can any of your correspondents inform me what is the amount of the absolute motion of each particle of the air, or other medium, in a sound wave? I do not know whether this has been or can be determined by experiment, but if it has been determined, I should like to know by what means. I suppose the amount will vary with the loudness of the sound. If this is so, what is its amount for the lowest sound we can hear?—Gy.

[12604.]—**Quill Pen Making.**—Will some one who is an adept at making quill pens by hand, kindly tell me how to insure a straight and clean "split"?—W.

[12605.]—**Organ.**—For some time back, I have been studying the various letters that have appeared in the Mechanic, with a view of commencing the building of a small organ, of one manual, and four stops. I can understand in theory, the making of the bellows, soundboard, and pipes, according to the instructions given; but I cannot as yet comprehend the mechanism of the key acting on the pallet. An illustration of an action to push down the pallet appears in Vol. XII., p. 187; and an illustration in Vol. XIV., p. 665, giving me some idea of the square action; but I cannot learn from it the position or use of the rollers and backfalls. The engraving seems to show the action as consisting of squares, trackers, and pull-downs. There is, I believe, an action called fan frame, said to be the most simple. Would some of your correspondents furnish diagrams, on a large scale, showing both actions, merely tracing the mechanism from the key to the pallet; also show how to connect the bass keys by cross action with the bass pipes, which may be placed at the treble end of the soundboard? I should also feel obliged if the length of middle C, 8ft. pitch clarabella, 1¼in. × 1⅝in., and the breadth, depth, and length of a CC dulciana (wood) could be given, to enable me to form a scale. The latter, I believe, being a narrower and longer pipe than the same note in diapason. As my acquaintance with the Mechanic commenced with Vol. XI., I am unable to refer farther back; and but for the valuable instructions lately given by the various contributors, my case would have been hopeless.—E. J. D.

[12606.]—**Submerged Forests.**—I should feel obliged if some one would inform me whether there is any cheap and special work on submerged forests. If not, where should I be most likely to see and learn something on the subject?—J. G. W. R.

[12607.]—**Watch Repairing.**—In a reply to "Second's Practical Watchmaker," by "Aberdeen Watch Jobber," let. 4609, is given a method of flattening a Geneva escape-wheel, which I do not think altogether safe, especially for young hands. I have done them in the manner described, but I think that one runs a great risk in thus flattening them. The way in which I have done them is by taking a strip of common soft solder, making a hole in the centre of it so as to admit the pinion and no more. As the wheels are generally all hard, and as a rule in treating anything hard—say, for instance, a pinion—you would strike the article to be made straight on the low side, so as to raise it, so in flattening the escape-wheel, I rested the wheel on the solder, striking the cross which wanted to be raised on the low side gently; the cross resting perfectly solid on the solder runs no risk of breaking, as might occur in the method which our Aberdeen friend gives us, but perhaps some of our brother pivots would kindly give us more information on the subject, and explain the reason why steel when hard requires to be struck on the low side to bring it up, and when soft, to be struck on the side that is bent.—A Midlothian Pivot.

[12608.]—**Bookbinder's Press.**—Wanted to know the best method for lapping the holes for the screws to work in bookbinder's press, the diameter of screw ⅞in. I have no way but the ordinary screw box and its corresponding lap, and to send it through 5½in. dry hard beech is more than two men can accomplish. Any instructions or notice of any apparatus to save so much labour would be gladly received by—Dublin Subscriber.

[12609.]—**Packing Grapes.**—What is the best plan to pack grapes to travel by rail without knocking the bloom off them?—A. B.

[12610.]—**Lighting Gas by Electricity.**—Can any reader of "ours" oblige a brother by giving practical details of the method employed to light the gas at the Royal Albert Hall. All the various burners are lighted at same instant by electricity, but is it accomplished by an induction coil? and if so, how are the wires insulated? and do the points from which the spark passes remain constantly in the gas flames, or is any method used to remove them when the gas has been lighted?—A. Bosquet.

[12611.]—**Moth in Pianoforte.**—What is the best thing to destroy moths which have attacked the dampers, &c., in a pianoforte?—Graham Young.

[12612.]—**Action of Oil on Waves.**—In an account given of a shipwreck which occurred recently, the crew took to the pinnace (the ship's cargo consisted chiefly of colza oil), on board which they took a large quantity of colza oil. The waves being very boisterous, and being in momentary danger of being swamped, they poured the above on the waves, which quite calmed them. In fact, had it not been for the action of the oil on the water they must have gone to the bottom. The above is quite an old story, but I never yet heard the scientific reason why.—Graham Young.

[12613.]—**Drying by Steam.**—I have fitted up some steam pipes for drying purposes, with indiarubber washers between the flanges, but cannot get heat enough. Will any of my fellow readers tell me if superheated steam will destroy the rubber?—T. King.

[12614.]—**Corpulence.**—Will some one kindly inform me on the following points: How can a thin fellow acquire bulk (fat or flesh)? Is it to be done by diet, inactivity, or what? Some say sugar, milk, cocoa, &c., are good for producing the desired effect. Any information on this subject will oblige.—Anti-Banting.

[12615.]—**Tide Waiters.**—What are the qualifications of a tide waiter in the Customs (not clerkship), and what are the examinations necessary to undergo?—A Subscriber from the Beginning.

[12616.]—**Hemlock.**—The mention of hemlock once or twice lately as a poison reminds me of a paragraph I read a year or two ago in the *Graphic*, in which it was stated that some professor had been experimenting and had found it *not* a poison. Does any botanical correspondent remember this statement, and is it false? In the same number were mentioned the researches of a Swiss savant, which showed that the far-famed William Tell must be considered a rather mythical person.—A. C. G.

[12617.]—**Tennessee.**—Can any of "our" readers furnish any reliable information as to the prospects in Tennessee, or the adjoining States, for a settler with a few hundred pounds? Are farms cheap? What prices does produce fetch, and is there a ready sale?—Emigrant.

[12618.]—**Excessive Perspiration.**—I should feel much obliged if one or more of your readers would tell me of a remedy for excessive perspiration. It is a great source of annoyance to myself and others, this hot weather especially.—A.

[12619.]—**Bad Water.**—I think that there is something very deleterious in my pump water. If new potatoes be scraped and washed in it the water becomes at once quite of an inky colour. And if a little of the water be put into a goblet and two teaspoonsful of white brandy be added it immediately turns to a dark brown. Can any of your numerous readers account for these occurrences?—Inquirer, Rugeley.

[12620.]—**Suspended Tramways.**—Will some subscriber inform me which of the two suspended tramways is the most simply constructed, and require least labour to push the load along? It is for conveying grain in baskets, which we now run on the floor by means of wheels fixed to bottom of baskets, but find the wheels crush and damage a large quantity of the grain.—H. B.

[12621.]—**Black Dye for Leather.**—Will any one inform me what is the best dye for staining leather a good black?—R. M.

[12622.]—**Labour Saving Machines.**—A cabinet manufacturer, employing some 16 to 20 hands, wishes to be informed by some of your practical correspondents of the most useful labour saving machines for the workshop where steam is not practicable. He is informed that in many of the workshops in Scotland very useful machines are employed, more especially for veneering, &c.—S. V., Dublin.

[12623.]—**Lampblack.**—Can any reader describe or give a sketch of the arrangements that are necessary for the manufacture of lampblack on a commercial scale from tar, pitch, &c.? What weight of pitch is required for one ton of lampblack?—Fr. Scot.

[12624.]—**Stuffing Reptiles.**—Will some brother reader kindly tell me how to stuff a boa constrictor's and shark's skin? They are both dried. Also how to make a varnish for the same?—W. C. C.

[12625.]—**Heat Bumps.**—Would some one inform me of a good recipe for heat bumps? I have tried two good doctors and every thing I could think of, and all to no effect. The child is three years old, and sometimes there appears twenty of these bumps in a night, and some as large as a threepenny piece, very unsightly and irritable; we are frequently disturbed four or five hours in a night.—D. C.

[12626.]—**Indiarubber Models.**—Will any reader of the Mechanic kindly give information on the following subject. I want to make an indiarubber model which shall retain its elasticity when made. Something, *e.g.*, like a flexible doll's face. 1. How can I dissolve the indiarubber? 2. How liquid must it be? 3. Must anything be mixed with it? 4. What substance and in what proportion? 5. Of what must the moulds be made, will plaster of Paris do or must it be some metal, and if so of what kind? 6. By what process must the model be set? 7. If by heat, what degree and how procured? 8. If excess above or deficiency from the prescribed degree, what would be the effect?—Claudio.

[12627.]—**Carbolic Acid as a Hair Dye.**—Will "Outgenious Whitesmith," (Qy. 12001), please say how often he applied the carbolic acid, and if he washed his face in the same water. Does it darken the skin or injure the hair, and does he continue to wash in the water with carbolic acid after his hair has turned colour, and does he use it every time he washes.—A. J.

[12628.]—**Rusty Iron Castings.**—I have 10 or 12 hundredweight of small castings, such as pinions, bearings, &c., deeply rusted, can I clean them with acid so as to get them painted?—Paddy.

[12629.]—**Skeleton Flowers.**—Will any reader of "ours" kindly tell me how to prepare "skeleton flowers and leaves," and the best time of year for doing so?—J. B.

[12630.]—**Magnetism.**—I have a strong electro-magnetic machine of the usual horse-shoe form with revolving cylinders or coils of wire. I used it for rheumatism. Can I use it for any other purpose, useful or ornamental, and if so, how?—D.

[12631.]—**Fixing the Bloom of Scarlet Runners.**—How can I prevent the bloom falling off? I have some stalks on which there have been as many as thirty blooms, all of which have fallen off instead of coming to beans.—Disappointed.

[12632.]—**Photochrome.**—What is the nature and composition of photochrome, which is used for darkening the hair?—Disappointed.

[12633.]—**Dried Yeast.**—Will any of your chemical correspondents inform me what ingredient is necessary to be added to compressed yeast to insure its keeping for some days? I press mine with one of Needham and Kite's presses, but find it will not keep often more than a few hours before it becomes moist. Many brewers sell an article which keeps as well as the German yeast. There is no doubt some chemical is added to insure this.—H. W. T.

[12634.]—**Photography.**—Can "Photo.-Bristolienis," or other fellow-reader, tell me how to produce a photograph on porcelain or opal glass, and the best known vehicle or medium for an artist to work them up in watercolour with?—Art-Photo.

[12635.]—**Transferring Pencil Drawing on Paper to other Paper.**—Will John Hopkins or some one else, give me instructions how to transfer a pencil drawing on paper to other paper, and the sort of paper used. Also how to take an impression of a printed impression or engraving on paper on to other paper?—T. H.

[12636.]—**Enlarging Photographs.**—I shall be most happy to hear "Photo-Bristoliensis'" suggestions with regard to the above, assuring him that daylight will answer my purpose equally as well as the magnesium, and at the same time I am anxious to go to work as cheaply as possible.—Industrious Will.

[12637.]—**Optics.**—Can any of your numerous mathematicians or students of optics kindly inform me how to work the following:—At what distance from a mark ¼in. square shall I stand so that it may appear of the same size as a mark 8in. square at the distance of 200 yards?—Optics.

[12638.]—**Fleas in Dogs.**—Will any brother reader inform me if one teaspoonful of sulphurous acid mixed with a quart of water sponged over a dog would be injurious to his skin or hair, as I find that acid so diluted will kill fleas almost instantly?—Countryman.

[12639.]—**Worms in Pony.**—What is the best thing to give a pony that is troubled with worms? All the food he eats seems to do him but little good. Could I give him anything with his food to destroy them? They appear to be about 2in. long.—Countryman.

[12640.]—**Ice.**—Can any of "ours" give a recipe for a cheap freezing powder, and cost for making a gallon of water into ice?—W. R.

[12641.]—**Sticklebacks.**—Can any one kindly inform me the bestway to destroy sticklebacks without destroying the other fish?—Boatman.

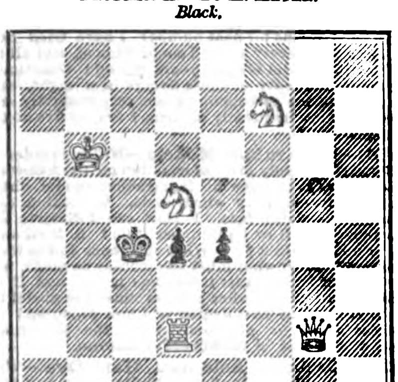
CHESS.

All communications intended for this department to be addressed to J. W. Abbott, 7, Claremont-place, Loughborough-road, Brixton, S.W.

A match is being arranged between Steinitz and Zukertort, the prizes being £20 for the winner and £10 for the loser. The winner of the first seven games to be the victor, drawn games not counting. The struggle between these two athletes in the recent tourney which resulted in a game for each, and three drawn games, imparts additional speculation to the present contest, and the result will be watched with interest by chess players in all parts of the world.

Problem X.—By H. Meyer.

Black.



White.

White to play and mate in two moves.

*** In future the solutions to our problems will be withheld for a fortnight.

T. A. Hind.—Thanks for the "Knight's Tour," but we have no space for the same; moreover, such productions are only interesting to a few.

R. S. and A. Cunnington.—The Black King has two moves at his disposal—if to Q 5 Kt takes P, mate; if to Q 3 Kt to K B 7 mate. Surely this is plain enough.

W. Airey.—You are not the only correspondent who has failed to solve Problem VIII. The defence to the line of play that you and others suggest is—

$$(1)\ \frac{\text{R to Q B 6}}{\text{P takes R}}\quad (2)\ \frac{\text{B to K B 5}}{\text{Q to Kt sq.}}$$

How do you propose to mate next move?

A. L. (Lincoln).—You shall be informed of the result.

G. Haywood.—A very neat little problem; it shall appear in its turn.

Sea-Serpents.—According to *Nature*, the South African Museum, Cape Town, recently received a specimen of the Ribbon fish (*Gymnoterus*) fifteen feet long without the tail. It appears that this fish is known to distant inland fishermen as being forty feet long, and from its slender shape and snake-like movement is probably the "sea-serpent" of late years so minutely described by navigators. From its head there is erected a plume of flexible rose-coloured spines, and from head to tail along its back there is a conspicuous mane-like fin. Its general colour is like burnished silver. The eye is large and silvery, and the profile of the head comports well with that of the horse. The specimen could not be preserved, but there are two smaller specimens in the Museum.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

The following are the initials, &c., of letters to hand up to Tuesday morning, August 6, and unacknowledged elsewhere:—

W. L. Breare.—Rev. G. M. M'Cord.—E. C. Phillips.—J. Dresser.—Thomas Baker.—Alfred W. Knight.—P. Frank.—James Puttick.—E. Woodward.—J. Sharpe.—George Jarmain.—Henry Northcote.—W. Crisp.—L. E. N.—J. Taylor.—Taylor and Bodley.—H. H.—J. K. P.—Thomas Fletcher.—Wm. Pakeman.—James Pulman.—P. and L.—J. H. R.—E. B. W.—Chip of the Old Block.—Jack of All Trades.—A Berlin Subscriber.—T. J. M.—Columbia.—Hy. Clarke.—James Simpson.—F. Perks.—Rev. F. Gilbert White.—Edward Mould.—A. Chesterton.—James Malins.—E. Jones.—C. H. Wingfield.—Webb and Son.—J. M. Gilbert.—P. A. Calais.—Thomas Fletcher.—J. J. H.—E. P. Hart.—C. B. A.—J. B. Waring.—E. Sutcliffe.—James Hazard.—J. F. Coulson.—James Ward.—C. H. P.—Rev. James Henry.—World Wide.—Clock Maker.—Sun Spots.—J. T. M.—J. H. Catchpole.—C. B. Turner.—American Subscriber.—Westward Ho!—Young Astronomer.—J. Carlton, R. J. H.—J. H. Withers.—E. L. C.—Saul Rymea.—One of a Trade.—J. H. E.—A. M. C.—Kent.—C. Coleby.—Whitesmith.—F.R.A.S.—S. Capper.—Three Years' Subscriber.—Village Blacksmith.—Overlooker.—J. Brumby.—Salop.—J. Arrowsmith.—James Beardsley.—Ontario.—James P. Smith.—J. B. H.—W. S. T.—Outre Mer.—St. Crispin.—James Daw.—The Harmonious Blacksmith.—W. J. Hodgson.—Soda.—George Knott.—Epilepsy.—The Suffolk Amateur.—A Subscriber.—J. B. Sharpey.—Wm. Cruickshank.—R. Mellor.—J. Griffith.—Herbert Jackson.—Aquarium-Maker.—T. J. W.—Tyro.—J. Johnson.—Excelsior.—Wm. Tryer.—J. M. G.—Horatio.—Surveyor.—J. G. Matthews.—Paste.—Aqua.—Amateur.—J. G. N.—W. H. K.—H. Bastow.—W. H. H. C.—Wm. Hoyle.—W. George.—J. H. Gilbert.—X.—Rat-Tat.—E. O. Simmonds.—Vandyke.—W. Hatfield.—R. A. Proctor.—C. Norris.—E. L. G.—Odgen and Gibbs.—Fiddler.—Sting.—L. H. O.—Simplex.—James Martyn.—S. Canning.—Inquirer.—J. W. Rhodes.—Alfred A. Allen.—W. Pike.—Rev. H. R. Bayley.—Artillery Captain.—Mil.—L. W. D.—F. R.—J. W. Fennell.—R. Henry.—Reckoner.—Busy B.—C. N. Abbott.—A Mental Sufferer.—Thom.—A. B. W.—W. S. B.—Salmon Sons and Ritchie.—A Bookkeeper.—R. A. H.—Aries.—Commoder.—E. T. Grays.—Tawse.—A. C. L.—Coach-painter.—Padlock.—R. Stephenson.—A Lecturer.—Bobo.—Artillery Gunner.—Beekeeper.—V. B.—A. L. G.—M. Paris.—Collen.—Balcairn.—N. Y. R.—Gypsum. T. E.—T. Hucklebridge.—J. K. P.—James Hicks.—Jack of All Trades.—W. H. H. C.

Veritas, W. F. Dawson, Canary, and Gold Leaf, are requested to consult back numbers.

Landscape House.—Your inquiry about the earth being recently in the tail of a comet would possibly lead to an idle controversy. If you wish to excite discussion why not suggest something more practical and of every-day utility.

H. A. G.—Your query is an advertisement.

J. Williams.—You will find information on the Whitworth scholarships on p. 258 of Vol. XIV., No. 348; but all the particulars are to be obtained from the Science and Art Department, South Kensington. The examination papers of the Science and Art Department are to be obtained from the same source, by addressing a letter to the secretary.

Erratum.—In letter 4579, p. 484, "Sucram" intended to say that *no* glue should be put on for the first time of placing the paper round in making organ pipes.

Communications which can only appear as advertisements to hand from W. Karslake, Young Telegraphist, Musical Subscriber, A. W. H., A. M. Z., A. Douse.

Chime.—It is not lawful.

C. C. C., T. M. P., E. O. S. Z., E. Gardner, and Tinker, are referred to indices to back volumes.

J. Baxter.—No. Of course if you vary the invention the matter is different. We have no more room for replies to the query answered by you.

Birmingham Subscriber.—Apply to the chief of the department in the town in which you reside.

B. B.—Advertise your coins if you wish to know their selling value.

C. Townley.—The furnace described in this number by "Outgenious Whitesmith" will perhaps meet your requirements.

H. Menz.—Yearly subscription, including postage to Prussia, 17s. 4d. A reduction is made on such a series of advertisements as you mention. Prussian paper money may be sent.

"T. A.," in a letter, says he "cannot comply with 'E. L. G.'s' request of fixing the time of change in reckoning in the genealogy of Shem and the lives of Abraham, Isaac, and Jacob, because he has not the Septuagint, and our version being so notoriously incorrect." If "T. A." had the Septuagint, and was able to satisfy "E. L. G.," "ours" would not be the fittest columns for the controversy.

Tinman.—We have given the process of galvanising iron in several places in back numbers. The articles to be galvanised are cleansed by dipping into a bath of diluted sulphuric acid, scoured with sand, and immersed in melted zinc, which should have a tolerably thick covering of sal ammoniac. It would seem that you have not had sufficient sal ammoniac, or the heat has not been high enough to prevent the article chilling the zinc when immersed. Try again, and if you fail, write.

Nathaniel Waterall.—The lengths of the Atlantic cables are as follows:—The 1865 cable contains 1,896 knots; the 1866, 1,852 knots. The French cable contains from Brest to S. Pierre, 2,584 knots; and from S. Pierre to Duxburg, 749. 100 knots are equivalent to 115·2840 miles.

Samuel Smither.—Next week.

R. A. Proctor.—Next week. On account of what is called the Bank Holiday we had to prepare for press ast Saturday.

C. E., James Leeward, Tomatoes.—Your queries are advertisements. See "Notes to Correspondents."

Hy. Clark.—Let there be no subterfuge. Will you or any professional phrenologist accept the challenge such as it was? The merits of the inquiry in no way affect the statements in your rejected letter.

E. H. Thomas.—The best way is to write on white paper with black ink. Red ink on white paper is not so good, neither is black ink on blue paper.

W. G.—We can bind your volumes in cloth at half-a-crown per volume.

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*** Subscribers are requested to order Cases and Vols through their booksellers, and not to send direct. The new regulations of the Post-office prevent their transmission through the Post.

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The remittance should be made by International Post-office Order. Back numbers cannot be sent by the ordinary newspaper post, but must be remitted for at the rate of 5d. each to cover extra postage.

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The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 16, 1872.

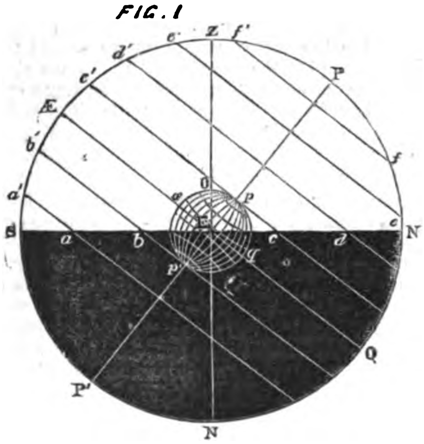
ARTICLES.

THE EQUATOREAL—ITS USE AND ADJUSTMENTS.

By a Fellow of the Royal Astronomical Society.

SOONER or later (and, as a rule, sooner rather than later) every possessor of a telescope who employs it for the purpose of celestial observation finds out the discomfort, annoyance, and impracticability of a mounting which, like the ordinary tripod stand, admits only of motions in a vertical and a horizontal direction. Such a mounting in effect limits him to the employment of low powers, prevents him from recognising a star or other heavenly body from a catalogue, and absolutely precludes him from any form of micrometrical measurement, or from even the approximate determination of the place of any unknown body in the heavens; so that he ultimately discovers that, for anything like systematic work, an equatoreal, in some shape, is absolutely indispensable. Moreover, this is true concerning every description of telescope (reflecting or refracting) in use; the kind of mounting of which we are speaking being alike applicable to, and necessary for, the efficiency of instruments of the Galilean,

FIG. 1



Achromatic, Newtonian, Herschelian, Gregorian, and Cassegrainian forms. In the interest, then, of those who are not already familiar with the nature of an equatorial mounting, we propose to explain, in the first place, the principles on which its action depends, and we shall then go on, in the next, to describe one of the most usual forms in which it is constructed, and to give such detailed instructions for its adjustment and use as shall enable the possessors of telescopes thus mounted (who may yet not be sufficiently familiar with the theory of astronomical instruments to adjust them with facility) to regulate and employ them in the most efficient manner. Here, as in our preliminary explanation, we shall endeavour to employ the most simple language at our command, and systematically sacrifice any mere grace of diction to our leading object of making ourselves apprehensible to those, whose acquaintance with the subject has yet, in effect, to be made.

For the purpose, then, of the exposition which we have proposed to offer, it will be necessary to begin at the very beginning, and to recall some of the most rudimentary astronomical facts to the recollection of the student. Let us, therefore, conceive ourselves to be placed upon a very small island in the midst of the sea, in some northern latitude; let us further imagine the evening to be sufficiently far advanced for stars to be visible, and let us try to realise the spectacle which will be presented to us.

At the first glance we shall notice that the sea and sky do not, as it were, shade off into each other, but form all round a hard, sharp, well-defined line, in point of fact a circle, of which the eye of the observer forms the centre. This circle, pretty evidently, cuts the heavens into two equal hemispheres, one of which above us, is visible; while the other, beneath our feet, cannot be seen. We will suppose, too, that we know the point of the horizon above which the sun is situated at apparent noon. This will, of course, be the south. (Further on we shall reiterate directions, already given in these columns, for finding this south point with some considerable degree of accuracy, but at present we will imagine it to be

FIG. 2

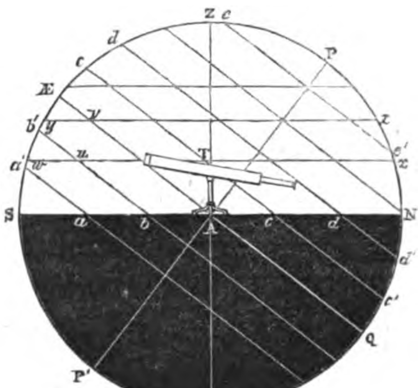


FIG. 3

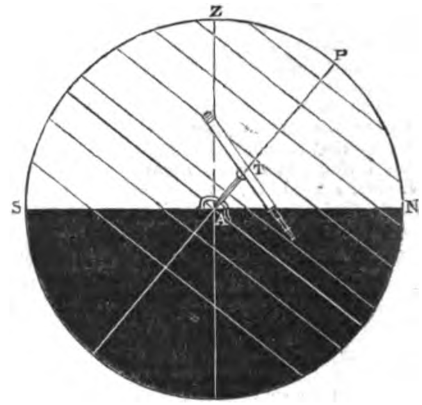
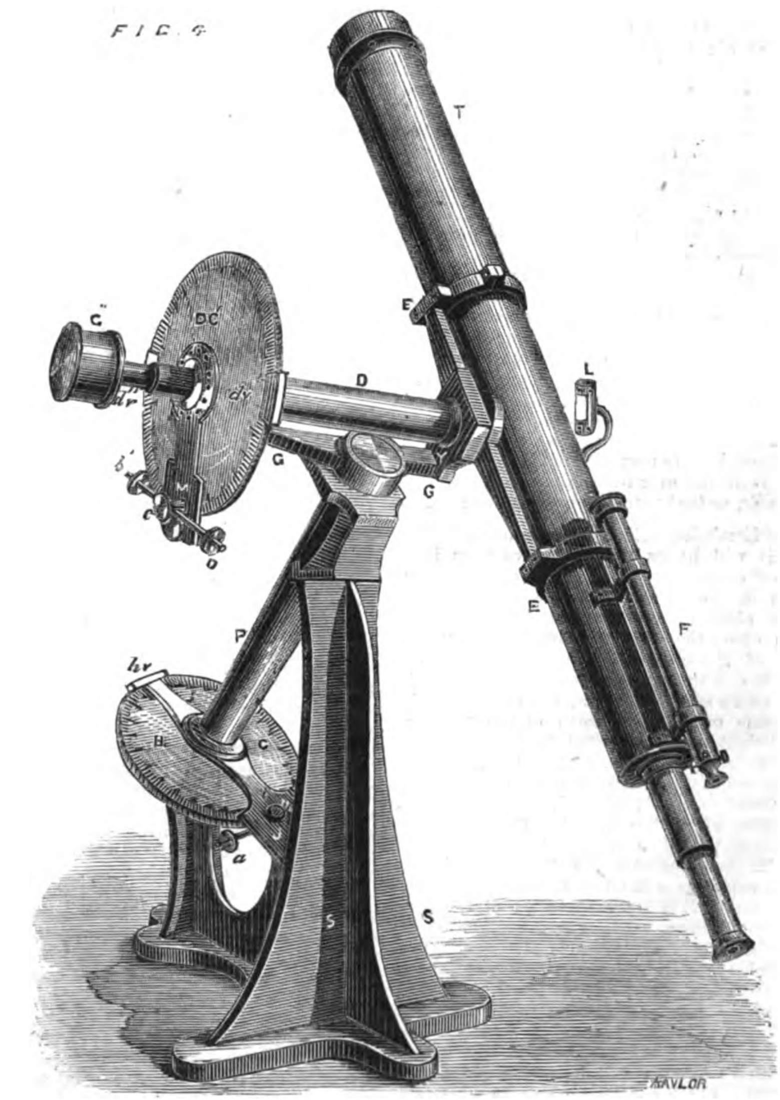


FIG. 4



known.) Facing, now, towards the south, we shall notice stars in the western part of the celestial concave, gradually disappearing beneath the horizon, while others previously invisible will rise in the east. Furthermore, if we can watch through any considerable interval of time it will be seen that every star seems to describe more or less of a circle in the sky; but that these circles are not all of the same size, those stars, for example, which rise very little to the east of south describing a very small segment of a circle of certain size, and remaining a very short time above the horizon; those which rise further toward the east, a larger segment of a larger circle, and remaining longer visible; and so on, until we come to stars which rise due east, which will be found to travel over a semicircle, and set exactly in the west just 12 hours after the time of their rising. If, now, we consider those which rise to the north of east, we shall observe that they describe the larger part of their diurnal paths above the horizon, and remain visible for more than 12 hours (the circles themselves, however, growing smaller, inasmuch as the greatest of all are those described by stars which rise precisely in the east), and so on, until we shall find some which never disappear below our horizon at all, but describe their entire diurnal circular path above it, round one common point which is called the pole of the heavens. There is no visible star exactly on this point, but there is one sufficiently near it in our northern heavens to justify its appellation of the Pole Star. Its position may be recognised by reference to the map on p. 25 of our tenth volume. Moreover, we shall notice that the stars do not change their relative positions in the sky, but revolve as though they were attached to the internal surface of a vast sphere, which itself rotates on an axis passing through the pole just spoken of and an opposite and, of course, invisible one, beneath the horizon. Furthermore, a little attention will show us that there is a point in the sky at which each star ceases to ascend and begins to descend, and it will not be very difficult to discover that a semicircle drawn perpendicular to the horizon, and passing through its north and south points, will be that upon which stars will, one and all, reach their highest points, or, as it is technically called, culminate. This line is called the Meridian (from the Latin word *meridies*, mid-day, because at noon the sun is upon it). It is further self-evident that it must pass through the poles and also through the point immediately over the observer's head, or, as it is called, the zenith. Its determination, as we shall hereafter see, is a matter of the highest importance.

Before proceeding any farther, it will, perhaps, be as well if we endeavour to realise the description and definitions which we have just given by the aid of a figure.

In our first figure, then, O represents our imaginary observer and S E N his horizon, of which S is the south point, E the east, and N the north point (the west point being obviously *behind* E, as seen in our sketch). Then $a\ a'$ will represent the path of a star in the southern part of the sky from its rising, at a, to its culmination, or transit, at a'; after passing which it will, of course, begin to descend and set as far from S on the *other* side of a' as it rose on this. b represents a star rising nearer to the east, and so on to E, which shows one which rises precisely in the east, reaches Æ (or arrives at the meridian) 6 hours afterwards, and sets, at the expiration of another 6 hours, exactly in the west point of the horizon. As we proceed northwards, d, d', e, e'', and f, f'', may stand for the apparent diurnal circles described in the sky, by stars nearer and nearer to the pole. The visible pole, or end of the axis, about which the celestial sphere seems to rotate, is seen at P; the other extremity of such axis P' being, of course, invisible; and if we imagine a huge sheet of metal to pass through the earth's equator, $æ\ q$, and to be produced outwardly, until it cuts the heavens, it will trace out the great circle, Æ, E, Q, distant, of course, at all points 90°, or the quarter of a circle, from the points P and P'. We may add that Z is the zenith, or point vertically over the observer's head, and N the nadir, or that precisely beneath his feet.

Before dismissing this figure from our consideration, it will be as well to prove from it a theorem of capital importance in the consideration of the principle of the equatoreal. We mean that the elevation of the visible pole of the heavens above the horizon is always equal to the latitude of the place of observation. For, let $æ$, q, be the earth's equator, and O the observer's position on its surface, then $æ$, E, O is obviously his latitude or distance north of the equator. Now, all right angles are equal (a fact of which the veriest tyro may assure himself by placing a pencil square to the surface of a slate, and viewing it from various positions), and, therefore, in our figure Æ, E, P = Z E N. Take away the part common to both Z E P, and the remainder Æ E Z = the remainder P E N. But Æ E Z (which is evidently $æ$ E O) is the latitude of the observer, and P E N is the elevation of the pole P above the horizon. Therefore the elevation of the pole at any given place is always equal to the latitude. Q E D. Assuming the student, then, to have thoroughly familiarised himself with the nature of the apparent diurnal motion of the celestial vault, let us proceed to examine the condition of any one with respect to it, who is provided with a telescope mounted on a pillar and claw stand. Fig. 2 has been drawn to illustrate this.

A very brief study of it will suffice to show that, while the apparent paths of the stars a, a'; b, b', &c., are inclined to the horizon at a definite angle (that of the co-latitude, or 90°—latitude), and the axis of rotation of the sphere P P' has the inclination P N to it; the telescope rotates round the vertical axis T, A, and cuts out the circles $w\ x$, $y\ z$, &c., in the heavens, parallel to the horizon, intersecting those of the stars' paths at two points only (such as u or v, and their corresponding ones on the other side of the meridian). Hence it will be seen that (save at the time of its culmination) a star must always be travelling *obliquely* through the field of an instrument thus mounted; so that, in order to follow it, *two* simultaneous motions are required, vertical and horizontal; or, as they are technically called, in altitude and azimuth. Annoying as this is with low powers, and in the observation of large objects like the Sun or Moon, it becomes almost insufferable and intolerable when we are examining faint stars with a high power; while, as we have previously intimated at the beginning of this essay, it practically precludes the observer from the identification of a star from a catalogue; or from any form of micrometrical measurement.

The remedy, however, will readily suggest itself to any one who has considered our last figure with the smallest attention. It is indicated in our sketch below; in which it will be at once seen that all we have done is to make the principal axis of rotation of the telescope T A *coincide with the axis of rotation of the heavens*; so that, if we now set it upon any given star, by turning the telescope round such axis, we can, by a single motion, follow that star from its rising to its setting. (We here ignore the effect of refraction as immaterial to our present purpose.) In fact, we have converted our telescope into a rude form of Equatoreal.

We have, however, gained but one solitary advantage attendant on an equatorial mounting, that of following certain stars by a single motion of the telescope. We have said *certain* stars advisedly, because it must at once strike the most careless observer of our third figure that it would be absolutely impossible, in the position of the telescope there delineated, to turn it upon any object at all near the pole. Preserving then, the vital principle of the coincidence of the principal axis of rotation of our instrument with that of the heavens, let us see how our primitive mounting can be modified so as to enable us to reach every part of the visible hemisphere; and, incidentally, to set it, by the aid of certain co-ordinates, upon any object contained in a list or catalogue.

Now, the object of these papers being wholly practical, we shall not occupy needless space by the delineation and description of the various shapes which the equatoreal has assumed, but shall, at once, proceed to describe the German or Fraunhöfer form of it. We select this, since it is the one most commonly employed to carry all telescopes, such as are ordinarily found in the possession of amateurs; and as, moreover, our explanation of its construction and detailed instructions for its adjustment and use, will, if once fairly mastered, enable the student to deal satisfactorily with any kind of equatorial mounting which may come under his notice. It is shown in Fig. 4.

Here we see the telescope T supported by a cradle E E', and thus immovably fixed to the end of the declination axis D, to the other extremity of which the declination circle D C' is also attached. As this axis terminates in cylindrical pivots which rotate in two Y's (one of which is shown at Y, and the other is hidden behind the declination circle in our drawing), it will be seen that the telescope and circle must move together. The Y's, as inspection of the figure will show, are carried by or form part of the framework G G, which is itself attached at right angles to the polar axis P; the principal axis of rotation of the instrument, the extremities of which of course must point to the poles of the heavens. Means for adjusting the declination axis to a small extent are provided at l Y; those for the adjustment of the polar axis are covered by the hour circle—H C in our figure. This hour circle, which is divided right round to XXIV. hours, is read by the aid of the vernier $h\ v$; the vernier being adjustable by the arrangement shown at $i\ j$. It should, of course, read either XII. or XXIV. hours, when the telescope is accurately in the meridian, according as it is placed to the west or east of the polar axis. In our sketch it will be noticed that we have shown the telescope to the west of that axis, and the declination circle, of course, to the east of it. The declination circle D C'—is almost always divided into 4 quadrants of 90° each, starting from the equator as their initial points; so that when the optical axis of the telescope is directed to the equator, the verniers $d\ v$ and $d'\ v'$ read 0°. The verniers referred to are supported by, and adjustable on, a framework, which the declination itself covers in the figure. S S is the cast-iron stand supporting the working parts of the equatoreal; this is generally cemented or screwed down on to a pillar, according as the latter is formed of brick or stone, or of iron. The rest of the mounting is almost invariably constructed of gun-metal. The edges of the circles D C and H C are racked with a screw tool, and into the worm-wheels thus generated work endless screws $a\ j$, $b\ c\ b'$ by which slow motions are given in right ascension and declination, respectively. These screws are thrown in and out of gear by a simple arrangement at c and m, which it is scarcely necessary here to describe. C'' is a counterpoise, which is shifted when a micrometer or analagous apparatus is attached to the telescope. F is, of course, the finder, and L a little lamp swinging in gimbals. This reflects light through a hole cut in the side of a telescope on to a perforated mirror, placed diagonally in it, which itself casts the light down the tube, and so illuminates the wires of the micrometer or transit eyepiece.

An equatoreal mounted as completely as the one we have attempted to delineate and describe would almost certainly have a clockwork movement to drive it in opposition to the diurnal motion of the earth, and so to keep a star apparently immovable in the field of view; but we have omitted a clock in our sketch to avoid needless complexity. In practice, the motion of such a clock would be controlled by a conical pendulum, in which the friction of an arrangement analogous to the governor of a steam engine, against the inside of a cone, supplies the regulating power. An equable motion thus obtained would be communicated by light shafting to the endless screw $a\ j$; and so the hour circle H C (and with it, obviously, the whole instrument) caused to rotate at precisely the same rate as the earth, but in an opposite direction. We shall presently speak, too, of a spirit-level, but as every one who is likely to use our directions for the employment and adjustment of the equatoreal must almost certainly be familiar with this in some form, we abstain from its illustration and description. It only remains, then, that we should formally exemplify the meaning of the terms right ascension and declination, before proceeding to the immediate object of these papers; that of explaining the best and most available mode of getting a telescope equatorially mounted in correct adjustment with reference to the heavens.

Obviously, we must have the means of identifying a star; and for this purpose *two* co-ordinates, of some sort, are absolutely indispensable. Now, the north and south poles P and P' Fig. 1, may be considered as fixed points in the celestial sphere; consequently the equator Æ E Q (same figure) is a fixed circle therein. Furthermore, every one who has ever opened a book on astronomy knows that the axis of the earth is inclined 23° 27' from a perpendicular to its orbit; and that, consequently, such orbit must form that angle with the equator, or (as it is called when projected on the concave face of the heavens) equinoctial. The immediate effect of this is to cause the apparent annual path of the Sun through the heavens, the ecliptic, to cut the equinoctial in two parts, 180°, or 12 hours, apart. The Sun is *on* the equator on the 21st of March; after which he continues to travel northward until the 21st of June, when he attains his greatest distance 23° 27' north of it; after this he descends again, once more crosses the equinoctial on the 21st of September, travels down 23° 27' south by the 21st of December, begins to ascend again, and so on. Now, the point of the equator, which the ecliptic crosses on March 21, is called the first point of Aries; and from this right ascension is reckoned *eastward* on the equinoctial. Perhaps the simplest definition of right ascension that we can give is, that it is the interval in time which elapses between the transit of this first point of Aries over the meridian of any given place, and the arrival of the body whose R. A. is to be determined on the same meridian. Declination is the distance of a star, or other heavenly body, north or south of the equinoctial; for example, in our first figure Æ d' would be the north declination of a star d', while Æ a' would be the south declination of another one a'. In many fixed observatories north polar distance is employed in lieu of declination as a second co-ordinate; but, as the *Nautical Almanac* uses declination, and as, moreover, all the chief popular lists of double stars, &c., give the element in this form, we shall, ourselves, invariably use it in our subsequent exposition. Should the student have access to a celestial globe, reference to it will materially facilitate the understanding of what we have been endeavouring to explain.

(*To be continued.*)

THE MUSEUMS OF LONDON.—II.

SOUTH KENSINGTON MUSEUM (1).

THIS Museum is under the direction of the Science and Art Department of the Committee of Council on Education, and the chief offices of the department adjoin the Museum. It is situated at South Kensington, near the site of the last great International Exhibition. The Museum is strictly educational, and is one of the most popular of similar institutions in the metropolis. This will be seen from the following statistics of the number of visitors.—In 1857 (the first year of opening) the number was 268,291; in 1862 (the year of the Exhibition), 1,241,369, the highest yearly total yet attained; 646,516 in 1867; 1,014,849 in 1870; and in the first six months of the present year 710,111; a total up to that time from the opening (June 22nd, 1857) of 12,355,470.

The nucleus of the Museum was a collection of objects of art in connection with the schools of art held in Marlborough House, about the year 1852. In 1857 the collection was removed to temporary buildings at South Kensington, popularly known as the "Brompton boilers." This temporary building is in course of being replaced by a permanent structure, parts of which, as completed, are successively thrown open. The temporary arrangement, as might be expected, was inadequate and inconvenient, but the new buildings are large, airy, well lighted, and adapted for the purposes for which they are intended. When completed, and the old buildings removed, the South Kensington Museum will take its place amongst the architectural features of London. In rooms connected with the Museum are the National Art Training Schools—the various working rooms of which are open to public inspection on Saturdays from 2 p.m. till dusk—and the Naval School; a new block of buildings for a Science and Naval School is now nearly completed. The new buildings are all of bright red brick, which shows very conspicuously in comparison with the neighbouring stone and plastered buildings.

Turning to the interior we find that the whole of the collections fall into two divisions; those belonging to the art department comprising paintings, sculptures, architectural models, &c., which occupy the bulk of the building, and a smaller division, comprising objects belonging to a more general and elementary education—*e.g.*, school fittings and materials. Connected with each of these divisions is a library and reading-room. Not only is there a permanent collection exhibited in the Museum but a special feature consists in having usually on view loan exhibitions of various classes of objects, an excellent means of making the public acquainted with the art treasures which are scattered about the country in the possession of private individuals. As examples of these loan exhibitions we might mention those of fans, the Duke of Edinburgh's collection during his voyage, school furniture, ancient and modern jewellery, and musical instruments: the last two at present on view.

On Mondays, Tuesdays, and Saturdays the Museum is open free from 10 a.m. till 10 p.m.; Wednesdays, Thursdays, and Fridays are set apart as students' days, when certain privileges are granted to persons wishing to make copies of the objects or paintings; the public are admitted on payment of sixpence. It may be as well to mention, persons who have obtained a certificate for drawing in the second stage, or a science certificate in the advanced stage, can, by application to the Secretary of the Science and Art Department, obtain a ticket which will insure them free admission to the Museum on all days when it is open, and also to the two libraries. On students' days the closing time is 4, 5, or 6 p.m., according to the season. During the whole of Easter week, Whit week, and Christmas week the Museum is open free till 10 p.m., and the number of visitors at each of these periods is very considerable.

Entering the building by the principal entrance in Cromwell-road, we first come into the temporary portion from which a corridor on either hand leads to the larger rooms. Looking through the window facing the entrance the new front of the permanent building may be seen. Let us leave the art collections for the present and turn to the left to the educational series. English and German domestic life of the seventeenth and eighteenth centuries are strangely portrayed in two cases in this entrance hall, one being a large doll's house without a front, plentifully stocked with miniature furniture and utensils, which was made for a daughter of an Archbishop of York in the reign of Queen Anne; the other being a somewhat similar toy-house made at Nuremburg in the seventeenth century. Near the window in the hall one of the daily reports and charts of the meteorological office is hung, and the observations of temperature and pressure are taken at the Museum.

The corridor is lined on both sides with bookcases, filled with modern volumes on the various subjects included under general education. The reading-room opens on the left, and is accessible to teachers, school managers, students with tickets, and subscribers. The works included are, as a rule, given by the various publishing firms, together with educational periodicals. New additions are for a short time placed on an open table in the room, after that they are consigned to the various cases; to obtain them then it is necessary to fill up a printed form. Farther on, the corridor contains specimens of school desks and seats, and a few cases illustrating the late Professor Henslow's method of teaching elementary botany. On the wall, on the same side, are large botanical diagrams and specimens with description, a very useful adjunct to the textbook; the wall on the other side is occupied by drawing models, and amongst other things a collection of the postage stamps of the British Empire. A small passage on the left contains examples of the weights and measures of several European countries, and a series of metrical weights and measures, as here shown, in a school would be the best means of making the scholars familiar with the advantages and applications of that system, and would enable them to compare these with our present standards. Here also is a specimen of a somewhat strange educational apparatus for assisting in the grammatical construction of sentences for translation into another language, the principal being that with the knowledge of a few words a large number of sentences can be constructed. It was brought out about seven or eight years ago under the name of the "Metabolical Machine," and consists of a certain number of cubes, having a different word on each of their faces, those on the same cube being interchangeable. They are arranged in separate divisions of a box with glass front, so that by a movement of the box one or more of the cubes can fall over and exhibit a fresh face.

In the rooms on the right-hand side of the main corridor the bulk of the educational collections will be found. The end room contains a collection of educational appliances from Sweden, and of school harmoniums; and on the wall a case, also, is well worthy of attention. It contains the skeleton of a fish (cod), bird (duck), and mammal (cat), taken to pieces and arranged and numbered so as to show the homology of the various portions. A similar case has recently been placed in the geological museum, and we need scarcely point out the value of such (unfortunately unusual) specimens to the student of comparative anatomy. In the succeeding room is a series of geographical accessories, maps (amongst which we would direct attention to Sydow's beautiful relief maps), globes (terrestrial and astronomical), topographical models, &c. At the base of one of the windows, with mirrors set so as to properly reflect the light, is a photograph of the moon, arranged as a stereoscopic object by Dr. De La Rue, and presented by him, forming a highly interesting illustration of the telescopic appearance of our satellite. Among a series of mathematical, optical, and meteorological instruments in the wall cases will be found the identical quadrant which the famous Capt. Cook employed in his voyage round the world. The floor cases contain small collections of shells, mineralogical specimens, and geological cabinets; and one has a number of flint implements, and casts of engravings on horn, made by the cave men in the south of France during the reindeer period. These floor cases are not the usual flat, or nearly flat ones, so commonly seen, but are higher, narrower, and have one or more shelves filled in, thus greatly economising ground space. In another of the cases will be seen a graphical representation of the principles of perspective; the figure on the picture plane (represented by an upright piece of glass) is shown to be produced by the intersection of lines of sight (represented by cotton threads) from the various parts of the object (models of bridges, &c.) to the observer's eye. The next room contains several very complete series of instruments used in the majority of chemical and electrical experiments, and also a series of working models of various simple machines and pieces of mechanism. In a small case by itself will be seen a strange-looking mass of wheels intricately fitted together, and with three vertical rows of wheels in the front, having the digits marked in order round their circumference. This is Babbage's famous calculating machine, exhibited by the Board of Works. Near to this are a number of small pieces of apparatus designed to illustrate practically such astronomical principles as the cause of the seasons, eclipses, and the precession of the equinoxes. In this room, too, is a small map of London of a date antecedent to the Fire, with an engraving of the old St. Paul's Cathedral. The last room in this department is filled with a very miscellaneous collection, the most important of which is a series of iron working models exhibiting many of the first principles of mechanism, as the nature and uses of cams, cogs; several modes of obtaining reversing and reciprocating action, &c. This part of the Museum we have been describing is always closed at dusk. The remaining portion of the Museum we must leave for a subsequent paper.

W. H. W. T.

DR. CARPENTER ON OCEANIC CIRCULATION AND THE GULF STREAM.

IN Mr. Proctor's argument for the superior efficacy of equatorial heat over polar cold, in producing the *vertical* oceanic circulation—which, equally with myself, he recognises,—he appears to me to have left out of view one very important consideration. If his view be correct—that the excess of evaporation in the intertropical area produces, as in the Mediterranean, an *inflow* of water from an extraneous source—such excess ought to show itself, as in the Mediterranean, in an *increase* of specific gravity. Now, as all trustworthy observations agree in showing that the specific gravity of equatorial water is *lower* than that of tropical water, I cannot see how Mr. Proctor's thesis can be sustained.

But further, if, as I gather from his criticism on my experimental illustration, he considers that the removal of equatorial *surface*-water by evaporation *draws in* polar water at the *bottom*, it would be necessary that the *whole intermediate stratum* should first rise towards the surface in order to *make room* for it. Now this hypothesis is open to the *prima-facie* objection of violating the principle of "least action," which I had urged against Professor Wyville Thomson's hypothesis that the deep flow of polar water towards the equatorial area is an *indraught*, replacing that which has been swept off from the surface by the action of the trade winds in producing the Gulf Stream. This question was discussed last year in Section A of the British Association; and as three of the most eminent physicists in this country—Sir William Thomson, Prof. Stokes, and Prof. Tait—agreed with me that any such loss of *surface*-water *must* be replaced (in the open ocean) by a *surface*, not by a *bottom*, inflow, I must venture to maintain my previous conclusion, that the "creeping flow" of polar water towards the equatorial area is due to the excess in the specific gravity of the polar over the equatorial column. And that this excess is maintained rather by polar cold than by equatorial heat, seems evident from the fact that while, as all recent observations concur in showing, the temperature of the sea in high latitudes, where not affected by any special currents, diminishes from 36° at, or little beneath, the surface, to below 30° at great depths, the influence of equatorial heat is not in the least perceptible at 200 fathoms' depth, as I learn from the temperature observations made last year in the school-ship *Mercury*, kindly communicated to me by Prof. Draper, of New York. This fully justifies Sir J. Herschel's very significant (*not* humorous) remark on the "more intense action" of polar cold.

Now, since the specific gravity of equatorial surface-water is rather *under* than over that of extra-tropical water, the question arises how the enormous loss of water by evaporation in the inter-tropical area is replaced. In assuming that it goes to supply the rainfall which feeds the rivers of Europe and North America, it seems to me that Mr. Proctor neglects two very important considerations: (1) that the greater part, if not the whole, of the rainfall of Europe and North America may be accounted for by the evaporation of the Mid-Atlantic beyond the region of the trade winds, say between 20° and 40° N. lat.; and (2) that there is an enormous rainfall in the region of "equatorial calms," which is attributed by Sir J. Herschel to the deposit of the waters taken up by the N.E. and S.E. trades. For, he says, "these winds arrive from higher latitudes, deficient both in heat and moisture, and take up both in their progress towards the equator, while they return little or none of the fresh water so taken up in the form of rain, till their arrival at and near the equator itself. There, however, they at once precipitate a large proportion of the water so absorbed, a process which, being in constant operation, must in some degree freshen the surface." (Physical Geography, Section 20.) It seems to me a pity that before committing himself to any "prediction" as to the superior efficacy of surface-*heat* over surface-*cold* in producing a vertical circulation, Mr. Proctor had not *tried the experiment*. If he will do so, he will (I venture to say) be rather astonished at the way in which the introduction of a piece of ice causes the surface-stratum close to it at once to tumble down (no other expression will so well describe the movement) to the bottom, where, as each new fall takes place, it creeps onwards to the other end of the trough. On the other hand, the application of surface-heat, in any way that can be devised, does not *per se* produce any rise from below; the only movement it produces being a slight surface-flow *towards* the heated area, to replace what is lost by evaporation. It is only when it acts *in combination* with the surface-cold at the other end of the trough, that it helps to maintain the vertical circulation, by keeping up the antagonism of temperature. For if there were a constant renewal of cold at one end of the trough, without any restoration of heat at the other, there would be a continued reduction in the temperature of *the entire mass of water in the trough* (supposing its bottom and sides to be non-conducting) until the whole comes to be as cold as its coldest part In making this assertion I am justified by the authority of the greatest master of Thermotics in this country; for after the discussion in Edinburgh Sir William Thomson gave me authority to state that he entirely accorded in my view of the matter.

As Mr. Proctor is, so far as I know, the only man of science in this country who agrees with Captain Maury in attributing the Gulf Stream to some other cause than the impelling force of the trade winds, I would strongly recommend him to study the "Wind and Current Charts of the Atlantic," published two years ago by the Admiralty. He will there find that the *predominance* of easternly winds in the area of the equatorial current is so enormous that to say that they will *not* produce a powerful drift-current is to run counter to all we know of the action of wind in giving surface-movement to water. No one (so far as I am aware) questions the action of the predominant south-westerly winds in giving a N.E. drift to the surface-water of the North Atlantic. But *their* predominance is far less than that of the N.E. and S.E. trades. The *general direction* of a drift-current will, of course, be determined by the *excess in the whole movement of the air in one direction* above its whole movement in *any other direction*. And until Mr. Proctor can show that there is no such westerly excess in the intertropical area, I must take leave to express my coincidence with Sir. J. Herschel in an expression of surprise that "there can be any possible ground for doubting that the Gulf Stream owes its origin *entirely* to the trade winds." It happened to me in early years to make a voyage to the West Indies, and I found the regular sailing course to be to keep as nearly *south* as possible until "the trades" were entered, a perfect reliance being felt that *they* would do all the *westing*. This was fully justified by what, after an interval of nearly forty years, is still among the pleasantest recollections of my life—the "run down the trades" with a steady breeze on the quarter, making every sail draw, that carried a heavily-laden merchant ship at the rate of eight or nine knots an hour for ten or twelve days continuously. And if any interruption to the regular trade-winds should occur, all experience shows that it is *local*, the *general* westerly movement being undoubted by every navigator I have ever met.

WILLIAM B. CARPENTER.

MECHANISM.*

(Continued from p. 533.)

IT is obvious that, whilst we have been forming these and similar curves, and taking portions of them for teeth, we may continue them, and it is possible we may find such continuations useful in their character of sliding surfaces. They reappear in that character, and receive the name of cams. A cam consists, generally speaking, of a curved piece, which conveys motion to a pin or to another curved piece. If, now (the lecturer referred to a model), this curved piece went round in that direction, it would raise the bar between the two guides, but if the curved piece came back again it would leave the bar at the point to which it had been raised. Place, however, a curved piece on the other side, and by that means the bar would be brought back. That is generally called a constrained cam. The curved cam may drive a shaft, or it may move an arm. If the curve forming a cam was passed round on a flat surface, it would form what is called a flat screw-wheel. It may also appear in another form, and this form is a very instructive one. Here is a piece of board, about 10in. by 6in., and we will suppose it to represent a page of printed matter in two columns. There is through the board a groove which passes as from the bottom left-hand corner of one column to the top right-hand corner of the same column. Let there be a pin in this groove, and let it be fixed on a bar constrained to move parallel to the lines on the page. Suppose the grooved wood to be slid for its whole length parallel to the binding of the volume, then will the end of the bar have travelled the breadth of a column of type. In this is a straight-line cam, and it is one of a very old form. It seems to have passed out of use for a long time, but has been reintroduced. If you put it round a cylinder it becomes a screw. In certain processes the screw is not conveniently available, and there are two cases known to many of you in which this flat or inclined plane cam is used for the purpose of generating screws—in the case of rifling guns, for instance. The rifling down the gun is a very long kind of screw, similar to the one on this old Chinese cotton gin, and that rifling is obtained by the use of this straight cam. In the fusee barrels of watches and clocks, the screw that takes the chain is also obtained from the straight cam. You have this same straight cam in the Archimedian drill.

As was said just now, motion is given to pins or bars by means of these cams. It is easy to see that if one pin is not of sufficient strength two may be put side by side, or three, or four, until at length you reach the form which ultimately develops into half a nut, and that half nut is used in Sir Joseph Whitworth's lathes, and is the mode by which the cutting tool is adjusted upon the lathe, the half nut being used because it can at any time be lifted out of gear so as to allow the slide-rest to go rapidly back. We may multiply or increase the length of this half nut and diminish the length of the screw, and we then reach the rack; for as the nut increases it extends into a rack, and the screw works upon it, causing it to travel (Fig. 18). We may also curve the rack round a ring, as in Fig. 19, and then it becomes what we call a worm-wheel, and we get the ordinary worm-wheel motion. This mechanism, therefore, has altogether resulted from a straight slit in a board moving on a plane, simply by throwing the elementary parts upon curved surfaces. The screw may take two forms, so as to work either from right to left, or from left to right. In this piece the screw or worm is revolving on a shaft in a horizontal direction, and it communicates motion to a shaft at right angles to itself.

We found the same mechanism in that old Chinese churka, or cotton gin; it is very oddly made, and of very rude construction. In it are two screws, viz., a right-handed one gearing into a left-handed one, acting as if they were toothed wheels, and so causing two shafts to rotate parallel to each other.

FIG. 18

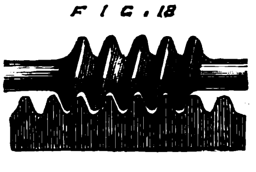


FIG. 19

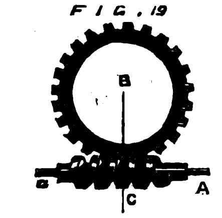


FIG. 21

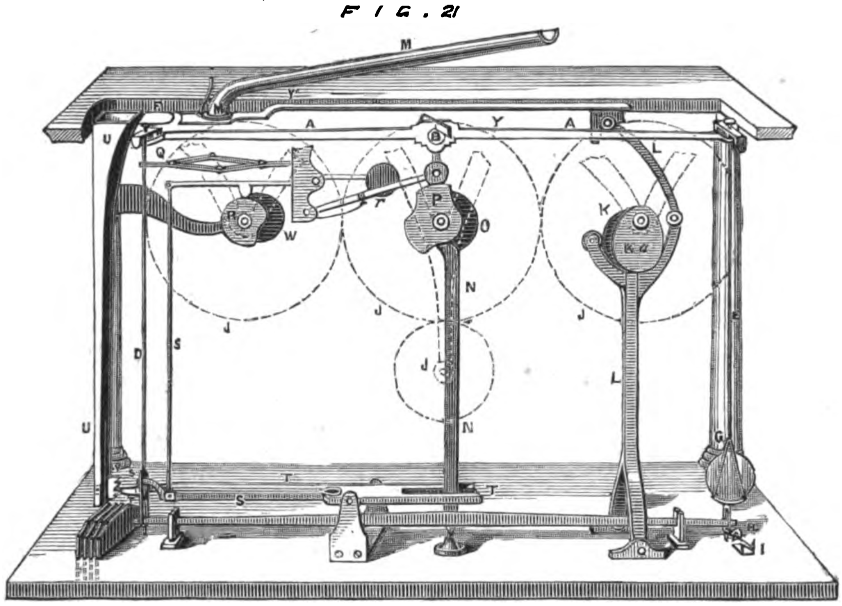


FIG. 20

This worm-wheel motion appears in a variety of forms, and it is generally employed in reducing speed; for one revolution of the shaft only allows one tooth of the wheel to pass. You may remember it in the crane kindly sent from Crewe. There was a very high velocity, which had ultimately to be very materially reduced; and the latter part of the reduction was by means of one of these worm-wheels. This is therefore a mode of converting velocity into power. The perfection to which these screws have attained is very great; so great that practically what we have hitherto called "clearance" is dispensed with.

This is one of Mr. Whitworth's standard measuring instruments. We have a screw perfectly made, working in a nut perfectly made—that is, as perfect as hands can make them. There is a certain number of threads upon the screw, say 50 in an inch If, therefore, this wheel, which is divided into 100 graduations, be keyed on the end of the screw, it would divide one inch into 100 times 50 parts, which would be 5,000; so that one of these divisions on the wheels would indicate the 5000th part of an inch. The manufacture of the apparatus is so perfect that it is capable of dividing an inch into 10,000 parts. It is used for the purpose of determining gauges, and is a case of cam motion applied as a screw.

These cams are also employed in another way very different to that, and here is a Swedish machine intended to represent some of the phenomena of light, heat, and sound. It consists of three rows of levers, which at one end work in a series of cams on rollers, and by turning these cams the wave-like motion which you see is produced.

This is another very useful development of the same thing. Here you have the mode by which the thread is laid on the bobbins in cotton spinning.

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

You will find the pin which originated the nut in this case is one only, but extended to a flat piece, and the grooves of the screw are so arranged that there is a return motion which gives a varying direction to a bar.

Here, again, is another which differs both in form and name. On turning a handle at E in Fig. 20, the upright bar, G, remains steady,* but by changing the angle of this plate, F, an up and down motion is produced. This is a cam acting parallel to its axis; it is called a "swash" plate.

In this machine, Fig. 21, are the arrangements by which gold and silver coins are weighed before being issued from the Mint. It is upon a much larger scale than the actual machines, and has been kindly lent by the Master of the Mint. It may be well to preface any explanations of the cam contrivances in it by a statement of the circumstances under which the machines are used.

In the process of coining, some of the coined pieces may be too heavy, and some too light. Such irregularities in weight must be within very narrow limits, and by means of mechanism, constructed as this large machine, it is determined which coins are too heavy or too light, and must not be allowed to pass into circulation, and which may so pass.

The coins are placed in heaps; they pass down a spout; and the machines take coin after coin, and give a verdict which consigns the coin to the public for use or to the crucible for remelting. The mechanism is self-acting, being driven by power derived from heat. The coins are weighed at the rate of about twenty per minute. In the Mint there are nineteen of these self-acting machines at work, capable therefore of weighing 22,800 coins per hour.

As an illustration of what is required from the mechanism, we may take the case of arrangements being made for weighing sovereigns:—

	Grains.
The legal weight of a sovereign is	123·2744
Less allowance	·2
Therefore the weight of one blank or counterpoise is	123·0744 (A)
Making a similar allowance of ·2 grains for excess, has led to the adoption of a weight consisting of a platinum wire, and called "the remedy," of	·4
	123·4744 (B)

All coins below the weight marked (A) are too light and must be rejected.

Again, all coins above the weight marked (B), are too heavy, and must also be rejected. It will be observed that a coin heavier than the blank and "remedy" combined must be rejected. Hence one blank and one "remedy" wire constitute the weight on one side of the beam.

Mechanism similar to this is in use at some banks, and actuated by electricity. In one mechanistic respect it differs; for its judgment is only invited as to a coin being too light. The machines at the Mint are expert at keeping from the public coins too heavy. Therefore, where the Mint mechanism has three courses of decision open to it, the bank machines need only one.

Let us now turn to the mechanism, and follow the operations in weighing these metal blanks, which are our representative sovereigns:—

It will be observed that at the lower end of D there are two slits, and at the lower end of E only one slit.

A horizontal bar, rigidly fixed to the vertically guided rod N N, has its ends passed through the lower end of these two slits, consequently, if at any time the scale-beam is out of level, a depression of this vertical bar N N will restore the beam to the level.

L is a rocking bar attached to a horizontal slide, Y L Y. If this slide be moved from the reader's left hand towards his right it will be withdrawn from below the coin at M. If now it be moved from right to left, the coin will be advanced, and placed upon the scale-pan, F. Beneath that scale-pan is a pair of nippers, marked Q, by the action of which the pendant D, and consequently the beam A A, can be held in any position.

Such is an outline of the contrivances attached to the "weighing." Let us now turn to another class of contrivances which have reference to the determination of the destiny of the coin being weighed. Passing one through and the other near the upper of the two slits in the pendant D, there may be seen in the general drawing two pieces marked respectively S S and T T. The one marked S S passes through the upper slot in D. The one marked T T passes outside the slot in D, and carries the chisel-shaped end T, which is so counterpoised that when free the right hand end preponderates. S is called an indicating finger; T is called an indicator. S may, when permitted by the mechanism, fall on the lower part of the slot in D, and so by a projecting piece (not shown) carry down with it the indicator, T.

If we now pass to the extreme left of the figure, a curved spout, having at its upper end a wide mouth, may be traced. It is lettered U U. At the lower end of this spout and fixed to it may be seen three notched steps. The spout is free to move near its upper end about a horizontal axis perpendicular to the plane of the paper. Dependent upon the position of the lower extremity of the spout is decided into which of the three troughs (shown on the base-board of the machine) any coin passing down the spout may be discharged. These three troughs are the respective entrances to the vessels arranged to receive the light, the correct, and the heavy coins.

Having thus described the general construction of the essential parts of the weighing and distributing arrangements, we may turn our attention to the wheels and cams by which the whole of the previously described parts discharge their appointed duties, and in the required order.

J J J J are four small-toothed wheels, the three upper ones being of the same size. On the axes of each wheel are two cams, lettered K and Ka, P and O, W and R. The cams have very varied portions of their circumferences struck with the same radius, and therefore when that portion of the circumference is upon the arm no motion is communicated. K and Ka cause the bar L to rock, and thus one coin is placed on F, and slid off by the second coin put on in consequence of a second rocking. Assume that a coin is on F, and that it is too heavy, the scale beam will be depressed. This depression will have raised not only the blank counterpoise in G, but also "the remedy" in H. So important and sensitive is the action on the remedy that the bearings shown at I, Fig. 23, on which the small "remedy" wire rests must be truly horizontal. This is secured by the three levelling screws, as shown in Fig. 23, which is placed under H in Fig. 22. To return to the weighing.

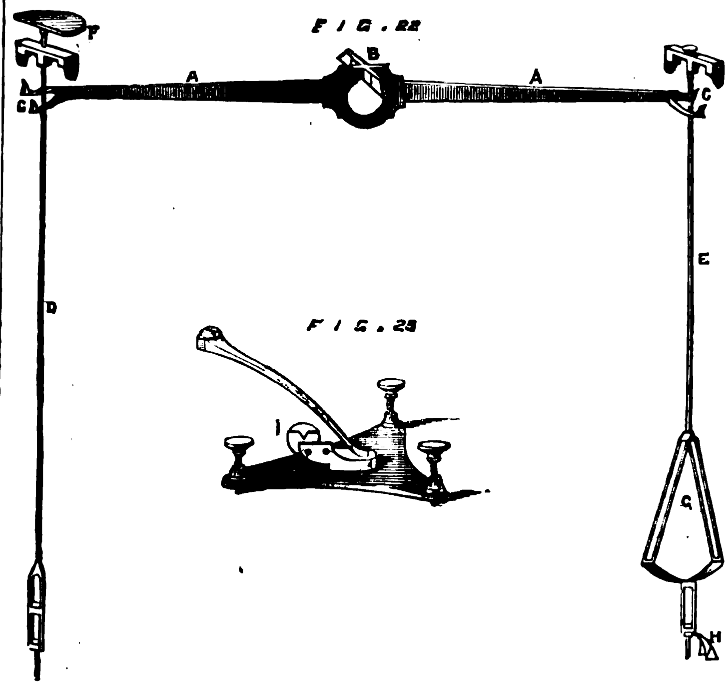


FIG. 22

FIG. 23

The action of the cam P releases a little weight which closes the nippers Q and holds the beam. The cam, R, then acts, and S falls upon the upper slit in D, carrying with it the chisel-shaped end, which is outside of the slit in D. The cam, W, now allows the spout U U, to fall, and, in the case assumed, the lower notch in V would rest upon the chisel end. (The drawing shows the middle notch so resting.) The destiny of the coin is now determined, and the scale beam may be restored to its proper level. This is accomplished by the cam O, which lowers the leveller attached to the vertical rod N N, the cam P having previously opened the nippers Q. This leveller, pressing upon the lower slots in the pendants D and E, restores the beam to horizontality. It will now be seen why the portion S S, which decides the drop of the spout, is double, for the levelling of the beam at this stage does not disturb the chisel end in the notch.

The beam being levelled, the cam P again permits the nippers to close. The cam K advances the slide Y Y, and with it another coin. Thus the one on F is displaced—it falls into the spout U U, and being too heavy is guided into the receptacle for heavy coins. The cam W returns U U to its first position; the counterpoised end of T T causes the chisel-shaped end to rise, and the apparatus is restored ready for another operation.

The lecturer illustrated the description by weighing metal blanks, some of which were too heavy, others too light, and others correct, and said the instrument is produced as an example of the uses in mechanism of cams, affording, as they do, periods of rest or of impulsive action. These cams are found in many machines. They have also been employed in the form of tappets, for the sudden opening and closing of the valves of steam engines, where it was considered that the action of the excentric (another name for a particularly formed cam) was too gradual.

There are, however, few if any machines, in which cam actions have been more successfully employed than in the large one now before us. It is for the making of those wire combs called cards, used for laying the fibres of cotton parallel to each other. A consideration of this machine must be postponed for a future occasion.

(*To be continued.*)

DISINFECTANTS.

WHAT may appropriately enough be termed the "battle of the disinfectants," if still unsettled in this country, may be regarded as approaching a satisfactory solution in France. What with the old-fashioned chloride of lime, carbolic acid, Condy's and other fluids, chloralum, and sundry other inventions, patented and otherwise, each said to be the best by interested persons, the uninitiated public is in a perfect quandary as to which to use, for of course the public is anxious to have the cheapest as well as the most reliable article. The commission appointed by the French Academy to inquire into the relative merits of the various disinfectants when employed in eradicating contagia report that the first place among agents for attacking and destroying infectious germs must be accorded to hyponitrous acid. Extraordinary precautions must, of course, be observed in making use of this dangerous gas; the doors and windows must be carefully sealed with gummed paper. When disinfecting a room containing 40 or 50 cubic yards, the materials are taken in the following proportions: 2 quarts of water, 3¼ pounds of ordinary commercial nitric acid, and ¼ pound of copper turnings or filings. A stoneware vessel is employed, holding two or three gallons. The exit doors are carefully pasted up, and the room left closed for 48 hours. The person opening the room at the expiration of the time should be protected in some way from breathing the gas, by a suitable respirator.

Carbolic acid, however, is cheaper, more easily used, less dangerous, and has proved equally efficacious. It is best employed mixed with sand or sawdust—one pound of acid to three pounds of an indifferent substance. The mixture, placed in earthen vessels, was used for the same purpose as the hyponitrous acid. Carbolic acid, diluted with 15 or 20 parts by weight of water, was found useful for daily sprinkling of the floor and bedclothes.

An interesting case is mentioned in the report where neither chlorine nor hypochlorous acid was able to destroy or render odourless the gases given off from the corpses in the Paris Morgue during the heat of summer. The object was attained by dissolving a quart of liquid carbolic acid in 500 gallons of fresh water, contained in the reservoir, and used to sprinkle the bodies. Putrefaction was entirely stopped.

Devergie found that water containing only one part to four thousand of its weight of carbolic acid sufficed to disinfect a dead-house, even in the hottest weather, when six to eight corpses were in it.

For fumigating linen, mattresses, and other bedding with chlorine, Regnault's latest method was used—namely, one pound of chloride of lime (bleaching-powder) is sewn up in a strong bag of sail cloth, holding about a quart, and put in an earthen pot containing a quart of common muriatic acid (specific gravity 1·15) and three quarts of water.

As soon as the acid comes in contact with the chloride of lime the room is closed, and the things exposed to the action of chlorine gas for 24 hours; the room is then aired for 48 hours. Ten such earthen pots give off about 14 cubic feet of chlorine, sufficient to disinfect from 20 to 25, more or less, dirty mattresses.

* In the model the plate F could be moved about (c) and placed at right angles to E, or in a horizontal plane.

ECONOMY OF FUEL IN STEAM NAVIGATION.*

THE writer stated that he had often been struck by the indifference to the question of economy in fuel which for so many years prevailed among the constructors and the users of marine steam-engines, and by the fact that, whilst wonderful progress was made in the increase of the speed of the ships, the quantity of fuel burned seemed not to be cared about, and excess in this respect was not looked upon as a reproach to marine engineering. In these days, when ships were tried for speed at the measured mile so carefully to ascertain the last portion of a knot that could be got out of them, the question as to the quantity of coals burned in obtaining this speed was never raised, and the suggestion that there was still a more important trial to be made—a trial as to the consumption of fuel—was never thrown out. The astonishment that was felt on looking back at this long-continued apathy as to the consumption in marine propulsion was increased when it was considered that the mine owner, the waterworks engineer, the locomotive superintendent, and—last, by no means least—the manufacturer of portable agricultural engines, had all along been trying to find out to what extent economy could be obtained, although not one of them had really so much cause to search after saving as had the proprietors of ocean-going steamers or the builders of marine engines. He believed this indifference to have arisen from various causes, amongst which was the fact that steam navigation in the outset was confined to coasting voyages or passages across the Channel, and, under the circumstances, the quantity of coal to be stored in the bunkers was comparatively small, whilst owners were content with a very slow rate of speed. The opening of new outlets for industry, requiring boats that could perform long voyages, led to a demand on the part of steamship owners for more economical steam-engines. There was a general opinion that marine engines were not suitable for the use of high pressure steam; but compound engines having been tried, with the use of high pressure steam, the beneficial results obtained induced owners almost universally to adopt them for vessels going long voyages; indeed, so great were the advantages found to be, that most of the large steamboat companies had the original single-cylinder engines in their existing ships replaced by compound ones. It was still an open question, however, whether the same effect obtained by the compound cylinder could not be obtained by the single cylinder working expansively, either arranged so that the expansion could not be tampered with, or else put into the hands of truly intelligent men who would not throw the expansion out of the gear. Theoretically, there could be no doubt that steam could be as advantageously expanded in one cylinder as in two, and even more advantageously, on account of a certain loss in the passages between the two cylinders of the compound engine, which loss did not arise when the expansion was made all in one cylinder.

The writer then proceeded to trace out the history of the compound engine, describing the various arrangements which have been from time to time brought into use, such as the original arrangement of Woolf, the modified plan of McNaught, and the various forms which have been given to compound engines as applied to marine purposes. The last arrangement described was that now most generally adopted for commercial steamships—namely, the steam-hammer type, with but two cylinders and an intermediate receiver. Mr. Bramwell also showed that, whereas the average consumption of the best marine engines of nine years ago was 4·5lb. of fuel per horse-power, the same results were now obtained with a consumption of 2·03lb. The construction of marine boilers for bearing higher pressure, he said, was a subject of essential importance in efficiently carrying out the advantages of high expansion in compound engines, and in connection with that subject there were important questions, such as care in the manufacture of the plates, their thickness and durability, and other matters; but they could not be entered upon in this paper.

DISCUSSION.

In the discussion which followed, Mr. Jamieson said there was no doubt there had been very great changes in engines since 1854, much greater even than Mr. Bramwell had stated. He was now aware of four-cylinder engines working with one-third of fuel used for engines in 1855. In a voyage to Valparaiso and Panama and back n the mail service in 1855 the consumption of coal was 1,080 to 1,200 tons, and this had been reduced to 550 and 600, and even to 300 and 400 tons. No doubt a great deal had been done in the last ten years, and even in the last five years, and it would be well to look at the effect of the adoption of the two cylinder engines on commerce. It was evident that the compound engine was the engine of the day for marine purposes, and in the future, attention must be directed to the further improvement of the engine and the boiler connected with it, with a view to a greater reduction in the economy of fuel. They must see if they could not get a better boiler, and a forced combustion in smaller tubes. He had reason to believe that in the next decade they would see the figures reduced as much as in the last.

Mr. Crampton urged that the only test of the performance of an engine which they should take into consideration was the amount of water or weight of steam used per indicated horse-power per hour. The quantity of coal used to evaporate that water depended upon the quality of the boiler, and in considering the performance of the engine it should be left out of the question altogether. Mr. Crampton proceeded to describe a series of experiments he had carried out on a small pumping engine doing a uniform duty, and capable of being worked with steam at pressures varying from 35lb. to 70lb. per square inch. The experiments were made with steam at the different pressures, the degree of expansion being varied so that in each case the engine was made to develop the same effective power. Each experiment lasted a week, and the results at which Mr. Crampton arrived were that practically nothing was to be gained by employing steam of more than about 40lb., pressure expanded six-fold. He also subsequently pointed out the importance of employing heavy reciprocating parts in single-cylinder engines working very expansively, and stated that in the case of the pumping engine to which he had alluded, the great length of the pump rods caused the reciprocating weight to be unusually large.

Mr. Thomson, in answer to an inquiry as to why some single cylinder marine engines, which had been built to work with high degrees of expansion had not succeeded, stated that the engines were given up in consequence of its being found impossible to get the valve gear to stand properly.

Mr. Head called attention to the practice of stoking by hand. He said he had never seen a stoker putting on coal in front of a blazing fire without thinking that it was a practice which ought to be put a stop to. He was told that not more than one man in three could endure the work in tropical climates, and that in the Red Sea it was not unfrequent to see the firemen drop down dead at their work. He appealed to the authority of Professor Huxley in saying that a human being who was undergoing severe physical exertions in extreme heat lost 2lb. or 3lb. in weight per hour. The application of steam power was brought very near to the stokehole, and the operation of taking up coal and putting it on the fire seemed only to require a little mechanical skill. It was not more complex than what had been achieved in the construction of the sewing-machine, the steam plough, and many other applications of steam power. In the interests of engineering, and also of common humanity, attention ought to be directed to the subject, and he should be glad to know from the marine engineers present whether there was any prospect of mechanical firing being applied to marine engines.

Mr. William Laird said the firm of which he was a member had been engaged for many years in the construction of engines, and of late years they had found that nothing but the compound engines were called for for commercial purposes. The great economy which had followed their introduction had been of such immense advantage to those who had applied them that the compound engines had really displaced altogether the old system of engine. In some cases an opportunity had been afforded of testing practically the economy obtained in the use of compound engines as compared with the old system, by the substitution of the modern for the old engine in the refitting of ships, and the result in a series of voyages had been that the quantity of coal consumed was about one-half the consumption with engines of the old type. This, he thought, was conclusive proof that the adoption of the compound engines had been of immense benefit to commerce, and the result was that almost all the large steamship owners in Liverpool had, more or less, adopted them for their vessels. In some companies all vessels refitted had been supplied with the compound engines, while they had been adopted in the new vessels. Without entering into details, he merely wished to intimate the general and successful adoption of the compound engines, and he felt satisfied that if they receded from the stage at which they had now arrived, and used a lower pressure for engines or another system, they would make a great mistake.

Mr. Crampton said that in the statement made by Mr. William Laird the point was ignored that the engine taken out might be the worst type of single-cylinder engine.

Mr. William Laird said, in making the statement, he only meant to show how generally the compound engine had been adopted in Liverpool, and he thought it was sufficient to put the matter in a general way. Perhaps his way of stating the matter gave too great an advantage to the engines on the compound system. He merely mentioned the fact to show, in a commercial sense, the great advantage which had been gained through the introduction of the compound engines, and the state of perfection to which they had been brought by engineers throughout the country. He did not intend to claim any special credit for Liverpool.

Mr. Ramsbottom said as to the abstract view of the question there was no room perhaps for two opinions, as far as theory went, because no doubt an advantage was to be derived from the increased pressure of steam, and from its earlier cutting off; but whether it was done by one cylinder or two was, he thought, a matter of very little consequence. It became a question whether they could get materials which would do something more than the materials now known; but he thought they had pretty nearly reached the practical limits of commercial economy. He did not think they were likely to reduce their pressure much below what they had now attained, and he should be glad to see that they were likely to increase materially upon it. If they could find materials, the mode of construction would be speedily hit upon, and they might look for higher pressure and corresponding economy. With regard to experiments, those which were isolated, and of merely a few hours' duration, were of very little value. He attached very little importance to speed mile trips, the truest and safest results being, he thought, found in more lengthened working, such as actual sea voyages.

Mr. Bramwell, in replying on the discussion, said he thought there had been too much of the tone of finality about it. With regard to the observations of Mr. Ramsbottom in depreciation of mile trials, and in favour of long voyage trials, he most entirely agreed with him, if the thing to be tried was not a steamboat. He thought a six hours' trial, carefully conducted, was a better test of what engines could do in the way of economy of fuel than the test to be derived from a long voyage. Assuming that the continuous indicator could be relied upon for giving good results, he trusted that steamship owners would go to the expense of fitting their steamers with implements of that kind, so as to arrive at truthful results. The getting a better evaporation of water for the fuel burnt was at the root of economy. As to mechanical stoking, alluded to by Mr. Head, he most thoroughly agreed with the suggestion, and he could not help thinking that it was a problem which ought to be solved. If they succeeded in doing so they might get a more regular combustion of fuel. At the shows of the Royal Society he had seen as many as from thirty-five to forty firings in an hour; they endeavoured to get by rapidity of hand stoking the uniform and good effects obtained from efficient apparatus. Mr. Bramwell also deprecated anything like finality in scientific discussions, and in illustration quoted some exceedingly amusing extracts from evidence given by some of the leading engineers early in the present century on the occasion of a Parliamentary inquiry, this evidence going to show that the use of steam of higher pressures than 4lb. or 5lb. was unnecessary and absurd, and that cast iron was far preferable to wrought iron as a material for boiler making, although one witness admitted that wrought-iron boilers possessed one advantage, inasmuch as "each rivet formed a safety-valve."

* Abstract of paper read by Mr. F. J. BRAMWELL, before the Institution of Mechanical Engineers at Liverpool.

AUTOMATIC GASLIGHTING.

A NEW patent apparatus for the instantaneous lighting or extinguishing of gas-lamps has just been, it is said, successfully tried at Preston. The apparatus constituting the invention looks like a moderate-sized globular inkstand of glass, surmounted by a tube of the same material, with a metallic top; and by screwing off the burner it can be very easily attached to any lamp, chandelier, pipe, or ordinary gas jet. The base or globular portion is filled with a deep red coloured liquid—a simple chemical mixture, with no combustible properties, almost without smell, and so cheap that threepennyworth of it will serve one lamp for twelve months. Over this liquid, and within the glass tube, there is a plate of zinc, along with a piece of graphite or gas carbon, and between these and a thin coiled platinum wire fixed over the cap of the general vessel into which a gas burner is inserted galvanic communication is obtained. A pipe, to be screwed to that up which the ordinary gas supply flows, runs through the base of the vessel to about the centre of the surmounting tube; pressure brought to bear upon the gas in this pipe causes, by small collateral openings, a simultaneous depression upon the chemical solution which occupies a lower level in two side tubes; the gas occupies the vacuum caused by the displaced liquid, and then ascends to a chamber in connection with the burner; whilst the displaced liquid is pressed into two side tubes effecting contact with the zinc and graphite, generating galvanic activity, which is communicated to the platinum wire, and exciting the catalytic power of the wire, which, when exposed to the ascending jet of gas, results in immediate, almost instantaneous, ignition. Each lamp requires one of these appliances: but, as stated, they are cheap, and the price of the requisite liquid may be termed nominal. The apparatus is virtually self-acting; it requires no skilled hands to superintend its operations; it may be attached by a novice; it may be replenished at any ordinary chemist's shop for a few pence per year; it needs nothing but fixing, and then being subjected to the simple action of gas pressure.

SCIENCE IN SEARCH OF COALS.

SCIENCE, says the *Daily News*, is about to attempt the solution of a problem which is of immediate interest to every householder in London and the South. It is nothing less than a search for coal under the rocks of the South-Eastern counties. A committee of the British Association has been appointed to discover what is the order in which the strata lie under the Wealden which occupies a great part of Kent and Sussex; and a boring is to be commenced in the latter county on occasion of the meeting of the Association at Brighton in the present week. This boring is intended to go through the Wealden and the underlying secondary rocks to the Palæozoic strata which are supposed to lie still farther down at a depth of from 700 feet to 1,700 feet. It is expected by many geologists that at that depth coal-measures will be found which will be practically a continuation of the Belgian coalfields on the east and the Somerset coalfields on the west. There is little doubt that at some time the coal-measures have been there, and the question is whether, as the late Sir Roderick Murchison believed, they have been swept away by the extensive denudations which preceded the deposit of the chalk. Up to the present time no coal has ever been discovered south-east of a line which may be drawn from Bath to Stamford and continued thence to Yarmouth. The whole area thus marked off is occupied by strata far newer than the coal-measures; and though thin beds of shale and lignite have been found, and beds of sandstone strongly resembling those which overlie the coal, all attempts to discover coal have hitherto been useless. Some curious efforts have been made. Nearly two hundred years ago the Rev. Giles Thornbury bored for coal at Guildford. In grubbing up the roots of an old oak, he had found some pieces of lignite, and the discovery at once suggested the search for coal. According to Aubrey, the coal was actually found—"a kind of rocky coal," he says, "like that which they call Kennell coal, which burns like a candle." But when the borers got to the coal the irons broke, and as fast as new irons were put in they snapped off; and as Mr. W. Lilly, the astrologer, thought the irons were broken by subterraneous spirits, the attempt was abandoned. In the first years of this century a shaft was sunk to the depth of 164 feet at Bexhill, in Sussex, and two seams of lignite were met with; but the mine was drowned out, and the scheme was abandoned. About thirty years ago an attempt was made to get up a colliery company to sink a shaft 150ft. deep at Worplesdon, near Woking, through the Bagshot Sands; but it of course failed. Mr. Joseph Prestwich, in an article in the current number of the *Popular Science Review*, states that among experienced coal miners an impression exists that coal is to be found in the Lower Tertiary strata, between the London clay and the chalk; but that all these expectations, founded as they are on the presence of irregular seams of lignite, are necessarily futile. Coal is never to be found in these newer rocks. It is a relic of an earlier condition of the planet's surface; the buried ruins of an older world.

The failure of previous efforts to find coal in the south-east of England is, however, no reason for believing that coal does not exist. It has never yet been looked for in the right place. The coal-measures are the upper part of the Palæozoic series of rocks, and those rocks underlie the Tertiary and Secondary series, when those series are present as they are in this part of England. Speaking roughly there are some fourteen of these strata which come in regular succession, and which are altogether between 7,000 and 8,000 feet in thickness. On the assumption, therefore, that the coal-measures which lie to the east of us in Belgium, and to the west of us in Somerset and South Wales, are continued under us, it was estimated that they would lie at some 8,000 feet below the surface. But it has now been discovered that a good many of these intervening strata are absent. In a well sunk at Kentish-town a few years since, which it was hoped would pierce the water-bearing formation of the Lower Greensand, it was discovered that there was no greensand to penetrate; indeed, all the lower secondary strata were absent, and at 1,113 feet deep, what was supposed to be the Old Red Sandstone, which underlies the coal-measures, was found. At Harwich, a year or two later, a like discovery was made, though the rock found at a depth of 1,025 feet was mountain limestone. This is very nearly the depth at which the same Palæozoic rocks are found on the other side of the Channel, and it at once suggests the very strong probability that in some parts of the southern counties the coal-measures themselves may be found at a similar depth. The Somerset coal seams are lost at a point between Bath and Frome, at a depth of 500 feet. Between that point and London no trial pits or wells have been sunk to anything like a thousand feet, yet it is after going to at least that depth that the chances of finding coal begin. There is a well near Reigate 900 feet deep, another at Chichester 945 feet, and one at Southampton which is still in the chalk, at a depth of 1,317 feet. It is intended that the boring now to be set on foot shall be continued to the depth of about 2,000 feet. It may or may not pierce a seam of coal; but it will at least show in what order the older strata lie, and will give geologists facts which will enable them to point out where coal may be found, or to decide that it cannot be found at all.

Happily the chances are that coal will be found. The general drift of scientific opinion during the last few years has been towards the belief that there are workable coal seams under a great part of Kent and Sussex. Mr. Prestwich, indeed, places them under Essex and Hertfordshire; Mr. Godwin Austen, who, as long ago as 1855, brought the subject before the Geological Society, places them in the line of the Thames valley, parallel with the North Downs, and believes that they continued thence under Reading and the Kennet valley to join the Bristol coalfield. Wherever they are, the coal is likely to be plentiful and good—more like the Somersetshire coal than that of either the Midland or the Northern counties. In report D attached to the Report of the Royal Commission on Coal Supply, Mr. Prestwich, who ably supports Mr. Godwin Austen's argument, estimates the area of the supposed coalfield at 150 miles in length, by a breadth varying from two miles to eight. Such a coalfield would be no insignificant addition to our national resources. Even though it should lie at a depth at which coal is at present only occasionally worked, it would be cheaper and more available to us in London than the nearest coal now worked. It would be premature to speculate on the social and industrial results of the discovery of a vast coalfield at our doors. To make coal as cheap on the Thames as it is upon the Tyne, as plentiful south of London as it is north of the Trent, would probably be to cause the rise of a belt of manufacturing cities round London. But the first thing, of course, is to ascertain whether the coal is there. There is almost every scientific probability in favour of its existence; and should the geologists of the British Association succeed in finding it, or even in pointing out where it will be found, they will do the greatest service that science has yet rendered even to a generation which it has so greatly instructed and enriched.

PYRO-PLATING.*

THE end of pyro-plating, like that of all other methods of plating, is to affix to a baser metal a sheet of one of the superior metals; but this method is applicable where none of the other methods can be applied with success. "Close plating," whether with hard or soft solder, cannot be applied with success to any cutting instrument, as a knife or a pair of scissors, &c. Hard soldering would completely destroy a knife-blade or a pair of scissors. The soft solder plating can be applied to a knife or a pair of scissors without destroying the steel, though with difficulty; with the scissors the first attempt to cut would shear off the plating, and with the knife, if it were sharpened so that it would cut, the plating would chip off in using it. Common electro-plating is not applicable to steel or iron, as by that method these metals cannot be got perfectly clean, that is—chemically clean, therefore, by that method no adhering coating can be obtained.

In fact, for all manner of plating or soldering, the first requisite is, that the two metals that are to be applied to each other must be chemically clean, or no proper adhesion can be obtained.

This cleanness is obtained in various ways: In soldering by various fluxes; in electro-plating to such metals as that method is applicable, by dipping the article in an acid which will readily dissolve the metal of which it is made—and not only so, but the salt formed by this solution of the metal in the acid used must be readily soluble in water, or no clean surface can be obtained. There is still another condition to be considered, that is when the surface of the metal has been made thoroughly clean, it must be protected from contact with the air in its transit from the cleansing-baths to the solution wherein it is to be coated. This condition not being recognised in the first attempts at electro-plating caused many failures and much trouble, till it was discovered that a film of mercury prevented the contact of the air with the cleaned metal. Moreover, mercury has this advantage, that it amalgamates with the metal to be coated, and with the coating, though this amalgamation is not absolutely necessary, yet it facilitates the coating of metals with other metals by electro-deposition, when the two metals will readily amalgamate.

There are cases where amalgamation is not possible; for example, where one of the metals will not amalgamate, as with steel and iron coated with copper, gold, or silver; or when neither will amalgamate, as with steel or iron coated with aluminium or nickel; not that it is impossible to form an amalgam with these metals, for even steel can be amalgamated by the intervention of sodium, but it is not possible for plating purposes, as a diluted solution of a mercuric salt must be used.

Now, for all such cases as these where the amalgamation process cannot be used, pyro-plating is especially applicable. The name pyro-plating is given to this process to distinguish it from the electro-plating process, and because the coating is driven into the surface of the metal on which it is put by means of heat and pneumatic pressure. It is not confined to coating with silver as its name might indicate, but it is at present applied to coating with gold, platinum, silver, nickel, aluminium, copper, brass, or bronze and aluminium bronze.

The rationale of the process is very simple; but the various details require much care and attention. The end to be obtained is simply this. That the metal to be coated shall be "chemically clean" when immersed in the solution in which it is to be coated. There are several ways in which the attainment of this end may be prevented: By inadequate means for cleansing, by the passage through the air of two or three feet after being cleansed, by the metal being positive in the coating solution—in this case the metal is fouled on contact. This refers to cyanide solutions, to sulphate and chloride solutions, to double sulphates and chlorides, as of nickel and ammonia, and of platinum and potash or soda. All of these may be used in certain cases for pyro-plating, but they are *not* used. There is a special solution used for pyro-plating in all cases, because most of these solutions leave matters in the metal that is being coated, if it be in the slightest degree porous or "roaky," as is the case with steel that has been badly faggoted, and on the article passing through the furnace these matters volatilise, and cause an irruption in the coating. The method used for cleansing steel and iron articles is as follows: They are first boiled in caustic alkali to free them from grease; they are then mechanically cleansed with fine flour emery and brushes in water; they are then brushed with steel wire brushes under a stream of a solution of carbonate of soda; then they are wired and hung in the same solution ready for being made chemically clean. This is done by means of nascent hydrogen in a hot alkaline solution. The water of solution is decomposed on the article by means of a strong current of electricity, the article being made negative. If the solution be kept strong and not carbonised, a film of this solution is sufficient to protect the article from contact with the air in its quick transit from the last purifying process to the solution wherein it is to be coated. The time for it to be transferred can easily be seen by the experienced eye; the article assuming gradually a more silvery appearance. After the proper amount of metal is put on in the coating bath the articles are taken out and washed and dried. The amount of metal put on is ascertained by having a test-surface put in with the articles, and the exact time of putting in and the exact weight of the test noted, and this test is carefully weighed from hour to hour till the amount desired is put on. After being dried, the articles are put into the furnace to have the silver or other metal driven into the surface of the coated metal. The firing furnace, as it is technically called, is of simple construction. The conditions to be observed in its construction are two, namely, to obtain a bright red heat in the chamber where the articles are put, and to secure the articles from coming in contact with the fuel or products of combustion. In firing knife-blades and other cutting instruments care has to be taken that they are not carried higher than between 450° and 500° F. This is ascertained by trials on a pad of prepared test paper; a blade is taken out from time to time and tried upon the pad and the colour is noted—whether it scorches it straw-colour, yellow, pale brown, deep brown, or black. Alum-water is used for regulating this paper as to the colour for the proper degree of heat. After the proper heat is attained the blade is instantly quenched point downwards in cold water, and all that were in the firing chamber with it. For articles that do not require tempering, or that are made of metal that will not temper, as iron, copper, good brass, or German silver, the heat may be higher. Even if a steel article should be carried so high as to soften it, it can be re-hardened and tempered with the silver or other metal upon it, without in any way injuring the coating. The theory of this part of the process, which is technically called "burning in," is this: The coating metal in all cases is one of the superior metals as compared with the coated metal, and is less porous whether cold or hot.

The article being heated, it naturally expands and becomes more porous, as of course both article and coating do, but their relative porosity remains the same, consequently on expansion there will be an infinite number of small cists into which by atmospheric pressure the coating will be driven on attaining the proper heat. Then on the instantaneous quenching in cold water, the coating is seized and retained by the suddenly contracting under metal. This is seen to be the case on filing or grinding the coating off the under metal; for though the coating may be filed or ground off till both coating and under metal are filed or ground off together, yet the under-metal remains spotted all over with an infinity of little points of the coating metal.

* By J. Baynes Thompson in *Chemical News*.

SOMETHING WRONG WITH THE SUN.*

WHEN we consider the intense heat which has prevailed in Europe during July, and the circumstance that n America also the heat has been excessive, insomuch that in New York the number of deaths during the week ending July 6 was three times greater than the average, we are naturally led to the conclusion that the sun himself is giving out more heat than usual. Though not indorsing such an opinion, which, indeed, is not warranted by the facts, since terrestrial causes are quite sufficient to explain the recent unusual heats, we cannot refrain from noting, as at least a curious coincidence, that at the very time when the heat has been so great, the great central luminary of the solar system has been the scene of a very remarkable disturbance—an event, in fact, altogether unlike any which astronomers have hitherto observed.

Now certain Italian spectroscopists—Respighi, Secchi, Tacchini, and others—have set themselves the task of keeping a continual watch upon the chromatosphere. They draw pictures of it, and of the mighty coloured prominences which are from time to time upreared out of, or through, the chromatospheric envelope. They note the vapours which are present, as well as what can be learned of the heat at which these vapours exist, their pressure, their rate of motion, and other like circumstances. It was while engaged in some of the more difficult and delicate of these tasks that Tacchini noticed the strange occurrence now to be described.

"I have observed a phenomenon," he says, "which is altogether new in the whole series of my observations. Since May 6, I had found certain regions in the sun remarkable for the presence of magnesium." Some of these extended half-way round the sun. This state of things continued, the extension of these magnesium regions gradually growing greater, until at length, "on June 18," says Tacchini, "I was able to recognise the presence of magnesium quite round the sun—that is to say, the chromatosphere was completely invaded by the vapour of this metal. This ebullition was accompanied by an absence of the coloured prominences, while, on the contrary, the flames of the chromatosphere were very marked and brilliant. It seemed to me as though I could see the surface of our great source of light renewing itself." While this was going on Tacchini noticed (as had frequently happened before in his experience) that the bright streaks on the sun which are called faculæ were particularly brilliant close to those parts of the edge of the disc where the flames of the chromatosphere were most splendid and characteristic. The granulations also, which the astronomer can recognise all over the sun, when a large telescope is employed, were unusually distinct.

Tacchini concludes (and the inference seems just) that there had not been a number of local eruptions of magnesium vapour, but complete expulsions. Only we would venture to substitute for the word "expulsion" the expression "outflow" or "uprising," since it may well be that these vapours rise by a quiet process resembling evaporation, and not by any action so violent that it could properly be regarded as expulsive.

In whatever way, however, the glowing vapour of magnesium thus streamed into the envelope of the sun, it would seem that the aspect of our luminary was modified by the process—not indeed in a very striking manner, or our observers in England would have noticed the change, yet appreciably. "More than one person," says Tacchini, "has told me that the light of the sun has not at present its ordinary aspect; and at the Observatory we have judged that we might make the same remark. The change must be attributed to magnesium."

It is impossible to consider attentively the remarkable occurrence recorded by Tacchini without being struck by the evidence which it affords of solar mutability. We know that during thousands of years our sun has poured forth his light and heat upon the worlds which circle around him, and that there has been no marked intermittence of the supply. We hear, indeed, of occasions when the sun has been darkened for a while; and we have abundant reasons for believing that he has at times been so spot-covered that there has been a notable diminution of the supply of light and heat for several days together. Yet we have had no reasons for anticipating that our sun might permanently lose so much of his heat and lustre that the inhabitants of earth would suffer. Tacchini's observation reminds us, however, that processes are at work upon the sun which admit of being checked or increased, interrupted altogether or exaggerated so violently (as it were), that the whole aspect of the sun, his condition as the fire and lamp of the planetary system, may be seriously affected.

If we only remember that our sun is one of the stars, not in any way distinguished, unless perhaps by relative insignificance, from the great bulk of the stars which illuminate our skies at night, or are revealed by the telescope, we shall learn to recognise the possibility that he may undergo marked changes. There are stars which, after shining with apparent steadiness for thousands of years (possibly for millions of years before astronomy was thought of), have become suddenly much reduced in brightness, or after a few flickerings (as it were) have gone out altogether. There are others which have shone with equal steadiness, and have then suddenly blazed out for a while with a lustre exceeding a hundredfold that which they formerly possessed. It would be equally unpleasant for ourselves whether the sun suddenly lost the best part of his light, and presently went out altogether, or whether he suddenly grew fifty-fold brighter and hotter than he now is. Yet in the present position of sidereal astronomy, it is quite impossible to assert confidently that one event or the other might not take place at any time.

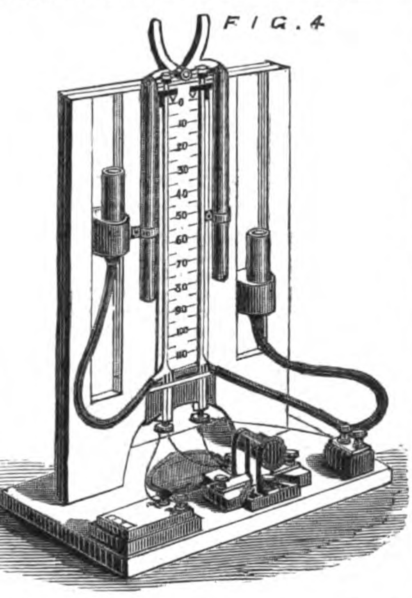
Fortunately, we may view this matter (just as astronomers have learned to view the prospect of mischievous collisions with comets), as a question of probabilities. Among so many thousands of stars there have been so many sudden outbursts of light and fire, so many sudden defalcations of splendour. Our sun is one of those thousands, and so far as we know, takes his chance with the rest.

* From the *Spectator*.

ON MEASURING TEMPERATURES BY ELECTRICITY.*

(*Concluded from page 534.*)

ALTHOUGH I have explained that by means of a differential galvanometer and a variable resistance (constituting in effect a Wheatstone bridge arrangement) the increasing resistance of the platinum spiral may be measured, it was found that the use of a delicate galvanometer is attended with considerable practical difficulty in iron works and other rough places where it is important to measure elevated temperatures, or on board ship for measuring deep sea temperatures. I was, therefore, induced



to seek the same result by the conception of an instrument which is independent in its action from tremulous motion, or from magnetic disturbance caused by moving masses of iron, and which requires no careful adjustment or special skill on the part of the operator. This instrument is represented by Fig. 4, and may be termed a chemical resistance measurer or "differential voltameter." The immortal Faraday has proved that the decomposition of water in a voltameter, expressed by the volumes of gases V, is proportionate in the unit of time to the intensity I of the decomposing current, or that

$$I = \frac{V}{T}$$

According to Ohm's general law, the intensity I is governed by the electro-motive force E, and inversely by the resistance R, or it is

$$I = \frac{E}{R}. \text{ It is, therefore, } \frac{V}{T} = \frac{E}{R} \text{ or } V = \frac{ET}{R};$$

or the volume V would give a correct measure of the electrical resistance R if only the electro-motive force E and time T were known and constant quantities. But the electro-motive force of a battery is very variable; it is influenced by polarisation of the electrodes, by temperature, and the strength and purity of the acid employed. The volume of gases obtained is influenced, moreover, by the atmospheric pressure, and it is extremely difficult to make time observations correctly. It occurred to me, however, that these uncertain elements might be entirely eliminated in combining two similar voltameters in such a manner that the current of the same battery was divided between the two, the one branch comprising the unknown resistance to be measured and the other a known and constant resistance. The volume of gas V^1 produced in this second voltameter, having a resistance R^1 in circuit, would be expressed by

$$V^1 = \frac{ET}{R^1}$$

and we should have the proportion of

$$V : V^1 = \frac{ET}{R} : \frac{ET}{R^1};$$

or E and T, being the same in both cases, may be struck out, and the expression will assume the simple form

$$V : V^1 = R^1 \div R.$$

The constant resistance R of the one circuit being known, it follows that the unknown resistance R^1 is expressed by $\frac{R^v}{V^1}$; that is to say, by a constant multiplied by the proportion of gas produced in the two voltameters irrespective of time, or strength of battery, or temperature, or the state of the barometer.

The resistance R and R^1 are composed each of two resistances—namely, that of the principal coils, which we may term R or R^1, and of the voltameter and leading wires, which is the same in both cases, and may be expressed by y. The expression should therefore be written as follows:

$$V : V^1 = R^1 + y^1 : R + y,$$

R^1 being the unknown quantity.

The mechanical arrangement of the instrument will be understood from the diagram, Fig. 4; and the whole arrangement of the pyrometer, with its leading wire and resistauce measurer, from the general view given in Fig. 5. The voltametric resistance measurer consists of two calibrated vertical tubes of glass of about three millimetres diameter, which are fixed upon a scale showing arbitrary but equal divisions. The upper ends of the tubes are closed by small cushions of indiarubber pressed down upon the openings by means of weighted levers, whereas the lower portions of the tubes are widened out and closed by plugs of wood, through which the electrodes in the form of pointed platinum wires penetrated to the depth of about twenty-five millimetres into the widened portions of the tubes. By a side branch the widened portion of each vertical tube communicates by means of an indiarubber connecting pipe to a little glass reservoir containing acidulated water, and supported in a vertical slide. In raising the weighted cushions closing the upper ends of the vertical tubes, and in adjusting the position of the small reservoirs, the acidulated water will rise in both tubes to the zero line of the scale. In turning a button in front of the tubes the battery current is passed through both pairs of electrodes, the one circuit comprising the permanent resistance R and the leading wires up to the pyrometer, and the other the leading wires and the pyrometer coil. If the resistance of the pyrometer coil should be equal to the permanent resistance R, the $R^1 + y$ will be equal to $R + y$, and therefore, $V = V^1$, but as the resistances differ, so will the volumes. Necessary conditions are: that both reservoirs are filled with the same standard solution of pure water with about ten per cent. of sulphuric acid, that all the electrodes are of the same form and size, and that their polarity is reversed frequently during the progress of each observation, in order to avoid unequal polarisation. With these precautions, which involve no particular skill or knowledge of electrical observation on the part of the operator, very accurate results are obtained; but in order not to incur considerable error of observation it is advisable to continue the current, reversing the same, say twice, until at least forty divisions of gases are produced in the least activated tube, which operation will occupy from two to three minutes, if a battery of from four to six Daniell elements is employed. The volumes V and V^1 being noted, after having allowed half a minute for the gases to collect after the current has ceased, the weighted cushions upon the tubes are raised in order to allow the gases to escape, when the water levels will immediately return to their zero position, to make ready for another observation. By inserting the observed values for V and V^1 into the expression above given, the unknown resistance R^1 can be easily calculated; but in order to facilitate the use of the instrument I have prepared a table which gives at a glance the resistance due to any two observed volumes, the volumes V governing the vertical, V^1 the horizontal columns, and the resistance being read off at the point of intersection. At each point of intersection the resistance is marked in black, and the corresponding temperature in red ink.

It now remains only to be shown what is the relation between the resistance and temperature in heating a platinum wire. The researches of Dr. Matthiessen, who has made the latest investigations on the effect of temperature upon electrical resistance, are restricted to the narrow range of temperatures between 0° and 100° Cent., nor do they comprise platinum. He adopted the following general expression for the pure metals:

$$R = \frac{R_0}{1 + xt + yt^2},$$

* Read at the Royal Institution, by Mr. C. W. SIEMENS, F.R.S

which, in determining the specific values of x and y for each metal, gives a close agreement with observation between the narrow limits indicated, but is wholly inapplicable for temperatures exceeding 200° Cent., when the value t^2 commences to predominate and to produce absurd values for R_t.

It was necessary for my purpose to undertake a series of elaborate experiments with a view of finding a ratio of general application. Coils of thin wire, of platinum, iron, copper, and some other metals, were gradually heated and cooled in metallic chambers containing the bulbs of mercury thermometers, and for higher temperatures of air thermometers, and the electrical resistances were carefully noted. The progressive increase of electrical resistance was thus compared directly with the increasing volume of a permanent gas (carefully dried) between the limits of zero and 470° Cent. and a ratio established, which is represented by the formula.

$$R_t = \alpha T^{\frac{1}{2}} + \beta T + \gamma,$$

in which T signifies total temperature counting from the absolute zero, and α β and γ specific co-efficients for each metal. According to this formula the electrical resistance is a constant at the absolute zero, and progresses in a ratio represented graphically by a tipped-up parabola, approaching more and more toward a uniform ratio at elevated temperatures. Although the comparison with the air thermometer could only be carried up to 470° Cent., the general correctness of the ratio of increase just stated has been verified by indirect means in measuring progressive heats, and by comparison with the platinum ball pyrometer.

It is important to mention here that great care must be exercised in the selection of the platinum wire for the measuring spiral, platinum wire having been met with conducting only 4·7 times better than mercury at zero, Cent., and others; conducting 8·2 times better than mercury, although both samples had been supplied by the same eminent makers, Messrs. Johnson and Mathey. The abnormal electrical resistance of some platinum wire is due chiefly to the admixture of iridium or other metals of the same group, and it appears that the platinum prepared by the old welding process is purer, and therefore better suited for electrical purposes than the metal consolidated by fusion in a Deville furnace.

In conclusion, I shall show some working results of the pyrometer in measuring by means of the same protected coil a mixture of ice and water, boiling water, molten lead, and the fire itself by which the lead is melted, the readings produced being 2° Cent., 98° Cent., 330° Cent., and 860° Cent. respectively. The latter temperature signified a cherry red heat, as may be judged by the appearance of the tube when withdrawn from the fire. The instrument which I have had the honour to bring before you this evening has already received several useful applications. Through its first application an important telegraph cable was saved from destruction through spontaneous generation of heat. Prof. Bolzani, of Kasan, has made some interesting applications of it for recording the temperature at elevated points and at points below the earth's surface. Mr. Lowthian Bell has used it in his well-known researches on blast furnace economy; and at several ironworks pyrometer tubes are introduced into the heating stoves, and permanently connected with the office, where the heat of each stove can at all times be read off and recorded. These and other applications are sufficiently self-evident, if the soundness of the principles upon which I rely is conceded; but I feel that the shortness of time at my command has hardly enabled me to do more than to pass these in review, while endeavouring to demonstrate the results obtained of recording the temperatures of distant or inaccessible places, including furnace temperatures.

SPONGES.

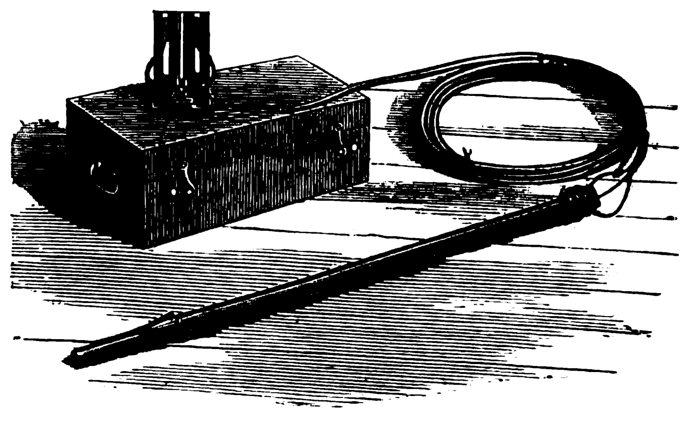
VERY few among the thousands who are now seeking recreation at the seaside are aware of the immense variety of life the sea contains, or the wonderful and interesting character of the marine plants and animals that are within reach of the hand upon every part of the coast. Thus, says the *Gardener's Magazine*, on all our coasts sponges abound, yet the fact is scarcely known except to the naturalist. They are to be found growing on seaweeds, on the backs of crabs and lobsters, on and within the empty shells of whelks and cockles, and upon rocks and sand everywhere. The seaweed collector will meet with sponges at every turn, whether in gathering from the deep sea or from the tidal pools. Seaweeds and sponges are, however, far separate in organisation and their respective sequence of development, though constantly in proximity as products of the waters. The first are true vegetables, the second true animals. We know somewhat, though perhaps but little, of the first, but of the second we know next to nothing; and yet the sponges carry us farther into the realms of romance than the seaweeds do, for they were doubtless among the earliest and most industrious builders of the world, and have left their frail skeletons as memorials of their existence in the "white cliffs of Albion," every separate flint being, to use a homely phrase, a "petrified" sponge.

Take a thin slice of flint, properly prepared for the microscope, and let the instrument unravel its history. If used to the detection of fossil infusoria, you will hardly fail to find them in it, and you gain one step towards an answer as to its history.

Organised forms have had something to do with its formation; at some time, very far back in the past, there has been animal life there, and that life was marine. But you cannot account for the formation of separate and independent nodules of silica, scattered over a bed of chalk, by the help of these infusoria. Try a splinter of flint broken off in the rough; but be very careful not to spoil your object-glass by bringing the two surfaces into close contact. Now what do you see? Remains of shells, and here and there distinct traces of a sort of reticulated structure, sparry incrustations of a contour which you cannot but believe is derived from some organic form, long since annihilated. These appearances are repeated in various specimens, and have a general relationship one to the other, especially in the interlacing lines and spiculæ of which they consist.

Life may be said to begin or end in the sponges; they are the very lowest in the scale of animated

FIG. 5



nature; but it is quite certain they are not members of the vegetable kingdom. Take a piece of sponge, such as is commonly used on the toilet table, and dip it into a thin solution of size, and you have a fair resemblance of its condition when living. The sponge proper is the skeleton, the gelatinous coating is organised and animal; and the best proof of the fact is afforded by the microscope, which reveals ciliary motion, and there is an end of the difficulty as to what place it should occupy. The openings in the sponge are chambers, interlaced with silicated fibres, and, by the play of the cilia on the gelatinous surface, the water is made to circulate from chamber to chamber, so that the sponges obtain their food by the same process as a vorticella or rotifer—namely, by creating currents through the agency of cilia. The exterior film is the life of the sponge, the skeleton is a deposit.

But the film must be understood as pervading the inner as well as the exterior chambers, so that the currents of water pass through the entire mass, and carry nourishment to all the mouths for which the cilia work so incessantly. A very dead sort of creature is a living sponge. It has none of the organs of sense which distinguish terrestrial animals; and not even the irritability which makes a sea-anemone of so peevish or spasmodic a temper. But it has its history, however brief, like others of the great class of zoophytes. The sponges increase by gemmation. Little buds appear within the openings of the reticulated mass, and these at last detach themselves, and exhibit the same play of cilia as their parents.

But instead of at once becoming fixed, the action of the cilia causes the sponge to spin about in the water, so as to have a real locomotive power of finding for itself a site, where it casts anchor, and for the rest of its days never knows either the pleasures or the pains of travel. If every separate flint was once a separate sponge, this locomotion accounts for their detachment and their subsequent concretion in distinct nodules.

LIGHTNING AND LIGHTNING CONDUCTORS.

IN a letter on this subject to the *Times*, Mr. W. H. Preece, of Southampton, gives the following information:—

I wish to express merely the results of my own study and experience. If, however, twenty years' training in that profession which, according to one of your correspondents, "lives by lightning," if the personal inspection of innumerable lightning accidents, of the erection of lightning conductors (not in tens or hundreds but in thousands), entitle one to express an opinion, then I trust your readers will believe that what I say is not mere sciolism, but the lessons of that best of all teachers—experience. I said, "Every one can, if he choose, at the expense of a few shillings, render his house absolutely safe with a perfect system of lightning conductors." I will now show how this can be done.

But, first, what is lightning? It is, like thunder, one of the effects of electric discharge. It is not the destructive discharge itself. The amount of misconception and error in the public mind on the subject of electric storms is astonishing. We read of the "electric fluid" being attracted by this thing and by that—at one time by the lamp irons on the ends of a railway carriage, at another time by the looking-glasses, which are carefully removed; we hear of "ascending" lightning, its course is traced —it entered here and went out there, and "so off to the clouds overhead;" "it struck her face, passed to her chest, and crossed over the region of her heart;" it objects "to turn round sharp corners;" and so on. All such statements are scientific absurdities.

Modern physicists know no such thing as the "electric fluid." Electricity is no more matter than is heat, or light, or sound. The laws of its transmission are simple and thoroughly well known. Thunderstorms are but gigantic repetitions of drawing-room experiments; they are simple electrical phenomena, differing only in degree from the ordinary spark exhibited by a lump of sugar. There must be two masses in opposite electrical states, separated by a non-conductor. Two "thunder" clouds, or the earth and a thunder cloud separated by the air, gives these conditions. When the intensity of the charges becomes too great for the intervening non-conductor to prevent their neutralisation by combination, or when its thickness, and therefore its resistance, is sufficiently reduced by the charged bodies approaching each other, we have discharge and its effects—light, heat, mechanical energy, and sound, or thunder and lightning and its destructive effects. The so-called "electric fluid" can no more be said to ascend from the earth to the cloud than to descend from the cloud to the earth. The discharge invariably occurs along the line of least resistance, and it is continuous and instantaneous along the whole line. The line of least resistance may be made up of metals, bricks and mortar, trees, or animal flesh. Whatever offers the least resistance will be the chosen path. The chief function of a lightning conductor is to furnish this path. But it has a much higher and important function. It dissipates the conditions which determine discharge. In fact, it prevents lightning. This it does in virtue of the principle of points. A pointed body directed towards an electrified conductor reduces its charge, so that when a thunder-cloud passes over a lightning conductor its charge is silently, quietly, and continuously neutralised. If a galvanometer were inserted in this conductor at such a time it would give indications of the presence of an electric current. Telegraph wires are invariably occupied with currents on such occasions. The presence of a storm at Newfoundland was observed at the extremity of the Atlantic cable in Ireland.

Hence the conditions that determine a perfect conductor are that it shall expose in some prominent position of a building a metallic point, and that it shall offer from this point to the ground a path of little or no resistance. I say that the ordinary galvanised iron wire known as No. 4, which is ¼in. in diameter, tipped with a gilded brass point or cone, is amply sufficient for any dwelling-house. It costs about 1d. per yard, and the brass cones would cost about 6d. each. Thirty shillings would pay for all the materials required for an ordinary house.

My reasons for recommending this wire are these: —When telegraph poles were first erected in this country they were protected with lightning conductors. This practice was subsequently found to be too expensive, and was abandoned. Such "earth wires," or conductors, were, however, found to effect another and very important object, and their use was continued on all main lines. I have never known a case of a pole so protected being damaged during a thunderstorm, whereas scarcely a thunderstorm occurs without some unprotected poles being injured. I remember, near Romsey, twenty unprotected poles being shattered by one discharge, and upon the Basingstoke and Andover line 15 per cent. were found to have been struck. The line was renewed and earth wired, and not one single case of damage has occurred since, though some years have elapsed. A pole was very recently found in South Wales with 8in. of its top shattered — the earth wire only went so far; the charge from that point went harmlessly to earth through the wire. The cross arms are frequently found damaged as far as the earth wire, never beyond. I could multiply instances *ad infinitum*, and as the wire used is generally No. 8 (·170in. in diameter), and sometimes even smaller, I think I am fully justified in saying that No. 4 wire, which is twice as thick and offers half the resistance, is amply sufficient for the protection of our houses. The precautions to be used in fixing conductors are those:—

1. The conductor must be solid and continuous from its gilded point to the ground.

2. Its connection with the ground must be sound and good. It may be connected with the iron, gas, or water mains, or be buried several feet deep in a bed of coke, or be attached to a mass of metal in moist earth, or be carried down a well.

3. Each conductor, if there be more than one, should make a separate earth if possible, and they should all be connected together below the surface. The lead roofing and all external masses of metal should be connected with them.

4. All joints and connections should be soldered.

It is better that each chimney stack should have its own conductor, and they should be periodically examined to see that their points remain intact, and that their metallic continuity is perfect. The custom is to fix them and then to leave them to chance.

The precautions that are not necessary are these: —1. It need not be copper. 2. It need not be insulated. 3. It need not be carried externally to their disfigurement in the cases of church spires, columns, and chimneys. I never pass Trafalgar-square without regretting the disfigurement of Nelson's statue. It is, however, better to carry the wire externally in the case of dwelling-houses, lest it pass too near the lead gas-pipes, which, being good conductors and soft metal, might be fused. The wire can go round a corner as well as through it, but acute angles are best avoided. The more direct the course to the earth the better.

The area protected by a conductor is said to be that whose radius is equal to twice the height of the conductor from the ground; but it is safer to take the radius as equal to the height of the conductor. Thus, for small houses one conductor is enough, but it is safer to attach one to each stack. If it project a yard above the stack it is sufficient, and it is within reach for inspection. The stack pipes down the sides of a house are convenient conduits for the wire, and there is no reason why it should not be carried down to the ground inside them, so as to be out of sight. If there be no convenient stack pipe, the wire can be run up and stapled to the brickwork or stone. With 30s. for materials and 10s. for labour any intelligent man can, with these directions and precautions, safely protect his house from the destructive effects of thunderstorms.

The effect of thunderstorms upon our telegraphs is not very serious, though the extension of such a network of wires, 130,000 miles in length, over the whole country would lead one to expect considerable damage. All the telegraphic apparatus in the Postal Telegraph Department—and there are 8,500 in use—are supplied with lightning protectors. The wires themselves are excellent protectors. Accidents are due either to imperfect apparatus, careless construction, or neglect of instructions. The percentage of instruments damaged is very small. It was before the transfer of the telegraphs to the State 3 per cent.; it is now decidedly less. The Postal Telegraph Department possesses about 3,500 stations of its own; scarcely half-a-dozen have been injured throughout the whole of this severe season. At two or three stations the wires were carelessly carried parallel to the lead gas-pipe. As sparks passed from the wire to the pipe the pipe was fused and the gas lit. At Berwick, some years ago, not only this happened, but over the gas-pipe was a lead water pipe, which was fused by the gas, and the water which escaped extinguished the flame.

During thunderstorms the wires are active. Every discharge disturbs them by induction. Frequent and powerful currents pervade them. Brilliant flashes are observed about the apparatus, but no injuries occur to the manipulators, though shocks are sometimes felt. I have known one or two clerks knocked down, but principally by fright. If there were any truth in the popular notion that metal attracts lightning telegraphists would lead but a sorry life during thunderstorms. During a recent very severe thunderstorm I was watching its effects in a large office. Not one clerk left his post or shirked his duty, and all appeared perfectly indifferent to the roar and fury of the elements outside.

In suggesting "putting grates to earth," I advise a telegraphist's cure. An external system is better and cheaper, though this plan would add an additional and material security to the house. The grate must be taken out, and a pin tapped into the back of it, to which must be welded the galvanised iron wire. Separate wire should be carried from each grate straight down the side of the flues, and united together at the ground line, and thence taken "to earth." The wire should not be allowed to go near any lead gas-pipes.

Mr. Hyett's plan is an admirable one, and his pipe is an excellent conductor. The right angles are harmless if the pipe is carefully rounded at those places. Points and sharp edges are alone to be avoided.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

WEBB'S CELESTIAL OBJECTS AND PROCTOR'S STAR ATLAS.

[4699.]—M. C. GAUDIBERT is doing very useful work in noting the places, &c., of certain double stars, which he has observed on divers occasions. But I would venture to suggest that he might find a better way of classifying them than (let. 4688, p. 542) as "objects not in Webb's 'Celestial Objects' nor in Proctor's smaller atlas." His present method suggests to many that in each several instance he is indicating a flaw or blemish in the two works above-named. Of course he does not intend this; since he must be perfectly well aware that for every object which *could* be inserted in such a book as Webb's or such an atlas as my smaller one, there are dozens discoverable by very moderate telescopic power. Webb indicates this at p. 170 of his work, and no one can use a telescope for an hour on a good night without finding it out for himself.

I may take this opportunity of correcting a misapprehension, which I find very prevalent, as to my smaller atlas. When I say in the preface (2nd edition, p. viii) that the atlas is "specially intended to serve as a companion to Webb's charming work," I do not intend to indicate *that* as the primary purpose I had in view in planning the atlas. The scheme of the atlas was fully matured, and the larger atlas was completed, before I had had the advantage of reading the "Celestial Objects." My main object was to construct an atlas on a plan combining several qualities of great importance which had hitherto been (unaccountably) neglected; and the plan actually adopted was the result of the geometrical determination of the *one single method* by which those qualities *could* be combined. Having devised a plan fulfilling that *general* purpose, I thought I could not do better than make the larger atlas serve the *special* purpose of being a companion to Admiral Smyth's "Celestial Cycle," while I made the smaller serve the *special* purpose of being a companion to Mr. Webb's "Celestial Objects." These respective special purposes are quite distinct from the general purposes which the atlases were primarily intended to fulfil.

It will, perhaps, be understood that having given much time and thought to the invention of an atlas quite distinct from anything previously published (and, as I venture to think, the only atlas ever constructed on a really sound plan), I have to some degree objected to find my smaller atlas commonly spoken of as though it were a mere offshoot from another work, however highly that work is justly estimated. All the same I congratulate myself very much on the "happy thought" which led to the addition of an important special character to my smaller atlas. For it is as easy to conceive of an observatory without a telescope as without Webb's charming work.

RICHARD A. PROCTOR.

THE MOON IN PICTURES, ON HORIZON, &c.—To "M. A."

[4700.]—"M. A." (let. 4622, p. 509) has raised a question of considerable interest.

There can be no doubt, I think, that the size of the sun or moon in pictures depends a good deal on the artist's judgment. We have an ideal moon or sun. Moreover, the presentation does not equally well satisfy all who look at the picture. To my own judgment, for example, the moon introduced in some of Leech's pictures appears monstrous; yet it is probably enlarged only about as much as is just for pictorial effect.

I think all these points depend on ideas unconsciously formed as the result of a more or less trustworthy past experience, and the judgment is exercised as if on the intuitive assumption that those ideas are just.

For example, we see weathercocks ordinarily in a position which leads us to form the idea that they are smaller than they really are; but we have tolerably exact ideas of the dimensions of church doors, porches, buttresses, and so on. Hence, when we see a weathercock close by a church door, porch, or buttress, the mind is struck by the fact that the weathercock takes up more space than one would have expected.

Again, it has been shown by optical considerations that the sky near the horizon is mentally estimated as being between three and four times farther away than the sky at the zenith. Now we usually see the moon high up, or where the sky is apparently nearer. When it is near the horizon, still seeming on the sky, the mind entertains the impression that the moon is much farther away, and as it subtends (appreciably) the same angle instead of a much reduced angle, the mind receives the impression that the moon is larger than she had before been conceived to be.

Now, in pictorial representations of the moon there is precisely the converse of the case of the horizontal moon. The horizontal moon seems much larger than usual, and really subtends the same angle (appreciably to common observation); the pictorial moon seems about the right size, and really subtends a much larger angle. May not this be because, whereas in ordinary observation the horizontal sky seems much farther away than that overhead, the sky of a picture always seems much nearer than the natural sky?

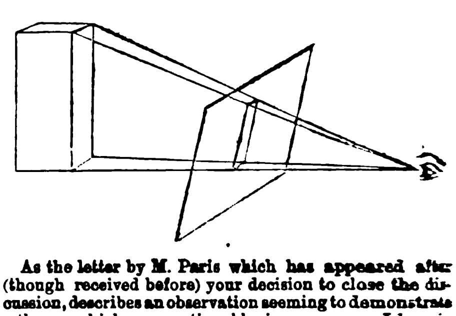
Everything seems consistently explained by the views here presented.

"M. A." is, of course, quite right in dwelling on the fact that a swiftly-moving body offers no *resistance* to deflection. He justly urges also the great objection to the term "centrifugal force," in cases where in reality *inertia* (or *absence of force*) is the essential feature. It is not quite true, as "C. H. W. B." says, that there exists no such force as "centrifugal force," but it is certainly quite true that what is commonly so called is no force at all. RICHARD A. PROCTOR.

ERRATUM AND ADDENDUM ABOUT PERSPECTIVE.

[4701.]—I NOTICE in my letter about perspective (4621, p. 509) an erratum, which arose from my adding a parenthetical remark without having the figure before me. Of course the sentence beginning "that M. Paris may not," &c., relates to the parallelism of the lines C A, D B.

As our common object is to get true ideas either established or promulgated, you will permit me, I trust, to indicate that the views of Sir David Brewster, quoted by M. Paris (let. 4623, p. 509), are strictly correct. M. Paris has misunderstood them. It is quite true that when we stand close to the base of a square tower and so direct our vision as to take in the whole tower in the most convenient manner (that is, with the head thrown slightly back), the perspective view we then obtain shows the sides of the tower converging, and they would so appear in a photograph if the prepared plate were placed in a correspondingly inclined position; or in a picture, if the plane of projection were supposed to be inclined, as shown in the accompanying figure. The disadvantages of such a mode of projection are too obvious to require discussion. Every picture so drawn would require half a page of explanatory matter to make it intelligible.



As the letter by M. Paris which has appeared after (though received before) your decision to close the discussion, describes an observation seeming to demonstrate a theory which unquestionably is erroneous, I beg, in the interests of your younger readers, who might otherwise be misled, to be permitted to point out that the result of M. Paris's observation with a plumb-line would have very fitly illustrated my paper on "Self-deception in observation." It is mathematically demonstrable that he cannot have seen what he supposes he saw, any more than he could have seen two straight lines enclosing a space. Indeed, if only it be granted that the perspective view of a straight line is also a straight line (which I suppose M. Paris will not question), it can readily be shown that according to his theory two straight lines can inclose a space. Thus, let there in a lofty square tower of equal width throughout, and let the observer be stationed at an upper window of a house close by so as to be opposite the middle of the tower. Then the top of the tower subtends a smaller visual angle than the middle; therefore, according to the theory, the sides bounding the nearest face must converge towards the top of the picture, and if produced far enough will meet in *that* direction. But the bottom of the tower being farther from the eye than the middle also subtends a smaller visual angle. Hence, according to the theory, the sides bounding the nearest face must converge towards the bottom of the picture, and if produced far enough will meet in *that* direction. Hence two straight lines will meet in two opposite directions, and, therefore, will inclose a space. This is usually regarded as impossible.

RICHARD A. PROCTOR.

PERSPECTIVE.

[4702.]—SINCE you have somewhat departed from your original intention of closing the discussion on perspective I hope you will be able to spare space for a few more letters on this interesting and far from exhausted subject. Mr. R. A. Proctor sends a diagram with his reasoning thereon, which certainly proves that the vertical lines are parallel in his diagram, but does not prove that vertical lines are optically parallel in nature, which Mr. Proctor seems to assert to be the case in the latter part of his letter, in which he speaks of the tower's sides being parallel. I know that the idea of a plane of projection is a useful, and perhaps the only admissible, idea in the theory of practical perspective, but in nature there is no such thing as a plane of projection. The only plane on which objects can be projected in the same way as they appear to the eye is, as Paddy says, no plane at all, but concavo-convex—concave interiorly and towards the eye, convex exteriorly and towards the object, and the plate of glass representing this so-called plane must be shaped like a watch-glass, with a curvature conformable to the sphericity of the eye, and equally conformable to the periphery of the sphere of vision, or the limit of man's vision in every direction. Diagrams, therefore, founded on the idea of a plane of projection, are only convincing as far as regards practical perspective, for the simple reason that on no other idea can we work out the rules of perspective, so we say, "Let it be granted" that there is a plane of projection, and on that postulate we form our rules, and according to our rules all vertical lines are to be represented vertical and parallel, notwithstanding that optically they are not so. Possibly, if an artist were to deviate in a very subtle and imperceptible way from this rule, and make his vertical lines very slightly converge, it might convey to the spectator the idea of greater height, while he would not know the reason why, but the artist, in order to be absolutely true to nature, must not make his converging lines straight lines, but curves, for all vertical lines in nature converge to the zenith in curved lines; but I do not know how the artist is to find out this curve, as it is that singular curve that eternally approaches a straight line but can never cross it. I think the artist would find the whole matter a bother about nothing, and stand upon the ancient way of representing the lines of vertical objects vertical and parallel, as it is not part of the artist's vocation to portray the imperceptible.

"E. L. G.," in his letter 4654, p. 586, makes the assertion that the optical convergence of vertical objects is neither slighter nor anywise less sensible than horizontal convergence in a street. Now this I consider as wantonly throwing down the gauntlet to fact. "E. L. G." must surely know that horizontal convergence in a street is obvious, perceptible, and patent to any one who gives any attention to the subject, while the convergence upwards within the cone of vision is imperceptible to the senses, although we know from optical rules that it does exist. Suppose a column 100ft. long laying on the ground, let the spectator stand at one end of it, the convergence is obvious, because the distance from the spectator to the other end of the column is 100ft.; now let the column be set on end vertically, and let the spectator stand at 200ft. distance then the column will be within the cone of vision, but the difference of distance from the spectator of base and summit will be only 25ft.; does "E. L. G." mean to assert that the convergence resulting from 25ft. distance is equal to that resulting from 100ft.

BONO.

[4703.]—MR. PROCTOR admits that the top of the tower is (setting illusion aside) optically narrower than the base. Now, we are not dealing with anything but the appearances to be represented by the sketcher. He is, therefore, I submit, not justified in making in his diagram the line A B equal in length to the line C D, and if not, all his reasoning is vitiated. Mr. Proctor states that there is no point on the plane of projection indefinitely extended to which the projections of the tower's sides converge, but the plane of projection so extended must reach the zenith, and the vanishing-point of the sides of the tower is the zenith. If the part of the plane not representing the tower be cut away we obtain a small tower coinciding with the real one, and how, then, can the zenith be the vanishing-point in one case and not in the other? Again, Mr. Proctor admits that the vanishing-point of any plumb-line is the zenith, but the plane of projection may obviously be considered as a number of plumb-lines placed side by side. Now, the sides of the tower may be looked upon as plumb-lines converging in the zenith, yet the lines on the plane, also plumb-lines, according to him, do not converge there. If the top of the tower subtends a smaller visual angle than the base the lines A C and B D cannot be parallel, and the plane of projection cannot make them so. The question now is, is Mr. Proctor justified in making in his diagram A B equal to C D? I say certainly not, and that mistake is fatal to his demonstration M. PARIS.

PARALLELOGRAM OF FORCES.

[4704.]—I THINK the Professor in the Andersonian University had probably another reason for leaving "Marine Engineer's" question (let. 4649, p. 515) unanswered than the mere desire to shirk a difficulty.

"M. E.'s" difficulty is based on two mistakes. The first is the common one which confounds the parallelogram of forces with the parallelogram of velocities. The law called the "parallelogram of forces" asserts nothing whatever about the time in which a body will traverse the diagonal A D (see the figure illustrating let. 4649). In too many of our catechisms on mechanics the question of time is dragged into the explanation, and even into the enunciation of this important law. "Marine Engineer" correctly enunciates the law (for the case in question), but what follows after the word "therefore" is a *non sequitur*; and if the theory of velocities were correctly stated by "Marine Engineer," the true *sequitur* would be, therefore the body under the action of the two forces will *not* reach D in the same time, &c. But his reading of the theory of projectiles is quite erroneous. Whenever a body's inertia is all that has to be overcome by a force, the velocity acquired in a given time is proportional to the force, and not to the square root of the force. The experimental law in gunnery that the velocity varies as the square root of the charge (other things being equal) depends on a number of circumstances altogether independent of the inertia of the ball. Into these matters "F.R.A.S." will probably enter at length, since on more than one occasion he has shown a knowledge of the theory of gunnery, to which I can lay no claim.

I am glad to see "C. H. W. B.'s" protest against the use of the term "centrifugal force." It has misled many. RICHARD A. PROCTOR.

[4705.]—I CANNOT but think that "Marine Engineer's" difficulty (let. 4649, p. 515) arises from a confusion between the work done in consequence of a certain velocity, and the power imparting that velocity. Referring to an illustration in "The Constitution of Nature" (p. 457 of ENGLISH MECHANIC), a man pitching up a brick with an initial velocity of 64ft. a second, will make an effort or do an amount of work four times greater than another man who throws up a brick of equal weight with only half the initial velocity, 32ft. a second, inasmuch as an equal weight will be raised in the former case to four times the height that it will be raised in the latter case. But the first brick will rise for one second, while the second brick will take two seconds in travelling its quadruple distance. Consequently, we have four times the amount of work performed, not in the same time, but in double the time, so that the force is not quadruple but only double.

V. B.

[4706.]—I TRUST the following will show "Marine Engineer" (let. 4649, p. 515) that the theory of projectiles and the parallelogram of forces are in complete harmony with each other.

The line A D in his diagram truly represents the resultant of the forces A B and A C, both in direction and intensity; but his statement "that a body under the joint action of the two forces must reach D in the same time it would have reached B or C, under the action of a single force," is only correct when the body acted on is moving in vacuo, but when moving in air the line A D merely represents the resultant force in propertion to the other two forces, and has nothing to do with the time occupied or distance traversed by the body.

In the theory of projectiles the resistance of the air has to be taken into account, and this increases (speaking roughly) as the square of the velocity, and to double the range of a projectile, four times the original force is required; but the velocity—that is, the initial velocity—is, I believe, in direct proportion to the amount of force used. Therefore, referring to "Marine Engineer's" diagram, if the line A C represents the space traversed in a certain time by a projectile acted on by a single force, the projectile under the influence of the combined forces (the resultant being nearly double) would not travel nearly 2 A C in the same space of time, but only about $1\frac{1}{2}$ A C, though it would have started at double the initial velocity to that which the single force gave it.

L. H. O.

[4707.]—IN answer to "Marine Engineer" (let. 4649, p. 515), it appears to me that his difficulty lies in the assumption that to produce a double velocity requires the expenditure of a fourfold force, which is only true when the space through which the force is exerted remains constant. If we employ the usual symbols of P for a uniform moving force, M for the mass of a body acted on, V for the velocity generated, and S for the space through which the force acts, then by a well-known formula, $P = \frac{MV^2}{2S}$, hence if S remains constant, and V is doubled, P must be increased fourfold; but if V and S are both doubled, as in the case of the diagram in "Marine Engineer's" letter, P will only require to be doubled also. I hope this explanation will remove "Marine Engineer's" difficulty. T. E.

THE DEATH OF THE CRANK.

[4708.]—THE crank is doomed at last—after all the attempts of disappointed would-be inventors; in spite of the money and time wasted by mechanicians in fruitless efforts to discover a substitute. The fortunate discoverer of the means of doing without the crank and avoiding its "defects" is a Mr. Thomas Morton, a member of the Senior Class of Racine College (U.S.), whose invention, according to the *Wisconsin Argus*, is deemed by many practical engineers and scientific men likely to prove one of the most valuable and useful inventions of the age. But I must quote the *Argus*, for I am afraid I might not do justice to the transcendent merits of the invention and the inventor:—

"Mr. Morton's improvement [it is said] does away with the dead points entirely, and keeps the power continually upon the long lever, or as engineers call it, the half-centre, thus nearly doubling the power, and so saving a great amount of fuel in engines. It can be applied to all kinds of crank machinery, engines, lathes, sewing-machines, &c. The simplicity of the arrangement is almost ridiculous, and makes one laugh and wonder why it was never thought of before. It consists of a ratchet wheel, which takes the place of the crank; over this ratchet wheel runs a frame, in the two sides of which are movable cogs or pawls. When the connecting rod drives the frame out the cogs on one side act upon the teeth of the wheel and carry it half way round, while, at the same time, the cogs on the opposite side, working in a contrary direction, when touched by the teeth of the wheel, are thrown out of the way, and the instant they scrape the teeth of the wheel they adjust themselves by their own weight, or by means of springs, and so are ready to carry the wheel the remaining half-revolution when the connecting rod is drawn in. Thus a revolution is obtained with every stroke of the piston, and no time is lost" (!)

There is just a little piece of information wanted to make this "mechanical triumph," as it is termed, complete. Mr. Morton may have "got up the invention and demonstrated it in two days," but has he tested it in actual work on any ordinary scale for two days? Pending an answer I think we need not yet alter our crank shafts. G. J. H.

TO "THE HARMONIOUS BLACKSMITH."

[4709.]—I MUST confess my full belief in "Hollowtonism," but not in shutting up poor Jack in a box, or contrarywise, allowing him to "waste his sweetness on the desert air." There is some semblance of classical authority for the creed. Has "The Harmonious Blacksmith" ever seen the famous group of statuary of the "Laocoon" (or cast thereof)? And does he know why this Trojan priest incurred the punishment thereby represented?—that it was for "fiddling" with the ribs of the wooden horse left by the Greeks as an ambuscade at the siege of Troy. What has all this to do with the matter? Not much; for mind the story is but a poetic fiction; but I am coming to the ideas of the poet Virgil (though draw a long-bow he might), to show that he was a "hollowtonian." As translated by Wharton, he says, describing the said fiddling match—

Swift at the word his pond'rous lance he threw,
Against the sides the furious javelin flew,
Through the wide womb a spacious passage found,
And shook with long vibrations in the wound;
The monster groans, and shakes the distant shore,
And round his caverns roll'd the deafening thunder's roar.

It may be very unclassical to give poor Laocoon a fiddlestick, but "The Harmonious Blacksmith" will perhaps take the arrangement in another sense, and say "a fiddle-stick for Laocoon"—never mind the bow. Laocoon was evidently represented as having a powerful tone, and with Virgil at my side, if I fall beneath the spear of "The Harmonious Blacksmith," I shall meet my fate in good company.

That the "box" in some shape or other is applied to every musical instrument acting by vibration of string or parchment for the purpose, and with the effect of increasing the volume of tone, seems a clear fact. Witness Æolian harp to piano, tambourine to big drum. The advantage of a sound-hole is established, and its size regulated by experience. Opening the back doors of the harp gives it what was before wanting—a sound-hole. So also in the grand piano elevating the lid is employed with the same effect. The case and soundboard here modify the "box."

Does "The Harmonious Blacksmith" really think that depriving a piano of its case (leaving the soundboard), a violin of its back, or a kettledrum of its "nether end" would improve the power of their tones? Truly, the kettledrum's matrimonial alliance of brass and parchment must be very ill assorted if improved by loss of its "better half." It is not clear that the cutting proper sound-holes in any drum, and increasing the thickness of the cylinder in the middle, that perchance also adding bass-bar or sound-post in the interior might not add to the drum's power.

As to tambourine and drum being like child and man, this is exactly corroborative of hollowtonism. The poor little child has no voice, his ribs are not grown to man's estate, nor his body long enough, while his mouth is so large and open that his puny voice "vanishes into empty air." Let the child grow and assume by degrees the proportions of the man. It will surely happen that the poor little drum or tambourette, if he grows even to a side-drum, will have a louder voice, to be increased by becoming a big drum.

I never before heard of an Irish fiddle without a back; it seems akin to the Irishman's Bath-chair without a bottom, on emergence from which, after a journey, Pat is reported to have said, "Sure and if it hadn't been for the honour of the thing, I might as well have walked." "The Harmonious Blacksmith" is assuredly joking, and I will then unfailingly convince him of the efficacy of the box principle. Let him make the experiment for himself: take a small boy, and apply a box to his ear, if the urchin does not give out his best tones, why I shall follow the bad fashion of the day and be "out upon strike." Extract the backbone of a "Strad" (as doctors serve the frogs), fancy the groans and screams of the unfortunate patient deprived of his backbone! "The Battle of the" Soundboards may, however, be more readily determined upon the modern mode of arbitration or experiment. Let "The Harmonious Blacksmith" make his invention perfect, as I before suggested, it would not be a long operation, and if successful add to the laurels he has already won by his ingenuity and pleasant contributions to the MECHANIC.

SUFFOLK AMATEUR.

[If those who controvert the opinions of "The Harmonious Blacksmith" are allowed to indulge in his style, we shall be mistaken for a comic journal. "Suffolk Amateur" does not often transgress, and the above letter has not, therefore, been severely dealt with. We warn "The Harmonious Blacksmith" that any allusions in his reply to "Vulcan," in connection with the Laocoon difficulty, will be ruthlessly excised.—ED.]

GREENHOUSE FLUES.

[4710.]—IN order to further "Saul Rymea's" very useful hints for the construction of mechanics' greenhouses (letter 4662), I venture to supplement them with a plan of flue construction which obviates all difficulty as regards the relative level of flue and furnace. The plan I propose is thoroughly accordant with sound principle, and I have thoroughly proved its practical value. No excavations are required. If there be a room on one side of a greenhouse, the furnace may open into it, whether the floor of the room be higher or lower than that of the greenhouse or level with it, and the flue may descend to any reasonable depth from the fire.

I furnished a plan to a lady a few years since, in which the furnace opened into the harness room, the floor of which was, perhaps, 2ft. higher than the flue. The mason had objected to the arrangement on that account, and great was the amusement elicited by my plan, until the fire was lit and the flame was seen curling downwards. And what is the rule by which a flue and furnace may be thus adapted, with full assurance of success, to any position; and the whole question of stokeholes and levels be summarily set aside? It is simply this. See that the arrangements are such that the bottom of the chimney shall be at once and thoroughly heated or warmed.

It is well known that greenhouse flues, which terminate in a chimney which derives warmth from a kitchen fire or from other chimney in a house which is much used, draw well: but heat slowly and partially making way through a mass of brickwork must not be trusted to in the case of a descending greenhouse flue. It is also well known that a return flue terminating close to the furnace, and in some cases passing over it before it enters the chimney, draws well. The bottom of the chimney is heated by this arrangement. But even in this case, when once the chimney is thoroughly cold, the flue sometimes draws badly until hours have elapsed and the mass of brickwork which separates the furnace from the base of the chimney is at length warmed thoroughly. These are but imperfect applications of the rule. They go to show that the rule is not new, also to encourage a more perfect application of it, and also to prove how little it is understood, and how slow men are to trace out a sound principle and make the best of it. A few words may suffice to show how a flue may be forced into instantaneous and perfect and constant action. Let the separating matter which divides the greenhouse chimney base from the furnace be a good conductor of heat instead of a bad one: an iron plate, for example, at one side of the furnace, if the chimney abuts against that side; or on the top, if the chimney is built immediately over the furnace. The last is the best arrangement. The first action of the fire is thus on the plate of iron; as the flame licks the metal the heat passes through, the air in the bottom of the chimney is heated and expands upwards. It is lightened and displaced by the pressure below. Instantaneous draught is established. If the flue descends much from the furnace, make the chimney a little higher on that account. I made assurance of success doubly sure in the case above described, by making a slide in the iron plate (a damper), so as to open direct communication between the furnace and chimney. If this is opened on the lighting of the fire, when all is cold, the flame draws through at first directly into the chimney and heats it. The slide being then closed the draught takes the course of the flue.

Nine-tenths of the whole difficulties attaching to commonly constructed flues are got rid of when this rule is fairly applied. I have cured smoking flues over and over again by acting on it in one form or another. When good draught is thus insured, flue construction involves no excessive care in making it air-tight. Leave a chink open to prove this, and hold the flame of a candle to it. Greenhouse flues, being used only to keep out frost or for drying and ventilating the house occasionally, are usually cold when the time comes to employ them. How important, then, is instantaneous action. How much more when severe frost demands instant attention, and warm air rather than poisonous smoke and vapour among the plants.

J. M. TAYLOR.

Seer Green Vicarage, near Beaconsfield.

THE WOOLWICH INFANT.

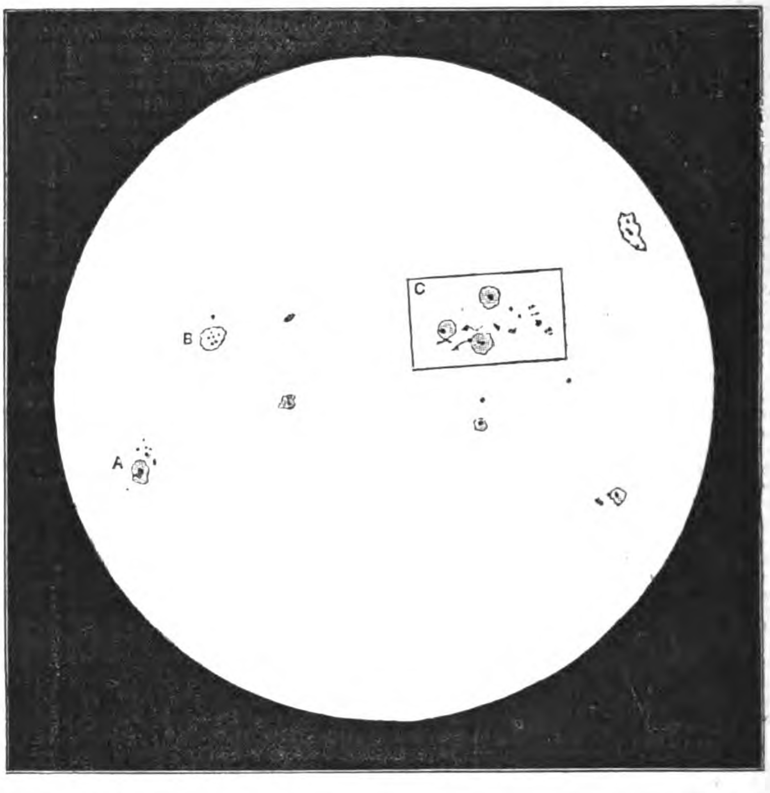
[4711.]—I INCLOSE a paragraph cut from a newspaper, which may be of some interest to our friend "The Harmonious Blacksmith" and others who take an interest in artillery. It confirms the opinion expressed by him and myself on the disadvantage of the "increasing twist" system of rifling, and the use of studded projectiles:—"Artillerists will be interested to learn that a hardened gun-metal stud, extracted from a recovered 700lb. projectile, is now to be seen at the Royal United Service Institution, Whitehall-yard. As the shot was supported and rotated by the studs, no part of the iron touching the bore, the injuries marked upon them show the irregular motions of the projectile in the gun. This particular stud is misshapen by the powerful wedge action in overriding the grooves about 1in., and displays a shear corresponding with the increasing spiral of the rifling. This explains the accumulation of gases in the powder-chamber which caused the crusher gauges to vary their register from 27 to 66 tons when firing only 120lb. of mild pebble powder. The sample stud speaks for itself, and the wonder is not that the 35-ton gun is now in the factory being rebuilt, but that its strength was sufficient to withstand nine such wedges without being rent to pieces."

ARTILLERY CAPTAIN.

GROUP OF SUNSPOTS.

[4712.]—ON August 6, at 10 a.m., I made the accompanying drawing of a very remarkable group of spots on the sun. The telescope employed was the Sheepshanks' equatorial 47/10in. aperture, lent to me by the Royal Astronomical Society, for star gauging. The air was not steady, but at intervals the definition was excellent, the granules showing better than I have yet seen them with this telescope. In the drawing, however, I have only presented the less delicate features, as a great bank of clouds approaching from the west left me in no doubt as to the shortness of the interval at my disposal.

I had time after completing the drawing, and the rough low-power view which accompanies it, to re-examine the picture, and to test the groupings by a sort of mental triangulation, taking the spots in sets of three, and comparing the shapes of the triangles so formed with the telescopic view. I can vouch for the accuracy of the drawing in all essential respects.



The most remarkable feature was the immense number of small umbræ, and their very peculiar arrangement. I may remark in passing that I have often noticed a tendency, in spots of this sort, to an arrangement of the umbræ into curved lines forming prolongations of the outer boundary of the penumbra, which are (in such cases) incomplete where the streak of umbræ appears, the main umbra being there trenched upon by very brilliant white masses, forming bridges, projections, &c. The contrast between the two great spots of this nature and the round spot with its comparatively uniform penumbræ is very marked. It is also noteworthy how a long train of irregular penumbral matter and broken umbræ extends from the space between the two great irregular multiple spots.

On Wednesday I had a momentary view of the group, which was then much changed in character—much simplified, so to speak.

In the low power view, C represents the space included in the other drawing; A was a spot remarkable for the way in which the penumbra was broken right across on the side nearest the sun's limb by an irregular extension of the umbra. The space B was occupied by a group of many small umbræ—very remarkable in its general aspect.

RICHARD A. PROCTOR.

EYEPIECES.

[4713.]—DURING my stay in Manchester a German gentleman showed me an eyepiece of the kind suggested by "Betsy Summercity" (letter 4634, p. 513). He told me that it was made by Steinheil. It was a small compound achromatic microscope, and when used as a microscope had a magnifying power of sixty diameters, its power as an eyepiece would, therefore, be equivalent to a single lens one-sixth of an inch in focal length. It was composed of a brass tube about ¾in. diameter, and about 4in. or 5in. long, as nearly as I can remember, into one end of which was screwed an object-glass, and into the other an eyepiece. The object-glass was composed of three lenses cemented together forming a solid cylinder of glass about ¼in. long, and of about the same thickness, and I think it was convex on both faces; the eyepiece also was peculiar, resembling the Huyghenian in external appearance, but being composed of a field-glass and two lenses, instead of the ordinary single eye-lens. I had no opportunity of testing this apparatus as an eyepiece in the telescope, but Mr. David Gill, F.R.A.S., of Aberdeen, showed me some similar ones, and spoke very highly of their performance with his 12in. reflector. They have, however, the disadvantage of erecting the image, and are, therefore, somewhat awkward to use at first.

A. WOOLSEY BLACKLOCK, M.D.

High-street, Godalming.

THE ORGAN BUILT.—IX.

[4714.]—It will be better now to make the pedal-board, and although I intend to describe a radiating one, because I look upon it as the easiest to play upon, yet the same plan will do to lay out a straight one if preferred. Get twenty-five bars of pine, 1¼in. by ⅞in. and 2ft. 2in. long, fifteen bars of American birch, 1in. by ⅞in. and 1ft. 6in. long, and ten pieces also of birch, 3in. by ⅞in. and 4in. long. Make an irregular-shaped frame, 2ft. 5in. long on the front side and 3ft. long at the side next the organ (see Fig. 1), divide it out into twenty-nine equal spaces, and make a mark in the centre of each space, and then obliterate the sixth, fourteenth, twentieth, and twenty-eighth marks, counting from the bass side; by obliterating these marks a proper space will be left between the B and C, and also between the E and F notes. Next insert pins of iron wire in the marks. The size of the wire should be No. 12, and the front row of pins on which the pedals are centred should be 1⅝in. long, and driven in so as to stand 1¼in. high. The guide-pins should be 3in. long, and go ¾in. into the top and bottom rails. Drive them tight into the bottom rail, which should be of oak, and let them fit loosely into the top rail, so that the rail may be lifted off when necessary. On one end of the pine bars glue a piece of ¼in. birch, 2in. long, and the width of the bar—viz., ⅞in.—and under each piece of birch bore a ⅜in. hole through the pine, so that the top edge of the hole just touches the birch (see Fig. 2). In the centre of the birch cut a small mortice, ⅝in. long and the exact width of the wire used for pins, and on the under side of the pedal bore a round hole that will just let the pin into it. After boring the hole very slightly, countersink it; if the mortices are nicely cut and fit the wire well, it prevents the pedals twisting over. Bore a hole through the pedal for the guide-pin to work in; the hole should be ⅜in. diameter, and lined with cloth to prevent noise. In the rail in front of the guide-pins cut a small groove for the end of the spring to work in. Having got the holes for the guide-pins finished, put all the bars in their places and mark the positions for the pieces of birch to be glued on (see Fig. 1), where the black lines show the birch, thus leaving the naturals higher than the sharps along the tread of the pedal, while the toe-piece on the sharps is sufficiently raised to clear the natural. On the under side of the pedal mark the place for the end of the spring, and also mark the end of the bars, so as to cut them to an even length. Take the bars off the frame again and glue on the proper pieces of birch and fix in the spring, which is only a piece of No. 15 iron wire, and if the pedal-board is to be fixed to the organ, insert a piece of thick upper shoe-leather in the end of the pedal, as shown at A, Fig. 2; but if the pedal-board is to be loose so that it may be lifted up out of the way —for the benefit of the housemaid—do not insert the leather. I intend showing the action for a movable board: Before putting on the pedals again, fasten a thickness of felt or baize on the rail on which the pedals work, and two thicknesses on the rails where the guide-pins are—viz., two below the pedals and two above. If the baize is not thick enough, use three, or even four. Nothing is more disagreeable than to hear the movement clattering when playing, and a well-built organ may be as silent as a piano. Good carpet felt is sufficiently good for the pedal-board. The end of the pedal-frame is shown by the dotted lines Fig. 2. Now make a rail, 3ft. long, of ⅞in. pine, and fasten makogany rails to it (see B, Fig. 2, in which the front vertical rail and also the broad rail at the back are mahogany). Make twenty-five levers, 7in. long, and cut grooves in the rails exactly opposite the end of each pedal. The lever is fixed into the back rail by a wire running through a bushed hole, and pinned down to the rail with wire hoops or staples. The front rail is merely a guide rail, and the grooves must be cut down far enough to allow play to the levers. In each lever insert two loops of whipcord to hook the trackers to. To insert them, bore a hole with a bradawl in the proper place, enlarge it on the under side with a taper bit, draw the whipcord through and drive in a small wedge dipped in glue in the enlarged side of the hole, then cut it off neat and close. By using whipcord a silent and at the same time a strong attachment is secured.

J. D.

FIG. 1

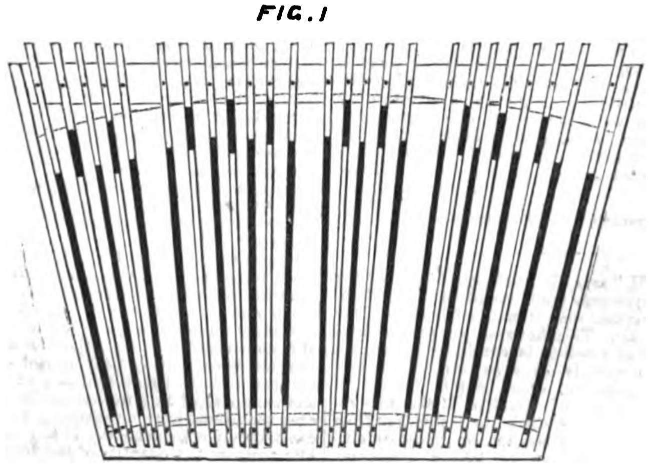
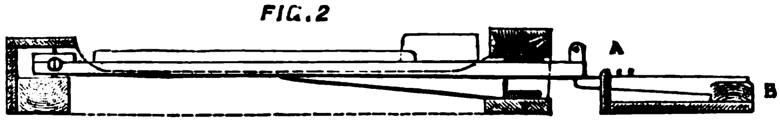


FIG. 2



LUNAR OBJECTS FOR OBSERVATION, SEPTEMBER, 1872.

[4715.]—Sept. 5, Mare Crisium, direction and appearance of central ridges. Sept. 6, Azout, Alhazen. Sept. 7, Macrobius, Proclus, Mount Glaisher, the highest of the Coxwell range east of Proclus named by the late Dr. Lee to commemorate the *highest* balloon ascent. Sept. 8, Altai Mountains, Polybius, Beaumont. Sept. 9, Aliacensis, Reaumur, Werner. Sept. 10, Palus Nebularum, Palus Putredinis. Fine mountain scenery in the neighbourhood. See English Mechanic, Vol. XIII., No. 322, May 26, 1871, p. 222. Sept. 11, Sasserides, Pictet, Sassure. Sept. 12, Carlini, Lambert, ridges from La Place to Heraclides. Sept. 13, Riphean Mountains, Euclides. Sept. 14, Anaximander, Galileo, Lehmann. Sept. 15, Bettinus, Kircher, Wilson. Sept. 16, Zuchius, Hansen, Bailly. Sept. 17, Wilhelm Humboldt and Phillips just east of it, may probably be seen under the evening illumination.

The *degree* of luminosity of the bright spot in Werner is an important point to ascertain, and it would be well for an observer who has the requisite leisure to observe it regularly every lunation. It should be compared with other bright spots in the neighbourhood, and its position in brightness should be placed on record, the names or designations of the spots compared being arranged in the order of brightness. The time of each comparison should be stated.

The bright spot Mösting A (Beer and Mädler) in lat. 3° 11′ S. long. 5·13 E., or 95° 13′ from the west or preceding limb in mean libration, has been recommended as a fundamental or reference mark in selenographical investigations. Bessel selected it for his researches relative to the moon's librations. He described it March 31, 1839, as very bright *seen* in full moon, and of a sharply-defined form. This was two nights after full. It is suggested that this spot should be made the subject of a similar series of observations as the bright spot in Werner.

The precise objects for which Mösting A should be considered as a point for reference does not clearly appear whether as a standard of brightness or size, or as a point to which all measures should be referred. As regards measurements, those for the determination of points of the first order are by far the most important; but at present none are made, nor have any been made since Mädler's great work. Each set of measures for this object is quite independent of every other, and therefore a reference point as regards them is quite unnecessary.

W. R. Birt.

CENTRIFUGAL FORCE.

[4716.]—Letter 4646, p. 514 ("C. H. W. B.").—No one in these days does maintain there is such a force. Writers sometimes use the term because it is well understood, and no other short term has been agreed upon. I proposed rectilinear tendency, and employed it in a recent letter.

M. Paris.

THE GYROSCOPE.

[4717.]—I do not agree with "E. H." (let. 4619) that because a writer has not full time for the complete (misprinted "proper") discussion of a subject he should let it alone altogether, for very often it may happen that a hint thrown out at a certain stage of a discussion may be of considerable use. As to what I threw out in this way I am certainly not prepared "either to admit that I have been in error or to put forward a convincing demonstration of its accuracy." But I am quite prepared to consider objections, if they are urged in a fair and courteous manner. So long as "E. H." refused to believe me when I pointed out that he had misunderstood me, it was hardly to be expected that I should care for the discussion; nor were matters improved when he said that he was prepared to see me "change my front" yet again. But in his last letter he avoids that objectionable tone.

In passing, let me remark that in saying that I am "quite right" as to a certain fact, but that "no one has disputed the fact in the current discussion," "E. H." seems to imply that no fact may be mentioned until it has been disputed. I fail to see the force of this.

The subject of the gyroscope came naturally to be discussed in my papers on the "Earth, her Figure and Motions" (I should have much preferred leaving it out altogether, but could not), and any one who will refer to my article (English Mechanic for January 21, 1870, pp. 445 and 446) will see how little I pretend to give a complete explanation. Moreover, I refer the reader to the true author of the general explanation there suggested. Nor was what I said a few weeks ago an attempt to explain the matter. Strictly speaking, I have made no attempt whatever to give a popular explanation of gyroscopic action; on the contrary, I have several times distinctly said that I believed no such explanation to be possible. Yet once more, I have not advised that "E. H.'s" explanation "should not be published." I advised him not to send it for publication, which is a very different matter.

Again, I have not said that I "have no doubt mathematical analysis would explain" the action of the gyroscope, but, *absolutely*, that mathematical analysis does explain that action—a very different matter.

"E. H." should be careful in making such statements, because a word or two introduced or omitted may quite alter the meaning. He has wasted space in making wrongly-worded statements, and has compelled me to waste more in correcting them.

As to the facts which "E. H." is supposed to be questioning, I do not wish to accuse "E. H." of quibbling; but what sort of answer am I to make to the remark that I ought not to have said "that the motion of one particle under the action of gravity would tend to shift the plane in one direction, and that of the opposite particle in precisely the opposite way;" since, says "E. H.," "the fact is that gravity tends to make both particles shift in precisely the same way—namely, in circular arcs having the point of support for their centre"? When I wrote the sentences (let. 4587, p. 460) which "E. H." supposes himself to be here fairly representing, it occurred to me that certain passages were so important as to require underlining. If "E. H." had seen the MS. instead of the printed matter I should have supposed he took the underlining for erasure. Does he suppose that when words are italicised they are meant to be overlooked altogether? Again, what he says about the particles moving in the same way is mere wording, not argument: in one sense, we may say that the particles of a grindstone in rapid motion are moving in the same way, though some are moving upwards and some downwards.

I maintain my original statement, not as a mere opinion, but as the statement of a fact, and one bearing importantly on the subject of rotating bodies, and tending to throw light on the apparent resistance which they oppose to the direct action of a force tending to change the position of the axis of rotation. If "E. H." chooses to imagine that in throwing out this hint I was pretending to offer a full popular explanation of the phenomena of gyration (and that in the very letter where I said I did not believe any such explanation could be given) it is not my fault. With a gyroscope within arm's reach as I wrote I did not need to be told that the axis of rotation *does* gyrate, even if I had not been for years perfectly familiar with the phenomena of gyroscopic motion. If I had meant what "E. H." seems now to suppose, the fact that when the gyration is checked the axis sinks, would be fatal against my reasoning. Yet this fact is one of the elementary ones of the subject.

If "E. H." really has a popular explanation, at once complete and clear, why does he not produce it without so much preliminary parade? He tells us that two years ago he showed the various proposed explanations to be faulty—including mine (akin to "takken the breeks aff a Hielander")—and was content with that achievement. *Why?* I know that he then claimed to have satisfied himself of the true explanation; and but for his assurance I should have said he tried to present a new explanation and failed. This not being the case, I withdraw my "Don't."

Richard A. Proctor.

[4718.]—On page 542 "E. H." writes an answer to "Gy's" question on page 484, and shows thereby that he is not a practical top-spinner. Moreover, it is quite wrong to say of "top or gyroscope" that "the axis would maintain the same inclination to the vertical." There is a very great difference between a gyroscope and a top in a very important respect. In the former both ends of the axis are supported, and, therefore, the fly-wheel may before spinning be placed in any desired position, and it exhibits no inclination to remove from that position when spun, so long as no external force is applied, such as hanging a weight to one or other bearing of the axis; in fact, the fly-wheel, whether spinning or not, is cut off from that attraction of the earth which makes a top fall instantly when you try to balance it on its peg. If one of the bearings of the axis of the gyroscope were suddenly removed the instrument would become a top to all intents and purposes, and I think any one will admit that it would be impossible for the instrument to continue spinning under such altered circumstances in the same manner as it did when it had two bearings to support it. Now to "Gy.'s" letter (4581). So far from the axis leaning more and more until the top falls over, it does precisely the contrary; in fact, the *upright* position is the one affording the least resistances to the top spinning, and the one which a top always assumes very quickly in whatever manner it may happen to have been spun at first, and it then, as the schoolboys call it, "sleeps." A good top-spinner can make a top spin at will, by a dexterous movement of the hand, after he has picked it up and has it spinning in the palm of hand, or in corner of thumb nail, or better in a tiny saucer, such as you buy gold paint in, with the axis inclining to right or left at pleasure, and on that dexterous movement ceasing the top gradually but quickly will stand spinning upright again. "L. H. O.," on p. 509, also seems to think that the axis of top will remain in *one* position, from what he says in line 28 *et. seq.* of his letter, which on the above showing is all wrong. He leaves the nutation out of the question; but it must not be left out, for as the axis of top, at first supposed to be inclined, does eventually come upright, and cannot possibly become so suddenly or in a straight line, the only possible line in which it can come up is a volute, or, what is the same thing, the nutation gradually decreases till it becomes nil. I leave "E. H." to practise and find out in what the "dexterous movement" mentioned above consists. There used to be a conjurer about the streets, whom I first saw in Hyde Park on the day after the Coronation of her Majesty, and who used to spin a large top in the air, catch it before it reached the ground, and then place the end (spherical) of its peg in a recess in the end of a long rattan cane, which moreover was considerably bent, and this he used to balance on his chin, and by moving up and down would make the top dance to the extent of two feet or more, and then would make it gradually deflect from the perpendicular till nearly horizontal, the little round knob on the end of the peg preventing it quitting its socket in the end of the cane, and then by holding quite still, allow it to resume the upright position. I may here remark that I never yet saw a London street boy spin a top decently (there being at least three ways of doing it). It may be from the fear of splitting tops on the hard stones and of breaking windows with the resulting fragments, that tops in London are universally, as far as I have seen, spun "underhand" in one of two ways, instead of with the bold stroke from far above the right ear, right down to the left hip, that was in vogue at "our" school some 33·3 years ago. We also used fine whipcord instead of the thick string sold at toyshops for the use of top-spinners, and with great advantage as regards velocity of rotation. I am sorry to say in the last sentence of letter 4691, "A., Liverpool," appears to me to "maintain" rubbish, which he will probably not get "Sigma" to attempt to "controvert." J. K. P.

[4719.]—The "curious contradictions" which were found by "E. H." in my letter (4510) are simply curiosities of misapprehension, traceable, perhaps, to some possible obscurity of the language in which I apologise for my own departure from "established ideas." I do not intend to charge "E. H." or others with doing so. I quite agree with "E. H." that the ideas embodied in the "ordinary theory" which I abandon, are not established by sound proof. I spoke of their establishment in men's minds by common acceptance. They crop up plentifully in one form or another, when the subject of the spinning-top is under discussion, and are found in Lardner's "Mechanical Philosophy." I think with "E. H." that Mr. Proctor's theory, so far as we can gain it by venturing to peep into the very little window which he has opened, is the same as "A.'s."

In reply to Mr. Proctor, I beg to say that I am not "eager to invalidate" established laws. I wish to see a new, because a more truthful, application of them to the subject. Without infringing on the rules of politeness, I may well inquire whether he has said anything in his letters to make one satisfied with old solutions? What the soundness of the theory may be which Mr. Proctor holds may be judged fairly from that "one feature" of it which he offers, and which must needs be treated as an essential part of it. I compare two sets of statements, which, in my poor judgment, directly contradict each other. "The moon" (let. 4509) "yields to the earth's attraction as obediently as a pebble drops from a child's hand," and this notwithstanding her distance from the earth, and the consequently diminished force of attraction. Her direction of motion is continually being changed. Here is one set of statements. On the other side are these spoken of: "A top flung through the air;" "the top's weight has time to act, and *eventually* (the italics are mine) "does so act as to change the direction of flight;" it is "insufficient to change the direction in a brief interval." The points of contradiction are surely conspicuous here. The moon's direction is being *continually* changed, the top's direction only *eventually*. The moon yields *obediently* to the earth's attraction, though that attraction is greatly diminished by distance. The top, though within the full influence of that attraction, is not heavy enough, it is evidently inferred, to submit so obediently. "Its weight is insufficient to change its direction in a brief interval." Yet, while the top's insufficient weight is to exempt it from the *continual* change to which the moon is subject, the pebble dropped from the child's hand (and which may well be less heavy than the top) is taken as the example of obedient submission of matter to the earth's attraction from which even the moon is not exempt.

It seems to me that there is no place either for "depths" or shallows of "misapprehension" in such statements as these, and that if the moon in her falling towards the earth crushes "A.'s" philosophy, the flinging of the top, or the dropping of the pebble from the child's hand is equally fatal to Mr. Proctor's. My own glass-house being demolished, I may venture to retaliate on Mr. Proctor's little window, with the pebble he provides me with. I acknowledge the full force of his remark on "action and reaction" with thanks, which I also render to "L. H. O." for his experiments in weighing the top, which seem equally conclusive against both my theories. "L. H. O.'s" explanation does not, however, seem to meet the case. Perpendicular lines are wanted in his explanatory figure (4620), to show the [independent] action of gravitation on the particles at the ends of the diameter of the disc.

Another question, however, and perhaps an important one, grows out of the suggestion and experiments of weighing the top both at rest and when spinning at different angles of inclination to the earth. The whole weight of a top seems to rest on its point of support when spinning at an acute angle with the earth. This would be the position of a falling tree. In this latter case is the whole weight—that of the falling tree—exerted against the support at the base, until the position of absolute prostration is attained, or not? A top spinning on the scale of a balance at an angle (say) of 45 degrees, requires a weight equal to that of the whole top to balance it. If this is not so in the case of the falling tree, or other falling object, by what laws of force or matter is the whole weight of a top [spinning] in the same position transferred to the point of support? Every machine in which the wheel and axle receive rapid motion would be liable to be affected more or less by those laws which regulate the position of the spinning-top. Is this found to be so by the watchmaker and others? J. M. Taylor.

Seer Green Vicarage, near Beaconsfield.

[4720.]—"E. H." says (let. 4690, p. 542) that the axis of a top or gyroscope would maintain the same inclination to the vertical were it not for friction and the resistance of the air. This, however, can only be true when the velocity of rotation is considerable, for if a very slow motion only is given to a top it will fall. There must be, therefore, some definite velocity of rotation, above which the inclination of the axis remains the same, and below which the inclination from the vertical increases, and the top or gyroscope ultimately falls down. Suppose we take a gyroscope, whose entire mass is contained in a ring 1ft. in diameter, and suppose that the distance of the centre of the ring from the point of support is also 1ft., and the inclination of the axis from the perpendicular is 30°. What would be the least velocity of rotation sufficient to keep it from falling, and how is this velocity to be calculated? Gy.

WATCH REPAIRING.

[4721.]—"Aberdeen Watch Jobber" (let. 4609, p. 489) states that I have not made it quite clear *how* to "bump" a Geneva escape-wheel so as to avoid "a smash." If he will refer to p. 421, probably his opinion may change; for at line 13, column 3, he will read that I foresaw the remark, and so dealt with the "bumping" process; then at line 15 I say in other words, "Don't." If this be insufficient, I will write again.

Concerning the bulging of pinion when it is a soft one, "Aberdeen Watch Jobber" is perfectly right so far; but then if the "jobber" should be so unfortunate as to strike the punch with "too much" force, the result will be as he states; but I never saw an escape-wheel so much out of flat as to require so much riveting as would destroy the pinion, as he states. When they are so, in most cases they are originally left so by the makers, the escapement-maker having fitted the rivets too easy in the escape-wheel, and to tighten it had to rivet the pinion so as to bulge the pinion-head. Therefore my remarks concerning "low-priced" Swiss watches are borne out, in which I stated that the materials were left very soft in order to produce them quickly. Seconds' Practical Watchmaker.

TEETH OF WHEELS.

[4722.]—The gentleman who writes "Mechanism" says, on p. 533, first column, half-way down, that the clearance between the teeth of wheels is sometimes wrongly called "backlash." Of course, if it is no more than it should be, "clearance" is the word to use; but may I ask what is the proper word when the clearance is excessive, or else varying in amount from the teeth being badly formed? As I wrote on April 19, p. 125, on the subject of "lantern pinions," and there in third column used the word "backlash" in the latter sense, I think it not improbable that the writer of "Mechanism" had me in his mind when he found fault with the use of the word as above. J. K. P.

DEAR COAL.—HOW IT MAY PROVE A BENEFIT.

[4723.]—Even in warm weather the great price of coal is a misfortune to many, and an inconvenience to more; when winter comes on it will be to all who find it difficult to make both ends meet an addition to that difficulty. Unusual cost of fuel does more mischief, moreover, indirectly than directly, by enhancing the cost of numberless articles for the production of which coal must be consumed, more especially of such articles as iron, bricks, lime, &c. The evident causes of the rise in price of coal are increased cost of getting it and a temporary excess of demand above the supply, the consequence partly of increased consumption, partly diminished supply from shortened hours of pitmen's labour. Coal being an article which many cannot, and more will not, do without, the price may be very considerably raised in consequence of only a small deficiency in the usual supply, as appears to be the case at present, the increased cost of getting coal being considerably less than its increased price. This will doubtless produce its own remedy, for increased earnings will naturally induce other labourers to become coal-getters, until the cost of labour is reduced again to its natural level, unless that be successfully impeded by the operation of the unions of the miners; we must, however, expect, I think, a continuance for some considerable time of the high price of coal, and possibly, at least, a temporary rise.

It is an interesting question whether or not we shall learn the "uses of adversity," and turn our present embarrassment to account, both by diminishing the cost of getting coal and preventing part of its excessive waste, both of which are easy to do if wisely set about, and if done even in a moderate degree would restore the balance between production and consumption, without putting any part of our population upon painfully short allowance. If, as is not improbable, the unions of pitmen attempt with any marked success to impede the reduction of their present unusually high wages by deterring other labourers from sharing in them, an impulse will probably be given to the introduction of coal-cutting machines by which the cost of coal-getting may be permanently reduced, and the tyrannical power of the unions effectually broken. This will, I hope, be one of the lasting good results from the temporary evil; another will be, if many be now compelled to be more economical in the use of coal because it is unusually dear, to learn how to make less coal do the work of more, and if they do learn that useful lesson effectually, a very large permanent saving will be the result of a comparative small temporary loss.

I have before shown that much more than half of the heat produced by the coal usually burnt for warming our houses is allowed uselessly to escape up the chimney, and that a large part of that which is not wasted in that manner is by using single instead of double-paned windows. Coal for mere warming is, however, burnt during part only of the year: during the rest little is burnt in houses except for cooking, and the waste of fuel for cooking is generally greater even than that burnt for warming, besides being more constant and more general. If any one doubts this let him compare the quantity of fuel burnt in an English with that in a French or Belgian kitchen, or in other countries either I dare say, but I speak of those I have seen. I do not know the average quantity of coal burnt in English kitchens, it varies so very much, but I do know that in my own kitchen by the use of a half-open stove instead of range, the cooking is better done with a consumption of about two-fifths of the coal formerly burnt, and that if I chose to look after it myself the consumption might be still largely reduced. I once used a closed stove (more economical, but less agreeable to use than a half-open one), in and on which two small joints and half a dozen smaller dishes could be cooked at once, with coke costing (at present prices) about three halfpence a day. It is impossible to save much out of so small a sum, but I have often doubted the expediency of lighting a fire at all when not desired for warmth, unless for cooking a large dinner. If I had time to spare I would try carefully the relative economy of coal and gas for cooking. I like best meat cooked in hot air or in steam, which is done very easily, either by using Captain Warren's cooking apparatus, or a common pan. The first consists of a smaller pan contained in a larger one with a double lid, when meat alone has to be cooked in it, or with a compartment above for vegetables, when they also have to be boiled in it. A little boiling water is put into the larger pan, which must be kept boiling, and the meat in the inner pan supported so that it is well out of the gravy. The steam surrounds the inner pan, and fills the compartment above it, and the space of the double lid. The meat is thus kept in air at the boiling temperature, and is gradually very nicely cooked. It is as tender as if boiled, and nearly as tasty as if roasted; sometimes we brown it before the fire to make it more like roast meat, which it then closely resembles, except being unusually tender. Now it is evident, if this cooking pan were covered with felt, and if escape of steam were nearly prevented, that the water in it might be kept hot with very little consumption of gas, indeed, I am not sure that it might not be kept hot enough without any additional heat at all, as in a Norwegian cooking-box. In either case it seems very probable that the cost of cooking would be trifling, and nearly all the fuel now burnt for cooking saved. A very simple saving is effected by letting the fire out as soon as the dinner is cooked, very little gas being needed for merely boiling a kettleful of water for tea, or for making coffee.

Gas, though a costly fuel in proportion to the heat it actually produces, is often a cheap one to use, because it need not be lighted before or burnt after it is wanted, while the quantity burnt may with care be nicely adjusted. It would be very much cheaper than other fuel for many purposes, especially for cooking in summer, when heat for warming is not desired, if it were supplied at a price little higher than the cost of making it, as it easily might be with profit to the gas companies. Those companies are, of course, obliged to charge for gas consumed at night far more than the cost of making, often more than twice as much, because the cost of management, the interest and repairs of pipes, and of gasometers to hold gas made at day to be burnt at night must also be paid for, but for gas to be supplied in the daytime, and especially in summer, as gas for cooking would be almost exclusively, no extra cost for pipes or gasometers would be incurred, and any charge for it beyond the mere cost of making (and for a slight increase of leakage if more pressure were wanted) would be clear profit. It would be very easy for consumers who wished to burn gas at a reduced price for cooking, to have a second meter, and not difficult to prevent gas so supplied being used for illumination. The effect of such a change would be a more steady business for the companies, and a great convenience to the public. The winter consumption of gas would be but little increased, because when heat for warming as well as cooking is desired, coal or coke would be generally more convenient and economical, but in summer, when far less gas is used than in winter, and when consequently many of the retorts wanted in winter are standing idle, it would be easy without any increase of the works to make more gas than is at all likely to be burnt for cooking, even if the practice of cooking with gas became general. If it did, not only would there be a great diminution in the consumption of coal, but, what many would value still more, in the production of smoke. The air of London might in summer be as clear as that of Paris, where wood and charcoal are so much burnt, our rain water might be fit to wash with, perhaps even to drink; we might grow flowers in our windows and courtyards, and the trees of our parks and squares would not lose their leaves in early autumn.

The consideration of other modes of saving fuel must be deferred for a future letter if you can spare room for it. PHILO.

COAL IN IRELAND.

[4724.]—THE great advance in the price of coal is a matter which affects almost every one in a pecuniary point of view. The supply of coals falls short of the demand, and any means of increasing the supply and lowering the price would be a benefit to the public. We lately exported coals to Belgium, now we import them, and the question is mooted if it would pay to bring coal from America. In Belfast we are now paying about 30s. a ton for coals which used to cost 18s. I observe, however, that some tons of very fair coal from Coalisland were sold a few days ago in Belfast for 12s. a ton. This brings me to the subject of Irish coal. The coal-fields of Ireland, although much less extensive than those of England, are yet of considerable importance, especially at the present crisis. There is one in Leinster, two in Munster, three in Ulster, and one in Connaught. The coal formation of Leinster extends over large portions of the counties of Carlow, Kilkenny, and Queen's County. The Kilkenny coal is anthracite or stone coal; that of the other counties bituminous. The Leinster coal area is estimated in Griffiths' survey to be 5,000 acres, and to contain about 63 million tons of coal.

In Tipperary there is a coal-field which may be regarded as a continuation of the Kilkenny coal; it is 20 miles long, and six broad at its widest part; a line of railway is being constructed between Clonmel and Thurles to connect the Great Southern with the Limerick and Waterford, which will open up communication with this coal-field. This coal costs 20s. per ton at the mouth of the pit, but the expense of carriage has hitherto prevented it coming into extensive use. The Munster coal-beds occupy parts of the counties of Limerick, Kerry, Clare, and Cork. Sir Robert Kane, in his work "The Industrial Resources of Ireland," says: "They are the most extensive development of the coal strata in the British Empire." There are six layers of coal in this district, according to Griffiths' survey, but the beds are not thick; the coal is softer and more slaty than the Kilkenny coal, but is a kind of anthracite. In Ulster we have a coal-bed in the County Tyrone—viz., Coalisland; its area is about ten square miles. The thickness of the seam is 20ft. to 30ft.; it is situated about 600ft. below the surface; it is used now by the Newry Gas Company. The Connaught coal-field occupies considerable portions of Sligo, Leitrim, and Roscommon; it is about 200 square miles in extent. At the time of Griffiths' survey this coal was sold at the pit's mouth for 4s. a ton! It thus appears that the coal-fields of Ireland are worthy of much greater attention than has hitherto been given to them, and are not unworthy of the consideration of the capitalist. PHILANTHROPIST.

ECONOMY IN USING COAL.

[4725.]—COAL dust or slack may be readily burnt if mixed with clay (say three-fourths dust to one-fourth clay; it throws out great heat, but takes some time to burn up. It would be extravagant to dry it before putting on the fire, as it then burns out rapidly and does not appear to me to throw out so much heat. It is best applied in the shape of large balls. The clay and dust must be well mixed.

At this present time I am burning "culm" (I believe the dust from stone coal), mixed with slime from the seashore, and so partial am I to it that could I obtain it when I leave here I would not burn anything else. The cost is as follows:—

2 tons culm at 9s. 6d.	0	19	0
1 load slime at 1s.	0	1	0
Carting culm and slime	0	3	0
Mixing and slacking	0	2	0
	£1	5	0

The month's supply for three fires.

Shall have pleasure in answering any inquiries.

INLAND.

COAL FOSSIL PLANTS.

[4726.]—WILL you kindly allow me to call the attention of your geological readers to the fact that I shall be exceedingly obliged if any friend could let me have small pieces of calamite, dictyoxylon, sigillari, and the like, suitable for grinding down for microscopic examination, and I should be happy to give a *quid pro quo*. I want them as soon as possible to enable me to go on with some papers on geology and the microscope.

12, Margaret-street, Hull. H. P. H.

GREATLY ELONGATED PROJECTILES FOR RIFLED GUNS.

[4727.]—I SHOULD be sorry to oppose my opinion to that of "The Harmonious Blacksmith" (let. 4652, p. 515), but I must confess that I see one or two defects in his projectile, which I will point out. In the first place, the "ogival" form of head is considered the best, as it offers the least resistance in passing through the air. In the second place, although Mr. Whitworth employed shot which tapered towards the rear with advantage, it has been found that too great a length (with tapering rear) is attended with one great disadvantage—namely, the rear of the shot, being lighter than the forward part, is liable to be blown aside by a moderate wind, and the head turned to windward, causing the gun to shoot to windward in a slight degree. In the next place, the point of the shot, besides not being the best for flight, is a bad one for penetration. Whitworth's flat-headed shot were as good as any for penetration. The "Sabot" might answer as far as it is itself concerned. Wooden bottoms have always been used for shells with smooth-bore guns, also for siege guns with both round shot and shell, and all brass field-guns.

We have some very long projectiles in the service—for instance, the 7in. double-shell is 27·2in. long; it is cylindrical, with ogival head and flat base. Although a very long projectile is theoretically the best, it is found that a shorter one, with quicker spin, is in reality better: for, in a military arm, stability under all circumstances of wind and weather must be the object.

Although the above are the generally-accepted opinions of those in the service, I may say that the best form of projectile is not yet finally settled. If "The Harmonious Blacksmith" could make any experiments with his new form of projectile, I should be very glad to hear the result, and if this letter be not quite satisfactory or not sufficiently comprehensive, I shall be happy to write again.

ARTILLERY CAPTAIN.

[4728.]—"THE HARMONIOUS BLACKSMITH'S" bullet (let. 4652, p. 515) would be all very well if it could be fired without altering its shape. Suppose a "Sabot" could be made strong enough (which I doubt, unless made of some hard metal) to withstand the blow it receives from the charge, the bullet itself would be "set up," and instead of leaving the bore a fine tapering bullet, it would leave a crushed-up lump of lead, anything but fit for passing through the air. This "setting up" action takes place in all rifles where soft lead bullets are used; but, as they are only a very little smaller than the bore, and supported by it, they simply leave the muzzle a trifle shorter than when loaded. I am afraid that a mechanical-fitting soft lead bullet would be too much of a good thing; besides, it would be some trouble to place it properly in the grooves when loading. ARTILLERY GUNNER.

A TOUR ON THE CONTINENT.

[4729.]—AT the present time, when strikes and lock-outs are unfortunately so general in this country, I have found it extremely interesting to travel on the Continent, and notice the difference which exists between German, French, and English workmen, as regards their hours of work and the manner in which such work is done. Travelling is as cheap, though not so rapid, as in this country, and with the aid of Cook's hotel coupons the expenses of living are quite as moderate as in England. With a knowledge of German and French, or indeed with French alone, it is possible to travel, of course, very much cheaper than we can do in this country, for to know the language is to have a double purse. With economy in the way of living, a great extent of ground can be got over, and much valuable information gained from a fortnight's tour through Germany, France, and Belgium; indeed, I know of no route where £15 can be so profitably invested by an English mechanic anxious to obtain valuable information, and a pleasant change of scene at the same time.

Let me mention Antwerp, the first city I stopped at. I got up there on a Monday morning, and found the shops open at 6 a.m., the Cathedral open, and the usual morning services proceeding. The market is generally over by 8 a.m.; indeed, all travellers complain that they are always being disturbed by the ringing of the church bells, and the tinkling of horses' bells in the early hours of the morning, which is to be heard in most continental cities. The working men seem to have an endless week of toil; frequently, have I noticed masons at work after 7 p.m., and Sunday only brings rest to those who can afford it; indeed, in Paris men generally work by the month, taking a day's holiday at the end, sometimes half a day in the middle. It is perfectly astonishing, and very sad, to see the uninterrupted manner in which work of all kinds is carried on day after day in the gayest capital of the world. It made a great impression on me this ceaseless toil, and the value of our English Sunday came to my mind as I had never experienced before. It must be necessary to man's health, to say the least, that he should have one day in seven as a day for rest from his daily work. In Germany, many kinds of work are carried on through the Sunday—harvest operations, for instance; almost all the corn is cut by hand, so that the hands have to be kept continually at work. Of course, there is a difference, and those who can afford, go to church or mass in the morning, and to the open-air Secular Concert in the evening, and appear to enjoy themselves; but, altogether, the value of a pause in the usual daily labour is very little appreciated on the Continent.

I was not in a position to visit any of the large factories at Cologne, or the Iron Works at Liège (the Birmingham of Belgium), consequently, I cannot speak technically of the actual hours of work in such establishments, but that the hours of labour are much longer than they are in England there can be no doubt, if we take the ordinary labouring mason as an example of the usual hours worked; while, as far as I have been able to form an opinion (after visiting Antwerp, Brussels, Cologne, Mayence, Strasburg, Metz, Sedan, Rheims, Paris, &c.), the men have a quiet contented look, and seem submissive to, if not contented with, their lot.

The custom of having the land let out in small lots, and the imperfect and awkward agricultural implements still used in Belgium, Germany (south), and some parts of France, appear to Englishmen certainly singular. The only reaping machine which I saw during my tour was in a large field some 20 miles out of Paris on the Northern Railway, and I naturally conclude that during unusually hot summer weather the corn must ripen too fast for the manual labour employed to cut it. Query, whether an English implement-maker would not make a good thing by sending some reaping machines over for the harvest time.

One word about the battle-fields. Those who expect to see marked traces of the bloody encounters which took place scarcely two years since will be greatly disappointed. Corn now waves and potatoes thrive on the plains of Forbach and the fields of Gravelotte. Little black wooden crosses here and there mark the resting places of the slain. At Saarbrück and Vionville, these crosses are massed together, and form cemeteries, near to which monuments are now in course of erection. The heights of Spicheren, however, should certainly be visited; and as the tourist climes the slippery side, studded with black cherry trees, he may well wonder how any general could have expected such a position to be taken except at a fearful sacrifice—it must have been complete butchery. One large mound I measured was 12 yards long by 5 wide; the base of the hill is dotted with numerous smaller graves, while monuments to commemorate the event now crown the summit. But I must conclude with the remark that the tourist should visit Saarbrück and Metz; Strasburg, too, if he should go as far south as Baden-Baden, but not otherwise, as it is of little interest except for its really splendid Cathedral, from the spire of which a most capital view can be obtained of the Museum, Library, Prefecture, and other buildings destroyed during the siege.

The beautiful scenery of the Rhine, the gaming saloons of Wiesbaden, and the ruined Chateau at Heidelberg, should be duly visited, and will, no doubt, call forth the same feelings of admiration and surprise as I experienced myself. Take all money in English gold, which is the best coinage to carry anywhere on the Continent; don't trouble to get a Continental Bradshaw, as you can get any information respecting the departure of trains at your hotel, but, instead, procure a little book, entitled "The Rhine and its Battle-fields, and Paris," which the traveller will find most useful; the cost is only one shilling, and it is published by Simpkin and Marshall, London. I found it more generally convenient than the large guide book of Baedeker, which gives very full and minute accounts of all the principal places of interest.

In conclusion, permit me to wish your readers pleasant company and fine weather, both of which I was fortunate in obtaining during my late visit.

JOHN HUGHES.

Ivy House, Hendon, London, August 7.

AN ECONOMIC CARRIAGE LAMP.

[4730.]—I HAVE been experimenting on a method of producing a light for carriage lamps which may be worthy the consideration of some of our readers. A frictional electric machine is caused to revolve rapidly by means of a belt and pulley fixed on the nave of the carriage wheel; the stream of sparks collected by an isolated conductor are caused to pass between two small brass balls sufficiently separated, and fixed in the focus of the lamp reflector, where the candle or oil flame is generally placed. Of course, as the carriage moves the light is evolved, and the objection to it is its weakness or want of brilliancy.

A magnet might answer better, but this I have not tried. I submit the idea which, as far as I know, is original, to the readers, hoping amongst them some one will be found to add more light to this most economic lamp. E. B. FENNESSY.

MR. PROCTOR'S GULF STREAM MAP.

[4781.]—The second sentence of Mr. J. Wilson's letter (4657, p. 537) shows the evil of an error I had intended to point out in the "equal-surface projection" chosen by Mr. Proctor for his twice-repeated map, pp. 478, 499. There was no kind of call or excuse for the distortion and excessive lengthening in latitude or compression in longitude, supposing the true ratios of surface the quality most needed. The preservation of equality in *areas* is consistent with any angular opening that might be chosen for the meridians in this projection; while an approach to correct *forms* was only possible by making the degrees on the mean parallel (or that of 40° for the particular extent of map Mr. Proctor had chosen) of their true length relatively to the longest on the scale of chords that divides each meridian, and this would have separated the meridians to about double the opening he has given them, those at the 30° intervals being inclined about 24°, whereas he has compressed them to little more than 12°. This at once alters immensely all the angles, and accounts for Mr. Wilson's remark on the false direction wherewith the current is made to impinge on the British Isles. Some error of this nature, however, would be inevitable in the upper and lower latitudes of any "equal-surface" projection, and leads to the very obvious conclusion, I think, that this kind of projections, instead of being fit, are extremely unfit for this particular object, and indeed nearly the worst that could be chosen for it. They ought to supersede the absurdly deceptive Mercator chart indeed, for most of the purposes of popular maps; for distinguishing political divisions, for giving all the possessions of one power (as in Chambers's capital little map of the British Possessions), for natural history maps, of mineral, vegetable, animal or human distribution, density of population, relative extent of races, religions, languages, staple cultivations, &c. For all these, while Mercator's (by strange perversity the most commonly applied to them, is of all possible projections the most outrageously falsifying and misapplied) "equal-surface" projections are the sole right ones. It would be worth while to place side by side two pairs of figures I once made but cannot now lay hands on, one of Ceylon and Spitzbergen to an identical scale, the other as these two islands appear on Mercator; Ceylon being about six times the larger of them in reality, and Spitzbergen about six times the larger on nearly all maps made at present to include both. But for this particular purpose of Mr. Proctor's to show the *forms* of currents (or, indeed, any forms) I must contend that the proportionality of areas is a very minor advantage compared to *identity of angles.* Now to keep all angles on the map identical with those on the globe, we are not driven to the miserably misapplied "Mercator." There is another projection quite as easy, which keeps all angles identical with their true size, and yet with so slight variation of scale for surfaces that even if extended to include half the world (which it can easily do, and the hemisphere round any point we please) it only doubles the areas at the very border compared with those at the centre. This is the perspective projection from the antipodes of the map's centre (the earth being supposed transparent), the only perspective that makes all circles, whether meridians, parallels, or any other, project themselves by circular curves on the map, and therefore entirely to be drawn with compasses; even a simpler operation than the straight-lined Mercator frame. In applying this to the whole North Atlantic and 10° of the South, or all that Mr. Proctor had to represent, the very extremities, Wellington Channel, Guayaquil, and the Bight of Biafra, would have their surfaces barely a third larger scale (superficial measure) than the Azores or Sargasso Sea; a difference truly immaterial.

What Mr. Wilson says about absence of beaches on all the Atlantic coasts of Ireland and Scotland is very singular, if true, and I suppose will be soon contradicted if not so. But we must remember it is not usual for primary rocks to form any sea-beach, and these are precisely the parts of the British coasts that happen to be primary. Again, there are certainly shores and beaches to the North Cornwall and Devon coast opposed to the current as directly as any part of Ireland. The only secondary cliffs I know totally destitute of beach are those of Portland stone for the few miles between Durlstone Head and S. Adhelm's (miscalled Alban's) Head, Dorset, and these by no means meet any gulf stream, but turn towards the sheltered south-east, looking straight across to Cherbourg, which is said to be sometimes visible from them. So great a length of coast as half that of Ireland, without beach, would surely be a phenomenon almost unparalleled on the globe. E. L. G.

THE HARP.

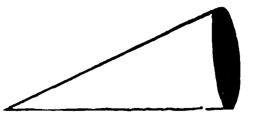
[4782.]—I had no intention of disparaging the harp in general, but merely that defective form of it which can be played in only one major key. This may have done well enough for King Brian and his contemporaries, but it can never hold its own in the nineteenth century against instruments of far greater capabilities. Almost all music that is worth anything, except quite plain simple airs, undergoes some sort of modulation, and then it cannot be played at all on such an instrument as the Irish harp. Transposition would, where accidentals occur, serve no purpose whatever. Would it not be better to sacrifice a few notes in compass and fit the harp with strings for sharps and flats? It might then be capable of becoming a really general favourite, as it is, it is simply nowhere.

Vertumnus.

IS THE MOON SPHERICAL?

[4783.]—I don't know what Ch. Rabache (let. 4639) may be driving at, the moon may be a sphere or not, or green cheese. I'll never be able to go up to see, but I have read two most extraordinary things, which I would like some of our astronomical authorities to deny or confirm. I think it was some Italian savant who told this tale. Observing an eclipse of the sun, when totality took place, he suddenly saw a bright spot burst out in the centre of the moon, and believed this could only be caused by the disc of the sun being seen right through a hole in our satellite. This, I think, is the best example of "moonshine" I ever heard; but such a careful selenographer as Mr. W. R. Birt, I should imagine, could settle this.

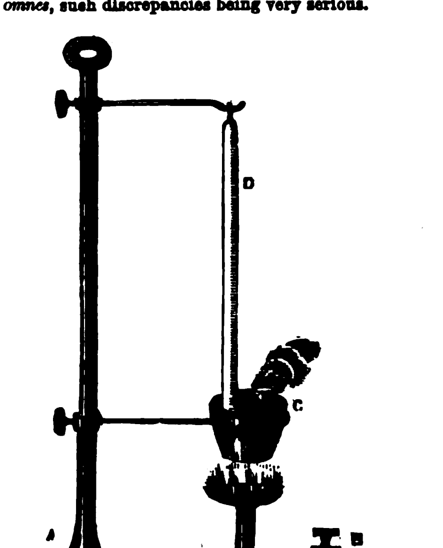
The second stunner was what may be Ch. Rabache's idea, that the moon was of shape shown in the sketch,



with the shaded part turned to the earth. We know there are irrefragable evidences of the presence of water at one time; but my authority said the reverse side of the moon was a great valley into which the water flowed, and may, for all we know, be inhabited by a set of lunatics, and may have lakes, rivers, railways, steamboats, &c., but that the inhabitants never can see us or we them. Except some lunar Livingstone could crawl up to and look over the edge at us when he ought to see a big blue wall in space—blue on account of the colour of our atmosphere. I believe it has been stated that, with our present telescopic power, we could see a building as big as St. Paul's if it existed. Now, Mr. Birt, what do you say to all this? I call it unmitigated trash. M. A. B.

THE IGNITION POINT OF EXPLOSIVES.

[4784.]—In your number for July 26th I perceive an article on the above subject to which, as a patentee, I have devoted considerable attention for many years, and thinking the matter might be interesting to your readers, I send you a drawing and explanation of a very trustworthy apparatus I devised, which appeared in a London magazine some five or six years ago. I am induced to do so the more on account of the very high temperatures assigned to the various explosives given by the gentlemen named in that article, which so astonish me that I fear the method adopted was very faulty. Fibrous gun-cotton, for instance, is put down at 428° Fahr., whereas by my method, which is exceedingly delicate, it is only 320°. So *ex uno disce omnes*, such discrepancies being very serious.



References.—A, retort-stand; B, gas-burner and regulator; C, tin oil-bath to hold thermometer and little porcelain igniting-cup; D, thermometer, ranging to 600° Fahr.

As the accompanying diagram states, I use olive oil as the caloric bath, which will absorb 600° of heat before it boils. Mercury would also do, but is objectionable on account of the fumes, which may salivate a person. The manner of using the apparatus is as follows: Having placed the thermometer and little cup in the oil, proceed to heat the oil up to, say, 300° Fahr., the thermometer being graduated in degrees and half degrees, then let your assistant (for there must always be two persons engaged) project into the little cup as much of the explosive under examination as will lay on the point of a penknife. If it ignites instantly at that point, the temperature must be lowered, and a fresh trial made, and so on. Two or three trials at most will suffice to determine the precise point of ignition. This method has been so far verified that it is now in general use.

John Horsley, F.C.S., Analytical Chemist.

Cheltenham, Aug. 9.

ELECTRICAL SPARKS.

[4785.]—I am in receipt of June number; seeing that the sparks are still flying, permit me to confirm the statement of "Philo's" friend (see let. 4105, p. 199) in regard to lighting the gas by electric sparks from the finger. It is quite possible in this "Canada of ours;" but, so far as I know, only in the winter, in houses heated by steam, and of course only when the steam is on—that is, when the building is warm, at which time and in such houses much electrical amusement may be obtained, such as getting a shock when shaking hands, or when touching the brass knob on the steam radiator, &c. If in the winter any of your buildings in England are heated by steam please try the experiment. To light the gas no special preparation is needed, further than first remove the glass globes (if any), then have some one near to turn on the gas-tap, as you must not touch glass or metal yourself when trying the experiment, now walk up and down the room a few times in your ordinary slippers, rubbing your feet on the carpet as you go, then approach the gas bracket, have the gas-tap turned on, carefully place your finger over the jet, but pointing down into without touching it; do not try the experiment with a crystal gaselier, as the metal pipe is usually disconnected. The truth of this I can prove in the strongest possible way if required. If your readers desire any experiments tried during the coming winter let them state clearly what they wish done, and, if not too difficult, we will try to carry out their suggestions.

I know that this experiment has been tried by competent parties in houses not heated by steam, but unsuccessfully.

Since writing above I have read the letter of "Traveller" (4168, p. 228), and beg to say that I am writing from Canada, and, to be more precise, I may say Montreal, where these facts are not known to all the intelligent persons. I refer, of course, to electrical sparks. I think "Traveller" must be mistaken in regard to the house being warmed by hot-air stoves; nor do I think the presence of sharp frost or snow is needed further than at such times the steam would be sure to be on. His statements about shocks, rubber combs, &c., are quite correct.

I should be glad to have "Sigma" come out here next winter to investigate this matter, when we would introduce him to electrical and other sparks, give him some sleigh rides, toboganing, snow-shoe tramps, and send him home as "happy as a sand boy."

Montreal. Canada Bear.

MATHEMATICAL PROBLEMS.

[4786.]—May I be allowed to make a suggestion which will be, I am sure, acceptable to readers of the English Mechanic? For some time past a chess problem has been weekly inserted for solution, and great interest has been taken in the chess department by many of our friends. I would suggest that a quarter of a column of your valuable space be devoted, in a similar way, to a mathematical problem every week, and to the best solution of the problem of the week before. The problems might be in geometry, algebra, trigonometry, mechanics, elementary differential calculus, &c.—that is, of such a nature and degree as to be of interest to mathematical students and mechanics who love to dabble in the science. The query to which I inclose an answer is a fair specimen of such a problem. I am sure such a mathematical corner would have a great attraction for very many readers. I should be happy to send, occasionally, problems of my own and of Cambridge friends, and should even be willing, for a few weeks, to look over and report on the solutions which would be sent. Aleph.

AURORA BOREALIS.

[4787.]—I last night witnessed from the east pier, Ramsgate, a fine display of the aurora borealis between the hours of 9.30 and 10 p.m. I should be glad to learn if this phenomenon, so unusual at the present season, has been observed elsewhere.

Deal, Aug. 9. A. E. L.

[4788.]—There was a fine aurora visible here for a short time last night, lasting from 9.50 till 10.10 p.m. The longest streamers reached up as high as the pole star. The maximum brilliancy, however, was a little westerly, just underneath the two hind wheels of the Wain.

Plymouth, Aug. 9. LXXXVIII.

INTERNAL RESISTANCE OF A BATTERY.

[4789.]—Will your correspondent "Pi," who notices my method for finding the internal resistance of a battery (as given on p. 359), kindly describe the methods proposed by Mance and Fitzgerald. I should then be able to judge as to their comparative advantages in practice. I may add that, supposing a Thomson's reflecting electrometer to be at disposal, I have found that instrument by far the most rapid and accurate in practice for finding the resistance of a battery. It is merely necessary to note the deflection given with this instrument, and then to adjust a shunt to the battery until the deflection falls to one-half, when clearly the resistance of shunt is that of the battery. I may note that I have tested my method (p. 359) with a reflecting galvanometer, and checked the result with the electrometer, with a satisfactory agreement. S. T. P.

P.S.—The remarks of "O." and others on matters connected with electric science are of general interest.

ON TUNING, AND REDUCTION IN THE SIZE OF MUSICAL INSTRUMENTS.

[4740.]—It is acknowledged by all that it is impossible to tune any instrument perfectly where chords are required to be played on a fixed series of strings, pipes, or reeds. This has become so great a nuisance that I am surprised our makers have done nothing towards remedying it. Often have I heard that the piano and organ would be more enjoyable if they were only in tune, although it is remarkable how many instruments are allowed to remain in a painful state of discord, and, shocking to relate, are continually played upon, to the detriment of player and hearer. All this has been premised by the remarks of "F. R. C. S." on page 487, but I have thought on the subject, and believe something can be done by altering the construction and at the same time making a little sacrifice of perfection—viz., the present regular series having a string or other medium for every tone. I do not believe in perfection in nature, but conceive that all our knowledge of perfection will be more utilised as we study imperfection and try to remedy it as far as we can. I shall now direct the attention of our readers to the fact that there are two notes (not tones) in music that seldom if ever are played together. It matters little whether I take the old notation or any other notations to express my meaning. We must take the key note, and represent it by the figure 1, or by the term doh, or by a dot on or off a line. Now, this key note has another directly under it—for instance, the key C has B next to it, and although by our keyboard and notation no difference is apparent in the relative value or distance of such notes, yet in fact they are the closest or nearest to each other of all the notes in the scale of C. So again, if we take F for the key note, we shall find that E is the nearest in the scale of F, and if we take any other key we shall be sure to find the same rule in force. Do not mistake the note (or tone) above, for that is vastly different, and comparatively a long way off the key note. I have noticed that in ordinary music these two notes, being so closely together, are never used together, and I know of few instances in operatic or classical music where they are to be found so used: I think Beethoven and Mendelssohn to be the greatest users of this discord, but they could not afford this luxury very often. The question is, first, cannot this fact be taken advantage of, and next, could no more efficient tuning be produced by the method? Let us take a pipe or whistle with one hole, to be opened or shut so as to make the two notes, or a string with a lever to act like a finger to use open or shut, or a reed with an appliance for lowering the tone when desired. These contrivances would have to act before the wind enters the pipe, or the hammer strikes the string, in fact, before the tone is produced, or we should hear two notes where one only is required. This is not so difficult as may be supposed, because the notes are so close together that we can play with them more than any of the others in the scale. A string may be played as tuned, although a piece of whalebone is placed lying on the string, when by a little pressure on the whalebone the next tone will be produced instantaneously. According to the pressure used, so would the tone be either higher or lower, and as much as the hole of the pipe was covered or uncovered so would the tone be again. If, then, this idea could be applied, so as to have only one medium for two notes, the size of our musical keyed instruments would be lessened one half, we should be able to play in tune, for every tone would be under the control of the player as in the violin, and we should be able to produce a better shake, trill, or thrill, than we can now, for in organ playing a good shake is impossible at present, while on the flute or clarionette it is quite practicable.

I think the great defect in the violin is a weakness of tone, especially in solo playing or in out-door music. For this reason I thank "The Harmonious Blacksmith" for his new fiddle, and think that if the string could be made to move all the soundboards, a great effect would be produced; and as for the box principle, one piece down each side would convert the spaces quickly enough. A wire string might do, but a bow could not move the string; this without doubt is the difficulty.

I saw lately a piano which cost £100, whose strings were placed slanting instead of upright, with action to correspond, a most laborious piece of work. In another piano I observed that while the strings were upright, the grain of the soundboard was slantwise. The tone of the last is superior to that of the first, and it cost less than a third, besides being more simple in its construction. FIDDLER.

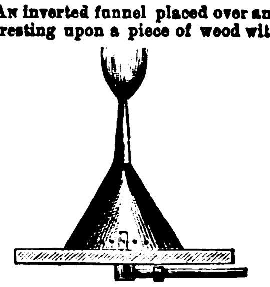
TESTING PLANE AND CONVEX SURFACES.

[4741.]—From time to time the columns of the ENGLISH MECHANIC have contained elaborate descriptions of various methods of grinding, polishing, and testing concave specula, but I do not remember having seen any particulars with reference to convex or plane surfaces. Some little time ago Mr. Tydeman promised us a description of the method of working planes for optical purposes, but his letter has not appeared yet. In the course of my reading I have managed to pick up a few facts with reference to the working and testing of planes, and, of course, the processes for working concave surfaces are almost all that can be required for convex ones, but I can find no account of how to test a convex surface, or how to distinguish between a spherical, elliptic, parabolic, or hyperbolic convex surface, or how to produce or to modify these peculiarities, or even how to distinguish between a regular and an irregular figure. Any particulars will be thankfully received by A. WOOLSEY BLACKLOCK, M.D.

High-street, Godalming, August 8.

A HANDY ATMOSPHERIC BURNER.

[4742.]—An inverted funnel placed over an ordinary gas burner, resting upon a piece of wood with a small

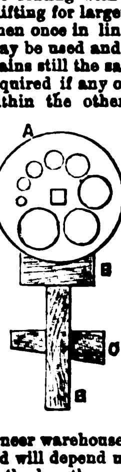


hole to admit it in the centre, as in sketch, will give an intense heat with little trouble of fixing. TINTUB.

ORNAMENTAL TURNING.—XIII.

[4743.]—In my last letter I referred to the mode in use amongst cabinet-makers in glueing and veneering small table tops. Before I leave this subject I will describe a table pillar not in very general use. Teak is the best wood. Turn a rod of teak, 2ft. in length, 1¼in. in diameter. Cut out a pattern No. 1 in cardboard, 18in. in length, the pattern to be, when cut, 1in. wide the whole distance. Procure a board of teak, 1in. thick, mark out six pieces from the pattern No. 1. When cut out, either with fret, band, or bow-saw, round off the edges with a spokeshave and paper them with glass-paper. Make them as round and as neat as possible. When finished, fix the rod upon the bench, plane off a portion of the rod top and bottom, on the underside, likewise the rod, then glue and brad the sweep upon the rod and follow on until the six are fixed. The sides at the top and bottom will require paring so that the six may fit within the circumference of the rod. When the six are fixed and the glue dry, fix the rod in the lathe in the same prong-holes as before, with the long corner of the chisel cut through the sweeps top and bottom until the rod is reached. Care must be used not to touch the brads; let them remain in, a touch with the hammer and punch will sink them below the surface. At the bottom a fillet or rabbet should be turned to allow a small collar to be fixed. The use the pillar may be put to is in every respect the same as that of an ordinary table pillar. A, the pattern; B B, the rod; C C, where to fix the sweeps. The length of the sweep may be varied to suit the fancy.

To turn a fishing-rod (common): Many of "our" readers may be aware that a goodly number of the common fishing-rods are turned in the lathe. The woods most suitable are hickory, lancewood, and yew; but our amateur turners may turn a common rod from ash sticks. I have turned a few out of ash. The wood sold in bundles I found the best. We called them sticks. I paid about 1s. 4d. to 1s. 8d. per bundle, containing about twenty-five to forty sticks, varying according to the thickness. For the purpose of turning these rods a boring collar will be required, to be purchased for two or three shillings, fixed as shown in sketch. The centre of the hole in collar should be in line with the centre of the mandril nose, or it will be impossible to turn properly. The seating for the boring collar can be made of a piece of dry beech, cut out as described, and may be fastened with a wedge under the lathe-bed. The collar or plate should be fastened to the seating with a bolt and nut, for the purpose of shifting for larger holes. If the plate is properly made, when once in line with the headstock any sized hole may be used and still remain in line, as the centre remains still the same. One or two long augers will be required if any of the rods are required to slide one within the other. The cheapest plan is to purchase four augers, say ¼in., ⅜in., ¾in., and 1¼in., take them to a blacksmith, tell him to cut them and strut a piece in, say 18in.; they will be handy at any time required. Those who do not wish to take the trouble to make the rods to slide, may fix them between strut and centre, turn them in proportion, and ferrule each end, or only one end; but two ends look neater. If the ferrules will not fit, file them down a bit while the lathe is in motion. The ferrules are best fastened with needle points—a small hole punched and a needle point driven in and filed off smooth (needle points to be had at the veneer warehouses). The size of the thick end of the rod will depend upon the taste of the maker, as well as the length required; but it is best to make the last joint of lancewood. The ferrules may be made from brass rod, cut to the length required either with a circular saw or an old file. Description of sketch: A, the boring plate, with eight holes of different size; B B, the frame or seating, the lower part B cut to fit between the lathe-bed, also cut with a groove to allow a wedge C to fix to the lathe-bed where required.



SAMUEL SMITHER.

FALL OF A BULLET.

[4744.]—The letter of Francis Lewis (4682, p. 541) deals with a new question. It was assumed that the figure of the earth was not to be considered. Practically it does not greatly affect the result, because if a cannon ball be fired horizontally from a place not much above the level of the ground, the range will not be great enough to give appreciable dip for earth's curvature.

A ball propelled fast enough might go round the earth, precisely as a cow's tail, if it were long enough, might reach to the moon. We can conceive these things. We cannot, however, conceive of those other motions which Mr. Lewis speaks of without first conceiving the law of gravity to be changed. Under gravity no ball could "revolve round and round the earth receding from it every revolution and part of a revolution." A ball might recede continually, but in this case it would not go "round and round;" if it went once round it would *then* be at its starting point—no farther away under any circumstances whatever.

If "A., Liverpool," wishes to retain his views (let. 4691) there is nothing on earth to prevent him. They are not likely to be very generally adopted. If they were, we should be put where people were before the laws of motion began to be recognised. "A.'s" letters are well worth studying, however. They show where beginners are likely to make mistakes. The writers of elementary text-books cannot too carefully note these points, for mistakes of the sort are much more common than one would imagine to be possible. "A." will forgive my setting him as a "horrid example." One has no choice where the ill-informed do not ask for information but undertake to teach.

It would be a useful exercise for "A." to inquire what keeps a kite afloat in such a way that the string rises *above* the point of support. When he has obtained a just answer to this question he can return with advantage to his light globe tied to a string. He will *then* scarcely suppose that such a globe illustrates quite exactly (or at all) the motion of a cannon ball.

RICHARD A. PROCTOR.

OCEANIC CIRCULATION—CARPENTER v. MUHRY.

[4745.]—In two letters, one of which appeared in the ENGLISH MECHANIC of October 6, 1871, p. 72, and the other in *Nature* of the previous day, p. 446, I showed that we were not justified in acceding to Dr. Carpenter's wish to have himself considered the original inventor of a certain theory on the above subject, but I regret to see a constant inclination on the part of English writers to ignore the statements that, in the cause of truth, I ventured to publish. Among those writers I particularly regret to see one so distinguished as Mr. Proctor, and I would ask him whether it is that he did not read my letters (the one in *Nature* appeared immediately under one of his own), or that having read them, and having consulted Dr. Mühry's pamphlet to which I referred, he found my conclusions incorrect.

I am led to my present remarks by Mr. Proctor's late articles on "Oceanic Circulation," where he regards Carpenter, and not Mühry, as the originator of the theory in question. At the same time, while thus complaining, I must say that I fully recognise the ability with which he puts forward his general views on a most difficult subject; and we must all admire the genuine wit and reasoning with which he deals with a certain reviewer, and demonstrates the ignorance of an egotist.

J. B.

[4746.]—I have read with much interest Mr. Proctor's articles on the circulation of the water in the Atlantic, &c. He does not, however, give the cause for the principal motion, which seems to be the primary cause of all the subsequent surface currents—viz., the current which sets from the Gulf of Guinea to the coast of Brazil. Perhaps he would kindly enlighten on this point, such of your readers as stand in need of the information with myself, in a future number.

POPULARIS.

IMPROVED BEEHIVES.

[4747.]—Thanks to Mr. Abbott for his letter (4502, p. 433). I should have written sooner, but waited for his promised photograph and description. Reply 12450, p. 519, however, tells us to spell patience.

Thanks, likewise, to our Danish friend for noticing my difficulties (letter 4628, p. 511), and describing his "centrifugal" honey-taker. This last, I cannot but think, might be much simplified. Would some one describe the American honey-taker which was said (p. 32, No. 366), to be a necessity to full success in bee management?

In spite of thunder and rain this year seems likely, in some localities at any rate, to be a good bee year; if so, we may have to moderate the sanguine expectations which Mr. Cheshire (letter 4629) and others might lead young beekeepers to entertain.

E. T. GRAYS.

NEW DOUBLE STARS.

[4748.]—As my observatory has been under repair, I have hardly done anything with the telescope for the last few weeks. On July 20th, however, I managed to get a set of measures of Mr. Burnham's new double star 11 Scorpii, with the following results:—P = 78·20°, D = 3·75″. The double star 12 Scorpii, to which Mr. Burnham refers in his letter (4549, p. 462), was observed by the late Sir John Herschel, at the Cape of Good

Hope, and is No. 4839 of the "Cape Catalogue," where the components are described as of the 7½ and 10 magnitudes. P = 84·5°, D = ·3″.

In reference to M. Gandibert's remarks (let. 4548, p. 462), I may say that on May 15th I turned my 7¼in. equatorial on μ^2 Boötis, and with mag. powers 425 and 605 thought the components almost if not quite separated. I estimated the angle of position to be about 150°, and the distance 0·6″ or 0·65″. I fancied it rather more open than ζ Cancri; but in this I may have been mistaken. δ Cygni is certainly a rather difficult star to see well, unless the atmospheric circumstances are good, from the disparity of the components. I think that it improves under red illumination. My measures last autumn gave P = 337·92°, D = 1·690″. Epoch 1871·74, mean of four sets.

GEORGE KNOTT.

Woodcroft Observatory, Cuckfield, August 6.

NOTE ON THE LIGHTNING OF JULY 25, 1872.

[4749.]—THE day was very hot throughout. At about 7 p.m. a storm came up from the SSE., accompanied with thunder and lightning (the drops of rain being very large), but it soon passed over to the NNW., the lightning, however, continuing in the N. From a little after 8 p.m. till past 9 p.m, I watched the magnificent display of lightning which took place. There were four distinct groups of cloud between N. by W. and E. by N., from which the lightning emanated. After a while these clouds seemed to merge together, but still there were the four distinct centres where the lightning was produced. I counted the number of flashes in a second and minute; three and four flashes per second were very frequent, sometimes five, and twice I counted six; I also counted forty-six and forty-two in a minute. The lightning lit up the whole group of cloud in which it was produced, which seemed to become glowing and incandescent; but a few small cumulus clouds, just in front, were not at all affected by it, but stood out looking very dark. The lightning continued more or less throughout the night.

Greenwich. W. N. M.

LIGHTNING CONDUCTORS.

[4750.]—THERE have been several letters lately on this subject in the *Times*, and one of the most recent, I think on August 10th, recommended the use of ⅝in. or ¾in. gas barrel, particularly on account of its cheapness. I cannot quite agree with the writer, for a ½in. round iron rod will conduct as well as a ⅝in. barrel, and, including the sockets for joining it together in the same manner as gas barrels are joined, would not cost more than five farthings per foot, instead of the 4½d. per foot of the writer in the *Times*. For a conductor built into the thickness of the wall, I think 1in. or 1¼in. flat bar, ¼in. thick, lap-jointed together, and riveted with two rivets, or bolted with a couple of ordinary ⅜in. or five-sixteenth inch bolts, would come in best, as it would not involve any cutting of bricks. As "Sigma" says, on p. 14 of the current volume, copper, no doubt, is better, size for size; but it would cost at least ten times as much, weight for weight, and is heavier too. I imagine a ½in. iron rod would be as good as a copper one of ⅜in. diameter, and, if inside a house or built in the walls, would last as well as copper would outside a a building. J. K. P.

LIGHTNING FROM THE EARTH.

[4751.]—SPEAKING of the loss of life by the recent thunderstorms the *Globe* says:—"It would certainly appear that the lightning came from the earth and not from the clouds. The body of man or beast acts as a conductor from the overcharged earth. Do not the clouds frequently change from negative to positive electricity, and influence at times those parts of the earth near them so powerfully as to draw lightning from the earth?"

During the late storms I have repeatedly seen, in addition to the ordinary descending forked lightning, ascending flashes likewise forked; but I never saw them in such abundance as during the last great storm, when the ascending flashes outnumbered the descending forks by eight to one. They were sent up in batches of from three to six, while the descending forks were only rarely double. The idea present to my mind the whole time was that Jupiter Tonans grasping the lightnings in his sculptured hand had thrown them together perpendicularly upwards. AMATEUR.

PIANOFORTE TUNING-KEY.

[4752.]—"BEDCA" has produced an implement that is a lever without a fulcrum, and is in the same condition as that of Archimedes when he demanded the ποῦ στῶ. What is wanted to enable it to act is a long lever attached to the central stalk E F, and held by some one else or resting against something solid. As it is represented, turning the handle would merely produce a rattle of wheelwork, resembling what you hear in your eight-day spring clock when the line breaks. J. K. P.

THE WOODEN HOUSE AT NORTH TAWTON.

[4753.]—ON page 445, present volume, you gave some particulars about a wooden house that came from Norway, for a gentleman of North Tawton, North Devon. It was stated that all the workmen required for fixing it came from Norway. But this is incorrect, there being only two foreigners on the building, all the others being men of this town. Living within five minutes' walk from the site, I can guarantee the truth of this statement. The house is being rapidly put together, and I should think from present appearances it will be a nice looking structure. When finished I may, perhaps, give your readers a fuller description with a drawing.

L. W. D.

ANCIENT MUSICAL INSTRUMENTS.

[4754.]—THE following is a list of certain and sundry ancient musical instruments which are *not* in the Loan Exhibition at South Kensington Museum:—

Clavitherium.
Clavicembalo. Specimens are said to exist.
Manichord.
Trumpet marine.
Transposing harpsichord or spinette.

Models of Marius' various piano actions; models of combined harpsichord and piano actions. These are said yet to exist in Paris, and doubtless the "liberal" French Government would gladly have lent them.

Specimens of Silberman's and Steen's pianofortes; the harpsichord made by Tschudi for the King of Prussia, A.D. 1765. Probably Bismarck or the new Emperor of Germany—who are almost as "liberal" as the French Government—would have lent these.

Lyrichord, invented by Plenius.
Screws for tuning harpsichords, &c., Wakefield.
Celestina harpsichord, Walker.
Hammer harpsichord, alias combined grand piano and harpsichord, Merlin. Marius seems to have anticipated this invention.
Celestial harp (extant A.D. 1837), Merlin.
Harpsichord and piano combined, Gillespie. Almost certainly anticipated by Marius.
Transposing guitar, Claggett.
Harpsichord and piano combined, Stodart.
Grand harmonica, Cheese.
Pianoforte with its hammers striking punches which strike its strings, Walton.
Celestes for pianos (some of them with very *un*-celestial effects), Bury.
Teleochordon, Claggett.
Piano, harpsichord, and celestina, without strings, Claggett.
Organised pianoforte, J. Crang Hancock. The inventor was probably related to Crang, who made the organ harpsichord now at South Kensington.
Piano, clavichord, and spinett combined, Gieb.
Grand piano with harpsichord action added, Davis.
Piano with harmonic octave stop, S. Erard.
Upright grand piano whose hammers and dampers are returned by counterweights, W. Stodart.
Harp with a keyboard, Southwell.
Metronome, Eckhardt.
Grand pianoforte with metal bracing (the earliest), Smith.
Volti subito, Antis.
Springs for maintaining the tension of musical strings, Litherland.
Upright pianoforte, about 4ft. high, with strings reaching nearly to the floor, complete metal framing with counter-tension bolts, key-frame made to turn upon pivots, screw apparatus for tuning its strings both singly and for altering the pitches of many strings at once, "soundboard exposed to the air on both its sides" (*i.e.*, not "boxed" in), and rendered capable of producing continuous sounds by hammers which are caused to repeat their blows at intervals too minute for observation, J. J. Hawkins.
Claviol with gut strings, horse-hair bows, pedal keys, harmonic octave stop, knee levers for rosining its bows, &c., J. J. Hawkins.
Apparatus for recording performances on keyed musical instruments, J. J. Hawkins and Earl Stanhope.

But for the Commissioners' perhaps wise rule, which, by the way, has been departed from in the case of her Majesty, I could largely extend this list, and could myself have contributed a terpodian, said to have been invented by Bushman, of Hamburg, about A.D. 1810, also a sostinente pianoforte.

THE HARMONIOUS BLACKSMITH.

ERRATUM.—"Ornamental Turning," p. 332, read 9d. to 10s. instead of 9s. to 10s.

ERRATA.—In letter 4651, p. 515, 5th line, for "16*a* to 7*a*," &c., read "16*a* – 7*a*," &c.; and in the 23rd line, "*a* inches" should be "3*a* inches."—PHILANTHROPIST.

Leroy's Non-Conducting Composition.—We have frequently had occasion to speak of the virtues of this compound as a covering for steam boilers, and more than once have drawn attention to its usefulness in preventing radiation of heat from roofs to the interior of houses. Further records of the results obtained from its employment are published by the *Times of India*, from which we learn that the temperature of a police chowkey, the roof of which was covered with Leroy's composition, was found on an average of seven days to be nearly 93° Fahr. at noon, while in a similar hut, but without the covering compound, from readings taken on the same days at the same hour, the average temperature at noon was 104⁴/₇°, or say 104½° as against 92½°—a difference which could not fail to make itself felt. The temperatures were also taken at 9 a.m. and 5 p.m., and the general average shows a still better result in favour of the composition covered roof. These are facts which speak for themselves.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[11621.]—**Killing Roots of Trees.**—In the region of Lake Superior they practice the following:—In the autumn bore an inch or an inch and a quarter hole (according to the size of the stump) vertically into the middle of the stump, 18in. deep, and put into it an ounce to an ounce and a half of saltpetre; fill the hole with water and plug it up; in the spring take out the plug and put into the hole half a gill to a gill of kerosene and ignite it; it will go on burning without any blaze until the whole stump to the extremity of the roots is consumed, leaving nothing but ashes. The stump must be moist, as an old dry stump will not be penetrated by the saltpetre.—CANADA BEAR.

[11849.]—**Printing in Canada.**—From reading this query I presume that "A Country Printer" desires to begin business in Canada as a printer. I think this would be unwise until he had spent a year there as a workman. Good workmen readily find employment in Canada; the wages in Montreal are from 10 dols. to 14 dols. per week (for good men)—that is (say) £2 to £3 English money. It would not do to bring material, as it is manufactured here, therefore bring money. Prospects good.—CANADA BEAR.

[12054.]—**The Needle Lock.**—I do not think that "Saul Rymea" need wonder at my crying out against the word unpickable, though he did not use it himself, because in the original query, to which the above number refers, the description of "the needle unpickable lock" was asked for, and the needle lock was the manufacture of "The Unpickable Lock Company." Against the idea of a lock being unpickable I protest strongly, and hold that opening a lock with a fictitious key is to all intents and purposes picking it. But, instead of being unpickable, the needle lock is not so secure against the simplest ordinary methods of lock picking as any common lever lock. The ease with which it may be forced by other and more simple means than a complicated "Jack-in-the-box" (these means I need not particularise), to which "Saul Rymea" refers, and which but few of the artists in burglary would care to take the trouble to use; also the ease with which it lets itself get of order, and refuses to answer to its own key, are reasons which make me demur to the needle lock being called "one of the best locks ever invented." The same means of forcing that I have hinted at would not have the remotest effect on the Citadel lock, neither would Chubb readily yield, while the needle lock would at once be at its mercy, and this by such an instrument as may be carried in the waistcoat pocket. The Unpickable Lock Company spent large sums in the production of this lock, but it would seem that the public found that it did not bear out the promise of its name, for the sale has been almost *nil*, and the manufacture of it has been, I believe, given up for many years. All the principal improvements in modern locks have been directed mostly to the protection from force, and this appears to have been especially studied in the Citadel lock, a specimen of which I would ask "Saul Rymea" to procure and study, both as regards its security from the effects of force, and also the simple manner in which it places difficulties in the way of the expert in lock picking, so that he may confess that the delicate though clever needle lock cannot hold even the subordinate place of "one of the best locks ever made."—Q. YORKE.

[12144.]—**Timber Houses.**—As "Philo" wished to be informed, on page 441, if I had tested the difference of a thick and thin layer of inclosed air, I beg to call his attention to the results of a couple of experiments which I have just made with different-sized bell-glasses (such as are used by confectioners) and two thermometers. (I was sorry I could not get a third thermometer as a check on the indications of the other two; but "Philo" may conduct some similar experiments on a less rough method for greater accuracy.) In the first place I stood the thermometers on a thick mahogany table, and placed a bell-glass over each, keeping the instruments as nearly as possible in the middle of the glasses. Both thermometers indicated the same temperature at the outset, and rose and fell with the variations of the weather during a very changeable day, though not to a precisely similar extent. By observing each thermometer attentively I noticed that the one inclosed in the small bell-glass, which was only 6in. in diameter (the other being a foot, and nearly 4in. higher), was more susceptible to a slight change in the outside temperature, but the difference in degrees as indicated by each was hardly appreciable. I then took out a thermometer from under the small glass and hung it on the wall of the room, and the mercury in it fell at once to a degree lower than the other still under cover, which I supposed to be air-tight. This was in the evening, when the weather grew somewhat colder than what it was a few hours before. There was no fire in the room, which was the most central in a large four-storied house. Bringing the thermometer from the top to the bottom story, and to the outer rooms, slightly variable readings were obtained, while the mercury in the thermometer under the cover remained for the time stationary. I then obtained a large box and placed it over the bell-glass, covering one thermometer, while the other was left uncovered. Removing the box after a few hours an almost imperceptible change was noticed in the position of the mercury, while that in the other had fallen considerably. In all cases I made the wooden and glass covers as air-tight as possible by inserting long strips of rubber under the edges.—Rat-Tat.

[12181.]—**Violin Case** (U. Q.).—See answer to query 12459, p. 519, present volume. The best thing for you to do is to get an American cheese-box from your grocer's. These are made of various tough woods, such as birch, rock elm, ash, &c.; they work up beautifully for such purposes.—Jack of All Trades.

[12198.]—**Extracting Iodine from Seaweed Ashes.**—The ashes or kelp is lixiviated with water, and after separating all the crystallisable salts there remains behind a dense oily-looking fluid, called "iodine ley," to which sulphuric acid is added, and after standing a day or two the acid ley is placed in a large leaden retort and gently heated with black oxide of manganese. Chlorine being produced very slowly liberates the iodine.—Horatio.

[12201.]—**Reducing Pith to Pulp** (U.Q.).—A rather difficult job, I should imagine; worse than cork. Treat it to a bath of caustic alkali or nitric acid; then drive it through a pair of sand stones, running horizontally, the same as mill stones.—Jack of All Trades.

[12210.]—**Manufacture of Blacklead** (U.Q.).—This material can be reduced in a runner, as described some time ago for foundry black. Some of the finer sorts, I believe, are reduced by mixing with chlorate of potash, and calcined in a crucible. Ingredients used for adulteration: Sulphate of lime, charcoal dust, and soot; finished by pressing into polished steel dies.—Jack of All Trades.

[12220.]—**Superheater** (U.Q.).—The querist does not say what class of boilers. If Cornish, place either a circular or else waggon-shaped one in the flue end. If boiler-plate chimney ends, have a tabular one.—Jack of All Trades.

[12222.]—**Iron Castings** (U.Q.).—I presume that "Caster" means the solid moulds taken from wax figures; if so, I was informed years ago that those beautiful iron and bronze figures, knights in armour, filigree work and drapery, are done in that way in Italy and Berlin.—Jack of All Trades.

[12231.]—**Iceland Spar** (U. Q.).—Iceland spar can be cut and polished upon a lapidary's or diamond-cutter's wheel.—Jack of All Trades.

[12234.]—**Hairsprings** (U. Q.).—Yes, they have gauges. The wire for hairsprings can be got upon reels of any size required. You cannot do better than put them the same as before.—Jack of All Trades.

[12243.]—**Turpentine and Wood Naphtha** (U.Q.).—The former is used for paints and various varnishes. The same with the wood naphtha, as well as lacquered and japanned goods, waterproof hats, bodies, and French polish. The first is got in various ways, principally from the distillation of the juices or sap of firs, which is collected for that purpose. It can be got likewise from cobs, foliage, and loppings, subjected to destructive distillation in a retort, the products being acid, a light spirit called camphine, and turpentine; the residue, pitch. Wood naphtha is got the same way from oak, ash, beech, &c. Products: Pyroligneous acid, naphtha, a dead oil, and pitch. I know of no work upon it.—Jack of All Trades.

[12245.]—**Chemical.**—Olefiant gas may be separated from marsh gas by passing it through Nordhausen sulphuric acid—that is, the fuming acid. Common oil of vitriol does not succeed so well, as the gas must be kept in contact with the acid for some time before complete absorption takes place. R. Terret may also change olefiant gas into marsh gas by passing it through a red-hot tube filled with pumice-stone, but should the temperature be very high, acetylene, or even hydrogen gas, may also be produced; a pale red heat, but not a white, is the proper temperature.—J. W. J.

[12246.]—**Seven-keyed Tuning-fork** (U.Q.).—This must be tuned to G when the slides are home to the bridge.—Jack of All Trades.

[12248.]—**Sheet-iron Fireproof Deed Box** (U.Q.).—This should be treble; an air space between the outer skins and between the inner; nothing better than loose fire clay.—Jack of All Trades.

[12254.]—**Aerostatics** (U.Q.).—Such a vast surface of the atmosphere must be acted upon before we can get anything like buoyancy, and the friction is so great that it requires an enormous amount of power to overcome the friction of the atmosphere; but if the weight is sustained, a power can be applied that will drive it where you like with little expense. The time is not far distant when those who feel inclined for an aërial trip may take it.—Jack of All Trades.

[12272.]—**Electrotyping.**—If "Zoo Andra" refers to p. 20, Vol. XIII., he will find some information which will help to put him right. This volume contains what I may term the "whole art" of electrotyping. In the electrotypes used by printers, "Zoo Andra" may rest assured that the copper is *not* deposited on the lead backing; neither is rosin used as a flux. Solder and chloride of zinc are the means usually employed to unite the backing with the film of copper. Heating the shell without spoiling it is the great difficulty for an amateur.—Saul Rymea.

[12289.]—**Electric Bell** (U.Q.).—I send an extract from the descriptive book of Tyer's bell instrument, which will explain the construction to "J.W.T." Of course, any suitable battery can be used with these instruments; but the mercury cell is that generally employed, requiring no porous partition. A series of ordinary preserve pots would of course do. The chemicals required are zinc, mercury, sulphuric acid, with platinised silver and guttapercha-covered wire. In the bell instrument the "exterior indicator on the dial is moved by a piece of soft iron, not permanently magnetised, and therefore cannot be demagnetised or its polarity reversed by lightning. It is actuated by transitory currents of electricity traversing a suitable coil of thick wire, and is only rendered magnetic at the moment of the passage of such current, by which means it is deflected either to the right or to the left as the case may require, and is retained in its position by a powerful permanent magnet of the horse-shoe form; and these being fixed away from, and out of the influence of the coils, are not affected by atmospherical charges of electricity, and, having their 'keepers' constantly attached to the poles, retain their magnetism for a prolonged period; and by a recent and very simple arrangement, these permanent horse-shoe magnets can at any time be recharged to saturation without disturbing the instrument or sending an inspector to perform this duty. The indicators can likewise be retained in their position by a very simple looking apparatus, so that no unusual vibration of any kind can alter their position. The coils, also, being wound with wire of considerable sectional area, allow ordinary charges of lightning to pass freely to 'earth' without injury to the instrument."—Tagee.

[12291.]—**Nature Printed Leaves** (U.Q.).—"Bobo" will find a description of the carbon printing process in the Photographic Almanacs for 1870. He can also obtain Mr. Johnson's specification from the Patent Office, "Manufacture or Production of Photographic Pictures," 1869, or go there and look at it. But possibly some of your readers will write a short description of a process which has not, I believe, been described in the English Mechanic.—Saul Rymea.

[12311.]—**Hydraulic.**—Some of the answers to this query exemplify the absurdities into which the mere theorist is often led. Let me ask H. Meyer and "C. R." to stir a little sawdust with a glass of clear water and then suck the water up through a tube. They will observe the sawdust crowding in from above, beneath, and from all sides—of course following the water. They can then draw their own inferences. "C. R." talks of the surface-water descending "in obedience to atmospheric pressure." Now, the atmosphere acts in the same way as a solid piston on the surface of the water, pressing it down, and the reaction of the bottom of the well presses the water up as much as the atmosphere presses it down. Let us suppose a particle at the mouth of the tube kept in equilibrium by opposite equal forces all round it. When the pump is worked, and consequently the downward force on the particle partially removed, the upward force, which was before neutralised, now forces the particle upwards, and fresh particles rush from all sides to supply its place. Thus the liquid at the mouth of the tube being sucked up, water rushes in in all directions. For a full explanation of the phenomenon further particulars would be required. If an ordinary well, the water would quickly subside to the level of neighbouring springs, and would not wait to be pumped out. One thing is certain, the water would be homogeneous from top to bottom. The following theory would explain the facts stated. The ordinary water level being 10ft. from the bottom, the rain would raise the water level of the neighbourhood another 10ft. (say). During the continuance of showers the surface of the well would be above the gradually rising water-level, so that there would be a percolation from the well outwards which would purify the water in the well, so that finally it would be filled with nearly pure rain water. The lowering of the surface of the well from the daily domestic use would about keep pace with the sinking of the whole water-level of the neighbourhood, so that there would be but little percolation through the sides. When, however, the water had sunk 10ft. (that is, to the natural level), the consumption would lower the surface of the well below this level, and the percolation of spring water would render the well again brackish. There would be a more constant supply at the natural level. This being a very interesting subject, further particulars from "Glaston" would be of general interest. Does he think the theory will fit the facts as he sees them?—Aleph.

[12311.]—**Hydraulic.**—From what source "C. R." derived the information embodied in his reply to "Glaston" (see p. 513) it is not easy to imagine. It seems rather one of the old sort of foolish practical jokes that have been condemned by all sensible correspondents cropping out again. "Glaston" can hardly wonder that when to his usual 10ft. of water, of "brackish and salt" quality in the well, an addition is made of pure water 15ft. deep (sufficient to fill the well), the quality of what he obtains by pumping is greatly improved. This improvement will remain unaltered until he has drawn the water down again to its old level of 10ft. deep, because in the mean time, so far from any more water entering the well from the springs or the drainage of the water-bearing stratum, the water of the well is, on the contrary, percolating outwards, from the fact of its surface-level being higher than that of the water in the ground outside. As soon, however, as the well is drawn down to the old level of 10ft. deep, then for every gallon pumped out a gallon of brackish and salt water enters from the surrounding ground, and the quality of what is pumped up will very rapidly return to its normal condition, or what it was before the rain-water was allowed to run into the well. "C. R." says truly enough that the end of the suction-pipe being near the bottom or high up does not matter generally. In any case the water immediately opposite and surrounding the entrance to the pipe is first drawn in; and I have known of a brick-bat that had fallen into a well being sucked right up the pipe into the valve-box, in a case where the pipe which was only 10in. diameter had to supply three 10in. pumps working at high speed; but then the end of the pipe was very deep in the pump-hole, and had no basket round it. I need hardly say that the pump broke down instantly.—J. K. P.

[12339.]—**Veneers.**—"Shanington" can obtain veneers any size and quantity as well as quality, at a warehouse in Shoreditch, or the Curtain-road, London, at prices to suit his pocket. If in the country I will execute a commission for him free of charge, less the cost and packing—that is, if he advertises his address in the Mechanic.—Samuel Smither.

[12347.]—**Stroke.**—I should like to make a few remarks on Molesworth's formula for the weight of the fly-wheel; if I should be in error, "P. W. H. J." or others will kindly put me right:—W = weight of the rim in cwts. $= \frac{PS}{45\,D}$ (1), P being the total average pressure on piston in pounds, S = stroke in feet, and D = mean diameter of wheel in feet, D = stroke × $3\frac{1}{2}$ or 4 generally. Suppose D = 4 S, and substitute in the formula (1), we get $W = \frac{PS}{180\,S} = \frac{P}{180}$, an expression in which W is made to depend on P. Now, it is evident that W should depend also on the speed of the engine, and also on the number of revolutions per minute, and thirdly on the degree of regularity of motion required, according to the purpose for which the engine is intended. A rapidly-moving fly-wheel has, *cæteris paribus*, more *vis viva* than a slowly-moving one, and if of the same weight will cause the ratio of the least velocity to the greatest to be more uniform. In the case of a pumping-engine irregularity does not matter much, but in some manufactures a very regular motion is required. No fly-wheel can produce a uniform motion. Would not some secondary compensation be useful along with the fly-wheel?—Philanthropist.

[12352.]—**Centrifugal Pump.**—Before assuming the duties of monitor to correct an error which "A., Liverpool," presumes or fancies, from rather indifferent grounds, that I have formed, he should have tried a simple experiment with water confined in a tube in the manner suggested. The arrangement I proposed is more like the principle of an ordinary injector than the spray apparatus to which he alludes. Doubtless, if an orifice for the escape of the water was provided, about an inch in diameter instead of 6in. or so, the water would be driven out in the form of spray, through the opening, supposing no considerable length of pump to be attached; but if this spray be made to pass through a bent tube, or a coil, water issues out in an undivided column. "A., Liverpool," may also try the following as a way of getting him to understand what sort of an arrangement I wished to suggest to "Teachable." Procure a copper or brass pipe a couple of inches in diameter. To this solder a tube somewhat larger, and of any shape, or screw both together, which is the best plan. Dip the end of the apparatus thus formed in a vessel containing water, and allow steam to enter a little below the joint. The steam feed is to be pointed upwards towards the top of the tube bent in the form of a siphon, and I could guarantee all the water will pass through the apparatus in a few minutes. Of course the condensed steam will have mingled with the water raised, but in pumps for mines, quarries, and general drainage works conducted underground, this, in my opinion, is a desideratum, as the exhaust steam is thus easily got rid of. For a drinkable fluid condensed steam from an iron boiler is very pure, and when mixed with other water tends to destroy germs and remove or precipitate impurities. But as I do not wish to enter on dangerous and forbidden ground, over which Montaigne holds undisputed sway, the question of purification by condensed steam may be left out of consideration until some other time. "A., Liverpool," may confine the water to be raised in a reservoir, natural or artificial, which is covered over air-tight with an iron or air-tight lid. At the bottom of the vessel form an opening, and attach a valve opening inwards, through which the water enters to find its own level. To an opening at one side, near the bottom, an exhaust pipe is to be attached, with a ball valve and metallic saddle a little above the junction. When the water has filled the reservoir to within about an inch of the top allow steam to enter through the lid, from a pipe communicating with the boiler. The water will at once raise the ball valve, and ascend through the pipe from the pressure of the steam above, while the bottom valve is closed simultaneously from the same cause. In this experiment the steam does not so soon condense as in the former, but expands and fills the space formed by the forced descent of the water. "A., Liverpool," may hold a different opinion, but when steam does not immediately mingle with a cold fluid or water of colder temperature, but merely rests upon it, as it does in this case, no condensation takes place until a comparatively long period has elapsed, and the upper surface of the water has time to influence the entire volume. In fact, the heating and compression of the thin layer of inclosed air at the top tends to maintain the temperature, and if steam is admitted when this space is filled, and instantly cut off, the quantity admitted from the force of expansion will be sufficient to empty the vessel if not disproportionately large. To obtain a continuous supply from this sort of pump the reservoir might be partitioned off in two divisions, and furnished with double valves, feed, and exhaust pipes. Or "A., Liverpool," may take two cylinders of equal dimensions, fitted with bottom and ball valves in the same manner. In the inside of each cylinder insert a floating air-tight piston. The action of the floating piston is thus explained: Water is made to enter the bottom valve with such force as to raise the float. To this is attached an upright rod, which, when raised with the piston to a certain distance, lifts a sliding cover from the face of the steam feed, and allows steam to enter, which at once forces down the piston, which at a part of its stroke brings down the sliding cover and closes the feed-pipe, while a corresponding rod attached to the opposite side of the piston opens the exhaust port. In none of the above experiments is the steam "instantly condensed," as "A., Liverpool," appears to think in one case where he makes an opening for the raised water above the steam nozzle. If I understand "Micawber" rightly, he says a continuous jet of high-pressure steam divides and passes through a fluid body of any temperature, like a bar or sheet of red-hot metal. It cannot then on entering be "instantly condensed."—Rat-Tat.

[12356.]—**Malleable Castings.**—The cast iron from red hematite is generally preferred for making malleable castings, finely-divided peroxide of iron being the acting agent in the process, removing carbon from the surface. The castings, which are very brittle when removed from the moulds, are packed in cast-iron crucibles with powdered red hematite, and submitted to heat in a furnace somewhat like a cementation chamber. All the apertures are closed and heat slowly applied and continued for from three to five days, according to the depth of malleability required. Castings prepared in this way become brittle on being heated, and are generally worked cold. M'Haffie has adapted the process in the construction of various portions of machinery, and it is largely employed in the manufacture of keys, buckles, gun-locks, toothed wheels, screw-propellers, &c. It is possible to case-harden the articles when finished, so that steel, malleable, and cast iron are to be found in the same article. If the goods are more than ⅜in. thick, a kernel of very soft cast iron is always left in the centre. Any description of good cast-iron can be made malleable by this process I believe.—B. M. J.

[12408.]—**Quill Pens.**—There are two methods of preparing goose-quills for pens. In one the quills are suspended in a strong vessel containing water which reaches nearly to the ends of the quills. This vessel is capable of being closed perfectly steam-tight. After submitting the quills to three or four hours' hard boiling in this position they are withdrawn and dried. The next day they are cut and the pith withdrawn, they are then polished with a piece of cloth, and stoved. This plan yields the best pens; but in ordinary practice the quills are merely plunged into hot sand (212° Fahr.) for a few seconds, scraped with a blunt knife, polished with a piece of woollen cloth, and stoved. In both processes the stoving must be very mild.—Tages.

[12432.]—**Testing Beer and Spirits.**—"J. W. F." can ascertain the strength of a sample of beer or spirits by Sykes's hydrometer. Price, with tables (glass), from £1 to £1 10s.; (metal) from £1, second-hand, to £4 4s. new. The beer and the spirits should, if they contain sugar, salt, or any other matter in solution, be distilled, and the original bulk made up with water before the hydrometer is used. The operation is conducted as follows:—Take a glass flask holding sufficient liquid to float the hydrometer, make a mark in the neck, and fill to the mark with the beer or spirits. Transfer to a retort, washing out the flask with water, the washings to be added to the sample in retort. Distil over in the retort (using the marked flask for a receiver) till about two-thirds of the liquid has come over; fill the flask up to the mark with water, and test its contents by means of the hydrometer. Should "J. W. F." require further information I shall be happy to give it. If he requires to test the beer to find its original strength before fermentation the process is more difficult. The above operations should be conducted at or near a temperature of 60°.—R. H.

[12432.]—**Testing Beer and Spirits.**—The reply by "M. A. B.," p. 519, is erroneous. Sykes's hydrometer will test spirits only. A good instrument cannot be purchased so low as the highest price he states; the prices range from 40s. to 90s. Beer can only be tested by distillation, and is the method used by the Excise to find the original gravity. The saccharometer is used to try the wort, but after fermentation it would not show the strength. It would show porter much stronger than ale, although the first might be the weakest.—Inland.

[12436.]—**Chromo-Lithography.**—In the following short description of this art it is as well to commence at the beginning—the quarry. The stones used are a kind of limestone; their qualifications are—to effervesce with an acid, easily affected by grease, and absorb water readily. They are found in various countries, but the best come from Solenhofen, in Bavaria. They are there sawn into various sized blocks of the average thickness of 3in. or 4in. When they arrive at their various destinations they have the appearance of ordinary paving-stones. The history of the invention may be summed up thus: Aloys Sennefelder, a poor author, residing at Munich, in Bavaria, about the year 1796, being anxious to publish his writings cheaply, experimented for this purpose. He found that soap, wax, and lampblack melted together, made into ink, when written on plates of various metals, and allowed to dry, resisted aquafortis. His mother on a certain occasion wished him to take an account of some linen that had to be sent to the laundry. Having nothing else at hand, he wrote it on a stone with the above ink. After he had written it, the happy thought occurred to him to try and print from it. He eat away the uncovered surface of the stone by strong acid, and printed from the writing which remained. This, in short, was the beginning of poly-autography, as it was at first called. This eating away by acid he afterwards found unnecessary; and it may be as well to state that every original idea—*i.e.*, the foundations of this art—was invented by Sennefelder alone, the introduction of improved machinery, &c., being common to many other inventions. The chalks, which are similar in appearance to the ordinary crayons, as also the ink, are composed of tallow, virgin wax, shellac, common soap, and lampblack, in various proportions. The printing ink is composed of burnt oil or varnish, and lampblack, or whatever may be the colour required. The stone is made to possess a very flat-grained face on the one side for drawing on; by placing over it another stone, the upper one is kept in motion, and the sand which is placed beforehand between the two produces with water the fineness or coarseness of granular surface sought after. The stone, when dry, receives the drawing by the artist, who proceeds exactly in the same manner as he would on paper, with a crayon (only more carefully, as every mark that is placed on the stone will afterwards print), a painting or drawing to be reproduced having been previously placed before him. In a simple white and black representation the subject is all drawn on one stone; where there are more colours than one, a separate stone is required for each, as it involves a fresh printing for every hue; there is one colour only to a stone. In a picture containing a dozen there will be as many stones, but the number of tints or colours vary very much. There is first the key drawing, having the main outline, and such parts finished which may appertain to it; this is, in fact, a map of the whole. This key or map is printed and then transferred or "set off" to all the other stones wanted to complete the picture, as many impressions from the key-stone being taken as there are transfers wanted. The artist proceeds to draw in each tint in its proper place, in relation to the painting before him as copy (all the parts of the drawing which may be in one tint), one colour only to a stone. On the key-stone, near the edge, he draws certain marks which are transferred with the key drawing to the others. Exactly on these marks on every stone the printer drills a small hole, sufficient to drop a needle point into. In each succeeding impression the marks which are printed from the key-stone to the paper are pierced by the needle, and so carried with the paper to the new stone; the needle drops into the hole. He does this with great care, by lifting up the edges of paper, &c., to see if all is right; the needles are then abstracted, and the paper left on the stone. This, properly done, is technically termed a correct register. The stone, which is in a moving tray, having been previously damped, then inked by a roller, the leather tympan is shut down over it, the whole drawn very tightly beneath a boxwood or other hard scraper (this gives great pressure), and so on for every impression to the end of that particular colour. And, again, this process is begun and carried through with every stone required to perfect the copy of prototype. A litho-press, by the way, somewhat resembles the ordinary Stanhope printing-press. The leather which is pulled down on to the stone in the lithographic answers to the tympan in the other; but in the ordinary letter-press simple downward vertical force is used—in the other the stone is moved by a handle over a roller and under the fixed scraper. There remains to be described the process between the time of its leaving the artist and the arrival at the printer's. In order to render the drawing capable of being printed from, a weak solution of acid is poured over the surface, which unites with and neutralises the alkali or soap contained in the chalk or ink, and renders it insoluble in water, otherwise it would all wash out. When the printer is about to take an impression, he first wets the entire surface with a sponge filled with water, and where the drawing is, being greasy, remains dry; every other part of the surface absorbs the moisture. A roller, properly covered with printing ink from a slab, is now moved over the whole upper surface of stone; the oil or varnish contained therein attaches itself to the portions where the drawing is—nowhere else. The damped paper is then laid over it as before described. To render this account more definite, it ought to be stated that the same sheet of paper that receives the impress from the key-stone (not the transfer sheets—that is a different business altogether) receives also the impress from each and every other of the colour stones separately, till it has obtained all their contributions, and so the cromo-lithograph is brought to perfection. Lastly, the principles involved in this art are the mutual aversion of grease and water, and the absorbing power of the stone for both.—A Working B.

[12438.]—**Chess.**—Of course any re-entering (or endless knight's tour answers this query, and it is easy to invent no end of re-entering as well as of nonre-entering ones; but it seems to me impossible for a tour of the whole board to form a symmetrical pattern, and I should like to know if any proof of this impossibility exists. It is easy to render Mr. Meyer's tour (p. 546) a regular pattern, by turning two of the white lines, namely, instead of those going from *7a* to *6c*, and *5b* to *4d*, let the former go to *5b*, and join *6c* to *4d*. But then it becomes two separate endless tours, of 32 steps each. Again, I find it easy to cover symmetrically 62 squares, either with a re-entering tour or one whose ends are separate, and *any* 62, I think. But it seems essential to omit 2 squares. Is this dependent on 64 being an "evenly even" number? Can it prove necessary for a symmetrical pattern to cover an "oddly even," or one whose half is odd as 62?—E. L. G.

[12444.]—**Day and Night Telescope.**—The word "unveiled," in reply on p. 519, should be "inverted."—Philanthropist.

[12457.]—**Geometry.**—To inscribe the largest rhombus in a given triangle A B C, with one angle of the rhombus at A, you have only to bisect that angle, and the line will meet B C at the point whence parallels to A C and A B will form the rhombus. "P. W. H. J.," p. 546, only produces a rhomboid.—E. L. G.

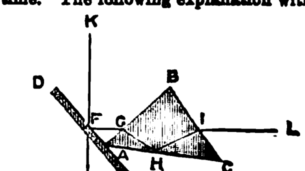
[12458.]—**Blowing Apparatus.**—If "P. W. H. J." (p. 519) will kindly show a working plan of his arrangement, taking an old engine cylinder as a basis of operations, he will confer an additional favour. We may add, there is a three-horse engine on the premises, which can be used for working his air-pump.—Simplex.

[12467.]—**Nitrate of Soda.**—This is likely to fall in price before December. Liverpool is the best market to buy in, export and import ship, but it depends where the purchaser resides. It has been at 13s. per cwt. this season, 15s. in July, and 14s. 6d. on the 1st of August.—Soda.

[12481.]—**Wax Moth.**—"R. A." can destroy the maggot of the wax moth in his empty combs with cyanide of potassium (poison). Break up a couple of ounces of the salt into small pieces, strew them on a board, and place the combs so that the vapour given off may readily permeate them, covering over the whole with two thicknesses of wet cloth, and leave it thus for 12 or 14 hours. I thus destroyed upwards of 300 silk-worm chrysalides in their cocoons, so as to preserve the silk uninjured, and fit to wind off.—George Fox.

[12482.]—**Integral and Differential Calculus.**—Without some knowledge of the integral and differential calculus it is absolutely impossible to peruse works on natural philosophy, in which the effects of the laws that are observed to govern the material world are reduced to calculation. The ordinary processes of geometry and trigonometry are sufficient for the mensuration and discussion of straight lines, and of figures contained by straight lines; but these methods fail when we come to discuss curved lines, and figures bounded by curved lines. In mechanics we can consider only uniform forces, but must obtain the assistance of the calculus in treating of forces which are continually varying from one moment to another. The circumferences and areas of circles, as well as the surfaces and capacities of cylinders, cones, and spheres, are calculated by the method of the calculus. The different curves whose properties it investigates are very important. The logarithmic curve is useful in exhibiting the law of the diminution of the density of the atmosphere, the cycloid in investigating the laws of the pendulum, and the fall of the celestial bodies towards the centre of the earth. In general, treatises on the calculus are divided into two or three courses, each of which is suited to a different class of readers. Those who merely wish to acquire a knowledge of the calculus sufficient to understand the elementary parts of physical science may confine their attention to the differentiation of functions of one variable successive differentiation, the theorems of Taylor and Maclaurin, the effects of particular values of the variable upon a function, maxima and minima, and the application of the differential calculus to plane and spherical curves, arcs and areas, with corresponding integration. A previous knowledge of the elements of geometry, algebra, plane and a little of the spherical trigonometry, with a tolerable knowledge of conic sections. I should recommend a beginner to use Ritchie's "Principles of the Differential and Integral Calculus," or Todhunter's Calculus. For those who may not have read a treatise on conic sections, Ritchie's would be a very admirable book, for he supplies this want. After mastering the contents of this book, the learner could apply his knowledge to a variety of useful purposes.—W. H. C.

[12504.] — **Sketching from Nature.** — "A Working B.," in his answer to Thomas King (p. 520), says that the great objection to a camera lucida lies in the difficulty of seeing both the image of the object reflected and the point of the pencil at the same time. This difficulty is caused by rays from the object giving an image which is farther from the eye than the pencil, and can be corrected by placing between the eye and prism a lens, which gives the same divergence to the rays from the pencil and those from the object. The eye must then be placed very near the edge of the prism so as to divide the aperture of the pupil into two parts, one of which sees the image and the other the pencil. There is another form of the camera lucida, devised by Amici, which is preferable, as it allows the eye to change its condition considerably, without ceasing to see the image and the pencil at the same time. The following explanation with reference to the diagram will explain it:



A B C a rectangular glass prism, having one of its perpendicular faces turned towards the object to be drawn, while the other is at right angles to an inclined plate of glass, D E. The rays, L I, entering the prism, are totally reflected from its base at H, and emerge in the direction G F. They are then partially reflected from the glass plate at F, and form a vertical image of the object, L, which is seen by the eye in the direction K L′. The eye, at the same time, sees through the glass the point of a pencil applied to the paper, and thus the outline of the object may be traced with great exactness.—E. B. H.

[12504.]—**Sketching from Nature.**—I have used the instrument described by John Hopkins where great accuracy was required. It is not necessary to have it so large; all that must be attended to is its relation to the size of the canvas or paper. If your canvas is 2ft. long you may employ the frame 2ft., 1ft., or only 6in. long, remembering that it must be held before the eye, as the canvas must be, at the distance of its length. But it is rarely required. The best plan is to place your paper or canvas at the distance stated, but so low as to allow you to see over its upper edge some prominent objects. Mark their places on this edge. You can then, if you like, do the same with the sides, holding your drawing material up before you at the right level. By this means you can obtain with your T square intersections, and fix very accurately the position of a number of objects. The intermediate spaces can then be filled in by the eye. A square eyeglass held at the right distance from the eye I have also employed. It is very useful in estimating the size of animals. It represents one of the imaginary squares into which your paper is divided.—M. PARIS.

[12507.]—**Cricket-Bat Making.**—The ordinary common cricket-bat is made from willow well-seasoned. Cut out nearly the shape with a two-handle, one-edge paring-knife; the bat is then fixed in the lathe, the handle turned, then finished of with a plane and spoke-shave, and papered, refixed in the lathe, the handle bound with waxed hemp, finished off with two or more coats of brown hard varnish, papering down each coat before laying on the next. Of the superior sort of bats I can give no opinion; never had any hand at them, but always understood the best bats had cane handles.—SAMUEL SMITHER.

[12511.]—**Gas.**—"R. A. H.," at p. 520, says very truly that the poorness of gas and the consequent increase of gas bills require to be thoroughly ventilated. I am interested both as a producer (shareholder) and consumer of gas, and am one of those who believe that honesty is the best policy in this as in other cases. It is evidently unjust for gas companies to sell bad gas at the price for good, but neither is it just for consumers to pay for gas, and complain if they do not get good. Evidently, the right plan must be that gas should be sold by measure, but paid for in proportion to its quality. For example, if the authority quoted by "Saul Rymea" at p. 529 be correct, a thousand feet of coal gas is worth hardly more than half as much as a like quantity of cannel gas, but the latter, though dearer to the producer, is cheaper to the consumer. How can we best reconcile these immediately conflicting interests? The plan tried of subjecting gas companies to penalties that supply gas of less than a minimum illuminating power, does not work well, and has no tendency to produce improvement beyond the standard. If the price chargeable were a fixed amount per thousand feet, multiplied by the average illuminating power of the gas supplied, there would be a constantly acting motive to supply gas of the most economical quality both to make and use. If we assume that to be 20 candle-power, and the fair price of 1,000 cubic feet of such gas to be (say) 5s., 1,000 cubic feet of gas of 12 candle-power would be worth only 3s., while that of 22 candle-power would be worth 5s. 6d.; it would then be soon decided what quality of gas it is best to make, which will depend upon the relative cost of the place in question of cannel coal and coke. There would then be no temptation to draw off the last dregs of poor gas to increase its quantity to the injury of its quality. The consumer would pay as he ought to do in proportion to the light he gets, and the producer would profit, as he ought to do, in proportion to his success in producing the light needed at the least cost. I believe if this simple and just principle of payment were adopted, it would be found more profitable to stop the process of gas making as soon as the poorer gas begins to be formed, so as to leave that in the coke, thereby rendering it a pleasant fuel for household use. If coke could thus be rendered a generally acceptable fuel, a great deal of the smoke by which we are annoyed and injured would be prevented, and thus another great benefit be secured by a simple act of justice and fair dealing.—PHILO.

[12515.]—**Mowing Machine.**—I am made to state that a piece of iron struck repeatedly on one place will drop in two pieces. What I meant to write, if I did not, was that if a rod of iron be struck repeatedly on one end it will drop in two pieces. I will undertake to cause a ¾in. round rod, 12ft. long, to fall in two pieces in less than ten minutes by merely striking it on one end with a hand hammer, and a new knife-box will break as soon as a well-mended one from the cause I stated, as, to my annoyance, I have proved.—OLD PLOUGHMAN.

[12516.]—**Mathematical.**—The querist says that the more 1's you affix to the ·1111 the nearer it approaches unity, but he might with equal truth say the nearer it approaches 2 or 1,000,000, and hence argue that ·1111 *ad infinitum* is = 2 or a million. Of course no number of the 1's can quite make it $= \frac{1}{9}$, but "C. H. W. B." has given the rigorous proof.—E. L. G.

[12516.]—**Mathematical.**—It by no means follows that because the numerator continually becomes slightly greater that it should ever equal the denominator, in fact $\frac{1}{9}$ is the limit it approaches, $\cdot 111 = \frac{111}{1000}$ The numerator has as many 1's as the denominator has ciphers, and evidently no matter how many places we take it never becomes greater than $\frac{1}{9}$, or even quite equal to it, much less then equal to one.—PHILANTHROPIST.

[12516.]—**Mathematical.**—It is absurd to suppose that the numerator will ever be "theoretically equal to the denominator," for it will evidently always have one figure less. Stated in a form different, though radically the same, we have $\cdot 1 = \frac{1}{10}$, $\cdot 11 = \frac{1}{10} + \frac{1}{100}$, $\cdot 1111$, or $\cdot\dot{1} = \frac{1}{10} + \frac{1}{100} + \frac{1}{1000} +$. The sum of the infinite series on the right is $\frac{1}{9}$.—ALEPH.

["Xenophon" has also answered this query.—ED.]

[12517.] — **Mathematical Machines and Tables.**—The calculating machine made calculations of tables of logarithms, &c., I understand, and when it made an error it gave notice of it in some way, either stopping or ringing a bell, or some such way. It was left incomplete from the Government declining to give further aid to its construction. It took several years to make it.—PHILANTHROPIST.

[12517.] — **Mathematical Machines and Tables.**—I read some years ago a minute and lengthy description of Babbage's machine in a book, the title of which, to the best of my recollection, is "The Boy Philosopher."—EXCELSIOR.

[12518.]—**The Island of Hayti.**—All that I can say respecting your query is that Hayti comprises two separate states; the Republic (formerly the empire) of Hayti, capital Porzan Prince; and Dominica, capital San Domingo. It was formerly divided between France and Spain, but acquired its independence during the French Revolution, after the most dreadful cruelties on the part both of the negroes and the French. Hayti, the west part, is still independent; but Dominica is reunited to Spain.—F. S. M. W.

[12519.]—**Acarus Crossii.**—The following extract is from a letter sent by the late Andrew Crosse, Esq., to the Electrical Society of London, which I find in an old periodical called the *Magazine of Science*, in the number for March 13, 1841, with an illustration, of which I inclose a rough tracing:—"Amongst other contrivances I constructed a wooden frame, of about 2ft. in height, consisting of four legs proceeding from a shelf at the bottom, supporting another at the top, and containing a third in the middle. (See Fig.) Each of these shelves was about 7in. square. The upper one was pierced with an aperture, in which was fixed a funnel of Wedgwood ware, within which rested a quart basin on a circular piece of mahogany placed within the funnel. When this basin was filled with a fluid, a strip of flannel wetted with the same was suspended over the edge of the basin, and inside the funnel, which, acting as a siphon, conveyed the fluid out of the basin through the funnel in successive drops. The middle shelf of the frame was likewise pierced with an aperture, in which was a smaller funnel of glass, which supported a piece of somewhat porous red oxide of iron from Vesuvius, immediately under the dropping of the upper funnel. This stone was kept constantly electrified by means of two platinum wires on either side of it, connected with the poles of a voltaic battery of nineteen pairs of 5in. zinc and copper single plates, in two porcelain troughs, the cells of which were filled at first with water and 1-500th part of hydrochloric acid, but afterwards with water alone. The lower shelf merely supported a wide-mouthed bottle, to receive the drops as they fell from the second funnel. When this basin was nearly emptied the fluid was poured back again from the bottle below into the basin above, without disturbing the position of the stone. The fluid with which I filled the basin was made as follows:—I reduced a piece of black flint to powder, having first exposed it to a red heat, and quenched it in water, to make it friable. Of this powder I took two ounces, and mixed them intensely with six ounces of carbonate of potassa, exposed them for fifteen minutes to a strong heat in a black-lead crucible in an air-furnace, and then poured the fused compound on an iron plate, reduced it to powder while still warm, poured boiling water on it, and kept it boiling for some minutes in a sand bath. The greater part of the soluble glass thus fused was taken up by the water, together with a portion of alumina from the crucible. To a portion of the silicate of potassa thus fused I added some boiling water to dilute it, and then slowly added hydrochloric acid to supersaturation. . . . On the fourteenth day from the commencement of the experiment I observed, though a glass lens, a few small whitish excrescences, or nipples, projecting from about the middle of the electrified stone, and nearly under the dropping of the fluid above. . On the twenty-second day these appearances were more elevated and distinct, and on the twenty-sixth day each figure assumed the form of a perfect insect, standing erect on a few bristles which formed its tail," &c. The letter then goes on to describe further experiments made by Mr. Crosse in the same direction.—G. C. C.

[12519.]—**Acarus Crossii.**—If I recollect right, these supposed new insects turned out to be common book worms, which swarmed in Mr. Crosse's library.—PHILO.

[12520.]—**Fluid Lens for Photography.**—The focal points will be on the mirror, and is reflected on to the ground glass. You can make one that way, but will not get a very brilliant effect, compared with the other kind when well made.—W. O.

[12520.]—**Fluid Lens for Photography.**—The focal length would be from L^1 to the plate, measuring in the direction a central ray took first to the mirror m''', and from that to the plate P. Of course, moving the object nearer to or further away from M would alter the focus; for a convex lens, the formula is $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ where f is the focus for parallel rays, u the distance of the object from the lens, and v the distance of the image of it from the lens, all distances being considered positive. Why use sulphuric acid in a watch glass? Although it is very heavy fluid it does not follow that it has the greatest refractive power, it is dangerous and corrosive. Bisulphide of carbon has great refractive power, but Mr. Bottone could tell you better about this subject than I. There would be a great loss of light by the four reflections from mirrors.—PHILANTHROPIST.

[12528.]—**Hay Asthma.**—I pity and sympathise with your fair correspondent "Kate." I have for more than twenty years suffered from hay fever, in various forms, principally in the form of influenza, but also as asthma. I believe there is no cure, but I can suggest a great relief. Let "Kate" get a friend to blow the spray of sulphurous acid (one part to ten of water) through one of the toys sold to throw a jet of scent in her face (eyes shut) three or four times a day; also take three times a day about thirty drops of strong spirits of camphor on sugar. Let her also keep her head cool, get plenty of fresh air, and splash the chest with cold water. Sea air is after all the only real means of getting rid of this painful complaint.—OLD BOOTS.

[12528.]—**Hay Asthma.**—"Kate" ought to try a few inhalations of "laughing gas." It has cured many cases of asthma.—RAT-TAT.

[12528.]—**Hay Asthma.**—If "Kate" were a gentleman I would advise (1) During the paroxysm smoke an havannah, some returns, or cut cavendish; (2) once a day inhale for five minutes the vapour arising from twenty drops of creosote in half a pint of boiling water; (3) avoid smells, and go for a fortnight to the sea-side.—LAMBDA.

[12528.]—**Hay Asthma.**—If "Kate" refers to the number for May 31st, on p. 280 she will find a remedy that has been very beneficial to me, a fellow sufferer, from violent sneezing fits in the summer season.—CHIME.

[12528.]—**Hay Asthma.**—Pour some water or equal parts of vinegar and water boiling hot over some herbs, as balm, hyssop, mint, southern wood, sage, or horehound, in a narrow-mouthed pot, and inhale the steam upon retiring to rest.—JACK OF ALL TRADES.

[12528.]—**Hay Asthma.**—This complaint is supposed, not I think proved, to be sometimes excited by the pollen of grass or other plants that flower during the hay season. I suspect it is also excited by chill when in a state of perspiration. I think it wise to guard against either risk by using Dr. Stenhouse's charcoal respirator, by day, and sleeping surrounded by net curtains by night, wearing a thin woollen or merino dress, and using a cold bath every morning, and having plenty of fresh air always.—M. R. C. S.

[12530.]—**Name of Plant.**—Probably *Reseda luteola*. Dyer's weed.—TRESSILIAN.

[12531.]—**Flatting.**—Use a little alum in the paint.—RAT-TAT.

[12531.]—**Flatting.**—Gold size is the best to mix with it, or a small portion of oil varnish; it requires very little, and great care and regularity in laying it on.—JACK OF ALL TRADES.

[12532.]—**Republican Months**:—

French Months.	Signification.	English Months.
	AUTUMN.	
1. Vindemaire.	Vintage.	Sept. 22.
2. Brumaire.	Foggy.	Oct. 22.
3. Frimaire.	Frosty or sleety.	Nov. 21.
	WINTER.	
4. Nivose.	Snowy.	Dec. 21.
5. Pluviose.	Rainy.	Jan. 20.
6. Ventose.	Windy.	Feb. 19.
	SPRING.	
7. Germinal.	Springing or budding.	March 21.
8. Floreal.	Flowery.	April 20.
9. Prairial.	Hay harvest.	May 20.
	SUMMER.	
10. Messidor.	Corn harvest.	June 19.
11. Thermidor.	Hot.	July 19.
12. Fructidor.	Fruit.	Aug. 18.

[12534.]—**Spring Furnace.**—Cannot "A. E." make a hollow fire upon his hearth with bricks and small coal?—JACK OF ALL TRADES.

[12535.]—**Spots on Whitechapel.**—This may proceed from contact with soapy water before dry, the use of a soapy sponge in rubbing down before varnishing, and bad varnish, or from a varnish brush that has been cleansed with soap or stood in soapy water.—JACK OF ALL TRADES.

[12535.]—**Spots on Whitechapel.**—The trap has become greasy or sweated the oil from being left under a warm cover for such long periods. Have it rubbed dry before washing.—RAT-TAT.

[12538.]—**Electrotyping.**—There are so many causes that prevent the regular deposit of the solution upon the mould, that it is almost impossible to prescribe a definite remedy for the bad deposit of which "Duplex" writes. However, as I have had to contend with a similar difficulty, I will readily give such information as I possess. I premise that a good constant battery is used; for, to obtain a fair deposit, the current of electricity must be continuous. If the deposit is granular, as seems to be the case, I should try a less amount of metal in the solution and let the surface of the metal, which resupplies the solution with the amount of metal it loses by the deposition on the mould, be smaller. Perhaps the deposition is obtained too quickly on account of the too high temperature of the solution. It was invariably the case with my own moulds, if I allowed the temperature to be too high, that they were coated with a rough deposit. Provided that the battery be in proper working order, the deposit will generally be very regular in cold weather, but of course slowly formed. If you use a solution for silver deposit, the colder the weather is the better. It would be a good plan to move the moulds about in the bath now and then, and rather quickly. When the hollow parts of the mould are insufficiently coated rinse the mould in clean water, and apply a scratch-brush (which may be attached to a lathe), and make the solution a little stronger, taking care to move the mould frequently in the solution.—W. H. H. C.

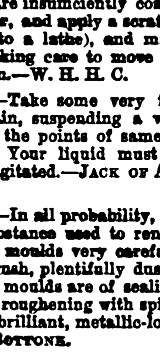
[12538.]—**Electrotyping.**—Take some very fine wire and conduct from the main, suspending a wire into the deep recesses, allowing the points of same to touch the bottom of recesses. Your liquid must be perfectly clear and frequently agitated.—Jack of All Trades.

[12536.]—**Electrotyping.**—In all probability, the cavities have not taken the substance used to render them conducting. Brush the moulds very carefully and thoroughly with a soft brush, plentifully dusted with fine plumbago. If your moulds are of sealing-wax they may require slightly roughening with spirit. All depends on getting a nice brilliant, metallic-looking coating of plumbago.—S. Bottone.

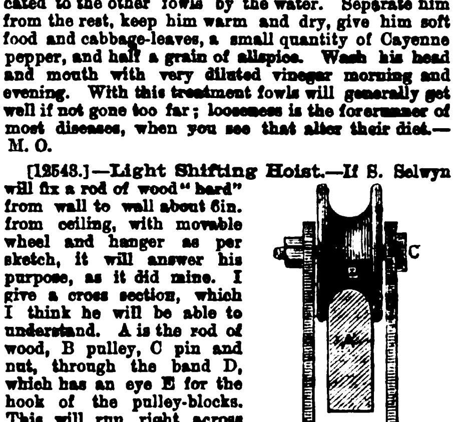
[12539.]—**House Fly.**—Neither.—S. Bottone.

[12540.]—**Poultry.**—If the fowls are kept clean, well-sheltered from wind and rain, have sufficient soft food, with greens, and a constant supply of good water, they will generally be free from disease; but if your fowl has the roup, it is caused by wet and wind, and terminates with a discharge from the nostrils and eyes, a thickening of the tongue; it is contagious, communicated to the other fowls by the water. Separate him from the rest, keep him warm and dry, give him soft food and cabbage-leaves, a small quantity of Cayenne pepper, and half a grain of allspice. Wash his head and mouth with very diluted vinegar morning and evening. With this treatment fowls will generally get well if not gone too far; looseness is the forerunner of most diseases, when you see that alter their diet.—M. O.

[12543.]—**Light Shifting Hoist.**—If S. Selwyn will fix a rod of wood "hard" from wall to wall about 6in. from ceiling, with movable wheel and hanger as per sketch, it will answer his purpose, as it did mine. I give a cross section, which I think he will be able to understand. A is the rod of wood, B pulley, C pin and nut, through the band D, which has an eye E for the hook of the pulley-blocks. This will run right across the room, and the band D prevents it from capsizing. This is same as the smiths have fixed to their crane.—Sting.



[12543.]—**Light Shifting Hoist.**—I send a diagram of a plan which will, I think, suit S. Selwyn, which is both simple and cheap. Two cast-iron brackets something like A, with slot-hole cast in centre of each to receive a flat bar of wrought iron (say) about 2in. by 1in., marked B in diagram, upon which to run a double-flanged pulley C (say) about 4in. diameter, with a turned spindle through it to support the two forks of



the strap D, through the eye of which hook your blocks. The bar of iron must be of sufficient length to allow the blocks to move from where the box is to be lifted from to the table, so that in lifting and lowering the blocks will hang perpendicular; of course it must be placed with one end over the table and the other over the trolley. The bar must be fixed in its place by letting it project through the brackets at each end, and putting a pin through it. I should recommend a pair of Weston's patent differential blocks, or some other kind of self-sustaining blocks which will sustain the load at any required height without making it fast to anything. A pair of 5 cwt. ones would be more than sufficient, but no smaller are made. E and F are the joists; if it should be required to run it across the joist the brackets would require packing down to allow the flange pulley to clear the joists, or they might be left as shown, and the bar cranked down at each end. If this plan should suit S. Selwyn and he should require any further information I shall be most happy to give it. By a slightly different arrangement he might, perhaps, be able to dispense with the trolley. If he wishes I shall have great pleasure in sending a diagram.—Vircas.

[12544.]—**Taraxacum.**—Dig up the dandelion roots; clean thoroughly; cut up into dice about ½in. square. Spread out to dry in the open air. When dry, roast in a coffee roaster till of a fine dark brown all through. Grind.—S. Bottone.

[12544.]—**Taraxacum.** — Gather the dandelion roots and wash, dry them in the sun, break them up short, and roast them in a revolving cylinder, either over or upon the fire.—Jack of All Trades.

[12546.]—**Protection for Steam Boiler.**—Take marl burnt, forge ashes, and horse droppings, or cocoa-nut fibre, chopped straw, or hair, of each alike, and mix in proportion five of these to one of lime, used the same as mortar.—Jack of All Trades.

[12547.]—**Pasting Cloth to Maps.**—I succeeded very well by thoroughly wetting the back of the map on a drawing-board, then putting thin paste on it, thoroughly wetting thin white calico to remove the dressing from it, and carefully lay on pasted back of map pressing wrinkles of air out with blotting-paper; dry slowly on top of a press under pressure. A little corrosive sublimate (10grs. to ounce) in paste if map is not tinted will preserve it from insects.—M. A. B.

[12547.]—**Pasting Cloth to Maps.**—"C. W. J." must get a piece of fine calico a little larger than the map, stretch the calico on a smooth board, and tack it all round as he stretches it with tin tacks, then paste the map and lay it on the calico, and take a sheet of paper larger than the map, lay it on the map and rub down with the palms of the hands, when dry give it two coats of white size, and when that is dry use white varnish, after that cut it on the board.—C. Colby.

[12547.]—**Pasting Cloth to Maps.**—Get some very common calico, cut it roughly to size, lay it on a smooth, clean board—a table leaf is first rate—sponge it with water till it lies quite smooth on the board. Paste the map, and lay it on the calico, then rub with a clean handkerchief till all the air-bubbles and wrinkles are gone. Leave it on the board till quite dry, when it will almost fall off and be perfectly smooth. Proved.—A. S. Boyd.

[12548.] — **Flexible Black Varnish for Leather.**—This is made of linseed oil and asphalte, in what proportions I know not. The blackness does not depend upon the varnish, but upon the ground coat, for which purpose use lamp black; never throw away old oil-cans that are seemed up, as that muck, as many throw away and call it, is invaluable for such purposes, and is easily dissolved with turps and heat.—Jack of All Trades.

[12548.] — **Flexible Black Varnish for Leather.**—I use Brunswick black, or as some places term it black Japan; if too thick, thin it with turps. I find nothing to excel both for cheapness and durability. I use it for the wings and dash-boards of my carts and gig, and find it answers well.—Samuel Smither.

[12550.]—**Seaweeds.**—See back number, p. 317, No. 325, Vol. XIII.—A. G. Boyd.

[12550.]—**Seaweeds.**—The weeds must be washed in two or three waters; then place each specimen on a card, holding the roots against the card, and float them on the surface of the water, and spread out with a fine pointed instrument, after which well dry and press.—Horatio.

[12550.]—**Seaweeds.**—Treat them to a bath of strong alum water, and well wash in several waters, then dry.—Jack of All Trades.

[12550.]—**Seaweeds.**—Place the specimen on a sheet of white letter paper or cardboard, having previously washed the weed in fresh water; while still wet arrange it nicely on the paper, separating the branches with a pin; then press it gently down on the paper.—Philanthropist.

[12551.]—**Picture Framing.**—Cut the moulding into the required lengths as nearly as possible at an angle of 45°. This is done by means of a "cutting-board," or by a bevil. The lengths are then "tried up" on a "mitreing board," which you can borrow of any carpenter, or easily make yourself. Two lengths properly tried up will form right angles to each other. Prepare four wood corners shape of letter L, same thickness as the moulding, and place one at each corner of the frame, passing a stout string four times loosely round the whole. Glue up, and compress by twisting the strings up tightly with slips of wood; allow to dry twenty-four hours, and then finish with two brads in each corner, or key with a slip of veneer.—W. S. B.

[12551.]—**Picture Framing.**—I find the best way is to cut the joinings in the lathe with a fine saw; this way they can be done remarkably quick and clean.—M. O.

[12552.]—**Aquarium.**—The writer, who is passionately fond of the aquarium (or, properly, aqua vivarium), would earnestly recommend "W. B.," supposing he intends having but one, to "go in" for a larger tank than specified, providing it is convenient to do so. When about it the extra cost will not be much. I would recommend the following—viz., 3ft. long, 1ft. 6in. wide (two cubes joined) × 1ft. 8in. deep. The [illegible] and ends should be of slate, which may be purchased for about 9d. per superficial foot, ready grooved and moulded. Thickness of bottom, 1½in. The glass should be best plate, and strong, not less than 7/8in. thick (I forget the number of ounces per foot). For cement, nothing will beat the old-fashioned recipe—viz., boiled linseed oil, litharge, red and white lead, using the greater proportion of the latter. After the cement is properly dry, give, in succession, three coats of japanner's gold size. Previous to putting in the creatures, &c., the tank should be soaked for about ten days, changing the water (say) three times. Cover the bottom with clean washed shingle to a depth of 2½in. A little rockwork, composed of tufa or coke cemented tastefully together by first dipping the coke in a batter of Portland cement, may be introduced, and has a very pleasing effect. If made of coke, it must be well soaked in water, frequently changed, previously to placing it *in situ*. Use no plants except the following, which must be planted in the shingle—viz., *Vallisneria spiralis* and *fontinalis*, and the three *Lemnas*, minor, trisulca, and polyrhiza, together with a few plants of *Hydrocharis morsusranæ*, which float on the surface and send their fine thread-like roots downwards. Now for the inhabitants thereof. Minnows (which, in spite of what "H. O'B." may say to the contrary, thoroughly enjoy the still water of the aquarium and grow fat), Prussian carp, and small eels (N.B.—No sticklebacks); a couple of tritons (*Christalus*), male and female; a few *Hydrachna* and diving water spiders; for scavengers, a few *Planorbis* of the various sorts, *Paludina vivipara*, and the *Glutinosa*. I find one or two of the small beetles can be tolerated, and give a variety to the scene. A pair of the *Hydroaspicens* also do well. The fish, &c., require to be regularly fed, or mischief will soon result. These are the principal or permanent inhabitants, but a few novelties may be introduced when in season, such as tadpoles, very small frogs, shrimps, &c. But the great thing to be guarded against is trying to keep too much animal life, and experience alone will teach how to preserve the proper balance. If intended to stand in a window during summer, a piece of green tissue-paper should be pasted over the glass next the light. The only thing now required, besides supplying water to compensate the loss from evaporation, is to let the aquarium take care of itself, and it will remain a "thing of beauty" and "a joy for ever."—Busy B.

[12552.] — **Aquarium.** — "W. R." has opened a large field, but I will give him my experience: (1) the best material for the bottom is generally considered to be slate; (2) I should advise him to get glass of a tolerable degree of thickness; (3) many recipes for cements have been given in back numbers of "ours;" (4) do not get your fish too large, the smaller are the most lively—minnows and young dace are capital, gudgeon are quite useless. The best weed is *Stratiotes*, a native of Italy. It is known as the water soldier, and can be obtained in Covent Garden. Next to this comes the *Anacharis*, which now chokes England's ditches, rivers, and ponds. I generally cut off the dead bits every now and then. There is a very useful little animal, called the fresh water shrimp, which I advise "W. R." to get. It is supposed to act as a scavenger. The small scarlet water spider looks very pretty. If he keeps a newt it will require a small worm occasionally, as will the fish if they are of any size. Dutch weed looks nicely on the top, it harbours animalcula, which are good for the fish. I should not let it spread over the whole of the water. A green curtain hung over the side of the aquarium exposed to the light is useful for regulating the light. The large water beetle, or *Dytiscus*, is handsome but ravenous. A small eel lives for a long time. "W. R." will find out more by experience than by any amount of writing, but before I conclude I must tell him one thing, that he should carefully boil all gravel or sand for the bottom of the aquarium, which should be about 2in. deep. I wish him success in this most interesting amusement.—V., Cambridge.

[12552.]—**Aquarium.**—I know of one made [illegible] years since still quite perfect, of plain but hard mahogany, the corners 1½in. squares into which rails are framed top and bottom. The bottom, a board of [illegible] mahogany, the top a frame movable, kept in place by four dowells, sides and ends rabbeted inside for glass (patent plate or patent sheet), bedded with white lead, not putty, bottom screwed firm to frame, the bottom edge of which frame was first coated with white lead; the inside of bottom also coated over with white lead and a sheet of glass laid upon it; well fitted this keeps water from the wood effectually, any small portion of wood work inside exposed to wet to be well painted; both bottom and top large enough to form suitable projecting moulding. Outer angle of uprights rounded, rabbet for glass of top must be outside, flat ball under each corner, but good workmanship essential. Gold and silver fish, few pieces of coral or rock, keep it usually in the dark part of your room, light of a window kills the fish, it is unnatural. Water-plants are pretty, but grow fast and give much trouble; the one referred to has a fountain, this is right in a greenhouse but inconvenient in a room.—Aqua.

[12552.]—**Aquarium.**—Let the bottom be [illegible] plate-glass sides, cemented with caustic lime and boiled oil beat up in the shape of stiff putty.—Jack of All Trades.

[12552.]—**Aquarium.**—Zinc is the best for the bottom and angle bars, use stout glass (plate, if possible), cement with red lead putty, fix it on any stand after dry and painted.—M. O.

[12555.]—**Packfong or Chinese White Copper.**—It is an alloy of 7 parts of zinc, 2·5 parts of copper and 6·5 of nickel. It has a great resemblance to German silver, and is used for plating metals. The remainder of the query I am unable to answer.—Vircas.

[12555.]—**Packfong or Chinese White Copper**—Contains nickel, copper, tin, and a small quantity of arsenic. It is much used for making those elegant mirrors, for which the Chinese are so famous, also for gongs, &c. The value of this alloy is not exactly known to me; I only know that the mirrors themselves can be bought at about 1s. each.—S. Bottone.

[12555.]—**Packfong or Chinese White Copper**—I have heard it stated is a composition of cobalt and copper, another told me it was composed of one part of bismuth and copper, and that they forge it into gongs and various articles as we forge Muntz metal. I for one hope to get some information upon this.—Jack of All Trades.

[12555.]—**Packfong or Chinese White Copper.**—This is an alloy of the metals arsenic and copper, formed by fusing together in a closely covered crucible 2 parts of metallic arsenic, and 4½ to 5 parts of copper clippings or filings, both by weight. The metals are usually arranged in alternate thin layers in the crucible, when the whole is capped with a thick layer of either common salt or powdered charcoal. The product is a white, hard, and slightly ductile, metal, permanent at ordinary temperatures in the air, and susceptible of a high polish; but it is decomposed by a temperature considerably below redness, yielding copious fumes of arsenious acid or white arsenic. Packfong was formerly much used for the scales of thermometers, quadrants, and other instruments, dial-plates, candlesticks, &c. Use in China similar. As it contains 10 to 12 per cent., or more, of metallic arsenic, and is readily acted on by acids, it is quite unfit to be used as a material for drinking vessels, household utensils, &c. In these realms it has long been superseded by the alloy of nickel and copper, commonly called "nickel silver" or "German silver."—Arotes.

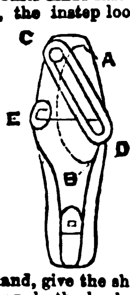
[12556.]—**Soda Water.**—The above generally sold, except by medical halls, is only common water charged with carbonic acid gas by a machine. Mineral water makers generally have four numbers of soda, they contain various quantities (4grs. to 20grs.) of soda carbonate per bottle. These are not wholesome to be constantly drinking, except under medical advice.—M. A. B.

[12557.]—**Nickel Silver.**—The alloy generally used for spoons, forks, &c., is a mixture of copper, nickel, and zinc. Having a nearly white colour it is called German silver, and sometimes nickel silver. All but the commonest goods are electro-plated. German silver is the only alloy of nickel in general use. An alloy of nickel and iron has recently been deposited on fenders and similar goods. Pure nickel unmixed with other metals is never employed. It is a magnetic metal, resembling iron, and having a high fusing point.—Alfred H. Allen.

[12557.]—**Nickel Silver.**—Is an alloy which contains variable amounts of nickel, ranging from 4 to 20 per cent., according to quality.—S. Bottone.

[12558.]—**Boot and Shoemaking.**—I have very large feet. When young, I was foolish enough to persist in wearing shoes not quite big enough, an effect of which has been to cause the joints of my big toes to be swelled and tender as "Irish Mechanic" says his are. My shoemaker overcame the difficulty he complains of by padding the inner part of the shoe, behind the swelled joint, so that there is no difficulty in withdrawing the last, the middle part of the shoe being made wide enough; the padding also diminishes the apparent size of the swelling. If this be insufficient, could not "Irish Mechanic" have his lasts made in three pieces longitudinally, so that by drawing out the middle pieces the others would be made quite loose in the shoes?—Philo.

[12558.]—**Boot and Shoemaking.**—Nothing easier. See the following sketch:—Supposing you have a bunion at E, a prominent big Ben at C, a ticklish little one, outer joint, the shoemaker should pare and rasp your last down at or from A to B, and fit a stout instep leather upon it, coming half way up the block, then put your risers on from C to D. Your bunion should be made fast to the block of last that it might be drawn with it; the risers for toe joints made fast at C, the remainder loose across to D, the instep loose from A, but fast at B. Now to draw your last, even if your foot was half as large again at E and D across the joints as across the instep, you could get it out. Take the block out as usual, with that out comes the bunion, and if not the instep leather, take the pincers and draw the leather, which will undermine the riser, which will drop down upon the edge of last where the block left it, and keep that from biting the upper or tearing it. Turn the boot bottom upwards, and taking the heal in the palm of the hand, give the shoe a blow with a hammer in the waist, apply the hook in the usual way and it is done.—Jack of All Trades.



[12557.]—**Nickel Silver.**—A superior sort of German silver, nickel and spelter.—Jack of All Trades.

[12559.]—**Cleaning Oil Paintings.**—This I have done with good effect by sprinkling them with common table salt and exposing them to the night dew. Wash with sponge and pure water. No soap.—Jack of All Trades.

[12559.]—**Cleaning Oil Paintings.**—If they are valuable don't do it, unless you are well acquainted with the manner in which the picture was painted, or you may spoil it altogether; you might lay a damp cloth on it over night and clear off the dirt in the morning; this is about all a man unacquainted with pictures ought to do. It takes years of study to be a good picture cleaner. He must understand the painting of pictures as well as an artist, but need not be able to paint.—M. O.

[12560.]—**Varnish for Marbled Edges.**—They are never varnished, but burnished with an agate stone. If you hammer the back of your book properly, the front will become a nice hollow without steps. This should be done after the boards are put on before covering.—M. O.

[12560.] — **Varnish for Marbled Edges.**—"Semper Paratus" must put the book between boards, and screw up tight in a press, and use an agate burnisher, pressing it very hard backwards and forwards; the top part of handle must rest on the shoulders. Keep your boards ¼in. above the edge of book.—C. Colbey.

[12560.]—**Varnish for Marbled Edges.**—Use glaire and burnish with a tooth. A dog's tooth, the old masters would say; but I have used any I could get so long as the enamel was perfect.—Jack of All Trades.

[12560.]—**Varnish for Marbled Edges.**—These are not varnished, but burnished with an agate.—S. Bottone.

[12561.]—**Curving Book Edges.**—This process, called rounding, is as follows:—Having put on your end papers, glued up the back, and cut the fore-edge, lay the book on your press, or other solid support, with the back to the left, beat the upper edge of the back over towards the fore-edge with the hammer, helping it over with the thumb of the left hand from top to bottom; turn the book over and treat the other side the same way; repeat this till you have a nice round on the back, and the fore-edge will have a corresponding hollow curve. The shoemaker's flat faced hammer is the best adapted for bookbinding. Let the glue on the back be pretty dry, and don't hammer too hard.—Vandyke.

[12561.]—**Curving Book Edges.**—After the book is sewn the back receives a thin coat of glue. When dry cut the fore-edge. Place your hand flat on the side of book, and hammer the back gently. At the same time draw your hand to you; you will soon see what kind of fore-edge you will have. Cut head and tail afterwards.—C. Colbey.

[12563.]—**Rough Skin.**—From the description you give of the morbid condition of the skin of your face, I suppose it is a mild form of a skin affection, called "psoriasis." I believe you will receive benefit from the application of liniment of iodide of potassium and soap, B.P. You can obtain it from a respectable chemist and druggist, or you can prepare it for yourself by the following formula:—Hard soap and iodide of potassium, each, one and a half ounce; glycerine, one fluid ounce; oil of lemons, one fluid drachm; distilled water, ten fluid ounces. Rub it well over the affected part at night before going to bed, and allow it to dry. Wash it off next morning.—Medicus.

[12563.]—**Rough Skin.**—Don't use soap to face, or very little white curd soap only. A popular remedy is a handful of tansy (a hedge weed) steeped in buttermilk, to wash the face, but I think "F. Acel" will be better pleased by using a little glycerine on a damp towel.—M. A. B.

[12563.]—**Rough Skin.**—Always wash with cold soft water; use a little oil to the skin.—M. O.

[12563.]—**Rough Skin.**—I have heard it stated that if a raw potato be cut in two and rubbed upon the cheeks every night going to bed it will cure roughness of the skin. It may, perhaps, appear too much like an old woman's cure, but I think it is worth a trial.—Vircas.

[12563.]—**Rough Skin.**—Take the old woman's remedy, "brimstone and treacle" internally; externally apply a pomade made with olive oil and flowers of sulphur, ½oz. of sulphur to 1oz. of oil.—S. Bottone.

[12563.]—**Rough Skin.**—Use less soap and partake freely of salads or cress, and less flesh meat. If you have been taking some of those blood purifiers with iodide of potassium in leave it off, the sooner the better, and look upon it for the future as you would a rattlesnake.—Jack of All Trades.

[12564.] — **Photographic.** — Do you "splash" your developer on the centre of the plate so as to wash away some of the free nitrate?—S. Bottone.

[12564.]—**Photographic.**—The negatives may be either under-exposed or under-developed, lacking proper density. Give a longer exposure in the camera, develop more fully, and, if necessary, intensify in the usual way, or if they are dense in the lights, with heavy shadows, the bath or developer may be too acid. Or there is a too direct light used, and a reflector is required to soften the shadows. In taking the negative a white sheet hung at a short distance from the sitter on the dark side will do.—W. Marquand.

[12565.]—**Sticks.**—Boil them and lay them over a brisk fire for a few minutes. Pass them either into holes in a stout block of wood that has been rounded off at the angles for the purpose, and lash fast until dry.—Jack of All Trades.

[12565.]—**Bending Sticks.**—Steam them. When bent to the required shape keep them so until perfectly dry.—M. O.

[12566.]—**Bees.**—If the swarm of bees took possession of your hive, they are undoubtedly your property, unless the owner had followed and kept in sight of them till they settled in your garden, in which case they belong to him.—J. W. S.

[12566.]—**Bees.**—I should say, Yes. Because in the case of game, if you pursued a hare off your estate and caught it on my estate, you would be locked up for poaching.—R. A. H.

[12567.]—**Brick and Tile Glazing.**—This is done in many instances with litharge, silica, and sulphate of lime, and assisted by throwing a little salt into the kiln. In some cases red lead is used instead of litharge; the proportions I know not.—Jack of All Trades.

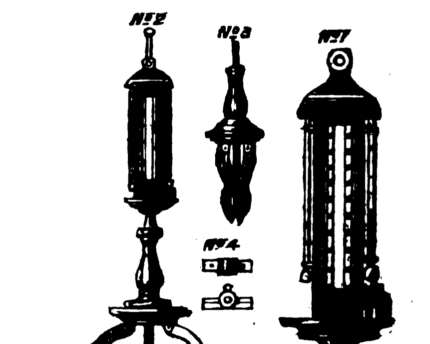
[12568.]—**Smoke and Light.**—The variation in the background causes the difference; in the same way that a cambric handkerchief looks beautifully white till laid on fresh-fallen snow.—A. G. Boyd.

[12568.] — **Smoke and Light.** — I should say sometimes owing to the effect of complementary colouring, sometimes to the transmission and non-transmission of light, coal smoke looks brown against the sky, blue amongst dark trees.—M. Paris.

[12568.]—**Smoke and Light.**—More light is reflected from the white background than from the dark one, and thus the smoke in the former case is viewed more by transmitted light.—Philanthropist.

[12570.]—**Sunrise and Sunset.**—If "Delta" will look among "Replies to Queries" in the English Mechanic, for the last week of January or the first week of February, he will find two methods of finding the time when a heavenly body will attain any given altitude. They will hardly, however, apply to the moon, whose rapid motion in right ascension complicates matters considerably. Before applying these methods we must know the right ascension and declination of the heavenly body, and the latitude of the place of observation.—V. B.

[12573.]—**Hygrometer.**—As the prices range from one to three guineas (Leslie's being the lowest), I will furnish diagrams. The hygrometer is one of the most useful inventions, as it indicates the temperature, dryness, and humidity of the atmosphere. If the air be very dry, the difference of the two thermometers will be very great, if moist less in proportion, when fully saturated both will be alike. Should the wind be strongly blowing upon the instrument, the degrees of dryness observed, multiplied by 2, give the absolute dryness (the excess of dryness being omitted in the calculation), because a strong current of air makes the instrument indicate the excess of dryness which is necessary to be added in a calm atmosphere. If the absolute dryness of an apartment be required, the instrument must be placed in the shade, and the dew point found, which, subtracted from the temperature of the apartment, will



give its absolute dryness. The reason is obvious, and arises from this law—namely, that air has its dryness doubled for every increase of temperature corresponding to 20° of Fahrenheit's thermometer, and in proportion for all intermediate temperatures. In diagrams sent it will be seen are two sensitive thermometers, the bulb of one being covered with silk, with a thread dipped in distilled or boiled water, which keeps the silk moist around the bulb, while the other is dry; the water should be renewed at least once a month. All draught and heat should be avoided if possible, and the instrument should not be too exposed to extreme frost. No. 1 for hanging up on wall; No. 2 mounted on pedestal for room table; No. 3, pedestal with tripod legs folded or shut up; No. 4, side and front view of clips to be fastened on. Back of instrument, and adjusted with small thumb-screws; this small tripod pedestal should be made of polished brass.—Joseph William Fennell.

[12576.]—**Buffalo Pickers.**—Is it not green hide lightly treated to a bath of alum?—Jack of All Trades.

[12577.]—**The Iris or Rainbow.**—It appears circular because the majority of, not all, the drops, are there in the position required for refracting. If all the drops were truly spherical, the colours could not be seen in any other part, but as we may observe by looking at dewdrops on the grass the colours may be refracted at any angle. This question reopens the great rainbow controversy which raged in the English Mechanic some time ago, and will probably awaken that sleeping lion, "E. L. G."—sleeping in this part of his brain only.—M. Paris.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

' Since our last "Jack of All Trades" has answered 12181, 12201, 12210, 12220, 12222, 12231, 12234, 12243, 12246, 12248, 12254; "Tages," 12289; "Saul Rymes," 12291.

12314 Bleaching Tanned Goods, p. 418
12320 Copper Coins, 418
12324 Spoiled Hams, 418
12326 Collodio-Bromide, 418
12327 Horn, 418
12336 Botanical Phenomenon, 418
12342 Pouncing Pattern on Printing Blocks, p. 419
12345 Ontario, 419
12349 Emigration, 419
12358 Grinding Scythes, 419
12354 Lathe Construction, 419
12355 Fermenting Bread with Starch, 419

QUERIES.

[12642.]—**Ice Cream.**—Will either you or one of your subscribers be kind enough to inform me through the medium of your journal the construction of an ice machine for the manufacture of ice cream, and also the materials used in the making of the cream?—Icicle.

[12643.]—**Dictionary of Scientific Terms.**—Will any one say whether there is a cheap and portable book explanatory of scientific terms?—Plough Driver.

[12644.]—**Harp Making.**—Would some kind subscriber to this paper please inform me how to construct a harp, where to begin, how to begin, how to get the right shape, and what would be the probable cost of making one—a medium size one? By doing which he will oblige—John Williamson, Bolton.

[12645.]—**Utilising Old Paper.**—Will any one of your readers inform me whether old newspapers and other paper upon which there is printed matter can be again made useful for the printing press? Is there any process known by which the printer's ink can be got rid of so that the paper pulp may be again utilised? Is it now done anywhere in England, and if so, where?—Inquirer, Baden-Baden.

[12646.]—**Alcohol.**—What is the best method for purifying and strengthening methylated spirit so that it can be used for the various processes in which it is needed in chemical analysis; for example, separation of Ba from Sr,Ca?—Y. A., Kew.

[12647.]—**Temperature of the Sun.**—At page 465 it is stated that the eminent French physicist, M. St. Claire Deville estimates the temperature of the sun at 6,000° to 8,000° C. Can any of your readers inform me how this result has been obtained? Father Secchi's mode of estimating the temperature is explained at p. 266 of his finely illustrated book on the sun. By inclosing a black bulb thermometer in a cylinder kept at a known temperature, and exposing the bulb alone to the sun's rays, the temperature of the bulb rises say θ degrees above the inclosure. If there were two suns the rise would be $2\,\theta$ degrees, if 100 suns it would be $100\,\theta$, and so on up to 183,960 suns, which would just cover the whole sphere of the heavens. The temperature of the thermometer would then be the same as the photosphere of the sun—viz., 183,960 times θ. θ varies according to the altitude of the sun and the climate. In this country, during the summer at noon, it is from 10° to 12° C. In India it is more than double. The air that surrounds the bulb deprives it of heat otherwise than by radiation, and the atmosphere intercepts an unknown amount, so that although θ cannot be less than 80° C., it may be a great deal more, for to deduce the temperature of the sun from θ, its value would require to be taken in a vacuum and outside the atmosphere. The effect of the air in reducing the value of θ from conviction has been made the subject of observation, but the screening effect of the atmosphere is not well known. Why should the atmosphere of India be so much less protective than the atmosphere of Britain? The amount of vapour dissolved in the atmosphere is much greater in India, so it is in vain to suppose that aqueous vapour acts as the parasol. Aqueous particles suspended in the air no doubt would be very effective, but it does not appear how there should be more aqueous particles in our sky when clear than in that of India. An instrument to enable the value of θ to be obtained readily is a desideratum of meteorology worthy the attention of some good instrument maker.—F. R.

[12648.]—**Moisture on Tin Surface.**—I have a large tin cistern used for warming water heated by a gas stove. As soon as the flame comes into contact with the bottom of the tin a large quantity of moisture forms around it, so much so, that on one occasion I was about to empty it to discover a supposed leak. What is the cause of this? I thought at first that it might be similar to the formation of dew upon grass, but according to the acknowledged theory the circumstances are reversed, dew being caused by a withdrawal of heat, while this is an application of heat.—Tintub.

[12649.]—**Kites.**—Will some one give me a hint how best to make a kite to fly for my boy; one in the shape of a bird or any other device?—C. Hillary.

[12650.]—**Government School.**—Will one of your correspondents kindly inform me the necessary routine to be observed for obtaining admittance for a lad to the Government School (I believe Woolwich) with a view to be educated as a naval engineer?—W. M.

[12651.]—**Piano Construction Without Down-Bearing of Strings.**—Can any fellow-reader inform me what results when the strings of a piano are in the same plane throughout the whole of these portions of their lengths between the wrest-plank bridge, and where they rest on the string-plate or bent side. Of course, they are supposed to be firmly clamped to the belly-bridge by sufficient side bearing against considerably inclined bridge-pins, or by screw clamps. In his patents A.D. 1741, No. 581, and A.D., 1745, No. 618, prices 4d. each, Plenius—the ingenious harpsichord maker, who probably constructed the first grand piano made in England—says all the strings of the said instruments are laid in "right horizontal lines" from the bridge which rests on the belly to the tail—query, hitch—pins; notwithstanding, every string has the required lateral pressure for producing its true sound—(*i.e.*, its vibrating length determined by side-bearings)—against two pins on its bridge near together, "so that the strings, having no downward pressure on its belly, it (the belly) is at full liberty to vibrate more equally (query, freely) than the bellies of other instruments." Query, must this necessarily diminish the loudness of the sounds; it would, I think, conduce to their longer continuance. There is some interesting information to be obtained by reading Plenius' specifications. He seems to have been the first to double pin his belly-bridges through, an improvement which did not exist in a square piano made by Tomkisson in 1814, formerly in my possession. He also seems to have been the first maker who clothed the mortices in the keys to prevent them from rattling; and was, I believe, the first harpsichord maker who employed a weighted-cranked lever for maintaining the tension of the strings of that instrument and the lyrichord.—The Harmonious Blacksmith.

[12652.]—**Merlin's Musical Instruments.**—Can any reader inform me what has become of the collection of musical instruments, or any of them, formerly in the possession of the celebrated John Joseph Merlin? These instruments were sold by public auction, A.D. 1837, by a Mr. Mills, whose family I have been unable to trace. Among them were the "celestial harp" and "full band of keyed-stringed instruments, having the power of a full orchestra, and made to sound by a catgut(?) band worked by brass circles." Also "Merlin's original private harpsichord," said to contain some remarkable examples of that rare constructive and executant ingenuity for which he was so renowned.—The Harmonious Blacksmith.

[12653.]—**Poultry Keeping.**—I keep, and have kept for several years, a lot of poultry—fowls, ducks, and geese—in an out-building. Can any of your correspondents say what is the best way to prevent thieves breaking in? I want a practical answer from some one who has lost a portion of his poultry, but has saved the remainder by his method of terrifying or catching the depredators. Profitable poultry keeping depends more upon "quiet possession" than the respective merits of barley meal, Indian corn, or refuse wheat.—Padlock.

[12654.]—**Tenoning Machine.**—Will some one tell me if the tenoning machine patented by Mr. Lloyd is in use, and where it may be seen, and what are its properties?—Paddington.

[12655.]—**Core Box.**—Will any of our engineering readers oblige me with instructions in what form to make a core-box? I am about to make a pattern for the casting of a cylinder, and wish to have the portways cast in it.—Electro.

12656.]—**Photographic.**—I want to make my transparencies (for lantern) a good black. There are a great many formulas for intensifying and toning in Vol. XII., No. 6. Most of them I have tried, but they are not for transparencies, they are for printing on paper. I have also tried the sulphuret of potass, recommended in a back number, but it does not make them black to my satisfaction; if either of our readers will give me the best formula, with a due regard to economy, I shall feel grateful.—Kent.

[12657.]—**Cutting Cylindrical Glass as Bottles and Chimneys.**—I have one of Palmer's small cylindrical-shaped candle lanterns, the glass of which is broken, necessitating my using it in-doors only. As I want to use it mostly for out-door work, I wish to cut a quinine bottle or paraffin chimney so as to fit it. Would any kind correspondent help me out of the difficulty? I have no diamond, and cannot get one.—W. Pike.

[12658.]—**Chemistry of Tea.**—I am desirous of analysing tea into its several different component parts; as, tannim, theine, saccharine matter, chlorine, phosphoric acid, sulphuric acid, manganese, manganic oxide, lime, potassa, magnesia, peroxide of iron, soda, silica, carbonic acid, theobromine, nitrogen, and ash. How am I to set about it, and which are the simplest instruments to be used to obtain the results? Will Mr. Bottone, Mr. Davis, or any able chemist tell me?—W. Pike.

[12659.]—**Water Pressure.**—We have a pressure of 300ft. through a 4in. meter. We wish to get the best supply of water, and one person says we shall do it by laying down from the meter 6in. pipes in the first mile, 7in. the second mile, and 8in. the third mile. Another says reverse the pipes—that is, commence at meter with 8in. first mile, 7in. second mile, and 6in. the third mile, will give us the best supply. Please say whether the small or large pipes from the meter will, in your opinion, prove the best.—W. Rhodes.

[12660.]—**Aerated Bread Making Machine.**—Can any brother subscriber give me a plan or description of the above machine, or whether I could utilise a mineral water machine for the purpose?—L.W.D.

[12661.]—**Beekeeping.**—May I ask Mr. Abbott to send plain directions for constructing his bar-frame hive? To mention that it is 20½in. by 17in., with thirteen frames, is scarcely sufficient to enable a "green hand" to construct one. What does he (or any other of the beekeepers) consider to be the best cover for hives? I use straw, but find it very inconvenient when feeding.—Mil.

[12662.]—**Steam Engine.**—I have made a horizontal slide-valve engine, and now wish to ascertain the power of it, and what size fly-wheel is required. Also, if it is capable of working a five inch gear lathe and planing machine, with eighteen inch stroke. The following are a few of the dimensions:—Cylinder 3in. by 4½in., with 6in. stroke and connecting-rod 15in. long; portholes 1½in. by ½in. I also wish to know which is the best kind of boiler, size required, and probable price. Will some brother reader kindly answer the above questions to oblige a constant subscriber?—F. Kitty.

[12663.]—**Sunrise, &c.**—Can "F. R. A. S." inform me of any work in which the calculation of the rising and setting of the moon and planets is given? I have a reader's ticket for the British Museum, so I have little doubt but that I could obtain the work if I knew the author's name.—Delta.

[12664.]—**To Stereotype Brass Blocks.**—Could some kind reader tell me a simple process of taking good sharp casts of brass blocks by the sterotyping process? Blocks are from ½in. to 8in. square.—J. B. Sharpley.

[12665.]—**Sea Sickness.**—Will any reader of "ours" kindly inform me the best way to prevent sea-sicknes on a voyage of twelve hours?—E. G. H. D.

[12666.]—**Works on Artillery.**—Will some reader be kind enough to give me the titles and authors of some good works on artillery subjects? I want the author's name for reference in the library of the British Museum.—J. W. Longford.

[12667.]—**Organ.**—Being about to construct a small organ, I feel a little at sea about the soundboard, and as far as I can learn from the directions of "J. D." I am first to get a piece of mahogany of the requisite size, and after planning out the position of the pipes from paper patterns, to divide it by glueing on strips of wood of certain dimensions, so as to divide it into fifty-four channels of the regulated dimensions. I then understand that I am to let in a piece of half-inch pine at seven inches from front between the bars, to form a base for the hinge of the pallets, after which I am to cover the bars carefully with strong cartridge paper, cutting it away where the grooves of the pallets occur. Are the pallets to be hinged on to the bars, and if so what forms the support in front for the pallet and guide pin? And after the wind chest is fixed on is there not a bottom board of pine to be glued and screwed on over the paper covering the bars to secure all? An answer to the above will be thankfully received.—W. L.

[12668.]—**Auburn Hair.**—I should be grateful for a recipe for turning dark hair to an auburn shade. I have an order for this, and am quite ignorant as to the way to manufacture it.—A Barber.

[12669.]—**Lottery Laws.**—Being very desirous to obtain a repeal or amendment of these laws, will any correspondent give me some information about them? I cannot see why raffling for pianos, fiddles, microscopes, and so on should be illegal. For a trifle given by many never missed, one person, at all events, might be made happier. Why should pictures be disposed of in this way and not a house? Government might make provision against mere gambling (and even otherwise the old lotteries were never so demoralising as our horse race betting), and make each ticket bear a penny stamp.—M. Paris.

[12670.]—**Engine-Turned Seals.**—What is the best way to prevent these deep engine-turned seals from turning black, and how can I prevent the sealing-wax from sticking to them?—C. H. L.

[12671.]—**Dressing Jack-Line.**—I have a new undressed jack-line. Will some reader favour me with a means of waterproofing it? I have rubbed on white wax, but by use it rubs off. With care, allowing it to dry, how long will one last? Any wrinkles in the fishing-tackle line will be useful.—J. D.

[12672.]—**Grove's Cell.**—What proportions and what forms of sulphuric and nitric acid should be used with Grove's cell to get the greatest power, with the least expenditure, in zinc or acids?—Semaj.

[12673.]—**Working Guttapercha.**—Will any one inform me how I can mould and polish a small article of guttapercha, and also how I can make the guttapercha a little harder than its usual quality?—N. K. R.

[12674.]—**Plant Boxes.**—A common but exceedingly pretty ornament in London may be seen in the form of an oblong box for containing window plants. The front is neatly decorated with what appears to be painted glass of various devices, the principal one of which is of alternate square of blue, red, and white, colours arranged after the manner of a draughtboard. Will some correspondent inform me how the above is made?—J. Griffin.

[12675.]—**Hay.**—There is no problem which so perplexes the farmer in this uncertain climate than that of drying hay in broken weather, of which certainly we have this year "an unlimited supply." I therefore submit the query to our readers, could not hay be sufficiently dried by pressure in a hydraulic press, or even by percussion beneath a great hammer? If such methods caused excessive exudation of the juices of the grass, could not such sap be collected, boiled into a syrup, and sprinkled over or amongst the pressed hay, thus reviving or restoring its nutrition and aroma? Hay might be dried in an oven with fire; but this method, or any modification of it which has yet been suggested, is open to the objection of cost. Simplicity and cheapness is the desideratum.—E. B. Fennessy.

[12676.]—**Book-Keeping.**—Can any one help me in the following difficulty? I took credit in my capital account when I opened my present set of books for what furniture I had on hands. I have a furniture account which is balanced at end of year, same as wages account and others, and carried to debit of profit and loss. The balance of the latter, if on credit side, is carried to same side of capital account, increasing that account accordingly. This last year I have laid out a large amount on new machinery, &c., so that the balance of profit and furniture will probably be on the other side, and thus the capital account will appear reduced. This will not give a fair statement of my capital, as I shall have the additional plant, though less cash in the bank. How should it be done?—A Book-Keeper.

[12677.]—**Stops in Telescope.**—Will any obliging correspondent in possession of a 3in. telescope take the trouble to measure and inform me how far (in inches) the second stop is placed from the object-glass, and how far the first is from the eyepiece when in focus? In my telescope there are two stops, which from some cause or other have slipped, and ever since I have not been able to see objects half so distinctly as formerly.—Tyro.

[12678.]—**The Bluecoat School.**—Will some of your correspondents favour me with information as to the nomination of candidates for Christ's Hospital? I wish to know at what age pupils are received, and what is necessary to render them eligible for entrance. Any information on this subject will be considered a favour.—Tawse.

[12679.]—**Papier Mache.**—A few practical hints to the preparation and manipulation of this mate-would oblige. "The Harmonious Blacksmith" has thrown out hints which lead me to put this query.—E. T. GRAYS.

[12680.]—**Darkening Graduations on Scales.**—I shall esteem it a favour would some of your practical correspondents inform me how to make and apply to vernier and other scales the needful blacking to darken their graduations. I have tried lamp-black with Lucca oil, but this mixture, continuing for some days after application in a moist state, easily comes out of the engraved parts when the scale is wiped. I presume a drying oil should be used, if so, what oil would leave the graduations filled with the darkening substance?—ARIES.

[12681.]—**Is the Interior of the Globe Vacuum?**—Will "C. H. W. B." or some one of your learned readers be so kind as to explain to me why it should not be so? Why should it be a solid body in preference? Why contain fluid or fire, as some assert? Take the globe at 8,000 miles diameter, put the crust, or earth, around at 550 miles thick, there is left for vacuum, or solid, fluid, or fire, 5,600 miles core. Please show me why it is not vacuum?—BALCAIRN.

[12682.]—**Evaporation of Water.**—Being about to make an experiment of a peculiar kind, the knowledge of a few facts here alluded to will be useful to me, and may possibly be the means of saving me a good deal of trouble. 1. About what rate does water spontaneously evaporate? 2. Is it in proportion to its bulk or its superficial surface? 3. Would it evaporate faster by increased pressure of the atmosphere or not?—TINTUB.

[12683.]—**Ornamental Turning.**—Will Samuel Smither show more distinctly the centreing of his holes in the ball of the table which he has shewn in Vol. XIV., p. 456, of the MECHANIC, as I cannot find out how the table can stand with the legs set all in one line?—T. A.

[12684.]—**Canoe.**—I shall be much obliged to any one for a design for a canoe 12ft. long, decked over, to carry only one, and suited for sailing; the sheeting in one case to be of wood, in the other strips of sheet zinc.—AQUARIUS.

[12685.]—**Garden Models.**—I have seen in gardens on the top of a pole models of a pair of sawyers at work, of a man turning a grindstone, &c., which, I believe, are worked by small sails something like windmill sails. I should be much obliged if some of "our" readers who have these things will inform me how they are made, and the different sizes and sort of materials.—A MECHANIC.

[12686.]—**Gravel for Aquarium.**—As I can get nothing but sea gravel I should like to know the best mode of treatment so as to entirely free it from salt.—J. COOK.

[12687.]—**Marking Ink.**—Having tried P. Fowler's recipe for marking ink (reply 7506, p. 217, Vol. XIII.) I find that instead of being black it dries brown. Will any reader kindly tell the cause of this, or suggest a remedy?—VANDYKE.

[12688.]—**Training for Bicycle Races.**—Can any one inform me how to train for running bicycle races?—R. M. D.

[12689.]—**Horses' Hoofs.**—I have a carriage horse which I am obliged to work on the road five or six hours every day, his feet are so very hard; the shoeing smith can make no impression on them with the knife, the consequence is they get broken very bad. I fear I shall not be able to use him for a time. Could any one tell me what I could apply to them to make them soft and tough, and procure a good healthy horn?—W. H. K.

[12690.]—**Fire Marks on Silver Goods.**—When I have repaired a silver article, such as spoons or mugs, and placed them to clean in the pickle (composed of sulphuric acid and water) I find upon taking them out that there are stains or fire marks upon them which no polishing will get out. What can I do to clean them thoroughly?—J. J. N.

[12691.]—**Sharpening Lawn Mower.**—Which is the best way to sharpen a "Climax" lawn-mower.—H. D. W.

[12692.]—**Deliquescents.**—Acetate of lead and sulphate of soda, if powdered and rubbed together in a mortar, deliquesce; so do acetate of lead and alum. Will S. Bottone kindly state any other pairs which behave in a similar manner; also which is the most deliquiescent of the salts given in reply 12188?—LXXXVIII.

[12693.]—**Yeast or Barm.**—German dried east as imported at the present time from Rotterdam and Hamburg being extremely high-priced, and of very inferior quality, I should esteem it a great favour if any of your numerous readers will furnish a really good recipe for making yeast that would be a substitute for the above.—SHENANGO.

[12694.]—**Fell and Meyer Engines.**—Can some one oblige with some particulars of construction, &c., of these engines? Also, particulars of comparative trials. A sketch, if possible, would greatly oblige.—A. B. BOYD.

[12695.]—**Verge Watch.**—Will any brother amateur kindly inform me how to alter the verge so as to give it more drop?—R. T. A.

[12696.]—**Atmospheric Pressures.**—Will any correspondent kindly name any work, not too costly, which gives a scale of atmospheric pressures, according to altitude?—J. M. TAYLOR.

[12697.]—**The Harp.**—Will "Ixion," "Vertumnus," or some other kind friend please tell me whether sheet iron or tin would do for the sound-box of the harp, and explain the tuning-pins, how they are fastened in, tightened, and what distance there should be between the strings?—UN BOUTS.

[12698.]—**Vermin.**—The parson has duties inside dirty cottages, and fleas have no respect to the cloth. Will any kind friend suggest a fluid remedy, harmless to clothing or bedding, which may obviate the nuisance?—SLEEPLESS.

[12699.]—**Onions.**—Does the "giant rocca" require to be sown in a frame, or will it grow if sown in an open bed exposed only to the south?—SODA.

[12700.]—**Bees.—Removing Supers.**—Can any of your bee-keeping readers inform me what is the best time of day for taking off a super from a Woodbury hive, and expelling the bees? My two great difficulties on former occasions have been to prevent the bees carrying the store below, when the super is raised over night on wedges, and getting them to entirely quit it after removal.—AMATEUR.

[12701.]—**Orbits of the Planets.**—I have been looking through back numbers of 1871 and 1872, and seek help for the following, with which no amount of books will supply me. Will "F. R. A. S." or one of our astronomical friends inform me at what period the two inner planets are at their brightest? This I know, that Venus transits at intervals of 113, 107, 113 years, and my meaning is in what length of time are these two planets best seen, and when will they be at their next extreme brightest, so that I can by adding reckon. Was Mercury easily visible on the 3rd, when at its greatest elevation from the sun, with a terrestrial telescope (my only instrument), and does Mercury always recede the same distance, as "F. R. A. S." in his notes of last year makes use of various angles of greatest elevation, and at what angle is it easiest discernible? Venus is most brilliant at 40°, and then (so says Guillemin) subtends a diameter of 61". The meaning of my question will now be apparent. Also at what different periods are the outer planets respectively in opposition? Mars, I notice, has not been well in view for a long time; I need hardly add that I want to know when they will next be in opposition? When will Mira Ocetus be at its brightest? May I venture a hint to "F. R. A. S.?" Could he not give every month, the first day, and the time on which Algol will be most brilliant?—T. H. SOMERVILLE.

CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

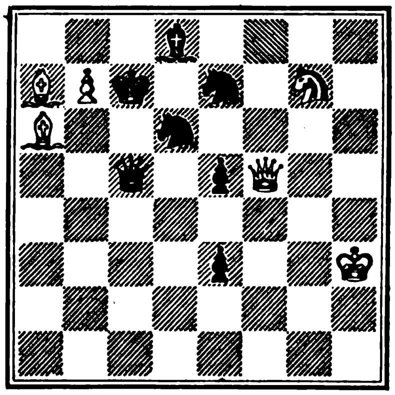
The death of Captain Evans is announced, at an advanced age, well-known in chess circles as the inventor of the "Evans' Gambit."

The score in the match now pending between Zukertort and Steinitz stands: Steinitz, 2; Zukertort, 0; drawn, 1.

We learn from the August number of the *Chess Players' Chronicle*, that a match of ten games has been arranged between Mr. Wisker and the Rev. John Owen.

PROBLEM XI.—BY R. A. PROCTOR.

Black.



White.

White to play and mate in three moves.

SOLUTION TO PROBLEM IX.

White.	*Black.*
1. R to K B sq.	1. P moves
2. B takes P	2. P moves
3. K to K B 2	3. K takes Kt
4. K to K Kt 3 dis. ch. and mate.	

EDROGRAPHY (Leicester).—Problem VIII. is quite sound, and admits of no other solution but that given by the author. The defence to your mate in *two* moves is (1) Q to R 7.

W. NASH (S. Neot's).—Thanks for pointing out the coincidence. Perhaps you will oblige us by sending the problem to which you refer.

C. W. (Sunbury).—Problems safely to hand, for which accept our best thanks.

M. L. MARKS (Swansea).—We infer, from the moves you send as the solution to Problem IX. that you must be joking; but, joking apart, we hope you will examine the positions more attentively before communicating with us.

F. C. COLLINS.—The problem shall be examined, and if up to your usual standard, it shall appear.

E. T. GRAYS.—Thanks for your courteous letter. The position shall be forwarded as directed.

G. C. HEYWOOD.—Quite right. It is far better to keep a problem for a month or two, and subject it to an occasional examination, than send it off the moment it is composed, for publicity. By adopting this plan you will become a careful composer, which is better than a prolific one.

CORRECT solutions to Problem IX. have been received from W. Nash (St. Neot's); W. N. P. (London); S.H.H. (York); J. L. (Lincoln); W. Airey (Worsley). All others are wrong.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£340	9	3
Philanthropist		2	6
J. Baxter		5	0
Faber (2nd contribution)..		10	0
	£341	4	9

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Tuesday morning, August 13, and unacknowledged elsewhere:—

E. T. S.—F. G. Dear.—W. G.—Wm. Dunlop.—Philo.—Amateur.—M. O.—J. E. Fitzgerald Kermey.—T. R. Leyden.—Richard H. Moore.—Hy. Downing.—G. Piggott.—H. P. H.—J. P. James.—Horatio.—A Windsor Subscriber.—Plymouthian.—James Grant.—Undecided.—J. H. Preece.—E. W. D.—L. L.—Superintendent.—Judson and Co.—Rev. J. Wardale.—March and Pattison—Ch. Rabache.—A. J. Burchardt.—Victor Buckley A. J. Dayman.—J. H. Booth.—Dr. J. Row Smith.—W. V. Eye.—B. M. Simpson.—J. B. Younger.—P. H. Jones—A Working B.—Fred Walton.—Veritas.—G. R. Dixon.—J. W. Johns.—Amateur.—J. W. W.—Francis Chrystie.—Joseph Brabazon.—C. R. Bree.—Julia.—Sucram.—James Hurte.—Ritualist.—Ada.—J. G.—Gillem.—Inquirer.—B. H. W.—Blackbeard.—Tim.—J. W. Durrad.—Mix.—C. E. S.—W.—Hy. Taylor.—Soda Water.—Philanthropist.—Duplex.—Gaucho.—F. W. Burnham.—Sting.—C. N. W.—W. S.—Rho.—Bro. Sam. No. 170.—Alfred H. Allen.—C. N. Abbott.—Jack of All Trades.—Optical Bricklayer.—Emigrant.—J. D.—Mechanical Equivalent.—P. R. C. P.—Tom-Tit.—D. P. L.—Yorkshire Amateur.—Opaline.—Daniel B.—S. Tolver Preston.—W. R. Birt.—A Reader.—F. R. A. S.—Dr. A. Woolsey Blacklock.—K.—Alastor.—Harmonious Blacksmith.—East-end Mechanic.—C. N. A.—R. A. Proctor.—Alliance.—J. W. Muggerige.—J. Alport.—Saul Rymes.—C. R. Wells.—C. S. Robertson.—F. R. Leyden.—H. R.—J. Pugh.—Mab.—Anxious Reader.—Poor Jack.—E. Johnson.—Canoeist.—G. W.—R. D. D. M.—W. Bull.—M. F. P.—G. A. W.—Stadaconor.—M. Paris.—James Tonkes.—T. T. M.—Hypo.—H. H. G.—E. L. G.—Geo. Dawson.—One That Tries.—No Soft Solder.—James Aulton.—D. E. F. G.—John Hopkins.—C Natural.—Excelsior.—Ventricosus.—Sedentary.—A. L.—Pianoforte Repairer.—Tremolo.—Will Hatch.—Bristol Subscriber.—Balcairn.—A Student.—R. C. Argenturo.—J. B. Clay.—W. E. C.—W. L. Brown.—Philanthropist.—G. A. Davidson.—Outgenious Whitesmith.—W. B.—Thetamu.—W. Welsh.—S. Trevail.—W. Q. R.—Apprentice Turner.—C. L. H. Hallett.—John Rei.—James Scaff.—Alex. B. Macdowell.—E. Erasmus Holden.—Semaj.—Ignoramus.—Horatio.—Initial.—Tub.—R. A. Proctor. John Thomas.—J. Stevens.—F. Virtue.—G. F. Chambers.—H.S.—Septimus Powell.

J. T. ATKINSON.—See ENGLISH MECHANIC, p. 509, Vol. XII., or write Secretary of Royal Microscopical Society, King's College, London.

ALFRED BARNES.—Your inclosure was not forwarded. See "Hints to Correspondents."

FRED. PRATT.—Your large diagram illustrating weather phenomena would not, in our opinion, be worth the tenth part of its cost to engrave. You conclude your letter with these words:—"Astronomic meteorology is one of the most interesting and valuable sciences ever offered to the public," and you sneer at "F.R.A.S." and Mr. Procter, who "go on with their sublime doctrine of chance." What is your doctrine but one of chance based on epileptic guesses, without even being sublime? Behind the "chance" of "F.R.A.S." and Mr. Proctor there is eternal, immutable, and irresistible law. We will give you another opportunity some day of airing your science of "Astronomic Meteorology" in our columns.

A. M. C., J. H. Gilbert, W. H. K., Horatio, Amateur and Edeos, are referred to indices to back volumes.

INQUIRER.—Culley's "Handbook of Practical Telegraphy," London, Longmans.

R. MURRAY.—If you wish to *describe* your spiral turning apparatus our columns are open to you; if you want an opinion on its merits "with a view to patenting it" they are not—except those devoted to advertisements.

W. PIKE.—We do not insert queries about advertised goods: this rule disposes of your first query. All the others are inserted except that on "Theory versus Practice," which would only bring on a profitless discussion, eliciting much empty argument, but no information.

JOHN COOK.—See reply 12552 in this number.

W. CRUICKSHANK.—You cannot now enter a caveat in the United Kingdom. Provisional protection, of course, practically secures the same object—viz., protection for a short period at small cost. Write to any of the agents advertising in our journal for a book of instructions, which they will send gratis, and if you are wise, employ one of them, or your evident ignorance of all connected with patents will probably end in loss and disappointment.

THOS. JOYNER (Poole).—Thanks. J. Pell's advertisement shall not again appear in our columns.

W. SHILLETO.—You ask about size of pipe, &c., for smoking opium. Have nothing to do with it. Shun it as you would sin or the devil.

THOMAS LATHAM would be much obliged to Zoo Andra by giving the offered information on printing in reply 12447.

HENRY CLARK (Derby).—Your letter on phrenology was rejected because it was silly. We, however, suggested a mode whereby you should test the truthfulness of your theory. You say that the skull conforms in external development exactly in proportion to certain biasses of character and intellect. We suggested a practical test. See our answer p. 523. Instead of accepting the challenge you quibble over it. We will now make another suggestion. We will put before you in a darkened room plaster casts of the heads of statesmen, philosophers, poets, engineers, navigators, soldiers, infamous convicts, &c., and we challenge you to pick out the head of the poet from that of the navigator, or the head of the philosopher from that of the scoundrel. If you cannot do this by manipulating the living head or casts of heads what becomes of the *science* of phrenology?

A SUFFERER.—Consult a medical man.

VERTUMNUS.—One of your contributions inserted: the other, on co-operative stores, would inevitably elicit a passionate reply.

BALCAIRN.—Vastly too imaginative for us.

F. W.—The query about suspended tramways was inserted not merely for "H. B.," but for any others who may be in want of similar information. We should therefore be glad to receive a reply from you, who evidently can well give it.

J. R. BURNE.—Write Trübner and Co., Paternoster-row.

J. YOULDON.—Declined with thanks.

T. R. THOMAS.—We don't answer by post. Ask one of our intelligent correspondents, and so word the question that the answer to it may be useful to others as well.

COMMON SENSE.—The extract is too long for our space.

Y. A. (Kew.)—You will find information on the best books for studying French and German in back volumes, particularly Vol. XIII. As you appear merely to desire sufficient knowledge to read works in those languages, probably Ahn's courses would suit you, and they are cheap. As to the time necessary to acquire this knowledge, that, of course, depends on the capacity of the pupil. Six months, six hours a week, of earnest study, ought to enable you to do what you require, with the occasional help of the dictionary, of course. But you will find your query answered over and over again in back volumes.

J. HATFIELD.—We believe there is a "Brassfounders' Guide" as you mention, but we have occupied some little time in endeavouring to discover the advertisement without success.

HYRAB SEN.—Your letter contains too many offensive epithets to be altogether palatable to the majority of the readers of the ENGLISH MECHANIC.

JOHN THOMAS.—"Lessons on Chemistry" appear on pp. 319, 395, 406, 438, 447, 460, 486, 497, 512, 538, 549, 578, and 589, Vol. XIV., and pp. 4, 29, 84, 111, 214, 241, 396, and 448, Vol. XV.

SEPTIMUS POWELL.—"A Practical Treatise on the Harmonium" appeared in Nos. 94, 96, 98, 100, 105, 109, 116, 118, 124, 126, 132, 133, 136, 141, 151, 158, 166, 172, 180, 190, and on pp. 25, 99, 178, 290, 433, 458, and 555, Vol. XI., and on pp. 5, 75, and 193, Vol. XII.

M. M.—See Vol. XIII., pp. 242, 267, 291, 446, for methods of drilling holes in earthenware.

ROBINSON CRUSOE.—In chess one king cannot move to a square adjoining the other king.

SUMMA says:—"In p. 518, let. 4639, there appears something like a challenge to Mr. Birt by Charles Babache, that latter gentleman wishing to prove the moon is not spherical. I hope Mr. Birt will not take up the challenge, but if he is fond of such discussions that you will not allow it to be discussed in the pages of 'ours.' We had some time ago something similar with respect to the earth, and I think most of our readers have had enough of that sort of thing, without going to the moon."

PLUMBER, W. S. C., Elias Jones, True Blue, J. Nelson, and Jasper. See Hints to Correspondents.

Y. A. (Kew.)—Can't say positively about chemical article.

F. L., A Coal Miner, W. H. P.—Your queries are advertisements.

Curious Phenomenon.—According to a correspondent of the *Madras Mail*, on the night of June 15 last the plain to the east, north, and north-east of Nandidroog was covered with "many thousands" of lights, which have been observed occasionally in former years. The correspondent compares the appearance to that of a large city brilliantly illuminated, and in one direction the scene, through a binocular glass, "looked like a view of part of the starry heavens, each flame being like a star." As many of the lights were from ten to fifteen miles distant from the reporter's point of view, he conjectures that each flame must have been 5ft. to 6ft. in length. An attempt is being made to find out the cause of the curious phenomenon, the most likely hypothesis being that the lights are "caused by the ignition of some inflammable gas escaping in jets from the surface of the earth."

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING JULY 30, 1872.

2189 C. L. Desmolins, Charing-cross, for an improved portable chevaux-de-frise or barricade.

2190 D. Cunningham, Dundee, for improvements in the construction of breakwaters, sea walls, and other subaqueous works.

2191 H. Defty, Middlesborough-on-Tees, for improvements in furnaces for smelting, refining, and puddling iron or other metals.

2192 M. Benson, Southampton-buildings, for an improvement in a combined smut machine and grain separators. A communication.

2193 J. Imray, Southampton-buildings, for improvements in the arrangement, construction, and working of valves for steam-engine cylinders. A communication.

2194 H. Sutcliffe and W. Sutcliffe, Halifax, for improvements in moulding or constructing stench traps or siphon pipes.

2195 W. T. Thompson, Gracechurch-street, City, for an improved ventilating, disinfecting, and deodorising apparatus.

2196 L. Smith, Manchester, for an improved construction of elastic surface suitable for spring mattresses and other articles for sitting or reclining upon.

2197 J. Napier, Argyle-street, Regent-street, for improvements in apparatus to be used in lieu of a coffer-dam in laying foundations under water, and for excluding water for other purposes.

2198 J. L. de Negroni, Paris, for improvements in stoppering bottles and other vessels.

2199 A. J. Woodman, Massachusetts, U.S., for a new and useful improvement in jacquard or fancy looms.

2200 W. R. Lake, Southampton-buildings, for improvements in sewing machines. A communication.

2201 G. Cottino, Tolmers-square, Hampstead-road, for improvements in piston apparatus of wind musical instruments.

2202 J. Cordier, Paris, for improvements in the mode of reflecting, projecting, and diffusing light by means of globe reflectors.

2203 T. Linwood, Glasgow, for improvements in signal and other lamps.

2204 J. Cox, East Stockwith, Lincolnshire, and S. Cox, Camberwell, for an improved apparatus for the recovery and extraction of oils and fats, spermaceti, paraffin, and wax by the distillation of a volatile solvent through the materials containing them, and the recovery of such volatile solvent.

2205 H. A. Dufrene, South-street, Finsbury, for improvements in concentrating and evaporating sulphuric acid and other liquids, and in the apparatus employed therefor. A communication.

2206 J. Walker, James-street, St. Luke's, for improvements in machinery for raising and reducing ores, and extracting the metal therefrom.

2207 B. Hunt, Serle-street, Lincoln's Inn, for a new or improved apparatus or means for excavating, drilling, cleaning, filling, or otherwise treating teeth. A communication.

2208 W. T. Allen, Upper Thames-street, City, and D. G. Fitzgerald, Loughborough-road, Brixton, for improvements in the electro-deposition of metals, and in the application of electro-deposition to the protection of iron, also in the battery and apparatus used in electro-deposition, such battery being applicable to other purposes.

2209 F. Clarke, Canterbury, for improved apparatus or arrangements for charging or filling and drawing off liquids and fluids from bottles and other vessels, and for measuring the quantities of said liquids or fluids supplied to or drawn off from such bottles or vessels.

2210 W. R. Lake, Southampton-buildings, for improvements in refrigerating apparatus. A communication.

2211 H. A. Bonneville, Piccadilly, for improvements in apparatus for the manufacture and application of wire coverings for securing the corks of bottles containing sparkling wines or other fermented or effervescent liquids. A communication.

2212 W. A. Lyttle, The Grove, Hammersmith, for improvements in the means and apparatus for obtaining sea-water for bathing and other purposes.

2213 W. F. Stanley, Great Turnstile, Holborn, for improvements in electrical apparatus.

2214 J. Davis, Great Dover-street, Southwark, for improvements in apparatus for supplying steam boilers with water.

2215 J. Bartlett, Middleton-street, Clerkenwell, for improvements in printing.

2216 H. Walker, Greetland, Yorkshire, for an improved apparatus for signalling on railways. A communication.

2217 J. Vivian and H. S. Mackenzie, Falmouth, for improvements in mechanical arrangements for obtaining reverse rotary motion from one centre, particularly applicable to screw propulsion when more than one screw is adopted.

2218 H. B. Fox, Oxton, and R. L. Gurden, Birkenhead, Cheshire, for an improved guard for protecting the windows and doors of railway and other carriages and moving structures from draught and dust.

2219 A. M. Clark, Chancery-lane, for an improved wrapper garment for travelling and other purposes, and holder for carrying the same and other articles.

2220 J. H. Johnson, Lincoln's Inn-fields, for improvements in the manufacture of plate-glass. A communication.

2221 W. H. Phillips, Birmingham, for a new or improved apparatus for cooling liquids and fluids preparatory to being drawn off for use, particularly applicable for cooling draught ale, porter, cider, or other drinks held in casks or vessels.

2222 H. W. Atkins, Birmingham, for improvements in metal springs for spring mattresses, applicable also for chairs, couches, sofas, and other like purposes where an easy expanding force is desirable.

2223 W. R. Lake, Southampton-buildings, for improvements in apparatus for adjusting window blinds or shades. A communication.

2224 W. E. Blake, New York, for improvements in guns by which the gun can be used as well as a spade or shovel as for firing, together with other improvements.

2225 A. Turner, Leicester, for improvements in the manufacture of elastic fabrics.

2226 W. Turner, Leicester, for improvements in levels.

2227 M. H. Synge, United Service Club, Pall Mall, for improvements in deodorising apparatus.

2228 C. Weekes, Dublin, for improvements in the arrangement and construction of central-fire breech loading cartridges.

2229 C. D. Abel, Southampton-buildings, for improvements in self-acting spinning mules for roving fine spinning and double spinning. A communication.

2230 J. R. Cressey, High-street, Homerton, for improvements applicable to kitchen ranges, kitcheners, and fire stoves.

2231 G. P. Renshaw, Nottingham, for improvements in continuous brakes and signalling apparatus for railway trains.

2232 W. Rose, Worcestershire, for improvements in steam boiler furnaces, puddling furnaces, and furnaces for heating retorts for the manufacture of gas, which improvements may also be applied to other kinds of furnaces.

2233 E. Partington, Manchester, for improvements in the utilisation of the products of combustion for the production of motive-power, and in furnaces and boilers to be employed for such purpose.

2234 H. A. Dufrene, South-street, Finsbury, for an improvement in the mode of constructing carriages and other wheel vehicles. A communication.

2235 C. Levey, Sussex-road, Holloway, for improvements in printing presses. A communication.

2236 F. W. Hartley, Millbank-street, Westminster, for improvements in regulating the pressure and delivery of gas, and in apparatus therefor.

2237 W. R. Lake, Southampton-buildings, for an improved sewing machine and apparatus to be attached to the same for stitching button-holes. A communication.

2238 A. A. Leaker, W. Norman, and W. H. Leaker, Bristol, for improvements in coffins.

2239 J. de Dedulin, Southampton-buildings, for an improved writing machine.

2240 C. E. Spagnoletti, Paddington, for improvements in tell-tale, indicating, and registering arrangements and mechanism.

2241 C. A. C. Eckhold, Green-street, Leicester-square, for an improvement of an apparatus for drawing corks or bungs from bottles or any other vessel.

2242 J. Pullar, Little Love-lane, City, for improvements in appliances for raising sunken ships and other vessels.

2243 W. Abbott, Limehouse, for improvements in portable baths.

2244 H. C. Ashlin and C. J. Clover, Liverpool, or improvements in steam engines.

2245 H. C. Ashlin and C. J. Clover, Liverpool, for improvements in apparatus for registering the number of passengers carried on omnibuses and public vehicles.

2246 C. Smith, Muswell-hill, for a new or improved mode of lettering and ornamenting mirrors for advertising, decorative, and other similar purposes. A communication.

2247 T. Mortlock, South Hackney, for improvements in irons, applicable also for gas stoves for domestic purposes.

2248 S. Lees, Huddersfield, for a new apparatus for raising safety valves in cases of either high steam or low water.

2249 J. Rieber, Islington, for an improved brake for omnibuses and other vehicles, together with an improved arrangement of wheels and axle for use with such brake and otherwise.

2250 M. Volk, Brighton, for an improved apparatus for turning over the leaves of music.

2251 M. Mattson, Southampton-buildings, for an improved apparatus for administering varginal and other injections, and box for containing the same.

2252 F. C. Coxhead, Liverpool and J. J. Miller, Camberwell, for improvements in marine steam-engines.

2253 A. C. Henderson, Charing-cross, for an improved save-all, suitable to all kinds of candlesticks, candle or reading lamps, or chandeliers, burning wax, composition, or other candles. A communication.

2254 J. Fletcher, Portfield, Chichester, for an improved eye cup. A communication.

2255 I. MacDonnell, Dublin, for printing from types or by a special adaptation for printing from stone or other flat surfaces.

2256 C. Brakell, Manchester, for a ballot box or apparatus for the registration of votes by ballot.

2257 A. Woore and J. Watt, Birkenhead, for an improved combined apparatus for heating and moving or forcing liquids.

2258 J. Adams, Strand, for improvements in the construction of breech-loading revolver fire-arms.

2259 J. Edwards, South Hackney, for improvements in fastenings for carriage doors and parts of the same.

2260 C. Fairholme, George-street, Hanover-square, for improvements in the means of effecting electrical communication in railway trains and apparatus therefor.

2261 W. E. Gill, Salisbury-street, Strand, for improvements in treating vegetable juices and in the apparatus and materials to be employed therefor.

2262 T. R. Crampton, Great George-street, Westminster, for improvements in the manufacture of gas and fuel, and in apparatus to be used for this purpose.

2263 G. T. Bousfield, Sutton, for improvements in furnaces for deoxydising iron ores preparatory to their being worked into wrought iron. A communication.

2264 J. P. Hawley, Brixton, for improvements in cocks and sluices.

2265 A. M. Clark, for improvements in the manufacture of phosphoric acid and acid phosphate of lime, and the application of the same. A communication.

PATENTS SEALED.

278 R. Saunders, for improvements in anchors and their accessories.

298 M. Wigzell, for a new or improved drawing board for the purpose of stretching drawing paper (or other materials for drawing, tracing, or painting upon) on one or both of its sides.

800 A. M. Clark, for an improvement in cigarettes.

830 E. Gilyard, for improvements in furniture for locks.

849 J. L. Clarke, for an improved method of and apparatus for preventing candles from guttering.

854 A. L. Dennison, for improvements in watches and pocket chronometers.

878 H. Holland, for improvements in clippers for clipping or shearing horses and other animals.

994 J. F. Lafregne, for improvements in the manufacture of gas for lighting and heating, and in apparatus employed therein.

1079 H. A. Bonneville, for an improved mode and means for obtaining imitation paintings of tapestry.

1525 E. Solvay, for improvements in the manufacture or production of carbonates and bicarbonate of soda, and accessory products thereof, and also in apparatus used in such manufacture.

1669 J. C. Tucker, for improvements in a composition adapted to pavement and other purposes, and in apparatus for treating the same, and also other analogous pavement and material.

224 N. Lloyd, for improvements in fixing colouring matters on prepared fabrics or yarns.

227 J. S. Russell, for improvements in ordnance, and in projectiles and cartridges for the same.

248 H. Aylesbury, for improvements in stoppers for bottles.

253 D. A. Burr, for an improved diaphragm motor, and its application in automatically operating valves and levers in low-water detectors, air-compressing machines, supply or discharge pipes, double-acting vacuum pumps, and other hydraulic or pneumatic machines and engines, by means of an intermittent fluid pressure.

262 G. Weir and J. Weir, for improvements in steam boilers.

267 J. Woodward, jun., and J. Emme, for improvements in breech-loading fire-arms.

270 A. Annandale, jun., for improvements in the manufacture of paper and in machinery or appliances for the purpose.

289 J. Ward, for improvements in the mode and means for securing ear-rings to the ears.

294 J. Knowles, for an improved instrument for rooting up weeds.

296 J. Cooper, for improvements in moulding boxes used in making moulds for casting metal.

305 J. A. Jaques and J. Banks, for improvements in the manufacture of surgical instruments.

310 J. H. Johnson, for improvements in fluting or crimping machines.

321 W. R. Lake, for an improved burner for lamps and other illuminating apparatus.

357 J. L. Norton, for improvements in stables, sheds for cattle and slaughterhouses, and in paving or flooring for the same and other surfaces.

397 J. Harris and D. Normington, for improvements in the joints of metallic bedsteads, sofas, couches, and other articles of like manufacture.

401 N. P. Stockwell, for improvements in sewing machines.

487 W. Nuttall and T. Nuttall, for improvements in looms for weaving.

555 W. H. Cory and E. Cory, for improvements in the manufacture of artificial fuel blocks and in machinery for compressing the same, which machinery is also applicable for compressing other materials into blocks.

609 A. M. Clark, for improvements in machinery for finishing horse-shoe nails.

686 A. M. Clark, for an improvement in saws.

787 A. Longsdon, for improvements in ships or vessels of war and in forts, batteries, and other armed or military structures, apparatus for use on sea and land.

1002 W. R. Lake, for an improved method of and machinery for utilising the butts and other parts of railway rails.

1004 B. Hunt, for an improved method of and apparatus for indicating the speed of railway trains, applicable also for other similar purposes.

1049 W. R. Lake, for improvements in ditching or trenching machines.

1155 E. F. Goransson, for improvements in apparatus for obtaining motive power.

1198 S. Johnson and A. Johnson, for an improved plumb-rule and level.

1382 R. Fish, for improvements in the method of and apparatus for revivifying materials used in the purification of gas.

1509 I. B. Harris, for improvements in and connected with moulds for the production of indiarubber valves and such like articles.

1655 W. R. Lake, for improvements in kilns for burning bricks.

1691 G. Westinghouse, jun., for improvements in apparatus for working brakes and communicating signals on railway trains by compressed air, parts of which improvements are applicable generally for retarding locomotives.

314 A. V. Newton, for improvements in the mode of and apparatus for manufacturing terry and cut-pile carpets and other terry fabrics.

317 R. Punshon, for improvements in apparatus for measuring and registering liquids.

348 S. Cutler, for improvements in fastening and securing window sashes and preventing the rattling thereof.

353 E. Burgess, for improvements in apparatus for evaporating and incinerating alkaline lyes or solutions ordinarily used in the manufacture of paper, and in the treatment of such solutions when spent, for the purpose of recovering therefrom valuable chemical products.

381 W. W. Hulse and B. T. McKay, for improvements in and relating to the manufacturing of floorcloth.

422 E. A. Cook and N. M. Henderson, for improvements in treating hydrocarbon oils.

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ARTICLES.

HEALTHY AND COMFORTABLE HOUSES.*

UNDER this attractive title Drs. Drysdale and Hayward have published accounts of the experiments made by them in the warming and ventilation of houses, and as these are accompanied by suggestions of practical value to the public, as well as to the architect and builder, our readers will, doubtless, feel interested in hearing what two well-known physicians have to say on subjects of such importance as fresh air and warmth in dwelling-houses. The important question how to construct a house which shall be at the same time healthy, comfortable, and not inelegant, has been answered in a variety of ways. Some have contented themselves with pointing out what the architect should do; others have put forward for his edification schemes more or less impracticable, which only their authors could repose confidence in; while others have told us what a house should be without showing us how to arrive at the desired result, so admirable in all respects—on paper. The authors of the present book do not come within either of these categories, for though they have, doubtless, theorised, speculated, and schemed, they have put their theories to the test of practice, and given us the results of their experiments. In 1861 Dr. Drysdale built a house in the suburbs of Liverpool, in which many of the defects of ordinary houses were avoided, and ventilation effected by what he terms a siphon-shaft, the foul air being removed from each room in the house by means of a separate pipe, and conveyed to a foul-air chamber in the roof, whence it was drawn by the "suction-power" or heat of the kitchen chimney. The house in question is a marine villa facing the sea, and is of two stories, with the main staircase in the centre of the plan. In a chamber under these stairs, a coil of pipes in connection with a boiler in the basement on the low pressure principle warms the air, which comes in through a flue opening to the external atmosphere. The fresh air passing through the chamber and becoming heated is distributed to the various apartments in the house through openings in the cornice near the ceiling, and through "hit-and-miss" gratings forming the upper section of the architraves of the bedroom doors. The vitiated air is conveyed from each room through a perforated ornament in the ceiling, by a zinc tube to a zinc drum about 6ft. by 5ft. in the roof. This drum communicates by means of a zinc tube and a shaft built into the wall with the bottom of the exhaust shaft, which is formed by constructing the smoke-flue from the kitchen fire of 14in. earthenware pipes placed within a square brick shaft, the intervening space forming the passage for the foul air, which finds an exit a few inches below the coping of the shaft. The fireplaces in this house are at the corners of the rooms, and no chimneys are placed in outer walls, while the windows are of thick plate-glass. The general result of the ten years' experience of different families who have occupied it is that it is warm and at the same time airy and comfortable, while Dr. Inman, who visited it on a bitterly cold day, says, in his "Preservation of Health," that he has never before or since been in a house which seemed so thoroughly comfortable. In the house built by Dr. Hayward, also at Liverpool, the same principle is applied; but in this a central lobby forms the ventilating shaft and divides the dwelling centrally. All the rooms on the three stories open into these lobbies, which, together, form a corridor extending from basement to attics, being connected by lattice work in the centre of the ceiling of each story and iron gratings at each side of the floor above. By this arrangement the warm air passes from the bottom lobby to the others, but the lattice work and gratings not being in line sufficient resistance is offered to its passage to compel an ample supply to pass into the rooms on either side of the corridor through a lattice enrichment in the respective cornices and perforations in the separating wall. Over the gaseliers are perforated plates connected to a zinc tube, which conveys the vitiated air to the chamber in the roof, whence it is drawn as before by means of the heated flue in the brick shaft.

This plan of ventilating and warming houses is not confined to any special description of dwelling, but may, as the authors point out, be adapted to the poorest class of houses by building them in blocks, just as easily as a common system of drainage is made applicable. But it is more especially to the "splendid blocks of offices" and workshops and warehouses, where graet numbers of persons spend a large portion of their lives, subjected to continual cold draughts and to the baneful influences of a vitiated atmosphere, that the authors desire to see their scheme applied. With respect to cost, the authors offer some sensible observations; for while acknowledging that the expense of the zinc pipes, and running them through and between the walls and ceilings, together with the other necessary appliances of the scheme, will amount to a considerable sum, they point out that a considerable saving may be effected in the brickwork and plastering of the house, which need not be so lofty or so large for equivalent requirements. Thus, living and bedrooms might be reduced in height, and the latter also in size, for with this system of ventilation a constant supply of fresh air is furnished, which more than compensates for diminished cubical capacity, especially where the air of the larger rooms is all but stagnant. But as things are, "what can architects do in changing the style of middle-class house building? They are constantly pressed to meet the requirements of the commercial value of a house as at present estimated, and forced to give as many and as large square boxes of rooms as will go under a roof and within four walls as can be got for the money. With such requirements, how can they study convenience, beauty, health, or comfort?"

We can, of course, only mention the principles of the method here, but ample details are supplied by the authors, and all necessary measurements given. The cost of this means of heating is said to be covered by savings in other directions; and lest some may think that the plan of ventilating would fail when the kitchen fire is not burning, it is desirable to mention that even when this is the case "there is still a sufficient amount of suction to keep up a good circulation of air throughout the house." Indeed, every detail of the scheme has been submitted to actual experiment, and all difficulties satisfactorily met. Several diagrams help to explain the method to the reader; and the book contains besides this, its main feature, much useful information on other matters connected with healthy houses, and a valuable appendix containing the methods of calculating the velocity of currents in hot air, with a record of the experiments carried out in the house built by Dr. Hayward, under the varying conditions of many, few, or no fires, open and closed doors, &c. Looked upon merely as a record of what has actually been done the book is worthy the attention of sanitarians.

* "Health and Comfort in House Building; or Ventilation with Warm Air by Self-acting Suction Power." By J. Drysdale, M.D., and J. W. Hayward, M.D.

INFLUENCE OF LIGHT ON PLANT LIFE.*

PLANTS grow by absorbing certain matters from the soil, and by decomposing, through their green parts, the carbonic acid gas in the air. Of this gas they assimilate the carbon and return the oxygen. This may be considered as plant respiration, and light is necessary to it.

Bonnet, in the eighteenth century, observed that plants always tend towards the sun, in whatever position their seed has been placed; also that plants immersed in water give out small gas bubbles in sunlight. In 1771, Priestly put a burning candle in a closed space, and after it had gone out (the air becoming unfit for combustion) he introduced the green parts of a fresh plant. In a few days the air was purified, so that the candle could again be lit. Ingenhousz further observed that the purifying of impure air by plants only commences after sunrise, diminishes towards sunset, and is suspended in the night time; that plants which are shaded do not purify the air, but give out a noxious gas; and that only the leaves and green parts have the purifying action referred to.

Senebier proved the precise nature of the gases absorbed and exhaled. De Saussure showed that the volume of oxygen liberated is less than that of the carbonic acid absorbed, and also that plants exhaled a certain quantity of nitrogen. In sunlight, plant-respiration takes place very energetically.

In 1848 MM. Cloëz and Gratiolet brought to light some new facts about aquatic plants. These do not give out carbonic acid gas at night. The instantaneity of the sun's action on their respiration was proved, the plant being put in water charged with carbonic acid gas, and the disengagement of bubbles from its surface observed when light was admitted. Diffuse light did not produce the decomposition of carbonic acid. Further, Van Tieghem has observed that the decomposing action, once commenced in sunlight, continues in darkness. The plant is thus capable of receiving, and storing up, as it were, some of the incident vibrations, these reappearing as chemical work. Many phosphorescent substances, and photographic processes, furnish analogous cases of conservation of force. The form of reappearance of the vibration-force varies in different bodies: it is sometimes luminous radiation, sometimes chemical work, sometimes mechanical work.

What is the influence of the various spectral rays on vegetation? The question has called forth much research, and is not yet fully answered. Daubeny, in 1836, was the first to examine the respiration of plants under coloured glass. He observed they exhaled less oxygen than in white light. The orange rays seemed the most energetic; then followed blue. Gardner, a few years later, put etiolated or blanched plants in the various spectral rays, and found that green coloration took place, with the yellow rays, in three hours and a half; with the orange, in four hours and a half; with the blue in eighteen hours. Thus the greatest energy of solar action (in this respect), does not correspond, either to the heat maximum at the extreme red, nor to the maximum of chemical intensity at the other extremity. Those radiations most chemically active influence least the phenomena of plant life. Prof. Draper, of New York, has recently shown that plants disengage most oxygen in the yellow and green rays; next follow the orange and the red. M. Cailletet thinks green acts like darkness in reference to plant respiration, and he thus explains the feebleness of vegetation in the shadow of large trees. M. Prillieux has studied the action of light from a different point. He sought to know the influence of lights having different colours, but of equal intensity. He inferred from his experiments that lights of different colours act in an equal degree, and produce an equal liberation of gas *for the same luminous intensity*. All the luminous rays cause reduction of carbonic acid gas in plants proportionally to their luminous power. Plants placed in obscurity become blanched and lose vigour, as if they were growing on a sterile soil. One effect of sunlight is a continual renewal of the moisture in the vegetable tissues. Where the moisture does not evaporate the plant becomes hydropical.

Sunlight produces numerous variations of the colour of flowers. The corolla of species which grow at a great height on mountains has more lively colours than that of the species found on lower parts. The sun's rays traverse the atmosphere more easily in the former case. In general, the vegetation in well illuminated places is richer in colour than where the light has little access. Some flowers, at first white, become coloured in the sunlight. The *Cheiranthus cameleo* is at first blue, then of a citron yellow, then violet-red. The flower of *Hibiscus mutabilis* is white in the morning, and becomes red during the day. Similarly, the colours of fruits are affected by light.

The mechanical effects of light on plants are various. The sleep of flowers, the inflexion of stems, the nutation of heliotrope plants, the intracellular motions of the chlorophyll, show, in this respect, a very delicate sensibility in certain species. Pliny refers to the plant which turned with the sun, and indicated the hour to labourers. Payer has made precise experiments on the motions of cresses under light. When put in a chamber lighted from one side, the stem curves rapidly. The upper part bends first, the lower remaining erect; this next inclines, while the upper part tends to resume its straightness, and the stem has finally a straight inclined position. If the light enters the chamber by two windows, the effects are as follows:—If the two are on the same side, and the light of equal brightness in both, the stem curves in a direction bisecting the angle of the rays meeting where it is placed. If one window lets in more light than the other, the

* Abstract of part of a paper in *Revue des Deux Mondes*, by M. Papillon.

stem tends towards it. If the windows are on opposite sides, and the light equal in both, the stem remains vertically straight; in the opposite case, it is directed towards the more intense rays. These motions appeared, moreover, to be produced by violet and blue rays, but not at all by red, orange, yellow, and green. M. Gardner has pushed this inquiry further. He sowed turnips, and let them grow in obscurity till they had a length of five or seven centimetres; then he cast on them the spectral rays from a prism. Those which were exposed to the red, orange, yellow, and green rays, became inclined towards the dark blue; while those exposed to the violet rays took an opposite direction. The plants had thus the appearance of a field of grain moved by two contrary winds. The turnips in the blue-violet region looked towards the prism. Thus it is the more refrangible rays that determine the flexure of young stems.

The stems of many plants grow in a spiral direction. This is generally from left to right, but not always, and the stems of some plants turn indifferently in either direction. Mr. Darwin has examined the influence of light on this phenomenon. If one of the plants referred to be put in a chamber and near a window, the extremity of the stem takes more time to describe the half revolution in which it is turned from the light, than the other half. Thus a convolvulus made an entire turn in 5 hours 20 minutes; the half revolution on the window side took a little less than an hour; and the other half 4 hours 30 minutes. M. Duchartre found that some plants which grow spirally in the light grow straight in darkness.

The sleep of plants, by which is understood the closing of the flowers and leaves, to expand again after a short lethargy, is not fully understood in its relation to luminous intensity.

The colouring matter of leaves and stems, called chlorophyll, consists of very small granules contained in the cells of these. Different shades in the colour are due to the greater or less number of these small grains in each cell. Sometimes they are very close together, covering the whole internal surface; sometimes they are fewer and more dispersed. In the latter case light, when introduced, produces a motion of the particles, in some cases agglomerating them to a point. M. Famintzin has studied these mechanical effects on leaves of mosses. During the day, the small grains of colouring matter are scattered over the upper and the lower parts of the cells of the leaves. In the night, on the other hand, they collect on the lateral walls. The blue rays act in this way less than white light, while under yellow and red rays, the grains remain in their nocturnal position. These intracellular motions take place in nearly all the cryptogams, and in many of the phanerogams. M. Roze has found that the grains of chlorophyll are joined by very fine threads of plasma, which he supposes to cause their change of position.

Biot, in 1807, exposed the leaves of a cactus in water charged with carbonic acid gas to a very strong artificial light, on which one could not look without being dazzled. No gas appeared to be disengaged. The vessel was carried into diffuse daylight, and the liberation of gas at once took place with great rapidity. He concluded that artificial light was incapable of producing the effects of solar light. But it has been recently proved that light from any source will cause the respiration of plants if only it be not too intense.

A. B. M.

LESSONS ON CHEMISTRY.*

By Selimo R. Bottone.

(*Late of the Istituto Bellino, Novara, Italy.*)

(*Continued from page 448.*)

206.—In order that the student may form a correct idea of the value of the discovery made by Messrs. Dulong and Petit, in connection with the aid which it affords us in fixing the atomic weights of the elements, it is necessary that he should call to mind a peculiar property, which different bodies have, with regard to the amounts of heat they can absorb, without showing a corresponding rise in temperature. It had been demonstrated by Dr. Black, Irvine, and others, towards the middle of the last century, that equal weights of water, iron, glass, &c., at an equal temperature, required very different amounts of heat applied to them, in order to raise their temperature by 1° Fahr.; in other words, the *capacity* which these bodies display for heat, varies with each. This capacity for heat is known under the name of the "specific heat" of the body. In 1819, Dulong and Petit announced that, according to the results of their experiments, "the product of the numbers indicating the specific heat of the different elements, multiplied by the numbers denoting their atomic weight, is a constant number;" in other words, "the specific heat of simple bodies is always in inverse ratio to their atomic weights."

To this constant number* the name "atomic heat" has been applied.

207.—Perhaps the most accurate method for ascertaining the specific heat of the elements is that of "cooling." Experiments have proved that on raising equal weights of different bodies to a given temperature, and allowing them to cool down to a certain point, the *times* required by them to reach this fixed point, are directly as their specific heat.

Taking the specific heat of water as unity, the following table, compiled from the researches of V. Regnault, Person, Favre, Silberman, and H. Kopp, shows the relative specific heats, atomic weights, and atomic heats of the more important elements:—

Name of Element.	Specific Heat.	Atomic Weight.	Atomic Heat.
Oxygen	0·250	16·	4·
Hydrogen	2·411	1·	2·4
Nitrogen	0·457	14·	6·4
Chlorine	0·180	35·5	6·4
Bromine	0·11294	80·0	6·75
Iodine	0·108	127·0	6·4
Sulphur	0·163	32·	5·22
Phosphorus	0·18870	31·	5·85
Selenium	0·07616	80·	6·4
Tellurium	0·04737	128·	6·4
Carbon	0·14687	12·	1·75
Antimony	0·0533	120·	6 4
Bismuth	0·03084	210·	6·4
Arsenic	0·08140	75·	6·11
Molybdenum	0·07218	96·	6·93
Tungsten	0·03342	184·	6·15
Uranium	0·06190	120·	7·43
Platinum	0·03243	197·	6·4
Rhodium	0·05527	104·	5·77
Palladium	0·05928	106·	6·28
Boron	0·2500	11·	2·75
Silicon (crystals)	0·17740	28·	4·97
Potassium	0·16956	39·	6·61
Sodium	0·29340	23·	6·75
Lithium	0·94080	7·	6·4
Thallium	0·03355	204·	6·84
Magnesium	0·24990	24·	6 00
Aluminium	0·21430	27·4	5·89
Manganese	0·12170	55·	6·69
Iron	0·11380	56·	6·37
Zinc	0·09555	65·	6·21
Tin	0·05623	118·	6·65
Cadmium	0·05669	112·	6·35
Nickel	0·11880	59·	6·50
Cobalt	0·10730	59·	6·30
Copper	0·09515	63·5	6·04
Lead	0·03065	207·	6·35
Mercury	0·03332	200·	6·38
Silver	0·05701	108·	6·16
Gold	0·03244	197·	6·36

208.—From this table we get at the relative atomic weights of most of the elements, independent of their compensating weights (11). Unfortunately, owing to their gaseous state, the specific heats of hydrogen and oxygen do not give the same constant as the majority of the elements, hence we are not able by this mode to state with certainty the relative atomic weights of these bodies. Consequently, though the theoretic law of Gay Lussac would point to their atomic weights being, relatively, 1 for hydrogen, and 16 for oxygen, *we have no proof*, as yet, that this proportion is more correct than that of 1 to 8.

Practically speaking, either mode of expression is equally correct; for it is indifferent in all chemical operations, whether we regard water as being composed of 2 parts of hydrogen, to 16 of oxygen, or of 1 of hydrogen to 8 of oxygen. Consequent upon the theoretic nature of the question involved, it behoves the student to bear always in mind, that although in all likelihood, the views of Gay Lussac, Avogadro, &c., are correct, yet we have no tangible proof that the volumes of hydrogen and oxygen are, respectively, equal to their atoms. Hence it follows, that the only certain basis we have for our calculations is the *fact*, that "elements will combine in certain fixed proportions only, or in multiples of these fixed proportions."

209.—The theory of *valency* is one which, up to the present time, admits of no positive proof, though many arguments may be adduced in favour of its existence. But though not supported by direct proof, it is of great assistance to the chemist in classifying various elements, and in enabling him to foretell, with considerable exactitude, the behaviour of certain bodies, when subjected to the different operations of the laboratory. Whether it be false or true, it has certainly conduced to the preparation artificially, of bodies hitherto supposed to be the products of living organisms exclusively, hence, while keeping our minds open to the reception of negative evidence, it is well to remember that this theory is the one which, up to the present time, gives us the most satisfactory explanation of the constitution of compounds, more especially of such as belong to the domain of organic chemistry.

210.—Let us briefly examine the grounds on which the theory of valency is based. When hydrogen is made to combine with oxygen, two compounds may be formed; the first is water H_2O, the second is hydrogen dioxide H_2O_2. As we have already seen (paragraphs 91 and 95), water is neutral, stable, and easy of preparation; while hydrogen dioxide is extremely unstable, is not neutral, and is very difficult of preparation. It is, therefore, evident that the second atom of oxygen is held much more loosely than the first, or, in other words, that the force of chemical affinity, saturating power, or whatever else we agree to call it, in the atom of hydrogen, is insufficient to satisfy to the full, the saturating power, &c., of the atom of oxygen.

Hydrogen combines with the chlorine in one proportion only (53)—viz., HCl, and here we find that the combining power of the one atom of hydrogen is perfectly satisfied by the combining power of one atom of chlorine. Carbon also can be caused to unite with hydrogen, and of the compounds thus produced the most stable and saturate is marsh gas CH_4, in which the combining powers of the four atoms of hydrogen are completely held in abeyance by the combining power of the one atom of carbon. We might adduce numerous examples, but the above will suffice to illustrate the subject.

211.—We find, then, that compounds do exist, in which the component elements show little or no tendency to *dissociate*, while in others (in which the self-same elements occur, united in different proportions) this tendency is very marked. The question naturally arises, On what do these peculiarities depend? The answer, as given by those who maintain the theory of valency, is as follows:—Each atom of the different elements is endowed with a certain fixed combining force. While the atoms of several of the elements possess similar amounts of combining force, and can, therefore, saturate one another when combining atom for atom, others are gifted with double, treble, quadruple, and even six times the amount of force; and hence, can satisfy the combining power of two, three, four, and six such atoms. Taking, as usual, hydrogen as the standard of comparison, and agreeing to consider its combining power, or *valency*, as unity, it follows that as one atom of oxygen can fix and saturate two atoms of hydrogen, oxygen must be possessed of *two* combining powers, or what amounts to the same thing, must be *bivalent*.

Chlorine can only unite with hydrogen in the proportion of 1 atom of chlorine to 1 atom of hydrogen, hence, we consider it as being possessed of only one combining power—that is to say, it is *monovalent* when compared with hydrogen. The same train of reasoning is applicable to nitrogen, carbon, &c., which satisfy, relatively, three and four atoms of hydrogen, &c.

212.—The intelligent student will immediately perceive that whether we take the modern atomic weights, or the ancient equivalents, as our starting point, similar conclusions may be deduced; but in the latter case, many elements which we now consider dyads will appear as monads, and those which we hold to be tetrads, will figure as dyads, &c.

213.—One point that must constantly be borne in mind, when making any application of the valency theory, is the fact, that the ratios expressed bear reference to, and are true only

* Regnault has shown that this is not really a constant, but varies within small limits, the average being 6·4. This variation is supposed to be due to the fact that the specific heats were not determined in all cases at equal distances from the fusing points of the bodies examined.

when compared with hydrogen; for it would appear that several elements which are markedly monads, dyads, and triads, when hydrogen is taken as the point of comparison, possess different valencies when combining with other elements. We have already noticed several of such cases (see paragraphs 62, 70, 71, 77), and many more will come under our observation in the course of these lessons. In closing these few remarks on valency, we cannot do better than quote the following passage from Professor Barff's "Introduction to Chemistry:"—"It must be borne in mind, that the explanation of properties by such terms as 'valency' is only a convenient method of stating what we know about them, and that the use of such terms may be only of short duration. It may be discovered that some of those substances, which we now regard as elements, are not elements at all, but compounds; and advanced knowledge may even substitute some theory which may have a more sure foundation than the atomic theory. It is well to remark this, as young minds are often apt to espouse warmly views of a certain school, and to regard as *facts* what are nothing more than *assumptions*. It is generally believed that the division of elements into those of even and uneven valency will stand; however the body, nitric oxide NO, is one which, for the present, at least, throws a doubt on this opinion, for nitrogen is usually trivalent, and oxygen divalent, and *here* one or the other must change its valency. It will be remembered that NO occupies two volumes, and this is strong evidence that *that* quantity of nitric oxide is the molecule."

214.—A few words in explanation of the mode in which the *names* of the various compounds which are formed by the union of the elements are built up, may not be amiss here. The elements are usually considered as belonging to two great classes—viz., those which are strongly electro-negative, such as oxygen, chlorine, fluorine, &c., and those which are more or less electro-positive.* Formerly it was customary to place first the name of the electro-negative, slightly modified by a termination in *ide*, then the preposition *of*, and lastly the name of the electro-positive element. Thus, for example, we had *oxide of iron* for a compound of oxygen and iron, *chloride of gold* for a compound of chlorine and gold, &c. In the modern nomenclature we begin by the name of the more electro-positive element, and place after it the name of the electro-negative element (changed as above) without any preposition. Thus, we now designate the compound of iron and oxygen by the name *iron oxide*, while the compound of chlorine and gold is called *gold chloride*, &c. In order to specify the number of atoms of either element which the compound may contain, abbreviations of the Greek numerals are prefixed to the name of the element of which it is required to fix the amount; thus, hydrogen *monoxide* is a compound containing one atom of oxygen in each molecule, hydrogen *dioxide* is a compound containing two atoms of oxygen in the molecule. The prefixes most in use are:—

Mono,	for 1 atom, &c.	
Di	" 2 atoms, &c.	
Tri	" 3	"
Tetra	" 4	"
Penta	" 5	"
Hexa	" 6	"
Hepta	" 7	"
Octa	" 8	"

The proportions in which both constituents of a compound occur in the molecule may thus be easily pointed out by the name, thus *dimanganic trioxide* is the name of a compound containing 2 atoms of manganese, united to 3 atoms of oxygen.

We do not lay much stress on nomenclature, as the rapidity with which the science of chemistry is extending itself renders it a matter of the greatest difficulty to find a system which meets *all* the requirements: in all probability a modification of Prof. Filopanti's atomic nomenclature (see p. 319, Vol. XV. of the ENGLISH MECHANIC) is the one most adapted to the present state of our knowledge.

It is necessary, however, to dilate somewhat on the terms *acid*, *anhydride*, &c., and on the terminations *ous* and *ic*, when applied to acids. In order to exemplify the subject, we shall make reference to the acids derived from sulphur and chlorine, as we have already had the advantage of passing them under review.

* It will be readily understood that this division is entirely relative; for, example, though iodine is electro-negative when compared with potassium, it is electro-positive when compared with chlorine. This observation holds good throughout the series of elements.

REVIEWS.

A Handbook of Chemical Technology. By RUDOLF WAGNER, Ph.D. Translated and Edited by WILLIAM CROOKES, F.R.S. London: J. and A. Churchill.

FEW Englishmen except those engaged in scientific pursuits, students of philology, and literary men, are acquainted with the German language. It is true that a smattering of it is taught in "commercial academies," but of the general run of average intelligent Englishmen met with in ordinary every-day life very few have any knowledge of German, whereas numbers have a more or less imperfect acquaintance with French. The great change in what is termed the "balance of power" brought about within the past half-dozen years will probably produce an alteration in this respect, and although it is useless to hope that German will become as familiar to Englishmen as the tongue of the latter is to our better educated cousins, there can be no doubt that it must be deemed of at least as much importance as French. Independently of the high-class literature which teems from the presses of Brunswick and Leipsic, and of the great beauties of what are known as the German classics, there is no language in which a larger proportion of valuable scientific works is written, and none which at the present day records more useful and interesting facts in the domain of "original research," the importance of which in connection with our manufactures was pointed out on p. 345. It is, perhaps, useless to look for a larger development of this stepping-stone to progress, until an acquaintance with the sciences underlying the processes and operations of our principal industries is more widely spread amongst the mass of workers. For this reason Mr. Crookes, in translating the "Handbuch der Chemischen Technologie" of Dr. Wagner, has done good service, and placed before the public a work containing abundant and reliable information on the subject of which it treats. In a volume containing some 750 pages, with numerous illustrations, the methods of preparing and working the various metals and their salts by the latest improved processes are described under the head of metallurgical chemistry, together with the application of the voltaic current to electro-metallurgy. Manufactures of such importance as the preparation of potash and soda salts, bleaching-powder, sulphuric acid, and the methods employed in recovering all that is of value from "waste" solutions and "rubbish" heaps, occupy prominent places. The manufacture of soap, glass, lime, stoneware, mortars, the technology of vegetable fibres, including paper-making, and the arts of brewing, distillation, dyeing, and others, all will be found explained in a necessarily concise yet ample manner. The subjects enumerated form but a portion of the contents of this book, which must be a valuable vade-mecum to the manufacturer and the student. That it has been fully appreciated in Germany is evidenced by the fact that the edition of which the present book is the English translation is the eighth, the first having been published in 1850. Mr. Crookes has edited the work carefully; all the improvements introduced since the publication of the German edition have been added, and the whole of the formulæ, which are molecular throughout, have been revised. At the conclusion of his preface the translator says: "We cannot let this work pass out of our hands without expressing the hope that, at no distant date, Chairs of Technology will be founded in all our universities, and that the subject will be included in the curriculum of every large school." With this aspiration all who wish to see British science and British manufactures not merely maintain their position but progress must cordially agree. Other nations are pressing us hard in the rear as regards industries which were once thought to be all our own, while in too many of the arts we are lagging behind. Technical education is the only thing that will enable us to keep our place, and such works as this Handbook of Chemical Technology will do much to supply us with that desideratum.

An Introduction to the Practical and Theoretical Study of Nautical Surveying. By JOHN KNOX LAUGHTON, M.A., F.R.A.S., &c. London: Longmans.

PROBABLY nothing is of greater importance to the mariner than a correct chart of the shores along which he coasts, or of the seas which he navigates, for if he becomes conscious of an error in his chart, the element of indecision is introduced into his tactics—an element which on board ship our readers will not require reminding is fraught with great danger. We believe, however, that the charts supplied to the English mariner, as a rule, are as correct as it is possible to make them; and in order to facilitate their construction on sound principles, the student who desires to obtain employment in nautical surveying is provided with the valuable "Introduction" to the study which forms the subject of the present notice. Mr. Laughton, who is mathematical and naval instructor at Portsmouth, mentions in his preface the dictum of an experienced and skilful surveyor that no officer can be qualified to take charge of the soundings of a survey with less than seven years' practice, and while acknowledging that practice and experience can alone give skill, he thinks, and rightly, that without a sound knowledge of the theoretical principles on which the skill should be applied, much of it will be thrown away on objects utterly useless. With the view of enabling the young officer, then, to obtain a sound knowledge of these theoretical principles, and to assist him in gaining a mastery of the science, Mr. Laughton has published what he modestly calls "only an introduction" to the art of surveying; but the introduction is of such a nature that the young officer who is well grounded in it will speedily find the advantage when he comes to handle the instruments in practice. Mr. Laughton is emphatically in favour of the student becoming an adept with the sextant before venturing to touch the theodolite, and he is so because, as he says, a complete survey may be carried on with the sextant alone, but not with the theodolite, while any one who is master of the former instrument will readily acquire facility and familiarity in using the latter. The text is illustrated with diagrams where necessary, and the student of nautical surveying will find this a very useful grammar of the art. Mr. Laughton, at the conclusion of his work, impresses on the commanders of vessels lying for any time in unfrequented harbours, the necessity of a verification of the soundings. This is more especially the case in volcanic districts, where, during one disturbance, the whole bed of the harbour may be suddenly altered. In these cases no reasonable opportunity of verifying soundings ought to be omitted, and we join with the author in expressing surprise that the Admiralty has never formally and imperatively ordered it to be done, for her Majesty's ships are rather costly emblems of power, and if their commanders are careless of their own safety, they might at least expend a little of their unexhausted energies in securing the safety of other, if less valuable, vessels.

The Noxious, Beneficial, and other Insects of the State of Missouri. By CHARLES V. RILEY, State Entomologist. Jefferson City, Missouri, U.S.A.: Regan and Edwards.

WE have had occasion to express our appreciation of the common sense displayed by the legislatures of several (we believe most) of the States of the Union in appointing scientific men to examine into and report upon the natural history of that portion of the earth contained within their boundaries. By this means, sound practical information is acquired of what is on the surface and what is beneath, of the mineralogy, the geology, the botany, the climatology, the natural productions and the animal life of the whole of the vast territory inhabited by Anglo-Saxons on the other side of the Atlantic. Not the least important of these annual reports is the one whose title is given above, being the fourth annual report of the accomplished State Entomologist of Missouri. The ravages effected by various predatory insects on the crops of the American farmers are only too well-known in that country, and have also been heard of here, in the shape of some marvellous tales, in which the authors had allowed their imaginations to overcome their appreciation of number; but making due allowance for the "tallness" of the accounts, the armies of insects which at times pass like tongues of fire across the cultivated fields of the States, cause sufficient destruction to crops to become matter for serious thought. Thus, take for instance the Colorado potato beetle, which was never so numerous as last year. In such numbers did this pest make its appearance that Mr. Riley says, "Before the potato leaves were fairly out of the ground the beetles were, as usual, after them, and the fighting on the part of potato-growers commenced with vigour, for it seemed that 20 bugs came to the funeral of every one slain." It is satisfactory to learn that by the use of Paris green, and the assistance of its natural enemies, aided by a hot, dry summer, there was a sudden disappearance of this bug, although the potato crop exhibited a falling off of quite 20 per cent. over the whole State. Having described the damage effected by this noxious insect, Mr. Riley then gives us a description of its natural enemies, with illustrations of them in their different states, so that the farmer may know exactly what to destroy and what to preserve. This system is followed throughout the whole of the list of noxious insects which Mr. Riley has been able to notice in the compass of the present report. The "beneficial" portion is this year occupied by an elaborate treatise on the silkworm, with some excellent page illustrations of the *Bombyx Yamamai*, the Ailanthus, Pernyi, Polyphemus, Cecropia, Luna, and sundry other of the silkworm moths. This life-history of these insects comes at an opportune time, when the *morus multicaulis*, or "silkworm fever," is again gaining ground in the States, in some parts of which there can be but little doubt the moths and worms might be successfully reared, and an important source of industry established. A few pages are devoted to "Innoxious insects," but we have not space to write more of a work which would deserve a page if it only applied to our own country. The money spent in obtaining these reports will return a high rate of interest in times to come.

Science and Commerce: their Influence on our Manufactures. By P. L. Simmonds. London: R. Hardwicke.

The statistical essays and lectures here gathered together in one volume have been delivered or published during the past twenty years, and appear to contain a fund of information of a popular nature on the subjects with which they deal. The articles on shells, the cotton, wool, and silk manufactures, on dyeing, and on nuts, are full of interesting matter. It is true some portions of the book are written in the "sensational" style, and Mr. Simmonds would do well to cut out unsparingly all passages of the kind. We do not appreciate the beauty or force of a simile which compares the ships of Britain to "enchanted castles (!) floating along her sea-girt shores," and it is quite possible to convey an idea of the result of submarine explosions without saying that the "obstructions are riven from their foundations, shooting upwards to the zenith with volcanic force into the aërial space!" Readers who can appreciate what there is of value in Mr. Simmonds' book will merely laugh at the high-sounding phraseology in which he at times indulges.

We have also received Nos. 1 and 2 of *Naval Science*, a quarterly magazine devoted to the subjects comprised under its title, containing able articles by competent writers, and edited by Mr. E. J. Reed; *A Standard Algebra*, with *Key*, by the Rev. John Hunter, M.A. (Longmans), forming volumes of the well-known School Series edited by the Rev. G. R. Gleig, M.A., which will be found not only adapted for their special purpose (school-use) but useful to the artisan whose education in this respect has been neglected. The size is suited to the pocket; *The Duke of Somerset's recent attack upon the Bible criticised*, by Rev. Joseph B. M'Caul, is a pamphlet which may interest those who delight in polemics; *As Regards Protoplasm*, by J. H. Stirling, F.R.C.S., LL.D. (Longmans), is an amended edition with additions of the author's pamphlet in reply to or rather attack upon Mr. Huxley; *Magnetism and Deviation of the Compass*, by J. Merrifield, LL.D. (Longmans); and *Plain and Ornamental Alphabets* (Brodie and Middleton), is a series of alphabets, the letters of which are of various designs and printed in different colours, of use to engravers, lithographers, painters, carvers, and others who require a guide in the construction of ornamental letters. We have also received *Life of Trevithick*, Vol. I. (Spons), and the *Battle of the Gauges Renewed*, by R. F. Fairlie (Effingham Wilson), notices of which must be postponed.

Black Bass in England.—Mr. Parnaby has succeeded in bringing sixty black bass fry home from America, and they are safely deposited in the tanks at Troutdale, Keswick; they are feeding heartily, so may now be considered safe. He found great difficulty in collecting the fry and bringing them safely across the Atlantic on account of the intense heat. Mr. Francis considers this the second greatest feat in pisciculture, the first being the conveyance of salmon to Australia.

THE WATCH, AND HOW TO REPAIR IT.

By "Seconds' Practical Watchmaker."

(*Continued from page 529.*)

The remarks in last article on this subject introduced us to that portion of the watch termed the escapement. Therefore, to render the following remarks somewhat more intelligible we introduce Fig. 6, which at A represents the balance. Many persons recognise this as the fly-wheel, though technically it is the balance. Through its centre is fixed a slender shaft, at each end having a small pivot for the purpose of working in the holes made for their reception, the lower one in the potence I, Fig. 1, and the upper one in a bridge above it. Immediately below the balance on this shaft—the verge—is a flat projecting blade, G, and at the lower end there is a similar one, both of which are termed pallets, the one near the balance being termed the upper, and the one below it, as might be supposed, the lower pallet. By referring to Figs. 1 and 2 there will be little difficulty in tracing the connection existing between the train and the wheels marked E F, Fig 6. Therefore, we now have to consider in what manner these two pallets of the verge, as well as the balance, serve the purpose of permitting the escape to take place.

The balance A is a rimmed wheel applied for the purpose of moving the verge and its pallets beyond that which would be natural to them without its application, for by its momentum it carries with it the verge, both being firmly riveted together. Now, the lower pallet must be first considered, as regards Fig. 6. The escape-wheel F has always an odd number of teeth, such, for instance, as 11, 13, and 15, which numbers are made use of respectively in connection with the relative numbers of the teeth of the wheels forming the train. It will be seen in the figure that the lower pallet has upon its face the point of

wheel's motion being horizontal, it is distinguished by this term. In Fig. 7, E represents a portion of the balance, and A also only a portion of the escapement-wheel. The shaft or central axis of the balance is seen at C, but may be more distinctly seen by the larger Fig. 8, which exhibits it without the balance being attached. A, the escape-wheel; B, the stem, which rises from the flat of the wheel with the tooth on its top; C, the cylinder; and D, the escape-wheel pinion. This constitutes the entire escapement, therefore the fourth or last wheel in the train acts into the pinion D, and hence motion is imparted to the escape-wheel, and the action is as follows: The escape-wheel teeth are wedges rising, as it were, upon upright pins or stems. Attached to the balance is a hollow cylinder K, Fig. 8, usually made of steel, the imaginary axis of which passes through the centre of the pivots which form the bearings. The teeth of this escape-wheel are of such length that they have very little freedom when inside the cylinder C and K, and the thickness of the cylinder is so made that there is the same freedom of the wedge teeth between the point of one tooth and the back part of the next, on the outside, as there is when the tooth is inside the cylinder. A notch or opening, K, Fig. 8, is made nearly half way down the diameter of the cylinder, the edges of which, made by this opening, are polished, the right-hand one being flanged inwards, and the left-hand one rounded, in order to allow the curved edge of the teeth to act easily, and with the least friction upon them. In this state of the cylinder, when the escape-wheel tooth entered it, the wheel could not pass, because the rim of it would touch the edge of the cylinder, therefore another opening has to be made lower down, as represented at M, Fig. 8.

While the vibration of the balance causes the cylinder to have common velocity with it, the wedge teeth being impelled by the mainspring

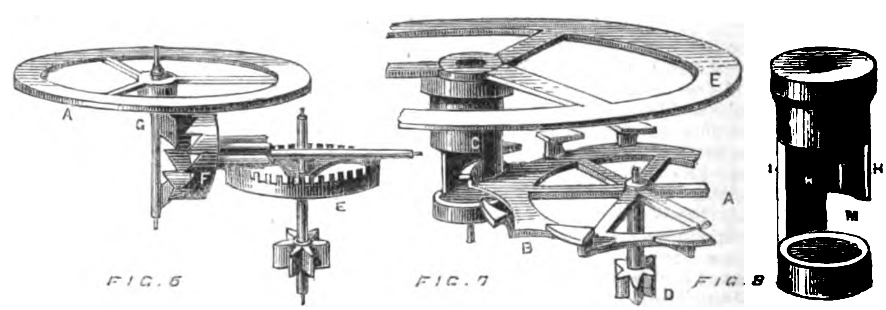


FIG. 6 FIG. 7 FIG. 8

the escape-wheel tooth, and as the train of wheels are exerting the power through the mainspring's force, that tooth must impel the balance forward in the direction of the arrow, and as the balance continues in its onward course the escape-wheel tooth, when it has passed over the entire breadth of this lower pallet, will slip or fall from it. At that instant the upper pallet will be in such a position that its face will be presented to the advancing tooth of the escape-wheel, and will receive it as it slips off the lower pallet, after which the balance, by its return motion, allows the escape-wheel tooth to fall from the upper pallet, and then the lower one is presented to receive another tooth of the escape-wheel, and this alternate motion of the balance permits the teeth of the escape-wheel to escape. Thus the utility of an arrangement termed the escapement, as has been previously stated, for without it the wheels would have revolved very rapidly; but by its introduction the time of their revolutions is considerably prolonged, for, as in the former case, the whole train of wheels would have completed their revolutions in less than two minutes. By its introduction we find that it would occupy about two days before the train required again winding up. But it may be said concerning this statement that a watch such as we have now under consideration does not continue to go for the term of two days. True; therefore when further attention has been called to the subject that important feature of the watch will be explained.

The wheel-work or train in the horizontal watch is very similar to that of the verge one. There is this difference: instead of the contrate wheel E, Fig. 6, which urges the pinion of the escape-wheel F, of the verge watch, in the horizontal one the escape-wheel is driven by a wheel termed the fourth wheel, which takes the place of the contrate wheel, and lies parallel with the frame and the rest of the wheels. Then, again, the escape-wheel itself is also parallel to them all, and that

force necessarily allow that wheel tooth to advance and enter the inside of the cylinder, and during the advance of that tooth its wedge shape presses the flanged edge H, and urges the cylinder onward, during which time the tooth succeeding approaches the opposite side of the cylinder, and the instant that the advancing tooth has left the wedge H of it, I is presented to the succeeding tooth, on which it drops; but the motion of the cylinder does not terminate at this point, for the momentum of the balance carries the cylinder onward, nearly half a turn on each side; therefore, during the oscillation of the balance, the point of the escape-wheel tooth will be resting on the circular portion of the cylinder. Then the tension of the pendulum spring will bring the balance back, and when at or near the centre of motion the succeeding tooth will commence acting on the rounded edge I of the cylinder, thereby impelling it until the point of tooth falls into the inside of it, there reposing until the balance has completed its extent of arc, and again returned to its quiescent point, at which another impulsion takes place, and thus successive lockings and escapings occur.

It may be easy to understand that, as most inventions become improved after a little time, the horizontal watch of Graham's became subject to the same rule, and so we find the fact, for although it held its place for a long time, and stood unsurpassed amongst all comers, scientific men of that and succeeding times directed their attention to improving the then best time-keeper, out of which the world has had presented to it an improvement in another form of watch.

In considering a watch of Graham's, and some even of a later date of the horizontal construction the escape-wheel calls forth from a practical person a little thought. In the first place, we find the majority of them made of brass, which is the worst material for such a wheel to be made of, for experience teaches us all that almost all cylinder watches, with steel cylinders and brass wheels, have their cylinders cut very rapidly, and hence, however correct the escapement may be made by the workman, so soon as the cylinder shows wear all is over with time-keeping. Again, the cylinder and escape-wheel teeth must have oil applied, else the watch would not go a month, that again conduces to wear the cylinder; and should the watch be one which has moderate motive power and a fair weight balance, there is the great drawback of the shape of the wedge forming the tooth, the angle being acute, the balance of such watches having about half a turn of motion, when at the best and just cleaned. Such were made by many London makers. But some few manufacturers introduced ruby cylinders, with gold or steel escape-wheels, and ultimately increased the angle of the wedge teeth; then with a little more strength of mainspring such watches kept time very well indeed. But it is very curious to observe that as the horizontal watch became gradually improved in the foregoing and a few other particulars, our French neighbours kept equal pace with us in that particular branch of industry; even the same angle of the wedge tooth was introduced from Geneva. Many still exist —of course very old watches—made by a firm in Geneva, and sold in London. Workmen may have many through their hands, and can readily distinguish such from their cases being very much bevelled off from the centre towards the edge. Such watches will never keep good time. They may also be recognised in many instances by the ratchet on the barrel, it being secured to it by three screws. Those who would wish to follow up this part of the subject more fully will do well to read "Cummings on Clock and Watch Making;" although an old work the horizontal escapement of that date is elaborately dealt with. Persons who may have Geneva watches to repair of a similar description to the foregoing will not be losers of time if they attend to a few little matters connected with the escapement. Let them be certain that the bridge which has the cylinder lower hole on it is screwed perfectly tight, for there are many which are minus the escapement adjusting screw; also that the end-piece screw is firm; these two little neglects often cause a deal of anxiety to young folk; but after the bridge of cylinder lower hole is secure, examine whether the escape-wheel is the proper depth, to ascertain which, screw the escape-wheel in the frame, and so adjust the bridge or bar that the point of the escape-wheel tooth passes exactly over the centre of the cylinder lower hole. That is a proper depth for horizontal escapement, for then the tooth, in falling from one side of the cylinder to the other, does so with the greatest mechanical advantage; but if the wheel were deep in the cylinder the blow from the escape-wheel tooth would be behind the centre, and impede the free motion of cylinder and balance, and if the wheel be very deep, I have known the pendulum spring's energy insufficient to bring back the balance for the escape, and hence the watch has stopped. Should the mainspring be rather strong that would be also greatly augmenting the defect.

THE PRIZES OF THE TURNERS' COMPANY.

THE Turners' Company of the City of London is determined to do something to encourage proficiency in the art from which it takes its name, and although the means taken may possibly not be the best for attaining the desired result, it is at any rate a step in the right direction. The competition for the silver medal and freedom of the company, which latter will include the freedom of the City, is thrown open to any workman or apprentice in England. We suppose that this is to be taken literally, and that the artisans of Ireland, Scotland, and Wales are debarred; if so, it is matter for regret, for the greater the number of competitors, the more honour will attach to the prize-winner. These competitions are to be continued annually, the materials on which the skill of the craftsman is displayed being varied each year, so as to include wood, ivory, metal, stone, &c., that for this year being "turning in hardened and tempered steel," as applied to horology—*e.g.*, the manufacture of pinions or escapements used in chronometers, watches, &c. Competitors are at liberty to select their subject for exhibition in turning and finishing, but it will be advisable to forward the complete escapement or train of wheels in position, to show the truth and accuracy of the work, the character of which will be judged of by the perfect truth, finish, and squareness of the parts, and as regards escapements by the accuracy of form and proportion for the purpose intended. Certificates will be required that the work has been done by the competitor alone during the period of the competition, and for their satisfaction the judges may require him to do a portion of similar work in their presence. In addition to the prize above named, the company's bronze medal will be awarded to the competitor whose work is found second in merit, and the company's certificate of merit to the third. The different objects must be delivered free at the Mansion House, London, during the week beginning Monday, October 21, and ending Saturday, October 26. They must be inclosed in a box or boxes, marked with a private sign or motto, and if more than one box, numbered consecutively. A list explanatory of the contents, and a sealed envelope bearing a corresponding sign or motto, and containing the name and address of the competitor, his age, if an apprentice, and in all cases a certificate of good conduct, as well as the certificate above named, must accompany the objects. This envelope will not be opened until the judges have made their report. Sir William Armstrong, Sir J. Brown, Mr. Jones, of the Strand, and Mr. S. Jackson, of Red Lion-street, Clerkenwell, will be the judges. The specimens will remain the property of the competitors, and must be removed within a week after the decision. Let us hope that one of our readers will carry off the prize.

TROTMAN'S HYDRAULIC GOVERNOR.

A NEW form of governor especially adapted for use in sea-going vessels, whether screw or paddle, has been recently patented by Mr. Trotman, who calls it the hydraulic governor to distinguish it from another of somewhat similar construction which he denominates the pneumatic governor. A really serviceable and reliable governor for steam vessels is certainly a desideratum, and whether Mr. Trotman has found a means of supplying this remains to be seen when his apparatus is tested by actual work in a rough sea. The advantages he claims for it are immediate automatic action in any position, non-liability to derangement, ease of application to any engine, and perfect command over the rate of working. Fig. 1 represents the hydraulic governor in longitudinal section, Fig. 2 being a transverse section through the middle, and Fig. 3 an elevation of the end at which connection with the throttle or steam-valve is made. A A are pump plungers working through glands into chambers, as shown; B B are cross-heads which connect the two plungers by means of rods working in guides, as seen in Fig. 2. D D are inlet or suction-valves to the pumps, and E E the corresponding outlet or delivery-valves. F is the hydraulic chamber with ram G, to the outer extremity of which the mechanism regulating the admission of steam is connected at the end H. I is a guide for the ram and a set-screw regulating the play of the spring which adjusts the ram G, tending to force it into the chamber F. P is a set-screw and conical plug limiting the area of the plug-hole connecting the delivery and suction passages S and T. V is a safety-valve capable of adjustment, and W, aperture through which the apparatus is filled with oil, water, or a saponaceous solution. With the diagrams and the foregoing explanations of the parts the action will be readily understood. The apparatus is connected to the engine or motive power by the pins C, shown in Fig. 2, and being filled with liquid and the aperture W closed, the governor is set by increasing or decreasing the amount of opening of P, by means of the hand-wheel, till the pressure in the chamber F exactly balances the counteracting pressure of the spring tending to force the ram G into the chamber F. It will be obvious, then, that if the speed of the engine is so great as to cause more of the liquid

FIG. 1

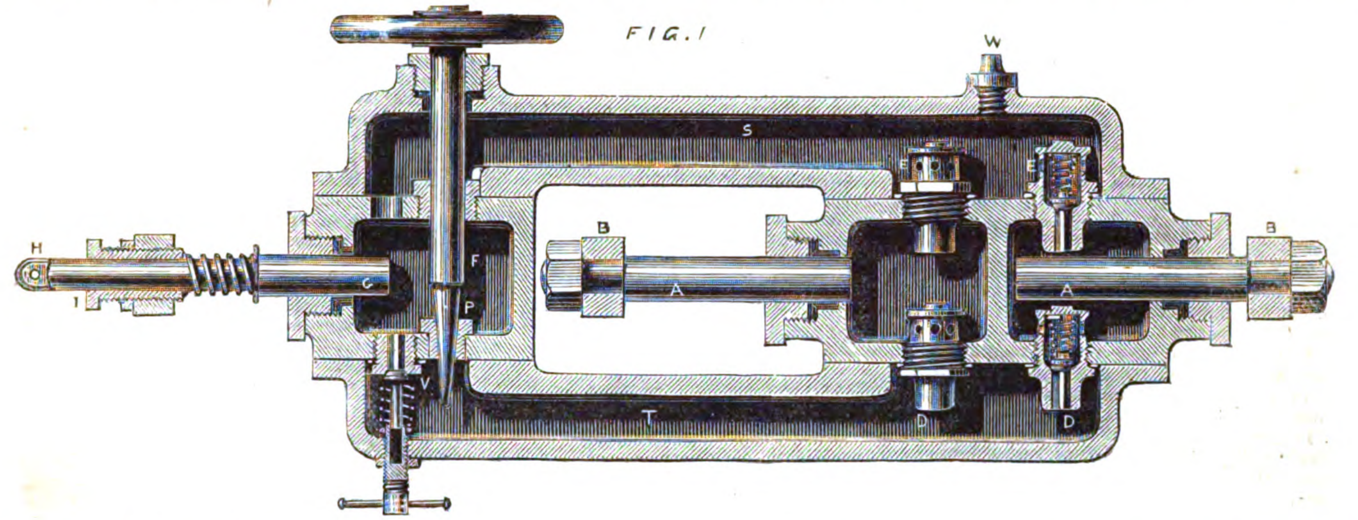


FIG. 2

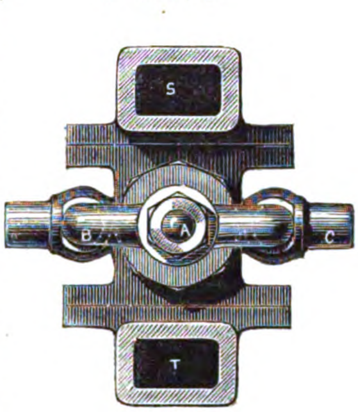
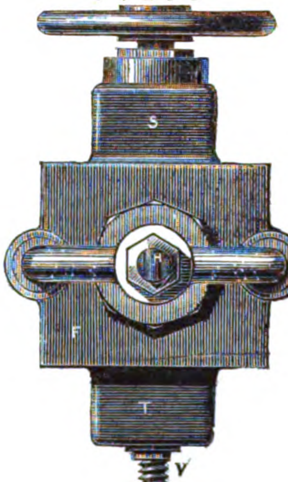


FIG. 3



to flow through the passage S, by reason of the more rapid action of the pump-plungers A A, than can pass through the plug-hole P, the area of which is limited by the conical plug, the ram G will be forced outwards and actuate the throttle-valve or other mechanism regulating the flow of steam to the cylinders of the engine. On the contrary, when the piston is travelling slowly the pump-plungers will cause less liquid to flow to the hydraulic chamber F in a given time, the spring will force the ram G further into the chamber, and move the steam-valve in the reverse way. It will be seen that the action of the apparatus does not depend on any particular or special position of the governor, but will be exactly the same when applied to engines of any arrangement; and while from this fact specially suitable to sea-going vessels, it is also applicable to every description of machine requiring prompt and automatic regulation.

PROPERTIES OF THE GYROSCOPE.

1. IN the gyroscope, when the wheel rotates, and the ring rests on the pivot, two forces are at work—the *tangential*, residing chiefly in the rim, and the *deflective*, caused generally (not invariably) by gravity.

2. This deflective force, acting on the wheel, and impelling the free end of the axis downwards, produces an equal angular deflection laterally, in the top of the rim.

3. The deflection of the revolving matter in the top part of the rim is at right angles to the tangential force.

4. These two forces, by "composition," produce a resultant in the same plane, in an intermediate direction, determined by the relation of the angular values of the two forces.

5. Each particle of the revolving matter, in passing at the top of the rim, suffers the same deflection, and thus receives a new direction the moment the deflection takes place.

6. In other words, the tangential force is suddenly converted, or twisted, as it were, into an intermediate one; but the wheel, being rigid on its axis, can effect the change of direction which it seeks only by pushing the axis backwards horizontally to the same angular extent, *till the tangential force coincides in direction with the resultant.* (See movable diagram).

7. This receding of the free end of the axis constitutes, in fact, the *lateral, horizontal*, or *orbital* revolution of the whole apparatus, which commences immediately on its being placed upon the pivot, and left at liberty to take its own course.

8. The same deflection occurs at the *bottom* of the rim, at the same moment, in the same degree, and the effect is similar to, and conspires with, that already described.

9. The deflective force is commonly that of gravity, which is constant and accelerative throughout. Other forces, however, of an intermittent kind, may be applied, as a blow, or the upward, downward, or lateral pressure of the finger.

10. As to the remarkable self-supporting power which the wheel acquires when rotating, it is to be carefully noticed that the horizontal revolution of the axis and ring round the pivot, which has just been shown to be an *effect*, becomes immediately a *like cause* of a *like effect.*

11. Thus, while the lateral deflection of the *top* of the rim, combined with the tangential force at the same point, produces the retrocession of the axis (*i.e.*, the horizontal revolution of the ring), this revolution of the ring becomes instantly a similar deflection of the *side* of the rim, which, combined with the tangential force at *that* point, produces a like swerving of the axis *upwards.* (By *side* of rim is meant the point at right-angular distance from top or bottom.)

12. The force of the swerve upwards is equal to the primary tendency of the axis downwards, and thus one balances the other. (It is not the intention here to enter into extreme mathematical niceties.)

13. In this continued and reciprocal action consists the self-supporting power which excites so much surprise, and which can exist only so long as the orbital motion is unimpeded.

14. As the deflection of the *bottom* of the rim conspires in its effect with that of the *top*, so, in like manner, the deflection of *one side* of the rim conspires in its effect with that of the *opposite.* The same reasoning applies to every other point and its opposite—all the deflections tending to the same result.

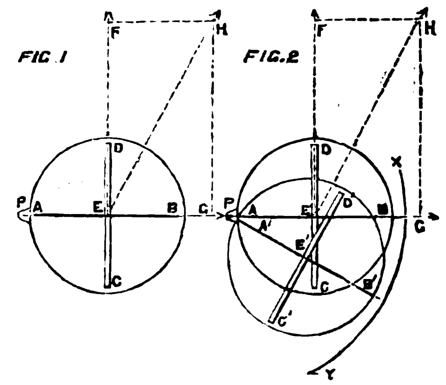
15. The law of rotation of a body on a movable axis, as illustrated in the gyroscope, though deduced in this paper from the "composition of forces," may be fully explained by the following general proposition of Frisi's, depending on the same principle. "When a body, revolving on an axis, is acted upon by a force tending to make it revolve on another, it will revolve on neither, but on a line in the same plane, dividing the angle which they contain into two parts, whose sines are inversely as the angular velocities which the body would have on the two axes, severally, under the separate conditions."

16. From the preceding explanations certain inferences follow, which may be easily tested by experiments.

(1.) When the deflective force is that of gravity, which is accelerative, the resulting orbital motion should be accelerated. This is always found to be the case.

(2.) The deviation of the resultant, and consequent receding of the axis, should be greatest when the deflective force, or downward tendency, is greatest in respect to the tangential. This, also, is conformable to experiment.

(3.) Therefore, to diminish the deflection by means of sliding weights on the contrary side of the wheel, is to lessen the orbital revolution. So, to reduce the deflection to zero, by an exact counterpoise, is to destroy the orbital motion altogether. Lastly, to increase the counterpoise so as to cause an opposite deflection—*i.e., negative* as respects the first direction—is to reverse the orbital revolution, or render it negative as respects is former direction. It may be remarked that the removal of the pivot to the opposite end of the axis, by reversing the deflection, reverses the orbital revolution.



(4.) As the tendency of the axis downwards produces the horizontal swerve, or orbital motion, and this motion in turn the upward swerve, it follows that to increase the orbital motion is to increase the upward swerve; and, *vice versa*, to hinder or destroy the orbital motion is to lessen or destroy the upward swerve or sustaining power. A very simple experiment proves this. Gently urge the receding axis with the finger, and the upward swerve will increase till the axis becomes vertical and the ring slides off the pivot. Evidently, the operation may be reversed.

(5.) If, instead of placing the apparatus on a pivot at one end of the axis, we balance it between two centres outside the ring, at right angles to the axis, and cause deflection by attaching weights or levers, we produce precisely similar effects to those already shown. In this experiment a second or outer ring is necessary to support the first, and must be left free to permit the orbital motion of the axis.

17. The gyroscope is simply a spinning-top differently mounted; that is, with distinct centres for wheel and ring. Teetotums, wheels, hoops, &c., belong to the same class of moving bodies, and are amenable to the same laws.

18. The conical motion of the axis of the spinning-top is identical with the orbital motion of the gyroscope.

19. This conical or oscillating motion of the common spinning-top is always the same way as the rotation—the centre of gravity being above the centre of motion and support. By raising the centre of motion within the body of the top till the centre of gravity falls below it the oscillation is reversed. There is here, in one respect, a resemblance to the slow motion of the earth's axis in the precession of the equinoxes.

20. The orbital motion of the gyroscope has always the *same direction as that of the rim on the side towards which the axis deflects.* Hence, if the free end of the axis deflects *downwards* the *bottom* of the rim determines its orbital direction, if *upwards* the *top.* This is an important fact to remember, as it not only includes the phenomena described in the last two propositions, but affords an *indication* of the *intentions* of the gyroscope in any given experiment. And here it may be observed how capricious those intentions seem. If when rotating it is held in the hand by a stem screwed into the ring it resists all attempts to move it in certain directions—straining and wriggling like a living thing, an imprisoned serpent—yet all the while aiming at one simple object, the *orbital turn of the axis*, on the principle laid down. It knows what it wants, and has a right to, by the laws of Nature, and it sets a good example by being content when that is attained.

The foregoing propositions, with others, can all, I am convinced, be understood and verified by any one who chooses to examine the subject attentively. They have been repeatedly demonstrated by the writer in years past by innumerable experiments, not one of which has proved inconsistent with the principles inculcated.

EXPLANATION OF DIAGRAMS.

Diagram, Fig. 1, represents the wheel and rim, as viewed from a point vertically above them. The circle is the open ring, CD the upper or visible half of the rim, E its top or highest point, AB the axis, B its free end, P the pivot EF, EG tangential and deflective forces, both acting at E; EH the resultant.

Diagram 2, a duplicate of the above, with a second circle movable about P, representing the ring in its changed position, after the orbital motion has commenced. XY denotes the direction of the orbit or line of retrocession, always contrary to the tangential force. In this figure it is shown how the axis recedes till CD, moving to C'D', has gained the same direction as the resultant EH.

N.B.—The lower circle is to be drawn on a separate paper, a pin passing through both papers at the point P.

Honley, Huddersfield. Wm. Hoyle.

IMPROVEMENTS IN PHOTOGRAPHY.

THE improvements in photography recently patented in this country by Mr. Vander Weyde, are attracting the attention of our principal professors of the art, large royalties having been paid in many instances for the exclusive right to use it in given districts. The new process, which the inventor describes as the production of mezzotint effects or "atmospheric stipples," consists in a method of combining and applying dry colours and crayons with other substances, on albumenised, glutenised, and gelatinised paper, surfaces suitable for photographic prints. The effects are rapidly, cheaply, and easily produced, and at a great saving of time and skill, the method being especially adapted to the finishing and beautifying of portrait and figure photographs, as the effects are thoroughly harmonious with their exquisite texture and delicate gradations and tones. It is well known that the surface of albumenised as well as other papers, while apparently flat, consists of prominences and indentations. Artists have observed that dry colour applied to these prominences and indentations alike gives the appearance of opaqueness and absence of atmospheric effect, and they have aimed to apply dry colour so as to touch only these prominences, leaving the tints in the indentations to shine through, so to speak, and thus secure the retiring atmospheric effect so desirable.

Mr. Vander Weyde's method gives the appearance of a very elaborate finish, such as could be attained in an approximate degree only by great labour, artistic skill, and patience. Chiaroscuro effects can by this process be produced with great rapidity by means of the luminous stippled half or middle tint which is first produced, as this tint is capable of being rapidly and readily lightened or darkened without destroying its quality, and because the size or grain of the stipple is to a certain extent under control. By this process a large surface can be treated almost as rapidly as a small one, and the process, when applied to photographic portraits or figures, has the effect of softening, subduing, and retiring the background accessories and hard outlines, and thus enhancing by contrast the solidity, brilliancy, and crispness of the head and figure belonging to an albumenised print, the character or likeness remaining unaltered.

By this process the background and drapery of a portrait photograph may be made to resemble the mezzotint effect in engraving, but with a higher degree of atmospheric effect (in any tint or colour, and with what is technically known as great breadth and freedom of touch, and a luminous quality. The effects obtained by previous attempts in this direction are not harmonious with the delicate gradations of the albumenised photograph, the chalky, raw effect, even when a stipple was obtained, being suited only to crayon drawings or rough sketches. Indian ink and water colours have also been applied with a brush, one stroke or stipple at a time. They have also been applied in the form of spray, but the effect is blotchy and inartistic. Various other methods by printing from negatives have also been used for producing stipples, but with indifferent results.

In applying the invention to a portrait photograph to be finished in monochrome, Mr. Vander Weyde prefers a comparatively fresh print, as age sometimes injuriously affects the albumen, of which the paper should have received one coat only, for if the albumen be too thick, it detracts from the artistic advantage found in the texture of the paper surface, and makes it too much like glass. The picture should be printed in vignette, the drapery fading away gradually, the background having been well masked, and the ground around the head and figure tinted very slightly by exposure to light, this tint flowing into the head and figure evenly, and the print should be as vigorous, and its tone as brilliant, as possible. It should be mounted, before drying, on a stiff, flat backing of cardboard—care having been taken to use paste or mucilage free from lumps and grit—and rolled on a steel plate before it is thoroughly dried or quite hard, using only sufficient pressure to flatten down any irregularities, though greater pressure is needed on small pictures where a fine stipple is required. The old method of rolling it on a lithographic stone of a fine grain may be used with advantage, if the surface be very smooth or glassy. The picture thus prepared, when fixed on a drawing-board, is ready for the application of the invention. About two parts of powdered pumice-stone, of a medium grade of fineness, and one part of finely crushed black crayon or pastel, preferably the softest French (though not what is known as stumping sauce) are sprinkled separately or mixed together over the surface to be treated, adding sufficient dry colour or crayon of a warm tint—such as crimson lake—to match the tone of the photograph. Then with the fingers or flat part of the hand, or a soft pad, rub this mixture over the parts to be treated, avoiding the face and all high lights not desirable to be toned down. There should be enough of the mixture used to prevent contact of the hand with the bare surface, and the rubbing should be with a slight pressure, with an even, steady, circular motion, avoiding a jerky, angular motion, and too much rubbing in one place; but all the parts should be rubbed equally and evenly as far as possible. Where a large or cross grained stipple is desired, as towards the edges of the picture, the motion should be broad and gliding, or skimming over the surface; while to obtain a fine stipple—as, for instance, immediately round the head and figure, where an increased receding effect is desirable—a quicker, closer movement is required. It is preferable to rub a little over the edges of the head and figure than to avoid them. Rub thus over all the parts to be treated several times, adding a little more crayon as it frees itself from the mixture and adheres to the surface, and occasionally blowing off the mixture to observe the effect, ceasing to rub wherever the colour has well adhered to the surface. Blow or dust off the loose mixture, when a dark, and seemingly dirty, smudgy surface appears; with the fingers apply a little of the mixture to darken any light spots or patches, then take a little powdered pumice-stone, rubbing it slightly over the whole, which has the effect of partially loosening the mixture ingrained in the surface, and further blending it. It will be observed that the effect of the pumice-stone is practically to dilute or attenuate and minutely separate the particles of the crayon, thus giving them a transparent quality which alone they do not possess; the powdered pumice-stone, or other material, being employed in a manner analogous to the oil or water used to thin or dilute the colours in oil or water-colour painting, but with this difference, that, without laboured skilful manipulations, a continuous flat tint only is obtained in oil or water-colours, however much the colour may be diluted, whereas by the use of pumice-stone with dry colour the transparent atmospheric stippled effect above mentioned may be obtained.

The effect produced up to this stage of the process can be produced also, but not so well, by first applying and rubbing the crayon on to the surface, afterwards adding and mingling the pumice-stone with it, and proceeding to rub as before, then sprinkle over all the parts treated a small portion of finely crushed, light gray, soft crayon, mixing sufficient warm colour, such as crimson lake, to match the tone of the picture, and rub this firmly over all, with the fingers, until the surface becomes quite smooth, and an atmospheric stipple appears. For the lower parts of the picture the inventor uses a crayon of a darker gray. Should the tone of the background not be in harmony with the picture, or should it be desired to darken any part of it, it may be changed by rubbing in with the finger any colour or crayon, with or without a little pumice-stone. To produce very delicate stippled effects on the white parts of the picture, such as the shirt front, or as shown in flesh when printed from hard or dense negatives, he rubs in with a piece of chamois or kid skin a mixture of gray crayon and pumice with a little colour, using plenty of pumice and great pressure. For the purpose of removing patches and obtaining an even surface, or lighting up any part desirable, pure pumice-stone may be applied with the finger, touching or lightly rubbing the parts, and thus further attenuating or reducing the depth, of colour. A little Naples yellow rubbed all over will increase the luminous effect.

Other materials may be substituted for pumice-stone, such as flour of glass, pulverised cuttle fish, and emery powder, when a brown colour is required. Dry colours also, other than crayons, may be used when combined with pumice-stone, but the crayons are best, because of their pasty cohesive nature, the Parisian softest pastels or crayons possessing these qualities in the highest degree. For the production of the above described effects in colours substitute crayons of the colour desired, in the place of black and gray crayons.

In carrying out this process the following directions for further finishing the picture and enhancing the effects may with advantage be attended to:—Wipe off the head and figure with clean chamois skin, and when lightening or darkening any part of the background relieve the shaded side of the head and figure by a light background gradually darkening towards the edge of the picture, and conversely for the light side of the head and figure. A vigorous cast shadow will always relieve the head and figure, and it should commence suddenly and boldly (yet not with hardness) on the light background next the shady side of the head, just under the shoulder of a three-quarter figure, and just over the shoulder if a head and bust. Here soft crayon sauce, warmed to match shadows of the picture, will be found more vigorous than black crayon. This part of the background should present the strongest contrast of light and shade. Ink-eraser and vulcanised india-rubber may be used with advantage to remove small patches or lines, and to put in edge lights to the cast shadow, as well as to clear up any part of the head or figure, and for high lights. The hair, eyes, eyebrows, and all strong drapery shadows in the centre of the figure, should be treated with prepared gum-water. For increasing high lights in white drapery, or linen, or jewellery, mix a little orange-chrome with thick Chinese white, to avoid a chalky effect.

MECHANISM.*

(Continued from p. 555.)

HITHERTO the communication of motion from one piece to another in mechanism has been considered as taking place only by direct contact of the pieces. The laws which govern the ratio of the velocities of the driver and follower were either obviously impressed upon the driver, as in the case of circular wheels rotating about fixed shafts, or of cams acting upon simple rollers, or sometimes, but less frequently, the law was impressed upon the combined action of the driver and the follower, as in the case of elliptical and lobe wheels, and sometimes cams acting upon cams. Whatever might be the law, the driver and follower must, in accordance with the principles before announced, be placed in communication by means of rigid bodies moving about centres or sliding in grooves. Such communication necessarily narrows the range of primary motion. The space within which rigid bodies alone can act thus, places a very great restriction on facilities for the transference of motion. Suppose it was requisite (and the case is a very common one) to convey a fractional part of an existing primary motion to one place, leaving a large amount of unutilised motion remaining. There must then be called into play a truly perplexing array of wheels, cams, and bars, rolling, oscillating, and sliding, in order beneficially to employ the remaining surplus motion.

Valuable to mechanics and engineers as may have been the deductions of the mechanician and mathematician in relation to the communication of motion by contact, the field of their operations must have been seriously contracted, from a simple incompetency to employ the heavy cumbersome means by which alone this mode could be utilised. Let any one enter a workshop or factory, where steam or water is a source of motion, and those things which first arrest his attention are not wheels, cams, and rods—they are not the rolling and sliding of material substances, each in mechanical contact with the other—but they are the straps, the chords, and the chains which are united in what is usually called wrapping gear. Take, for example, the sheds or rooms in which the weaving of cloth is carried on. They are generally on the basement floor, in consequence of the heavy weight of the number of looms placed close to each other. Curious as are other sights which varying manufacturing processes present, it may be questioned whether anything in the manufacturing line is more perplexingly curious than the strap-gearing, the, to the eye, endlessness of interlacing by which, in these sheds, motion is transferred from a supply-shaft to the recipient shafts of the respective looms. Speaking generally, there are from one hundred to two hundred, or more, of these looms in the same shed, so closely packed that those who attend to them have but narrow space in which to move. To give motion to the parts of these looms with which the mechanician is concerned, there are apparently from two hundred to four hundred straps coming from shafts generally near the ceiling. All straps are in rapid motion, and the labyrinth of these moving bands is so bewildering, and the hopelessness of penetrating with the eye through this labyrinth to the end of the sheds in which the looms are placed is so very great that there arises in the mind of an unaccustomed spectator a sense of fear rather than of respect for the skill which, from apparent chaos, brings perfect order. And further, in this same shed there is a whirr of wheels, a click of gathering ratchets, a din of beams, and sharp raps at brief intervals, now driving and now stopping the shuttles. There are material elements of varied forms seemingly endowed with life and action, each in its own sphere, disporting itself as though chaos and order were for once agreed. In the midst of these sounds and scenes the uninitiated is lost in wonder; the moving straps which cause this babel of mechanic tongues are themselves perfectly silent. Each strap is doing—what England expects every man to do—its allotted duty in its appointed way, too busy to meddle with its neighbour's concerns; and from straps such as these, thus simply constructed and sufficient for the purpose, mechanicians can now obtain from one moving shaft, without the cumbersome mechanism and contrivance which motions by contacts require, as great a variety of motions as plants obtain of flowers and fruits from the same garden soil.

For example, through the agency of straps, or of those wrapping connectors which partake somewhat of the character of straps, motion can be accelerated, as in spindles, lathes, and circular saws. It can be retarded, as in the descent of clock weights; it can cause tools to advance, as in planing and shaping machinery, or retrograde, as in empty kibbles descending mine shafts; it may be made to pause, as in punching and shearing machinery; it can remain at rest, as in the striking mechanism of a clock which remains at rest for an hour; or it may cause a combination of reciprocation, acceleration, and retardation, as in mule-spinning.

It is not only by means of straps and bands that we can communicate motion to a distance. There are many cases in which that can be done by the aid of physical and chemical laws, just in the same way as sliding contact was, by the mechanician's ingenuity and contrivance, brought to assist rolling contact, which it seemed entirely to destroy. On these aids from physical and chemical laws the mechanician is dependent for distinct motions. For example, in the relays of telegraphs and blocking of railways, electricity and magnetism are employed. In the delivery of parcels by the Pneumatic Company, blasts of wind are used; in the motion of ships, steam is employed; in the motion of project tiles, gunpowder and gun-cotton are used; in the semaphore, light is employed; and in the conveyance of sound, air is employed.

Interesting as it is to follow the ingenuities by which the contriving minds of thoughtful men have put in harness such mighty powers, and made them obedient to their will, yet duty requires that these must not now engage attention. One brief sentence at parting with some of the noblest triumphs of the human mind over the visible and invisible colossal powers of nature.

'Twas a sight not to be forgotten when Mr. James Nasmyth, with a delicacy of touch that would barely crush a soap-bubble, caused his newly invented steam hammer to gently tap an egg in a wine glass; to drive fine needles into wood, and then come down with a blow that shivered a block of oak, as though torn into splinters by a lightning flash; and all this within the space of one minute, and without any really personal effort.

Wrapping connectors are of various forms and different materials, and within limited distances are the most convenient mode for transferring motion. The purpose for which each is to be employed determines the material of the wrapper used. Stated generally—and the statement, though general, admits of but few exceptions—where the object is the transmission of motion with a view to obtain power, flat straps are used, and when that motion is very slow then flat chains may be employed. Where the object is to communicate velocity or to work up to velocity, then round bands or cords may take the place of flat straps or chains. The mode in which these straps are generally used is by means of what are called pulleys—not pulleys as we commonly understand the word. It is to be regretted that in mechanism, as in other departments, the same name is given to articles of very different character. Pulleys are really, as we are now speaking of them, simply wheels with or without rims. There are specimens on the diagram lettered A, B, C, D, E, and F. These, of which sections are given in Fig. 24, have all at one time or other been employed; they are but a selection from a very numerous class. It is really extraordinary to note how

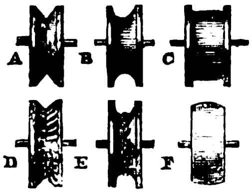
* By the Rev. Arthur Rigg, M.A., being the Cantor Lectures delivered before the Society of Arts.

prejudice or profit prompts opinions, for in pulleys the less satisfactory forms have sometimes displaced the more satisfactory ones. The selected six contain some peculiarities worth studying, for amongst them are to be found features which were once thought valuable, but would not now be employed.

A and B are smooth-grooved pulleys.

Sometimes the groove is sharp or pointed, as at A. At other times the sloping sides are rounded into each other, as at B. Those who were present at a former lecture may remember that attention was directed to the form of the sides of a large grooved pulley from the works at Crewe. The form of that groove, and the angle of inclination of the sloping sides in relation to the diameter of the rope, and the purpose for which the system was used, were then pointed out. Such a pulley would convey an amount of power, for the object of a pulley thus formed in the groove is to enable the cord which presses into the groove to drive the shaft to which the pulley is keyed. By the wedging of the cord between the sloping sides this is accomplished, and for this reason the slope of the sides and the diameter of the cord should be related. Other pulleys are arranged merely to guide the cord, and are not keyed on any shaft which must necessarily be driven by it. The groove in that case is formed as at B.*

FIG. 24



In the case of A (Fig. 24), it is essential that the cord should assume, by the force of tension and compression in the groove, something of an angular character, although only momentarily. The elasticity of the cord prevents it retaining the angular form, which is impressed upon it that the wheel may be driven. It was once thought essential, in order that a pulley might be driven by a cord, that the pulley should be roughened, or have spikes put in, as at E. The object was that the rope might lay hold of these, and so drag the pulley round. Many can remember the day when it was generally believed that railway trains could never run on smooth rails, and some of you may know that rails were laid down which were either adapted for toothed wheels, or roughened by some other means. So here it was thought that a cord could never drive a shaft through the agency of a pulley without some means of holding. Sometimes the pulley was grooved or serrated, as at D (Fig. 24), the rope laying hold on the serrated groove dragged the pulley round. Sometimes Y-shaped iron projections were fastened on the pulley, thus presenting lodgments for the links of chains, by means of which the pulley could be dragged round. Other plans for holding the chain links were also used.

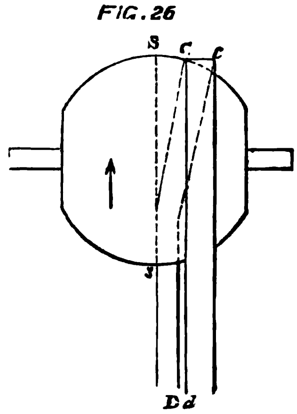
C and F (Fig. 24) are types of pulleys now in use. Those hitherto considered have been used with cords or chains. C and F are forms intended for straps. Until recent years all straps were formed of leather, latterly straps formed of gutta-percha and canvas have been introduced. Although it was found that the adhesion of the strap to the pulley gave sufficient driving-power, and so enabled mechanics to dispense with the contrivances previously named, yet it was considered that unless plans were adopted to hold the strap on the pulley it would not remain; and at the time referred to pulleys were supposed to retain the driving-band by such artificial means. Therefore pulleys, similar to C, with high edges or deep rims, were used, and the band was supposed to run between the edges or rims. Very serious difficulties encompassed this apparently simple and necessary appendage. Any mechanic who attempts it will find, that although he thus provides a way and a guide for the strap, yet the strap may be said to have "a will and a way of its own." He may persevere, and he may answer as one did when told that all facts were against a novel theory he had broached—"Then so much the worse for the facts." So here. Perseverance in a wrong opinion, however plausibly supported, cannot convert "wrong" into "right." The strap will rise up and run on these upper edges, or fray itself to pieces in the corners by attempting to rise, and so be destroyed.

Mechanics lost both time and temper in trying to keep that band in its place. It would not stop. Yet if we let the band alone it will stop where we want it to stop. It will not obey our dictation if we say you shall stop, but if we give it liberty to run off it never does. Off that plain pulley, F (Fig. 24), it never goes at all, but between those two walls on C it will not and cannot be bound. If anybody wants to destroy their bands, let them put guides upon such pulleys as this; the destruction will soon be complete.

*Many such formed pulleys are seen along the railways, guiding the cord or wire from the signal-post to the semaphore.

There is a peculiar and unexpected requirement here. A band always seeks the highest point upon the wheel, and those who take up mechanism or who take up physical science, or who take up any branch of Nature's laws, will find it their wisest plan to learn what Nature says should be done, and to seek to impress that upon what they wish to be done. We may just as well attempt to make water run up a hill as attempt to make a band run on a flat between confined walls. The proper method is to observe how a band behaves itself, and you will find it always trys to get to the highest point, in that respect imitating some of ourselves. Here (referring to a model) is a band running over a double cone, and about 6ft. lower down it runs over a cylindrical drum by which it is driven. On turning the lower drum the strap rises to the highest point of the cone. Why is that? You see it is now positively running on the edge formed by a junction of the bases of the two cones. There is no provision made to keep it there; indeed, the provision rather is that it should go down the hill, which we might think would be the easier to do; but it prefers going up and stopping at the top. The reason (now that we know the fact) is very simple—like many other facts that are easily explained when we know them. It was not so easy to anticipate it. The explanation may be given with the aid of this diagram. Fig. 25 is a rounded or coned pulley, very much distorted, in order to make the cause of the phenomenon more distinct. When a band is stretched between two pulleys, if there is any irregularity, however small it be, in the pulley or in the density of the band—we will assume it here to be in the pulley—then the line of the strap at C (Fig. 25) is clearly moving, owing to its position on the pulley, at a higher velocity than the line at c, and not only is it moving at a higher velocity, but that edge alone is conveying the power that is to be conveyed. The driving power is transmitted simply along the edge C D, because that edge is stretched and the edge (c d) is not stretched. The consequence is that the edge C D of the band touches the pulley, and the edge c d does not. Therefore, touching the pulley, it drives it, and the band being there most stretched is taken into the position shewn by the dotted lines; hence this portion of the band falls upon the larger diameter of the pulley, and is carried in a plane at right angles to the rotating shaft. A few revolutions of the shaft thus causes the edge of the band C to reach the upper or larger diameter as at S. Ultimately, the middle of the band transmits the pressure. It may not be the mathematical middle, but it is the middle, as regards density and elasticity; and although it may oscillate to one side or the other of the upper line, S, it is again driven back. It oscillates about the middle, owing entirely to the difference between the degree on which the outside and inside edges are stretched. Therefore, we have no need whatever to do anything to keep bands in their places, except give them a high point in the pulley to ride upon, and there they always stop.

FIG. 26



Another point about these bands is their great rigidity. Hence a question of some consequence arises, namely, that the pulleys should be of large diameters, and not too near each other. Nothing is more injurious to the band itself, and nothing involves a greater loss of power, than attempting to bend a rigid band round a small pulley.

So far, then, for bands and cords. Chains, however, are also used for these purposes. Chains, bands, and cords, as generally used, transfer a motion not regularly, that is to say, they do not transmit it with a definite and decided law, because there is a certain amount of sliding and slipping, and it becomes a very serious question if it is possible to arrange a flexible connector between a moving shaft and one to be moved, which shall transmit a velocity ratio identical with that which can be transferred by rolling and sliding contact. There are wheels with what may be called teeth upon them, not teeth in the sense of toothed-wheels driving other toothed-wheels, but teeth for a particular purpose, and chains made with links of a particular character, so that each link of the chain is held by a tooth of the wheel. The consequence is, that supposing another similar wheel engaged in driving this one, then the velocity ratio of those wheels would be preserved throughout the whole of the course. Thus the chain becomes, in fact, a flexible wheel with internal teeth, driving another wheel in the same direction, as it would if it was a circular wheel with internal teeth. There are other chains which hook upon hooks similar to those on the flanged pulley E, Fig. 24. A contrivance like this was used in the first mowing machine. Here are other forms of driving chains, this is one used in watches, chronometers and clocks—chains that may be bent in one direction but not in any other.

(*To be continued.*)

BRITISH ASSOCIATION.—ADDRESS OF THE PRESIDENT.

AT the recent meeting of the British Association, at Brighton, William B. Carpenter, M.D., LL.D., F.R.S., President, delivered the following address:—

Thirty-six years have now elapsed since at the first and (I regret to say) the only meeting of this Association held in Bristol—which ancient city followed immediately upon our national universities in giving it a welcome—I enjoyed the privilege which I hold it one of the most valuable functions of these annual assemblages to bestow; that of coming into personal relation with those distinguished men whose names are to every cultivator of science as "household words," and the light of whose brilliant example, and the warmth of whose cordial encouragement are the most precious influences by which his own aspirations can be fostered and directed. Under the Presidency of the Marquis of Lansdowne, with Conybeare and Prichard as Vice-Presidents, with Vernon Harcourt as General Secretary, and John Phillips as Assistant Secretary, were gathered together Whewell and Peacock, James Forbes and Sir W. Rowan Hamilton, Murchison and Sedgwick, Buckland and De la Beche, Henslow and Daubeny, Roget, Richardson, and Edward Forbes, with many others, perhaps not less distinguished, of whom my own recollection is less vivid.

In his honoured old age, Sedgwick still retains, in the academic home of his life, all his pristine interest in whatever bears on the advance of the science he has adorned as well as enriched; and Phillips still cultivates with all his old enthusiasm the congenial soil to which he has been transplanted. But the rest—our fathers and elder brothers—"Where are they?" It is for us of the present generation to show that they live in our lives; to carry forward the work which they commenced; and to transmit the influence of their example to our own successors.

There is one of these great men, whose departure from among us since last we met claims a special notice, and whose life—full as it was of years and honours—we should have all desired to see prolonged for a few months, could its feebleness have been unattended with suffering. For we should all then have sympathised with Murchison, in the delight with which he would have received the intelligence of the safety of the friend in whose scientific labours and personal welfare he felt to the last the keenest interest. That this intelligence, which our own expedition for the relief of Livingstone would have obtained (we will hope) a few months later, should have been brought to us through the generosity of one, and the enterprising ability—may I not use our peculiarly English word, the "pluck"—of another of our American brethren, cannot but be a matter of national regret to us. But let us bury that regret in the common joy which both nations feel in the result; and while we give a cordial welcome to Mr. Stanley, let us glory in the prospect now opening, that England and America will co-operate in that noble object which—far more than the discovery of the sources of the Nile—our great traveller has set before himself as his true mission, the extinction of the slave trade.

Government Aid to Science.

At the last meeting of this Association, I had the pleasure of being able to announce that I had received from the First Lord of the Admiralty a favourable reply to a representation I had ventured to make to him, as to the importance of prosecuting on a more extended scale the course of inquiry into the physical and biological conditions of the deep sea, on which, with my colleagues Professor Wyville Thomson and Mr. J. Gwyn Jeffreys, I had been engaged for the three preceding years. That for which I had asked was a circumnavigating expedition of at least three years' duration, provided with an adequate scientific staff, and with the most complete equipment that our experience could devise. The Council of the Royal Society having been led by the encouraging tenor of the answer I had received to make a formal application to this effect, the liberal arrangements of the Government have been carried out under the advice of a scientific committee which included representatives of this Association. H.M.S. *Challenger*, a vessel in every way suitable for the purpose, is now being fitted out at Sheerness; the command of the expedition is intrusted to Captain Nares, an officer of whose high qualifications I have myself the fullest assurance, while the scientific charge of it will be taken by my excellent friend Professor Wyville Thomson, at whose suggestion it was that these investigations were originally commenced, and whose zeal for the efficient prosecution of them is shown by his relinquishment for a time of the important academic position he at present fills. It is anticipated that the expedition will sail in November next; and I feel sure that the good wishes of all of you will go along with it.

The confident anticipation expressed by my predecessor, that for the utilisation of the total eclipse of the sun then impending, our Government would "exercise the same wise liberality as heretofore in the interests of science," has been amply fulfilled. An eclipse-expedition to India was organised at the charge of the Home Government, and placed under the direction of Mr. Lockyer; the Indian Government contributed its quota to the work; and a most valuable body of results was obtained, of which, with those of the previous year, a report is now being prepared under the direction of the Council of the Astronomical Society.

Man as the Interpreter of Nature.

It has been customary with successive occupants of this chair, distinguished as leaders in their several divisions of the noble army of science, to open the proceedings of the meetings over which they respectively presided, with a discourse on some aspect of Nature in her relation to man. But I am not aware that any one of them has taken up the other side of the inquiry—that which concerns man as the "interpreter of Nature;" and I have therefore thought it not inappropriate to lead you to the consideration of the mental processes by which are formed those fundamental conceptions of matter and force, of cause and effect, of law and order, which furnish the basis of all scientific reasoning, and constitute the *Philosophia prima* of Bacon. There is a great deal of what I cannot but regard as fallacious and misleading philosophy—"oppositions of science falsely so called"—abroad in the world at the present time. And I hope to satisfy you, that those who set up *their own conceptions* of the orderly sequence which they discern in the phenomena of nature, as fixed and determinate *laws*, by which those phenomena not only *are* within all human experience, but always *have been*, and always *must be*, invariably governed, are really guilty of the intellectual arrogance they condemn in the systems of the ancients, and place themselves in diametrical antagonism to those real philosophers, by whose comprehensive grasp and penetrating insight that order has been so far disclosed. For what love of the truth as it is in nature was ever more conspicuous than that which Kepler displayed, in his abandonment of each of the ingenious conceptions of the planetary system which his fertile imagination had successively devised, so soon as it proved to be inconsistent with the facts disclosed by observation? In that almost admiring description of the way in which his enemy Mars, "whom he had left at home a despised captive," had "burst all the chains of the equations, and broke forth from the prisons of the tables," who does not recognise the justice of Schiller's definition of the real philosopher, as one who always loves truth better than his system? And when at last he had gained the full assurance of a success so complete that (as he says) he thought he must be dreaming, or that he had been reasoning in a circle, who does not feel the almost sublimity of the self-abnegation with which, after attaining what was in his own estimation such a glorious reward of his life of toil, disappointment, and self-sacrifice, he abstains from claiming the applause of his contemporaries, but leaves his fame to after ages in these noble words: "The book is written; to be read either now or by posterity, I care not which. It may well wait a century for a reader, as God has waited six thousand years for an observer."

And when a yet greater than Kepler was bringing to its final issue that grandest of all scientific conceptions, long pondered over by his almost superhuman intellect—which linked together the heavens and the earth, the planets and the sun, the primaries and their satellites, and included even the vagrant comets, in the *nexus* of a universal attraction—establishing for all time the truth for whose utterance Galileo had been condemned, and giving to Kepler's laws a significance of which their author had never dreamed—what was the meaning of that agitation which prevented the philosopher from completing his computation, and compelled him to hand it over to his friend? That it was not the thought of his own greatness, but the glimpse of the grand universal order thus revealed to his mental vision, which shook the serene and massive soul of Newton to its foundations, we have the proof in that beautiful comparison in which he likened himself to a child picking up shells on the shore of the vast ocean of truth; a comparison which will be evidence to all time at once of his true philosophy and his profound humility.

Though it is with the intellectual representation of nature which we call *science* that we are primarily concerned, it will not be without its use to cast a glance in the first instance at the other two principal characters under which man acts as her interpreter—those, namely, of the artist and of the poet.

The artist serves as the interpreter of nature, not when he works as the mere copyist, delineating that which he sees with his bodily eyes, and which we could see as well for ourselves; but when he endeavours to awaken within us the perception of those beauties and harmonies which his own trained sense has recognised, and thus impart to us the pleasure he has himself derived from their contemplation. As no two artists agree in the original constitution and acquired habits of their minds, all look at nature with different (mental) eyes; so that to each, *Nature is what he individually sees in her.*

The poet, again, serves as the interpreter of nature, not so much when by skilful word-painting (whether in prose or verse) he calls up before our mental vision the picture of some actual or ideal scene, however beautiful; as when, by rendering into appropriate forms those deeper impressions made by the nature around him on the moral and emotional part of his own nature, he transfers these impressions to the corresponding part of ours. For it is the attribute of the true poet to penetrate the secret of those mysterious influences which we all unknowingly experience; and having discovered this to himself, to bring others, by the power he thus wields, into the like sympathetic relation with nature—evoking with skilful touch the varied response of the soul's finest chords, heightening its joys, assuaging its griefs, and elevating its aspirations. Whilst, then, the artist aims to picture what he *sees* in nature, it is the object of the poet to represent what he *feels* in nature; and to each true poet, *Nature is what he individually finds in her.*

The philosopher's interpretation of nature *seems* less individual than that of the artist or the poet, because it is based on facts which any one may verify and is elaborated by reasoning processes of which all admit the validity. He looks at the universe as a vast book lying open before him, of which he has in the first place to learn the characters, then to master the language, and finally to apprehend the ideas which that language conveys. In that book there are many chapters, treating of different subjects; and as life is too short for any one man to grasp the whole, the scientific interpretation of this book comes to be the work of many intellects, differing not merely in the range but also in the character of their powers. But whilst there are "diversities of gifts," there is "the same spirit." While each takes his special direction, the general method of study is the same for all. And it is a testimony alike to the truth of that method and to the unity of Nature, that there is an ever-increasing tendency towards agreement among those who use it aright;—temporary differences of interpretation being removed, sometimes by a more complete mastery of her language, sometimes by a better apprehension of her ideas;—and lines of pursuit which had seemed entirely distinct or even widely divergent, being found to lead at last to one common goal. And it is this agreement which gives rise to the general belief—in many, to the confident assurance—that the scientific interpretation of Nature represents her not merely as she *seems*, but as she *really is*.

The Scientific Interpretation of Nature.

When, however, we carefully examine the foundation of that assurance, we find reason to distrust its security; for it can be shown to be no less true of the scientific conception of Nature, than it is of the artistic or the poetic, that it is *a representation framed by the mind itself* out of the materials supplied by the impressions which external objects make upon the senses; so that to each man of science, *Nature is what he individually believes her to be.* And that belief will rest on very different bases, and will have very unequal values, in different departments of science. Thus in what are commonly known as the "exact" sciences, of which astronomy may be taken as the type, the data afforded by precise methods of observation can be made the basis of reasoning, in every step of which the mathematician feels the fullest assurance of certainty; and the final deduction is justified either by its conformity to known or ascertainable facts—as when Kepler determined the elliptic orbit of Mars; or by the fulfilment of the predictions it has sanctioned—as in the occurrence of an eclipse or an occultation at the precise moment specified many years previously; or, still more emphatically, by the actual discovery of phenomena till then unrecognised—as when the pertubations of the planets shown by Newton to be the necessary results of their mutual attraction, were proved by observation to have a real existence; or as when the unknown disturber of Uranus was found in the place assigned to him by the computations of Adams and Le Verrier.

We are accustomed, and I think most rightly, to speak of these achievements as triumphs of the human intellect. But the very phase implies that the work is done by mental agency; and the coincidence of its results with the facts of observation is far from proving the intellectual process to have been correct, for we learn from the honest confessions of Kepler that he was led to the discovery of the elliptic orbit of Mars by a series of happy accidents, which turned his erroneous guesses into the right direction; and to that of the passage of the radius vector over *equal areas in equal times*, by the notion of a whirling force emanating from the Sun, which we now regard as an entirely wrong conception of the cause of orbital revolution.* It should always be remembered, moreover, that the Ptolemaic system of astronomy, with all its cumbrous ideal mechanism of "centric and excentric, cycle and epicycle, orb in orb," did intellectually represent all that the astronomer, prior to the invention of the telescope, could see from his actual standpoint, the earth, with an accuracy which was proved by the fulfilment of his anticipations. And in that last and most memorable prediction which has given an imperishable fame to our two illustrious contemporaries, the inadequacy of the basis afforded by actual observation of the perturbations of Uranus required that it should be supplemented by an assumption of the probable distance of the disturbing planet beyond, which has been shown by subsequent observation to have been only an approximation to the truth.

Even in this most exact of sciences, therefore, we cannot proceed a step without translating the actual phenomena of nature into intellectual representations of those phenomena; and it is because the Newtonian conception is not only the most simple, but is also, up to the extent of our present knowledge, *universal* in its conformity to the facts of observation, that we accept it as the only scheme of the universe yet promulgated, which satisfies our intellectual requirements.

When, under the reign of the Ptolemaic system any new inequality was discovered in the motion of a planet, a new wheel had to be added to the ideal mechanism, as Ptolemy said, "to save appearances." If it should prove, a century hence, that the motion of Neptune himself is disturbed by some other attraction than that exerted by the interior planets, we should confidently expect that not an *ideal* but a *real* cause for that disturbance will be found in the existence of another planet beyond. But I trust that I have now made it evident to you that this confident expectation is not justified by any absolute necessity of Nature, but arises entirely out of *our belief* in her uniformity; and into the grounds of this and other primary beliefs, which serve as the foundation of all scientific reasoning, we shall presently inquire.

There is another class of cases, in which an equal certainty is generally claimed for conclusions that seem to flow immediately from observed facts, though really evolved by intellectual processes; the apparent simplicity and directness of those processes either causing them to be entirely overlooked, or veiling the assumptions on which they are based. Thus Mr. Lockyer speaks as confidently of the sun's chromosphere of incandescent hydrogen, and of the local outbursts which cause it to send forth projections tens of thousands of miles high, as if he had been able to capture a flask of this gas, and had generated water by causing it to unite with oxygen. Yet this confidence is entirely based on the assumption that a certain line which is seen in the spectrum of a hydrogen flame, *means* hydrogen also when seen in the spectrum of the sun's chromosphere; and high as is the probability of that assumption, it cannot be regarded as a demonstrated certainty, since it is by no means inconceivable that the same line might be produced by *some other* substance at present unknown. And so when Dr. Huggins deduces from the different relative positions of certain lines in the spectra of different stars, that these stars are moving from or towards us in space, his admirable train of reasoning is based on the assumption that these lines have *the same meaning*—that is, that they *represent the same elements*—in every luminary. That assumption, like the preceding, may be regarded as possessing a sufficiently high probability to justify the reasoning based upon it; more especially since, by the other researches of that excellent observer, the same chemical elements have been detected as vapours in those filmy cloudlets which seem to be stars in an early stage of consolidation. But when Frankland and Lockyer, seeing in the spectrum of the yellow solar prominences a certain bright line not identifiable with that of any known terrestrial flame, attribute this to a hypothetical new substance which they propose to call Helium, it is obvious that their assumption rests on a far less secure foundation; until it shall have received that verification, which, in the case of Mr. Crookes's researches on Thallium, was afforded by the actual discovery of the new metal, whose presence had been indicated to him by a line in the spectrum not attributable to any substance then known.

Common Sense.

In a large number of other cases, moreover, our scientific interpretations are clearly matters of *judgment*; and this is eminently a *personal act*, the value of its results depending in each case upon the qualifications of the *individual* for arriving at a correct decision. The surest of such judgments are those dictated by what we term "common sense,"

* See Drinkwater's "Life of Kepler," in the Library of Useful Knowledge, pp. 26—35.

as to matters on which there seems no room for difference of opinion, because every sane person comes to the same conclusion, although he may be able to give no other reason for it than that it appears to him "self-evident." Thus, while philosophers have raised a thick cloud of dust in the discussion of the basis of our belief in the existence of a world external to ourselves—of the Non Ego, as distinct from the Ego—and while every logician claims to have found some flaw in the proof advanced by every other—the common sense of mankind has arrived at a decision that is practically worth all the arguments of all the philosophers who have fought again and again over this battle-ground. And I think it can be shown that the trustworthiness of this common sense decision arises from its dependence, not on any one set of experiences, but upon *our unconscious co-ordination of the whole aggregate of our experiences*—not only on the conclusiveness of any one train of reasoning, but on *the convergence of all our lines of thought towards this one centre.*

Now, this "common sense," disciplined and enlarged by appropriate culture, becomes one of our most valuable instruments of scientific inquiry; affording in many instances the best, and sometimes the only, basis for a rational conclusion. Let us take as a typical case, in which no special knowledge is required, what we are accustomed to call the "flint implements" of the Abbeville and Amiens gravel-beds. No logical proof can be adduced that the peculiar shapes of these flints were given to them by human hands; but does any unprejudiced person now doubt it? The evidence of *design*, to which, after an examination of one or two such specimens, we should only be justified in attaching a probable value, derives an irresistible cogency from accumulation. On the other hand, the *im*probability that these flints acquired their peculiar shape by *accident* becomes to our minds greater and greater as more and more such specimens are found; until at last this hypothesis, although it cannot be directly disproved, is felt to be almost inconceivable, except by minds previously "possessed" by the "dominant idea" of the modern origin of man. And thus, what was in the first instance a matter of discussion, has now become one of those "self-evident" propositions, which claim the unhesitating assent of all whose opinion on the subject is entitled to the least weight.

Necessity of Special Knowledge.

We proceed, upwards, however, from such questions as the common sense of mankind generally is competent to decide, to those in which special knowledge is required to give value to the judgment; and thus the interpretation of Nature by the use of that faculty comes to be more and more *individual;* things being perfectly "self-evident" to men of special culture, which ordinary men, or men whose training has lain in a different direction, do not apprehend as such. Of all departments of science, geology seems to me to be the one that most depends on this specially-trained "common sense;" which brings as it were into one focus the light afforded by a great variety of studies, physical and chemical, geographical and biological, and throws it on the pages of that great stone book, on which the past history of our globe is recorded. And whilst astronomy is of all sciences that which may be considered as most nearly representing Nature as she really is, geology is that which most completely represents her as seen through the medium of the interpreting mind; the meaning of the phenomena that constitute its data being in almost every instance open to question, and the judgments passed upon the same facts being often different, according to the qualifications of the several judges. No one who has even a general acquaintance with the history of this department of science, can fail to see that the geology of each epoch has been the reflection of the minds by which its study was then directed; and that its true progress dates from the time when that "common sense" method of interpretation came to be *generally* adopted, which consists in seeking the explanation of past changes in the forces at present in operation, instead of invoking the aid of extraordinary and mysterious agencies, as the older geologists were wont to do, whenever they wanted—like the Ptolemaic astronomers—"to save appearances." The whole tendency of the ever-widening range of modern geological inquiry has been to show how little reliance can be placed upon the so-called "laws" of stratigraphical and paleontological succession, and how much allowance has to be made for local conditions. So that while the astronomer is constantly enabled to point to the fulfilment of his predictions as an evidence of the correctness of his method, the geologist is almost entirely destitute of any such means of verification. For the value of any prediction that he may hazard —as in regard to the existence or non-existence of coal in any given area—depends not only upon the [illegible] of the general doctrines of geology in regard [illegible] succession of stratified deposits, but still upon the detailed knowledge which he may [illegible]uired of the distribution of those deposits [illegible]articular locality. Hence no reasonably-[illegible]an would discredit either the general doctrines or the methods of geology, because the prediction proves untrue in such a case as that now about to be brought in this neighbourhood to the trial of experience.

Origin of Primary Beliefs.

We have thus considered man's function as the scientific interpreter of Nature in two departments of natural knowledge; one of which affords an example of the strictest, and the other of the freest method, which man can employ in constructing his intellectual representation of the universe. And as it would be found that in the study of all other departments the same methods are used, either separately or in combination, we may pass at once to the other side of our inquiry—namely, the origin of those primary beliefs which constitute the groundwork of all scientific reasoning.

The whole fabric of geometry rests upon certain axioms which every one accepts as true, but of which it is necessary that the truth should be *assumed*, because they are incapable of demonstration. So, too, the deliverances of our "common sense" derive their trustworthiness from what we consider the "self-evidence" of the propositions affirmed.

This inquiry brings us face to face with one of the great philosophical problems of our day, which has been discussed by logicians and metaphysicians of the very highest ability as leaders of opposing schools, with the one result of showing how much can be said on each side. By the *intuitionalists* it is asserted that the tendency to form these primary beliefs is inborn in man, an original part of his mental organisation; so that they grow up spontaneously in his mind as its faculties are gradually unfolded and developed, requiring no other experience for their genesis than that which suffices to call these faculties into exercise. But by the advocates of the doctrine which regards *experience* as the basis of all our knowledge, it is maintained that the primary beliefs of each individual are nothing else than generalisations which he forms of such experiences as he has either himself acquired or has consciously learned from others; and they deny that there is any original or intuitive tendency to the formation of such beliefs, beyond that which consists in the power of retaining and generalising experiences.

I have not introduced this subject with any idea of placing before you even a summary of the ingenious arguments by which these opposing doctrines have been respectively supported; nor should I have touched on the question at all, if I did not believe that a means of reconcilement between them can be found in the idea that *the intellectual intuitions of any one generation are the embodied experiences of the previous race.* For, as it appears to me, there has been a progressive improvement in the *thinking power* of man; every product of the culture which has preceded serving to prepare the soil for yet more abundant harvests in the future.

Now, as there can be no doubt of the hereditary transmission in man of acquired constitutional peculiarities, which manifest themselves alike in tendencies to bodily and to mental disease, so it seems equally certain that *acquired mental habitudes* often impress themselves on his organisation, with sufficient force and permanence to occasion their transmission to the offspring as *tendencies to similar modes of thought.* And thus, while all admit that *knowledge* cannot thus descend from one generation to another, an increased *aptitude* for the acquirement, either of knowledge generally, or of some particular kind of it, may be thus inherited. These tendencies and aptitudes will acquire additional strength, expansion, and permanence, in each new generation, from their habitual exercise upon the materials supplied by a continually enlarged experience; and thus the *acquired* habitudes produced by the intellectual culture of ages will become "a second nature" to every one who inherits them.*

We have an illustration of this progress in the fact of continual occurrence, that conceptions which prove inadmissible to the minds of one generation, in consequence either of their want of intellectual power to apprehend them or of their preoccupation by older habits of thought, subsequently find a universal acceptance, and even come to be approved as "self-evident." Thus the first law of motion, divined by the genius of Newton, though opposed by many philosophers of his time as contrary to all experience, is now accepted by common consent, not merely as a legitimate inference from experiment, but as the expression of a necessary and universal truth, and the same axiomatic value is extended to the still more general doctrine, that energy of any kind, whether manifested in the "molar" motion of masses, or consisting in the "molecular" motion of atoms, *must* continue under some form or other without abatement or decay; what all admit in regard to the indestructibility of matter being accepted as no less true of force—namely, that as *ex nihilo nil fit*, so *nil fit ad nihilum.**

But, it may be urged, the very conception of these and similar great truths is in itself a typical example of intuition. The men who divined and enunciated them stand out above their fellows, as possessed of a genius which could not only combine but create, of an insight which could clearly discern what reason could but dimly shadow forth. Granting this freely, I think it may be shown that the intuitions of individual genius are but specially exalted forms of endowments which are the general property of the race at the time, and which have come to be so in virtue of its whole previous culture. Who, for example, could refuse to the marvellous aptitude for perceiving the relations of numbers, which displayed itself in the untutored boyhood of George Bidder and Zerah Colburn, the title of an intuitive gift? But who, on the other hand, can believe that a Bidder or a Colburn could suddenly arise in a race of savages who cannot count beyond five? Or, again, in the history of the very earliest years of Mozart, who can fail to recognise the dawn of that glorious genius, whose brilliant but brief career left its imperishable impress on the art it enriched? But who would be bold enough to affirm that an infant Mozart could be born amongst a tribe, whose only musical instrument is a tom-tom, whose only song is a monotonous chant?

Again, by tracing the gradual *genesis* of some of those ideas which we now accept as "self-evident" —such, for example, as that of the "uniformity of Nature"—we are able to recognise them as the expressions of certain intellectual tendencies, which have progressively augmented in force in successive generations, and now manifest themselves as mental instincts that penetrate and direct our ordinary course of thought. Such instincts constitute a precious heritage, which has been transmitted to us with ever-increasing value through the long succession of preceding generations; and which it is for us to transmit to those who shall come after us, with all that further increase which our higher culture and wider range of knowledge can impart.

Matter and Force.

And now, having studied the working action of the human intellect in the scientific interpretation of Nature, we shall examine the general character of its products; and the first of these with which we shall deal is our conception of *matter* and of its relation to *force.*

The psychologist of the present day views matter entirely through the light of his own consciousness: his idea of matter in the abstract being that it is a "something" which has a permanent power of exciting sensations; his idea of any "property" of matter being the mental representation of some kind of sensory impression he has received from it; and his idea of any particular kind of matter being the representation of the whole aggregate of the sense-perceptions which its presence has called up in his mind. Thus when I press my hand against this table, I recognise its unyieldingness through the conjoint medium of my sense of touch, my muscular sense, and my mental sense of effort, to which it will be convenient to give the general designation of the tactile sense; and I attribute to that table a *hardness* which resists the effort I make to press my hand into its substance, whilst I also recognise the fact that the force I have employed is not sufficient to move its mass. But I press my hand against a lump of dough; and finding that its substance yields under my pressure, I call it *soft.* Or again, I press my hand against this desk; and I find that although I do not thereby change its *form*, I change its *place*; and so I get the tactile idea of *motion.* Again, by the impressions received through the same sensorial apparatus, when I lift this book in my hand, I am led to attach to it the notion of *weight* or ponderosity; and by lifting different solids of about the same size, I am enabled, by the different degrees of exertion I find myself obliged to make in order to sustain them, to distinguish some of them as *light* and others as *heavy.* Through the medium of another set of sense perceptions which some regard as belonging to a different category, we distinguish between bodies that *feel* "hot" and those that *feel* "cold;" and in this manner we arrive at the notion of differences of temperature. And it is through the medium of our tactile sense, without any aid from vision, that we

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* I am glad to be able to append the following extract from a letter which Mr. John Mill, the great Master of the Experiential School, was good enough to write to me a few months since, with reference to the attempt I had made to place "common sense" upon this basis (*Contemporary Review*, Feb. 1872):—"When states of mind in no respect innate or instinctive have been frequently repeated, the mind acquires, as is proved by the power of habit, a greatly increased facility of passing into those states; and this increased facility must be owing to some change of a physical character in the organic action of the brain. There is also considerable evidence that such acquired facilities of passing into certain modes of cerebral action can in many cases be transmitted, more or less completely, by inheritance. The limits of this power of transmission, and the conditions on which it depends, are a subject now fairly before the scientific world; and we shall, doubtless, in time know much more about them than we do now. But so far as my imperfect knowledge of the subject qualifies me to have an opinion, I take much the same view of it that you do, at least in principle."

* This is the form in which the doctrine now known as that of the "Conservation of Energy" was enunciated by Dr. Mayer, in the very remarkable essay published by him in 1845, entitled "Die organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel."

first gain the idea of *solid form*, or the three dimensions of space.

Again, by the extension of our tactile experiences, we acquire the notion of *liquids*, as forms of matter yielding readily to pressure, but possessing a sensible weight which may equal that of solids: and of *air*, whose resisting power is much slighter, and whose weight is so small that it can only be made sensible by artificial means. Thus, then, we arrive at the notions of *resistance* and of *weight* as properties common to all forms of matter; and now that we have got rid of that idea of light and heat, electricity and magnetism, as "imponderable fluids," which used to vex our souls in our scientific childhood, and of which the popular term "electric fluid" is a "survival," we accept these properties as affording the practical distinction between the "material" and the "immaterial."

Turning, now, to that other great portal of sensation, the sight, through which we receive most of the messages sent to us from the universe around, we recognise the same truth. Thus it is agreed alike by physicists and physiologists, that *colour* does not exist as *such* in the object itself; which has merely the power of reflecting or transmitting a certain number of millions of undulations in a second; and these only produce that affection of our conciousness which we call colour, when they fall upon the retina of the living percipient. And if there be that defect either in the retina or in the apparatus behind it, which we call "colour blindness" or Daltonism, some particular hues cannot be distinguished, or there may even be no power of distinguishing any colour whatever. If we were all like Dalton, we should see no difference, except in form, between ripe cherries hanging on a tree, and the green leaves around them: if we were all affected with the severest form of colour blindness, the fair face of nature would be seen by us as in the chiar'oscuro of an engraving of one of Turner's landscapes, not as in the glowing hues of the wondrous picture itself. And in regard to our visual conceptions it may be stated with perfect certainty, as the result of very numerous observations made upon persons who have acquired sight for the first time, that these do *not* serve for the recognition even of those objects with which the individual had become most familiar through the touch, until the two sets of sense-perceptions have been co-ordinated by experience.*

When once this co-ordination has been effected, however, the composite perception of form which we derive from the visual sense alone is so complete that we seldom require to fall back upon the touch for any further information respecting that quality of the object. So, again, while it is from the coordination of the two dissimilar pictures formed by any solid or projecting object upon our two retinæ that (as Sir Charles Wheatstone's admirable investigations have shown) we ordinarily derive through the sight alone a correct notion of its *solid* form, there is adequate evidence that this notion, also, is a mental *judgment* based on the experience we have acquired in early infancy by the consentaneous exercise of the visual and tactile senses.

Take, again, the case of those wonderful instruments by which our visual range is extended almost into the infinity of space, or into the infinity of minuteness. It is the mental, not the bodily, eye, that takes cognisance of what the telescope and the microscope reveal to us. For we should have no well-grounded confidence in their revelations as to the *unknown*, if we had not first acquired experience in distinguishing the true from the false by applying them to *known* objects; and every interpretation of what we see through their instrumentality is a *mental judgment* as to the probable form, size, and movement of bodies removed by either their distance or their minuteness from being cognosced by our sense of touch.

The case is still stronger in regard to that last addition to our scientific *armamentum*, which promises to be not inferior in value either to the telescope or the microscope; for it may be truly said of the spectroscope, that it has not merely extended the range of our vision, but has almost given us a new sense, by enabling us to recognise distinctive properties in the chemical elements which were previously quite unknown. And who shall now say that we know all that is to be known as to any form of matter; or that the science of the *fourth* quarter of this century may not furnish us with as great an enlargement of our knowledge of its properties, and of our power of recognising them as that of its *third* has done?

But, it may be said, is not this view of the material universe open to the imputation that it is "evolved out of the depths of our own conciousness"—a projection of our own intellect into what surrounds us—an *ideal* rather than a *real* world? If all we know of matter be an "intellectual conception," how are we to distinguish this from such as we form in our dreams?—for these, as our laureate no less happily than philosophically expresses it, are "true while they last." Here our "common sense" comes to the rescue. We "awake, and behold it was a dream." Every healthy mind is conscious of the difference between his waking and his dreaming experiences; or, if he is now and then puzzled to answer the question "Did this really happen, or did I dream it?" the perplexity arises from the conciousness that it *might* have happened. And every healthy mind, finding its own experiences of its waking state not only self-consistent, but consistent with the experiences of others, accepts them as the basis of his beliefs, in preference to even the most vivid recollections of his dreams.

The lunatic pauper who regards himself as a king, the asylum in which he is confined as a palace of regal splendour, and his keepers as obsequious attendants, is so "possessed" by the conception framed by his disordered intellect, that he *does* project it out of himself into his surroundings; his refusal to admit the corrective teaching of common sense being the very essence of his malady. And there are not a few persons abroad in the world, who equally resist the teachings of educated common sense, whenever they run counter to their own preconceptions; and who may be regarded as—in so far—affected with what I once heard Mr. Carlyle pithily characterise as a "diluted insanity."

It has been asserted, over and over again, of late years, by a class of men who claim to be the only true interpreters of Nature, that we know nothing but matter and the laws of matter, and that force is a mere fiction of the imagination. May it not be affirmed, on the other hand, that while our notion of *matter* is a conception of the intellect, *force* is that of which we have the *most* direct—perhaps even the *only* direct—cognisance? As I have already shown you, the knowledge of resistance and of weight which we gain through our tactile sense is derived from our own perception of *exertion;* and in vision, as in hearing, it is the force with which the undulations strike the sensitive surface, that affects our consciousness with sights or sounds. True it is that in our visual and auditory sensations, we do not, as in our tactile, *directly* cognosce the force which produces them; but the physicist has no difficulty in making sensible to us indirectly the undulations by which sound is propagated, and in proving to our intellect that the force concerned in the transmission of light is really enormous.*

It seems strange that those who make the loudest appeal to experience as the basis of all knowledge, should thus disregard the most constant, the most fundamental, the most direct of all experiences; as to which the common sense of mankind affords a guiding light much clearer than any that can be seen through the dust of philosophical discussion. For, as Sir John Herschel most truly remarked, the universal consciousness of mankind is as much in accord in regard to the existence of a real and intimate connection between cause and effect, as it is in regard to the existence of an external world; and that consciousness arises to every one out of his own sense of *personal* exertion in the origination of changes by his individual agency.

Now, while fully accepting the logical definition of cause as the "antecedent or concurrence of antecedents on which the effect is invariably and unconditionally consequent," we can always single out one *dynamical* antecedent—the power which does the work—from the aggregate of *material conditions* under which that power may be distributed and applied. No doubt the term cause is very loosely employed in popular phraseology; often (as Mr. Mill has shown) to designate the occurrence that immediately preceded the effect; as when it is said that the spark which falls into a barrel of gunpowder is the cause of its explosion, or that the slipping of a man's foot off the rung of a ladder is the cause of his fall. But even a very slightly trained intelligence can distinguish the power which acts in each case, from the conditions under which it acts. The force which produces the explosion is locked up (as it were) in the powder; and ignition merely liberates it, by bringing about new chemical combinations. The fall of the man from the ladder is due to the gravity which was equally pulling him down while he rested on it; and the loss of support, either by the slipping of his foot, or by the breaking of the rung, is merely that change in the material conditions which gives the power a new action.

Many of you have doubtless viewed with admiring interest that truly wonderful work of human design, the Walter printing machine. You first examine it at rest; presently comes a man who simply pulls a handle towards him; and the whole inert mechanism becomes instinct with life—the blank paper continuously rolling off the cylinder at one end, being delivered at the other, without any intermediate human agency, as large sheets of print, at the rate of 15,000 in an hour. Now what is the *cause* of this most marvellous effect? Surely it lies essentially in the power or force which the pulling of the handle brought to bear on the machine from some extraneous source of power—which we in this instance know to be a steam-engine on the other side of the wall. This force it is, which, distributed through the various parts of the mechanism, really performs the action of which each is the instrument; *they* only supply the vehicle for its transmission and application. The man comes again, pushes the handle in the opposite direction, detaches the machine from the steam-engine, and the whole comes to a stand; and so it remains like an inanimate corpse, until recalled to activity by the renewal of its moving power.

But, say the reasoners who deny that force is anything else than a fiction of the imagination, the revolving shaft of the steam-engine is "matter in motion;" and when the connection is established between that shaft and the one that drives the machine, the *motion* is communicated from the former to the latter, and thence distributed to the several parts of the mechanism. This account of the operation is just what an observer might give, who had looked on with entire ignorance of everything but what his *eyes* could *see*; the moment he puts his *hand* upon any part of the machinery, and tries to stop its motion, he takes as direct cognisance, through his sense of the effort required to resist it, of the *force* which produces that motion, as he does through his *eye* of the motion itself.

Now, since it is universally admitted that our notion of the external world would be not only incomplete, but erroneous, if our visual perceptions were not supplemented by our tactile, so, as it seems to me, our interpretation of the phenomena of the universe must be very inadequate, if we do not mentally co-ordinate the idea of force with that of motion, and recognise it as the "efficient cause" of those phenomena—the "material conditions" constituting (to use the old scholastic term) only "their formal cause." And I lay the greater stress on this point, because the mechanical philosophy of the present day tends more and more to express itself in terms of *motion* rather than in terms of *force;* to become *kinetics* instead of *dynamics.*

Thus from whatever side we look at this question, whether the common sense of mankind, the logical analysis of the relation between cause and effect, or the study of the working of our own intellects in the interpretation of nature, we seem led to the same conclusion; that the notion of *force* is one of those elementary forms of thought with which we can no more dispense, than we can with the notion of space or of succession. And I shall now, in the last place, endeavour to show you that it is the substitution of the dynamical for the mere phenomenal idea, which gives their highest value to our conceptions of that order of nature, which is worshipped as itself a God by the class of interpreters whose doctrine I call in question.

"Laws," and the Power which gives Effect to them.

The most illustrative as well as the most illustrious example of the difference between the mere generalisation of phenomena and the dynamical conception that applies to them, is furnished by the contrast between the so-called laws of planetary motion discovered by the persevering ingenuity of Kepler, and the interpretation of that motion given us by the profound insight of Newton. Kepler's three laws were nothing more than comprehensive statements of certain groups of phenomena determined by observation. The *first*, that of the revolution of the planets in elliptical orbits, was based on the study of the observed places of Mars alone; it might or might not be true of the other planets; for so far as Kepler knew, there was no reason why the orbits of some of them might not be the excentric circles which he had first supposed that of Mars to be. So Kepler's *second* law of the passage of the radius vector over equal areas in equal times, so long as it was simply a generalisation of facts in the case of that one planet, carried with it no *reason* for its applicability to other cases, except that which it might derive from his erroneous conception of a whirling force. And his *third* law was in like manner simply an expression of a certain harmonic relation which he had discovered between the times and the distances of the planets, having no more *rational* value than any other of his numerous hypotheses.

Now, the Newtonian "laws" are often spoken of as if they were merely *higher generalisations* in which Kepler's are included; to me they seem to possess an altogether different character. For starting with the conception of two *forces*, one of them tending to produce continuous uniform motion in a straight line, the other tending to produce a uniformly accelerated motion towards a fixed point, Newton's wonderful mastery of geometrical reasoning enabled him to show that, if these *dynamical* assumptions be granted, Kepler's *phenomenal* "laws," being necessary consequences of them, must be *universally* true. And

* Thus, in a recently recorded case in which sight was imparted by operation to a young woman who had been blind from birth, but who had nevertheless learned to work well with her needle, when the pair of scissors she had been accustomed to use was placed before her, though she described their shape, colour, and glistening metallic character, she was utterly unable to recognise them *as scissors* until she put her finger on them, when she at once named them, laughing at her own stupidity (as she called it) in not having made them out before.

* See Sir John Herschel's Familiar Lectures on Scientific Subjects.

while that demonstration would have been alone sufficient to give him an imperishable renown, it was his still greater glory to divine that the fall of the moon towards the earth—that is, the deflection of her path from a tangential line to an ellipse—*is a phenomenon of the same order* as the fall of a stone to the ground; and thus to show the applicability to the entire universe, of those simple dynamical conceptions which constitute the basis of the geometry of the principia.

Thus, then, whilst no "law" which is simply a *generalisation of phenomena* can be considered as having any *coercive* action, we may assign that value to laws which express *the universal conditions of the action of a force*, the existence of which we learn from the testimony of our own consciousness. The assurance we feel that the attraction of gravitation *must* act under all circumstances according to its one simple law, is of a very different order from that which we have in regard (for example) to the laws of chemical attraction, which are as yet only generalisations of phenomena. And yet even in that strong assurance, we are required by our examination of the basis on which it rests, to admit a *reserve* of the *possibility* of something different; a reserve which we may well believe that Newton himself must have entertained.

A most valuable lesson as to the allowance we ought always to make for the unknown "possibilities of nature," is taught us by an exceptional phenomenon so familiar that it does not attract the notice it has a right to claim. Next to the law of the universal attraction of masses of matter, there is none that has a wider range than that of the *expansion of bodies by heat*. Excluding water and one or two other substances, the fact of such expansion might be said to be *invariable*; and, as regards bodies whose gaseous condition is known, the law of expansion can be stated in a form no less simple and definite than the law of gravitation. Supposing those exceptions, then, to be unknown the law would be *universal* in its range. But it comes to be discovered that water, whilst conforming to it in its expansion from 39¼° *upwards* to its boiling-point, as also, when it passes into steam, to the special law of expansion of vapours, is exceptional in its *expansion* also from 39¼° *downwards* to its freezing point; and of this failure in the universality of the law, no rationale can be given. Still more strange is it, that by dissolving a little *salt* in water, we should remove this exceptional peculiarity; for *sea*-water continues to contract from 39¼° downwards to its freezing-point 12° or 14° lower, just as it does with reduction of temperature at higher ranges.

Thus from our study of the mode in which we arrive at those conceptions of the orderly sequence observable in the phenomena of Nature which we call "laws," we are led to the conclusion that they are human conceptions, subject to human fallibility; and that they *may* or *may not* express the ideas of the great author of Nature. To set up these laws as self-acting, and as either excluding or rendering unnecessary the power which alone can give them effect, appears to me as arrogant as it is unphilosophical. To speak of *any* law as "regulating" or "governing" phenomena, is only permissible on the assumption that the law is the expression of the *modus operandi* of a governing power. I was once in a great city which for two days was in the hands of a lawless mob. Magisterial authority was suspended by timidity and doubt; the force at its command was paralysed by want of resolute direction. The "laws" were on the statute book, but there was no power to enforce them. And so the powers of evil did their terrible work; and fire and rapine continued to destroy life and property without check, until new power came in, when the reign of law was restored.

And thus we are led to the culminating point of man's intellectual interpretation of nature—his recognition of the unity of the power, of which her phenomena are the diversified manifestations. Towards this point all scientific inquiry now tends. The convertibility of the physical forces, the correlation of these with the vital, and the intimacy of that *nexus* between mental and bodily activity, which, explain it as we may, cannot be denied, all lead upward towards one and the same conclusion; and the pyramid of which that philosophical conclusion is the apex has its foundation in the primitive instincts of humanity.

By our own remote progenitors, as by the untutored savage of the present day, every change in which human agency was not apparent was referred to a particular animating intelligence. And thus they attributed not only the movements of the heavenly bodies, but all the phenomena of Nature, each to its own deity. These deities were invested with more than human power; but they were also supposed capable of human passions, and subject to human capriciousness. As the uniformities of nature came to be more distinctly recognised, some of these deities were invested with a dominant control, while others were supposed to be their subordinate ministers. A serene majesty was attributed to the greater gods ...sit above the clouds; whilst their inferiors ...come down to earth in the likeness of men." ...growth of the scientific study of Nature, the conception of its harmony and unity gained ever-increasing strength. And so among the most enlightened of the Greek and Roman philosophers, we find a distinct recognition of the idea of the unity of the directing mind from which the order of nature proceeds; for they obviously believed that, as our modern poet has expressed it—

> All are but parts of one stupendous whole,
> Whose body Nature is, and God the Soul.

The science of modern times, however, has taken a more special direction. Fixing its attention exclusively on the *order* of nature, it has separated itself wholly from theology, whose function it is to seek after its *cause*. In this, science is fully justified, alike by the entire independence of its objects, and by the historical fact that it has been continually hampered and impeded in its search for the truth as it is in nature, by the restraints which theologians have attempted to impose upon its inquiries. But when science, passing beyond its own limits, assumes to take the place of theology, and sets up its own conception of the *order* of nature as a sufficient account of its *cause*, it is invading a province of thought to which it has no claim, and not unreasonably provokes the hostility of those who ought to be its best friends.

For whilst the deep-seated instincts of humanity and the profoundest researches of philosophy, alike point to mind as the one and only source of power it is the high perogative of science to demonstrate the *unity* of the power which is operating through the limitless extent and variety of the universe, and to trace its *continuity* through the vast series of ages that have been occupied in its evolution.

USEFUL AND SCIENTIFIC NOTES.

A New Rock Drill.—Many descriptions of rock drilling machines have been designed within the past ten years or so with more or less satisfactory results; and although perfection in this kind of boring apparatus is possibly not yet attained, a good step in this direction has been taken by Mr. McKean, who for the last six years has been experimenting, and has at length constructed a machine which, for simplicity, facility of manipulation and application in any position, combined with strength, is believed to be unrivalled. It is driven by either steam or compressed air, and can be adapted for open cutting or tunnelling. A machine weighing 150lb., driven by 75lb. steam, drills a 2¼in. hole to a depth of 13in. per minute in Aberdeen granite. This is a maximum, but an average duty of from 6in. to 9in. may be relied on. It makes from 500 to 1,000 strokes a minute, free from shock to the machine, as the piston cushions against steam or air, and the feed is either automatic or by hand as desired. One of these drills can be seen working daily in granite at 42, Borough-road.

The Oxyhydric Light.—In relation to the oxygen light of Tessié du Motay, of which we have made mention, it may be stated that M. P. Thomas, acting under instructions from the Paris Society of Civil Engineers, has recently presented to this body a report upon the process. This report simply treats of technical advantages and disadvantages, leaving out of sight the economical question, which is somewhat to be regretted in view of the indistinct statement of the causes which have led to its removal from some of the streets of Paris where it had been introduced. The conclusions arrived at are the following:—(1) Theoretically, the combustion of oxygen does not increase the illuminating power of a given volume of gas. (2) Practically, however, it enables a burner to consume four times the quantity of gas that can be burned in air, without detriment to the utilisation of the light which may be developed. In particular, it utilises the entire luminous capacity of the gases, however rich, and in almost any quantity. Consequently, it would be disadvantageous to employ it for ordinary street-lighting, on account of the limited quantity of gas consumed by the burners, the only advantage gained being the beauty of the light, provided the gas is very rich. (Here, unquestionably, would come in the objection of expense from the complication of the apparatus.) But it is very advantageous, and the more so in direct proportion to the richness of the gases employed—for great centres of light (sun-burners, &c.), where a large volume of gas is to be consumed without loss.

Fuel in Italy.—While the scarcity of coal is alarming the inhabitants of our island, the Italians are making great efforts to utilise their own products in a way that will render them independent of the present coal crisis. Lignite is procured from the mines of Monte Rufoli, which is being more and more widely used in the Peninsula. It burns well in fireplaces without making any noise, and experiments have been made which have proved it not very inferior to the most expensive Newcastle coal, one quintal of the former being equal to three-quarters of a quintal of the English coal. This material is already being used in distilleries, and it is likely to be employed in the fusion of the iron of Elba, as it contains no element injurious to that mineral. It will be all the easier for Italy to be independent of our coal, as the inhabitants consume charcoal in their kitchens in a very economical manner, their expenditure being about one-tenth of that of an English culinary establishment.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 81, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

MR. PROCTOR'S GULF STREAM MAP.

[4755.]—As this map was solely intended to give true areas, "E. L. G.'s" criticism (let. 4731, p. 566) is misapplied so far as his comparison between the equal surface and stereographic projection is concerned. (Surely he does not suppose there is anything new in his remarks beginning "there is another projection quite as easy," &c. The stereographic projection is probably the oldest in existence. Its properties were perfectly well known to me. They are considered and demonstated in a simple way in my "Handbook of the Stars," published more than six years ago. They are employed in the index-maps of my smaller atlas; both of which, by the way, show much more than a complete hemisphere. I have also suggested the use of the projection, applied so as to show nearly the whole sphere as the best possible contrivance for enabling nautical men to readily plot down "great circle" courses.) The difference ("barely a third larger superficial measure") which "E. L. G." considers "truly immaterial" seems to me simply monstrous. Does he consider it a matter of indifference if an area of 3,000,000 square miles is apparently increased by 1,000,000 square miles? But he is mistaken as to the limits of my map. It includes the *whole* of the Arctic Ocean, and the whole coast line of Asia. This was essential for my reasoning. "E. L. G." will find that if the stereographic projection were applied to such a range of our earth's surface, a change of superficial scale far greater even than his immaterial (though monstrous) change would accrue.

I had no occasion whatever to illustrate forms in my article on the Gulf Stream; though I fully recognise the interest of Mr. J. Wilson's communication, relative to the direction of the currents which impinge on the shores of the British Isles. Nor could I have opened out the meridians as "E. L. G." suggests, without carrying the boundaries of the Atlantic much too far away from each other, between South America and Africa, to be included in any map of reasonable dimensions.

I venture to think that I have had a much wider practical experience of all modes of projection than "E. L. G.," having constructed more than a thousand maps on different projections; and I will undertake to say that the purposes I had in view in constructing the map "E. L. G." speaks of can be fulfilled *by no other plan* than that which I have adopted, at least, not *on any definite projection*. A mixed construction would have served somewhat better; and I began the preparation of a map on such a plan; but I found it would take much more time than I could spare.

RICHARD A. PROCTOR.

OCEANIC CIRCULATION.—CARPENTER *v.* MUHRY.

[4756.]—IN answer to "J. B." (let. 4745, p. 567), I may remark that I had his letter and some other communications in view in saying that "in the year 1869, Dr. Carpenter was first led to *advocate* the theory" in question. If I had intended to imply that Dr. Carpenter was the original inventor, I should have substituted the words "put forward" for "advocate." A student of science cannot rightly be said to advocate a theory if he is the inventor of it. At least, Webster defines "advocate" as "one who pleads for another." But as my remark seems open to misconception, I am much obliged to "J. B." for setting the matter right.

I thank "J. B." for the very gratifying way in which he speaks of my essay. I ought to remark, however, that I have no settled convictions as to oceanic circulation. The subject is one which requires an abundance of research and observation before it can be regarded as in a position for safe theorising.

I am not aware that there is the slightest evidence to prove that the Gulf of Guinea is the place whence the Atlantic circulation has its origin, as suggested by "Popularis" in letter 4746, p. 567. If I could have included the South Atlantic in my map, the Gulf of Guinea would not have appeared to be in any sense distinguished from any other part of the surface circulation. It appears to me that the main (not the *sole*) cause of the oceanic circulation is the continual withdrawal of millions of tons of water from the tropical seas through evaporation. As far as I can judge, no other cause is comparable in energy with this tremendous process of solar suction.

R. A. PROCTOR.

ENGLISH MECHANIC TURNERS' SOCIETY.

[4757.]—I AM afraid the above has fallen through again. I was in hopes Samuel Smither would have given it a start, but nothing seems to have come of it.

FABER.

SETTING MOTHS.

[4758.]—ALLOW me to mention a method of setting these which is, in my opinion, superior to those already named. After securing the insects in position with needles, an operation which will be assisted by ruling guide lines across the stretcher, wind some fine glazed thread over the wings from end to end of the setting-board, securing it from slipping by notches in the board. Three threads across each wing are enough for the largest. A slight twirl given to the needles on pulling them out will prevent them dragging up the wing.

FABER.

THE ORGAN (EXPRESSION *A LA MAIN*).

[4759.]—I AM afraid our friend "The Harmonious Blacksmith" has proposed a practical impossibility, although theoretically it is possible: all these things are possible to an organ builder who has a good enough golden glass to look through. But before looking at the uses of this expression, and some of the difficulties to overcome, let us see what is the intended use of it. If I remember rightly "expression *à la main*" was introduced into harmoniums about the year 1850, principally to allow the treble note of an air to be heard more distinctly, although it also equally allowed any other note to be strengthened, or even a single chord or a whole passage could be so strengthened, yet the idea was to allow the tune to be more distinctly heard than it usually is in harmoniums, where all the notes blend together so much as to give the idea of one rich note rather than a musical combination of various notes (in passing, I may mention Dawe's melody attachment, which is another attempt to overcome the same defect, but does it by softening every note except the highest, so that the melody or air of the tune is distinctly heard). Such being the use of the expression, *à la main*, and the difficulty to be overcome, is there anything in the tone of the organ which wants improving in a similar manner, and what difficulties are there in the way of producing such an expression? To my mind, such an alteration would be no improvement; if it is required to give the melody more distinctly than usual it can already be done by playing it on a loud stop on one row of keys and the accompaniment on another row. I do not quite understand whether "The Harmonious Blacksmith" proposes to inclose each pipe of only one stop in a swell, or to have a swell to inclose the corresponding pipes of each stop, so if the organ has 54 notes there would be 54 swell boxes, each box inclosing the pipes belonging to the same key, the latter, I presume, is his meaning. To do so the pipes would require to be planted in a single line on the soundboard instead of a double one as at present, and that would require a windchest of something like ten feet from side to side, as space would have to be allowed for the side of the swell between each pipe. Now, to my mind, expression *à la main* could only be useful—if at all—in small organs with one row of keys, in fact, only in chamber organs, and an organ ten feet wide without a case would be rather too big for most people who are content with one row organs. There is, however, a serious defect to overcome also, if the swell shuts closely, and it ought to do so; the boxes being so small, if all the stops were drawn and a note played without opening the box the pressure of wind would very quickly increase to such a degree as considerably to flatten the tone, and what would our "Harmonious" friend say then? And last of all, it does not appear to me to be required, for unless a number of mutation stops are used, the tones belonging to each key are so distinct that every note in the fullest chord is readily distinguished.

J. D.

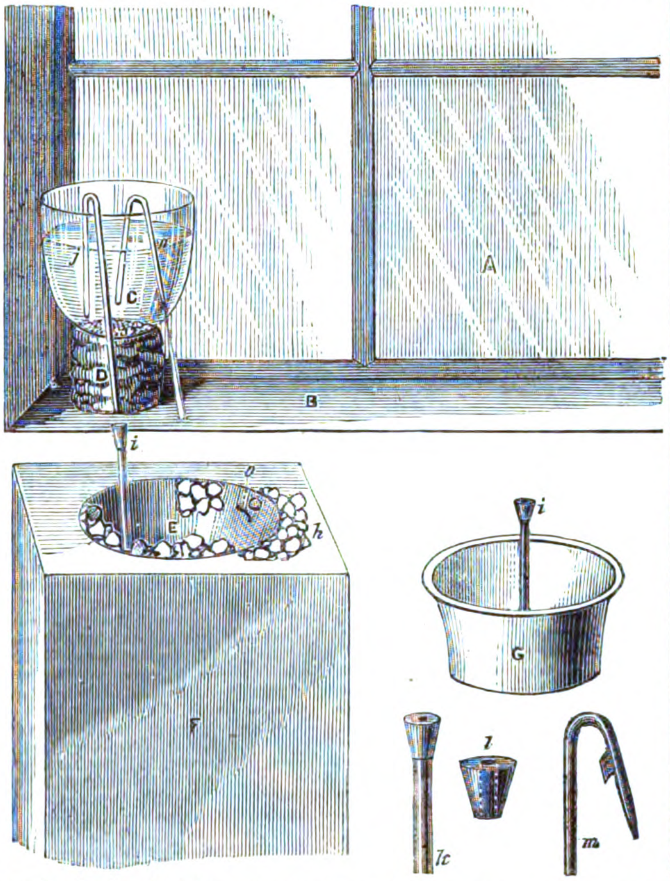
ECONOMY IN USING COAL.

[4760.]—IT is well known that most of our grates are very badly constructed, and the greater portion of the heat goes up the chimney. The sides of the grate should make an angle of 135°, with the back to reflect out the heat. Other faults are mentioned by Count Rumford.

PHILANTHROPIST.

MARINE AQUARIUM.

[4761.]—HAVING been rather successful with a marine aquarium (or rather a rock pool), I thought it likely that the readers of the ENGLISH MECHANIC would like to follow my plan, which seems to me to be good as well as cheap. On a window-sill place a moderate-sized glass globe aquarium of fresh water (see C); in this have two siphons, one short like *n*, and one long like *j*; bring a large earthenware pan about 2ft. in diameter and 9in. or 10in. deep; cover the inside of this with stones and rockwork, using pumice-stone, pebbles, gravel, and sand; in cementing the stones, &c., to the side of the pan use a cement made of two parts resin, one part beeswax; fix the pan in a rough deal table or stand, the top of which also ornament with rough rockwork (see *h*); in the crevices of the rocks plant seaweeds (sea-grass is the best); fix and cement to the pan a glass tube, reaching to the bottom (see *i*); this tube must have a cone-shaped cork (bored through the centre) fixed into it (see *k* and *l*); *m* is the shorter glass siphon, having a cork-rest fixed to it, so that it may rest on the edge of the globe when not in action. When the seaweeds have been planted in the rockwork of the pan fill up with sea-water, until a marked point is gained (see *o*). When the sea-water evaporates put the siphon of fresh water, *n*, in action, until the original level is gained; then stop the flow of the water. In some cases it is better to add the fresh water from the bottom of the pan, in which case fix the siphon *j* into the cork of the tube *i*, when the water will rise from the bottom and freshen the lower plants, &c. These rock pools may be made very cheaply, and if nicely done will afford quite as much instruction and amusement as the more expensive square glass aquariums.



A, window; B, window-sill; C, glass globe aquarium (fresh water); D, rustic stand for globe; E, large earthenware pan; F, rough deal table or stand; G, large earthenware pan before placed in the stand; *h*, rough rockwork; *i*, tube leading to the bottom of the earthenware pan to carry fresh water; *j*, siphon tube to be fixed to *i* tube; *k*, same as *i* tube, only drawn larger; *l*, cone-shaped cork, to fit into *i* tube. This cork to be bored through the centre; *m* siphon, with a cork-rest cement to it. *n*, same siphon in action.

CUPRUM.

SCREW CUTTING.

[4762.]—WITH the consciousness that I might prove of service to some of my young brother turners, I forward the following hints upon screw-cutting. I generally find that shopmates are jealous of another knowing the "tips" they have in screw-cutting, and if a beginner does not chance to be "well in" with some one who can screw-cut, he not unfrequently blunders, notwithstanding his knowledge in calculating wheels. I have not had much experience myself, but (as you would have us do) I write what I know, and no more. It is unnecessary for me to give any rules for finding wheels, as books already exist containing all the information required. My intention is to write such things about screw-cutting as I have not been able to find in books. My experience has been upon a lathe with the leading screw of 2 threads to the inch. Therefore, my remarks will only apply (practically) to that, as I have to write what I know, and no more:—If you are chasing a screw with an even number of threads in the inch, such as 2, 4, 6, &c., with the lathe screw of 2 threads per inch, you find the wheels required. Fix the tool in the box tight, then put the nut into gear with the leading screw, and set the lathe on. When it has travelled the length of the screw to be cut, you may either stop it or keep it going; take off the cut and the nut out of gear. But before doing this, put a mark on the boss of the hand-wheel fastened to the screw for working the cutter box, also on the fixing against which the boss of the hand-wheel goes, so that when you take off the cut, you can screw it to the same place again, and put whatever cut on you wish. If you have stopped the lathe, wind back the saddle a little way past the beginning of the screw; turn the hand-wheel until the marks are together again, and then put the cut on you wish to take; put the nut into gear with the leading screw, and start the lathe. Repeat this until the screw is cut. There is, however, no necessity for stopping the lathe if, as I have said before, you are cutting an even pitch; you may keep it running. When the saddle has travelled the length of the screw required, take off the cut (after marking the hand-wheel as before described) and the nut out of gear; wind back the saddle; put on another cut, then the nut into gear. There is no fear of your getting across the thread, if you put the nut properly into gear.

In cutting odd pitches, it is different, but I have found no difficulty by doing as follows:—If you are cutting (say, for example) 3 threads per inch with the leading screw of 2 per inch, and you only want the screw to be cut to be 1½in. long, if you can work the saddle farther than the length required, you may do so; thus, after making your tool and the thing you are going to cut ready, you put the screw into gear; turn the lathe round until you feel the saddle move; then put a mark behind the saddle on the lathe-bed; start the lathe; cut the 1½in.; then take the cut off, and let the lathe run another ½in., and put a mark at the other end of the saddle. The saddle has thus worked 2in.; bring it back, and do likewise. If it is not convenient for you to work the saddle farther than the length required, you may allow ½in. at the starting point. You will easily see that by letting the saddle work ½in. farther, we make the ratio between the screw to be cut and the leading screw of 6 to 4 an even pitch. One example will suffice, and I think this matter will be sufficiently understood. But should it not be convenient to work the saddle a greater distance than the length of the screw required, proceed as follows:—Put the saddle into gear with the leading screw, turn the lathe with your hand until you feel it move, then put a mark at the end of the saddle on the lathe-bed, one on the lathe-spindle and the fast headstock, just behind the face-plate, and another on the leading screw and the fixing that holds it in its place; then set the lathe on, and travel the length of the screw required. Stop the lathe, wind back the saddle to the starting mark, and then turn the lathe round until the marks on the lathe-spindle and headstock are together, and the marks on the leading screw and fixing are together; then put the nut into gear with the leading screw; start the lathe, and proceed in this manner until the screw is cut.

APPRENTICE TURNER.

NEW SOUTH WALES AND ITS METALS.

[4763.]—SINCE my last letter to you a new era has dawned on us. The golden age has been revived here, and an age of copper and tin is opening new treasures to our view. The mining mania here is now at fever heat. I will send you by this mail a copy of the *Sydney Morning Herald*, which will give you some idea of what is taking place in New South Wales at present, but it will not inform you of all that has been done in mining matters for the last few months. Since the commencement of the year to the 1st of May—a period of four months—upwards of 200 companies have been floated for the production of gold, copper, and tin, involving a nominal capital of some four millions sterling, and the floating of new companies is still in progress. Before this reaches you I have no doubt that the mineral richness of this colony will be known in England, as large shipments of metals and ores have been made for several months.

It has just occurred to me that the ENGLISH MECHANIC might be of great use in assisting the development of our resources by occasional articles on the extraction of metals from their ores. We have abundant supplies of coal and iron of the best quality, and gold and copper have for years been articles of export from these colonies, but tin is a recent discovery here, and is found in rich abundance imbedded in primitive rocks, or disseminated along the beds and banks of rivers and creeks in alluvial deposits, which are richer and purer than that obtained from mines, as by exposure to the atmosphere the pyrites originally associated with the tin is oxidised and disappears. Some of this stream tin is very rich in gold, the gold in some cases being as valuable as the tin. Now, as tin is a new product here, we want the advice of our English friends how to turn it to best advantage, and you would be conferring a great favour—which, I doubt not, would be appreciated by the colony—if some of your contributors were to publish from time to time the most approved methods of crushing, washing, and smelting the ore, and more particularly of separating the gold from the tin.

I merely throw out these hints as the mail is leaving, and you may make such use of them as you think advisable.

Sydney, N.S.W., June 15, 1872. JOHN RAE.

BEE MANAGEMENT.—DRIVING AND TRANSFERRING.

[4764.]—When it is necessary to transfer the contents of an ordinary straw skip, or box hive, to a bar frame hive, it involves the necessity of driving or drumming; names given to the operation by which bees are made to leave their combs and hive, and ascend to the hive placed above them for their reception. Given, then, a common straw skip full of combs and bees, to transfer to a bar frame hive. The first operation will be driving or drumming, henceforth by me called driving. In passing, I may say that the same process is that by which artificial swarms are made, and the presence of queens ascertained, and the queens themselves extracted if required.

Driving should be performed in the middle of the day, when the majority of the working bees are away in the fields, for reasons the most obvious—to wit, there will be fewer bees to deal with in driving, and the majority will be uninfluenced by the operation, whatever means be used, and consequently robbing need not be apprehended, as the said majority will quite be able to deal with all marauders.

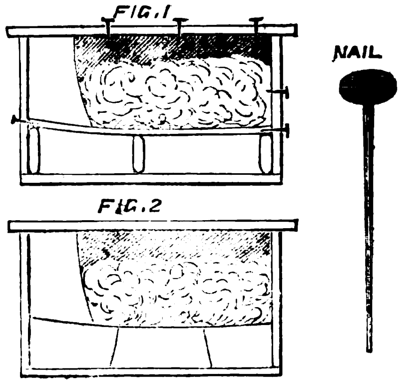
Driving is performed as follows: In the middle of the day blow a little smoke into the hive, a very little will do, and to do this the only apparatus required is a common pipe of any kind, but timid people may use a long clay. Put a small bit of tobacco in the bowl, put a lighted fuzee into the tobacco, wrap one or two thicknesses of handkerchief over the bowl, and apply the mouth to the bowl, blowing the smoke out of the waxed end of the pipe into the hive. A very little smoke must be used, or the bees will not come out with all the drumming you can give them, and if they are made drunk, they will stick in the combs as if entangled together. The reason for this is, that smoke frightens them, and their first impulse is to gorge themselves with honey as if determined to save all they possibly can of the sweets they think endangered. In that condition they are perfectly good tempered and controllable; but if too much smoke be given they become sick and drunk, and vomit their honey among themselves until they become a sticky, immovable mass.

After smoking (gently), the hive should be prised off its floor-board, and kept up, say an inch, so that the bees may be the more alarmed, and after about five minutes the hive may safely be carried from its stand; inverted, and set, if a round topped one, in a pail, if a flat topped one, on an inverted pail a few yards from the stand. An empty hive of the same size (or larger) should be set on it and another empty hive should be placed on the stand where the full hive was removed from. The empty hive is for the purpose of "amusing" the bees which return from the fields while the drumming goes on, and their astonishment at finding it there instead of the full one prevents the robbing and excitement one reads so much of. The empty hive having been fairly set on the inverted full one, a round towel should be bound tightly round their place of junction; and as a rule it will be found that the towel will go twice round, and may be secured by putting a stick in the loose fold and twisting it up tight. Then begins the drumming, so called because two sticks are used, one in each hand, to beat the sides of the lower hive. In this care should be taken not to drum too hard on the sides of the hive to which the ends of the combs are attached, for fear of causing a collapse of the whole, and it will be found that in about a quarter of an hour nearly all the bees will have ascended to the top hive. The real object of the drumming is to cause a slight jarring of the combs, a sort of miniature earthquake, which terrifies the bees and drives them out, unless they have had too much smoke.

The bees having ascended to the top hive it should be removed and set on its own stand instead of the empty one placed there, the pseudo empty one being turned over anywhere to cause the bees therein to join the main swarm, which they will readily do.

If it is required to get rid of the few remaining bees from the inverted hive—and it cannot be done with a feather—scrape a hole in the ground in front of the original stand, put the round towel into it, pour on about an ounce of chloroform, and set the hive over it for a few minutes, when it will be found quite free of bees, and it will also be found that those operated on are too full of honey and too tired to make any demonstration, all that has been written to the contrary notwithstanding. The cause of mischief is in cutting the honeycombs and filling the air with the aroma therefrom, which the bees from other hives scenting afar off come in thousands to partake of. Imperfect observers think they are the bees which have been operated on, but they, poor things, are already overcharged with honey or pollen, and have nowhere to deposit it, so why should they, or how could they be robbers? I have driven hundreds of swarms under all circumstances, and I most distinctly assert, without reservation, that a driven swarm is invariably cowed and helpless, and never volunteers a marauding attack. Transferring the combs after the bees have been got rid of is simply a mechanical operation; but had better be performed by an amateur in a room to which the bees have no access, for if they be allowed to taste the honey within doors, they will speedily and for several days become a nuisance to the household. The tools which will be necessary are a sharp carving knife, a large dish, a few strips of thin deal just a trifle longer than the frames are from front to rear, inside, a few wine corks, a fine awl, a few strong pins or nails, and little wooden rack or grating similar to a small hurdle. Lay the grating on the dish, and the frame on the grating, cut the hive containing the combs slick through between the two centre combs, and then cut out comb cleanly, and lay it in the frame. If it comes out of a flat-topped hive it will fit close along the upper bar of frame; but, if from a round-topped hive, it will require cutting to fit. Remember the comb must always be attached to the top bar of frame, and to one or both sides if possible. If it is too large or wide for the frame, cut away the parts containing honey, and let them fall through the grating into the dish, and crowd the comb into the frame with the knife, and if it fills the frame, a few pins or nails through the frame will hold it in its place until the bees have time to fix it permanently—hence the necessity for an awl, to bore the holes through the frames. Flat-headed slate nails will answer admirably for the purpose, they are about 1¼in. long, fine, straight, and clean, and are cheap. In fixing the comb by them they should not be thrust into the centre of the combs, but just a little on either side alternately, for the centre or foundation of the comb is much stronger than the cells, and if the pins are on both sides of it it cannot fall out. If the combs are too small, and will not fit or fill the frames, the best plan is to fit it to the corner of the frame, as in Fig. 1. Place one of the deal strips under it, and press it up tight with two or three of the corks, pin it in as shown, and raise it up to a perpendicular by raising up the grating so as not to cause any strain on the comb or fixings. The corks act capitally as blocks to keep up the strip at bottom of comb, and standing solid are not likely to turn or fall. The comb is now ready to put into the hive, and being a centre comb should be put into the centre of it. The other combs should be treated in a similar way, taking care that the combs are put into the new hive in the same order they were in the old hive, so as to keep all the brood together, and as soon as completed the whole should be taken to the original stand, and the bees smartly shaken into it.

It seldom happens that the contents of a straw skip will fill all the frames of a bar frame hive, but as it is much better to have six full frames than ten partly filled, I recommend my readers to fit in only such combs as contain brood, at the first operation, for a second operation is always necessary to remove the nails and strips, or wires, or whatever may have been used, for it is pretty certain that almost everybody will adopt some improvements of his own. To remove the *impedimenta* give the bees a little smoke as before, lift out one of the combs, brush all the bees off it, and carry it into the operating room—keep it perpendicular as it hung in hive, place the grating behind it, and lay it down on the dish, then draw all the nails, and remove the corks and wood, leaving the frame as in Fig. 2, the vacancies of which may be filled up with the reserved combs as suggested by the dotted marks.



This will be found a much better plan than attempting to fill up the whole frame at once with several pieces of comb, as is generally recommended, and will suggest to many persons who keep bees on the old plan an easy method by which the lives of their bees may be saved, and the portions of comb which contain brood and pollen, and which have generally been thrown away may be utilised. Any one with three or four stocks of bees which they wish "to take" may by this means save such a tremendous stock for next year as will make him wonder how he could have been for so long what Mr. Langstroth calls an "Old fogey bee-keeper."

Let me add a word of caution to my bee brethren. If you have any weak stocks to unite do it now; if any to feed, do it now, and give the bees a chance of evaporating the moisture out of it and out of the hive before the cold weather sets in. Cold and dry will never hurt bees, but cold and damp mean dysentery and death.

C. N. Abbott.

SOLUBLE GLASS.

[4765.]—As I have often seen inquiries about soluble glass in your columns I send the following, which may interest several of your readers. Soluble glass is simply a variety of purely alkaline glass in which the alkali is in excess. Ordinary window glass is a compound of silica with potash or soda, and in some cases lime; oxide of lead added to the compound of silica and potash or soda, gives flint glass; Bohemian glass is a compound of silica, soda, and lime; and the coarse glass used for bottles contains much iron and some alumina, which is the base of clay. According to the quantity of alkali employed, the glass will be soluble or insoluble, it being understood that all glass is soluble to a certain extent. Old window panes that have been exposed to the elements for years are in general so corroded that their surfaces are no longer perfectly transparent; and common flint glass, when finely powdered, dissolves in water to such an extent that its presence can be detected by the least delicate reagents. But when the proportion of alkali is largely increased, and especially when the compound consists of pure alkali and pure silica, we obtain a glass which dissolves entirely in water, and which may be applied as an incombustible varnish to wooden articles, or used as a cement, or as a coating for brick and stone. Soluble glass was first brought into practical use by Prof. Fuchs, of Munich, in Bavaria, in the year 1828, and hence is frequently known as Fuchs' soluble glass. At first it was prepared by fusing ten parts of pearlashes, fifteen parts of powdered quartz, and one part of charcoal together, and pulverising the mass, which was then added in small portions at a time to boiling water until the whole was dissolved. The solution was then evaporated to a jelly-like consistency, when it was ready for market. More recently it has been found that certain varieties of silica are soluble in a boiling solution of caustic soda; and also that, when the temperature of an alkaline solution is greatly increased, which may be done by boiling it in a close vessel under great pressure, flints and other hard varieties of silica dissolve rapidly. It is in this way, we believe, that Ransome prepares the soluble glass used in the manufacture of his famous artificial stone. It is therefore obvious, from a consideration of these methods, that soluble glass is readily prepared; and, as the materials are comparatively cheap, there is no reason why it should not come into very extensive use, provided it should prove really valuable in the arts.

The first notable application of soluble glass was to the theatre of Munich, where it was used for the purpose of preventing the recurrence of a fearful disaster by fire. Before trusting to its protecting qualities, however, a test was made of its powers, and a small building coated with soluble glass was erected in one of the public squares, and attempts made to fire it at several points, by placing small heaps of light wood in contact with it and setting these heaps on fire. Of course, where the flames came in contact with the building, the wood of which it was made was charred, and to a certain extent destroyed. But in no case did the building itself take fire or burn; and the test was deemed so satisfactory that the theatre was immediately coated in such a way as to be made fireproof. Since that time, it has been applied in many cases, and always with success when the application was made with a moderate amount of skill. That it might be used extensively for preventing fires, and for adding to the durability of all wooden structures, is unquestionable; and therefore a few hints as to the best methods of using it may not be out of place. These hints we are enabled to give more readily, since the whole subject was carefully investigated by the celebrated French chemist Dumas, who has, in his "Traité de Chimie appliqué aux Arts," detailed very fully the results at which he arrived. He found that, although soluble glass is of itself a good preservative from fire, it fulfils the object better when it is mixed with another incombustible body in powder. Clay, whiting, calcined bones, powdered glass, &c., may all be employed for the purpose, though it is difficult to decide which of them is the best. A mixture of clay and whiting appears to be better than either used separately. Flint glass, and the crude soluble glass as it comes from the furnace, are excellent additions. The powdered soluble glass ought to be exposed to the air until it has attracted some moisture; after which, if it be mixed with the solution and applied to any body whatever, it will in a short time form a coating as hard as stone, which, if the glass be of good quality, is unalterable by exposure, and resists fire admirably. When soluble glass is used for rendering wood fire-proof or indestructible, it is always well to apply, in the first place, a coating of the pure glass. The pores are in this way filled up; while, if we use a thick and paint-like mixture of the solution with some powder, the liquid does not penetrate beneath the surface, and much of the effect is lost. When properly prepared, soluble glass, after being dried by exposure to the air, suffers a change which renders it incapable of being washed off. The alkali not being completely neutralised in this form of glass, it is difficult to apply oil paint to woodwork that has been treated with it; but this objection might be remedied by treating the prepared surface, when dry, with a weak solution of acid.

G. J. H.

ATOMIC PROPORTIONED ALLOYS.

[4766.]—In the report of Mr. Laird's lecture on "Cast Iron," p. 534, the composition of speculum metal is given as "about two of tin to one of copper," which would be nearly that of their atomic weights. But are not the proportions here reversed? In Mr. E. B. Denison on Bells ("Lectures on Church Building," p. 283) he says "Lord Rosse adopted *multiples* of the chemical equivalents, or atomic proportions for combination, of copper and tin for his great 6ft. speculum. They are copper 32, tin 59, very nearly; and for speculum metal 4 equivalents of copper to 1 of tin give nearly the usual ratio of 2 to 1 in weight. For bell-metal 6 equivalents of copper to 1 of tin will give very nearly 15 to 4" (an error for 13 to 4), "which would probably be produced by putting the metals in the proportion of 2 to 7, as before recommended. It is impossible and useless to be very precise, because the waste of the tin in melting is not uniform, but is greater the longer it has to be kept hot."

With the latest values for the equivalents, the above atoms for speculum metal would give copper 13 to tin 6 very nearly; which might result from mixing 2 and 1, if the loss of tin by evaporation be about 8 per cent. I cannot anywhere find the reverse proportion stated; and the only case I have seen of an alloy directed to be made in what are now known to be the single atomic weights or near them, is the alloy of silver 2 and antimony 1, for penetrating glass with the red orange stain referred to in reply 12108, p. 544. In connection with this subject, can your chemical contributors tell us of any alloy having its more fusible component in excess? It seems to me as if the opposite rule, the less fusible metal to prevail in quantity, had the force of a law in useful alloys. E. L. G.

A NEW MATERIAL IN ORGAN BUILDING.

[4767.]—"SUCRAM" may rest satisfied that his suggestion, if not a new one, is of a practicable and useful character. Some years since I made a small bird-organ of pipes formed of waxed cartridge-paper, whose performance was "very tidy." It was only of 3 octaves compass, tuned in the key of C natural. It convinced me that the thing was feasible, and, in better hands, would, for amateur attempts, prove often convenient and satisfactory. From want of experience, I cannot say whether paper would answer well for larger pipes. I should think it would not for large ones. I found the tone was modified by the thickness and homogeneity, as also the solidity, of the walls of the pipe. I also made a paper flute, the tone of which was satisfactory, although, from my clumsiness and inexperience, it was not of much use, being considerably out of tune. Has "Sucram" tried guttapercha for small pipes? Pipes made of it give out a very sweet tone. A friend of mine devoted much time to making a guttapercha cornopean. Many were his failures before he succeeded in producing a satisfactory one, but the results amply rewarded him, as an amateur, for the time and labour he spent on it. The guttapercha, for this purpose, must be of the best quality and commercially pure; indeed, quite equal in quality to that used for insulating the copper wire of submarine telegraphs. The pipes must be made slightly longer than required, and, after being thoroughly seasoned, tuned and varnished.

AROTES.

[4768.]—I HAVE read Dr. Ussher's note in answer to mine upon a new material in organ-building, let. 4637, and am rather surprised at one or two remarks, which most likely he would not have made had he taken a little more time for consideration. I thank him for the little credit he awards me for my enthusiasm; but I certainly shall be sorry to find any of our amateurs running off on a wrong track, who, I think, cannot possibly do so, because those who enter upon the task of building an organ for themselves (it being to such I address myself principally), would certainly not run far before taking that consideration necessary for such an undertaking, and so try an experiment or two by way of proof to prevent the useless cruelty I am charged with. Knowing as I do that professionals, as a rule, will not teach others any more than they can possibly help, true it is that metal-pipe making must be learned at the bench; but these are things which a great many amateurs cannot get at, and are obliged to do without them, at the same time they must have an organ and build it themselves entirely. Dr. Ussher will find that I have not said, nor even hinted, that I recommend paper instead of metal, far from it; but I do say that paper may be turned to some account in organ-pipe making, in addition to the rest of materials, and so introduce means of producing tones of a character different from those brought out by the present range of materials. Dr. Ussher seems to forget that if an organ of (say) eight stops (four wood and four metal) were put up in a cottage and played full, it would drive everybody out of the house, and this entirely on account of the metal, whereas if the stops were four wood, three paper, and one metal (if metal must be used), it will be much softer and give the same variety. And as to the tuning and voicing, I must say there would be no difficulty, because it is only the cylinder I would have made of paper, so that the parts of a pipe concerned in the voicing would be made of wood like all wood pipes, and open to the same means as usual for that purpose, and as to tuning that would be simple enough. It does not follow that because the cone is used to metal that it must be used to paper; the means for tuning would suggest itself to any mind of moderate contrivance. He says, "Another medium may be got as good as wood, but would it be worth the trouble." I say name the medium, and some of us will try it, as I want some one to try mine, and as to the cat and king, I think one is as good as the other, when both are made of paper, neither of which will help us either in or out of a difficulty, but paper I feel sure, would, with the assistance of wood and metal. Perhaps I had better say before closing my remarks what I know to have been done by way of experiment. A cylinder was made of paper entirely, 9ft. in length, tapering from 1in. inside diameter at the bottom to 8in. at top; it was very hard, straight, and varnished inside and outside, and put upright and allowed to fall on to a stone floor for the purpose of trying its stability, which was found to be quite as good as before. Then it was slipped into a short tube made to receive it, the same tube containing a large striking reed similar to those used in a trumpet-stop, then it was blown by means of a small wind-chest and feeder made for the purpose of trying experiments. And now for the evidence obtained at the trial. A young man who has had some years of experience in an organ factory was brought into the adjoining room so that he might not see it before hearing it, and so give his candid opinion on it, and after expressing himself satisfied with its tone, he was taken into the room where it was, and there expressed his surprise at the result from such material, saying it was very good indeed, and that the pipe had been far more severely tried than it would be under usual circumstances. The reed was 4in. long, $\frac{3}{4}$in. wide, and rather thicker than usual, requiring very little wind. SUCRAM.

PIANOFORTE CONSTRUCTION.

[4769.]—"ONE WHO DESIRES TO BE INSTRUCTED" (let. 4665, p. 539) cannot see that the bridge in a pianoforte is the lever with which the string sets the soundboard in vibration. He thinks the string rises and lowers the soundboard bodily. I am pleased to think that I can show now more clearly than I have done before that the lever moves in a radius whose centre is according to the construction of the soundboard, in the bar, or soundboard, or if no bars are behind the soundboard may be within the lever itself. For economy's sake I avail myself of the opportunity to show the vibration of the breast of a violin at the same time. Fig. 1 is a section of a violin, and if at rest we may suppose the breast and back waveless, but when the bow is drawn across the string the latter will stick for a small interval of time to the bow, and consequently will be drawn out of its straight line, and that will increase its tension, press heavier on the bridge, and make an impression on the breast. At the same time it will pull on the neck and nut, which form levers to the back, which will be drawn towards a straight line; but that can only be done when the soundpost is making an impression underneath the breast. Leaving it in that position for a moment, I must say that if the breast is $\frac{1}{8}$in. thick, the soundpost should be $\frac{1}{4}$in. away from the bridge, to allow the two opposite pressures to create a full half wave, as seen in Fig. 1. Now, the string releases itself from the bow and springs back in a straight line, and the extra pressure is gone and the breast is waveless again. Of course the number of waves so created in a second depend upon the tension of the string. Fig. 2 is the same as Fig. 1, with the exception of the soundpost, and it will be clearly seen that if we go through the same experiment as before, the breast and back will move bodily in the dotted line and back again at each deflection of the string. Fig. 3 is a section of a piano, but before I describe its meaning I must cite a practical experiment of the brothers Weber, the description of which will be found in "Wellenlehre," p. 1, table 1, Fig. 1. If a rope or a string is struck with a hammer near one of its ends, it makes an impression on it, or as we will call it, a wave. This wave, when the hammer is drawn back quickly, will run along the string until it is checked on

FIG. 2

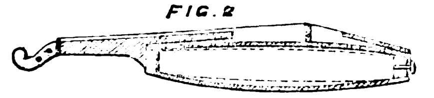


FIG. 1

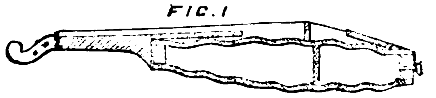


FIG. 3

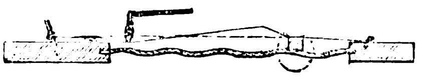
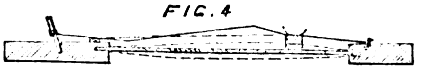


FIG. 4



the other end, then it will spring up to the opposite direction in which it came and return, spring in its original position, run along again, and so on, 1 2, 1 2, until it comes to rest again. Now, in Fig. 3, we see a hammer creating a wave on the string which, as above stated, will run along the string, and before it meets the lever will give it a turn towards the soundboard, then the wave will spring up in the position in which it returns and draw the lever back, and besides this the longitudinal vibrations of the string cannot act otherwise on the lever, but move it in a radius (see dotted line). Fig. 4 simply shows the transversal or bodily vibration of the soundboard, as in the violin without the post (see dotted lines in Figs. 2 and 4). Before I describe the different characters or timbre of the sound so produced I beg to cite Pellison. His opinion is derived from practical experiments. Pellison found that that construction of a soundboard is the best which prevents its vibration transversely or moving as a whole. However, such construction should not destroy its inner elasticity. See Dr. Oscar Paul's "Geschicte des Claviers," p. 15. "One who Desires to be Instructed" refers to an experiment made by Dr. Tyndall with a rod put vertically on a tray or box, the description of which will be found in his book on "Sound," p. 80, which I beg to say shows nothing in this respect, for Dr. Tyndall did not construct the box in such a form as to produce the loudest or clearest tone, but simply shows the transmission of the vibration of a tuning-fork through a long rod to the box. If the soundboard of a pianoforte is constructed so loose that it can vibrate transversely, the timbre of the tone is what "The Harmonious Blacksmith" properly calls "harpy;" but the tone of a harp can be produced by fastening a string on a common door panel or any unscientifically-constructed box or board. Many people think it a very sweet tone, but it is not the tone which highly-educated musicians patronise, for it is the least clear, or, if I may say so, the unclearest tone produced; vocally speaking, it borders on hoarseness. And besides this, I dare to say no instrument produces more than two or three octaves of this so-called sweet tone; the treble as well as the bass must always be wretched. The tone we want must be clear, no matter what peculiar character it has derived from the instrument by which it is produced. If we hear the voice of a good singer, we cannot fail to detect a delicate beating or pulse in it. The meaning of this is most highly valued by "The Harmonious Blacksmith's" friends, the pianofortetuners. Next after the human voice is the musical-box, the concertina, the harmonium, and organ.

J. H. SCHUCHT.

PIANOFORTE TUNING-KEY.

[4770.]—IN reply to "Bedca" (let. 4672), I designed two or three years ago, and with the assistance of a clockmaker, constructed a pianoforte tuning-key exactly on the same principle as the one illustrated on p. 540, with this difference; mine consists of two eight-leaved pinions and two forty-eight toothed wheels. If "Bedca" carries out his idea he will find that the spindle E F should not be fitted into a square hole in the handle G H, because it has the effect of making it work like an ordinary tuning-key, on account of the fulcrum and lever being moved together. The frame-plate should be held steady, and the spindle turned by another key. JAS. OULTON.

BLINKERS REMOVABLE.

[4771.]—IT was a learned man who once wrote that "early prejudice is stronger than the power of reason," and I think it is conceded that all unbiased minds have accepted the assertion as well founded. Being very unlearned (not all my own fault), I will not make a similar assertion, but offer an opinion that fashion exercises a greater power over the million than does reason, and that a vast amount of suffering both to the million and to the million's animals is the result.

Now, in East Kent it is the fashion for all farm horses to wear blinkers when drawing carts or waggons; in the fields, at plough, harrow, roll, or in Suffolk drill they are never used, as what is called the plough harness is not furnished with them, but the cart-harness is. If a farmer of that district purchased a horse from any of the adjoining counties where they are worn at field work, he would not for a moment think of sending him to plough in blinkers—it would not be the fashion, and the animal would not run away from his companions, at least, I never heard of such a case. I could mention instances of horses running away from another cause, but space forbids.

OLD PLOUGHMAN.

THE "FALLACIES OF DARWINISM."

[4772.]—NOTHING can more clearly show the *animus* which pervades the mind of the reviewer of my book than the paltry nature of his criticism and its misrepresentations. I will give an instance of each.

1. The paragraph about the two lines of religion and science is, I admit, unfortunate, but it had already been altered for future use. Instead of running "parallel," if your critic had simply told us it ought to have been "opposite," a good deal of ill-nature might have been spared.

2. The reviewer has misrepresented me to have said, "Speaking of the vivid colours of birds, Dr. Bree says they are produced by striæ of pigments which decompose the light, and enable the feathers to absorb the most brilliant rays."

What I did say was the following:—"To make a certain colour in a bird's plumage, either colour pigment is deposited in appropriate cells, or the little barbules are striated so as to decompose the light, or both of these means may be found in the same feather. But to make this colour, it may require 10,000 gradations either in the pigment or in the length or depth of the microscopical striæ on the barbules. Dark pigment here and lighter there—striæ which will decompose the light, and enable the feathers to absorb the most brilliant rays, and so commingle them as to produce the most vivid, the most varied, the most beautiful colouring in the world." (Page 230.)

Colchester. C. R. BREE.

[It is unnecessary for me to deny that any "*animus* pervaded my mind" when reviewing Dr. Bree's book. Whether the criticism is of a paltry nature, and guilty of misrepresentation, are questions that readers are evidently better able to decide than Dr. Bree. The word "parallel" is, no doubt, "unfortunate;" it is also very unfortunate that it should be attributed to Mr. Spencer—at least for Dr. Bree; because it is one of those mistakes which cause a writer's statements to be regarded with suspicion. Now, with respect to the "misrepresentation," Dr. Bree has apparently overlooked the meaning of the italicised word—"absorb," and has omitted the concluding part of the sentence; but this is immaterial, as he supplies the whole passage from his book, and many of his readers will doubtless wonder how feathers can produce the "most beautiful colouring in the world" by *absorbing* the "most brilliant rays" of the spectrum. Truly, this is a "misrepresentation"—of the theory of light and colour. I may here mention two errors which do appear in my review: "striæ of pigments" should be "striæ *or* pigments;" and the reply to M. Flourens by Professor Huxley was originally published in the *Natural History Review*, and is reprinted in his "Lay Sermons."—THE REVIEWER.]

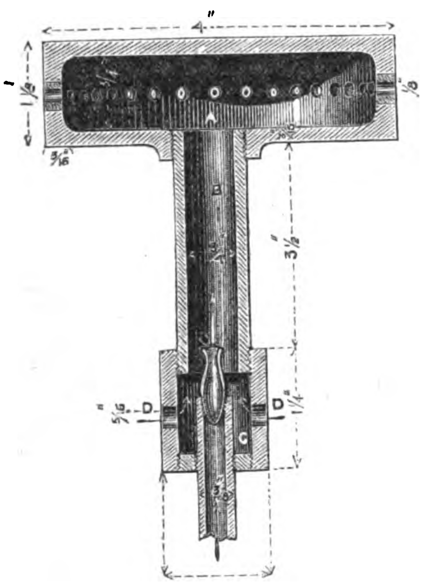
TESTS FOR TELESCOPES.

[4773.]—OF "F.R.A.S.'s" tests, the following are the results, taken from my observatory book:—τ Aquilæ, pretty well divided, well seen at times; λ Ophiuchi, well separated, colours yellowish and bluish; 73 Ophiuchi, not well seen, like an hour-glass. (In these observations the air was unsteady.) ζ Boötis, elongated pear-shaped; ϵ Equulii, well elongated. The rest I have not had the opportunity of looking at. Σ 2873 Pegasi I cannot find in Proctor's large atlas.

J. W DURRAD.

WARMING GREENHOUSES.

[4774.]—Seeing in last week's English Mechanic a letter on the construction of a moderate-priced greenhouse, and in view of the fact that some of your readers may wish to heat by gas either directly or indirectly, it has occurred to me that a few hints from one who has had some experience in greenhouse heating might be acceptable. Suggestions from practical readers of the Mechanic would also doubtless be very apropos at the present time, when the price of coals is rising so frightfully. I have experimented pretty largely with burners, and have at last designed one which will compete with any I have seen on the score of cheapness and economy. I inclose a sketch of one I made of cast iron principally, but the material is non-essential. The burner proper (A in sketch) consisted of a disc 4in. in diameter, cored out inside so as to leave $^3/_{16}$in. thickness of metal all round; the core being supported in the mould by a stalk which formed the central hole, and by which the ventilation was insured, and the core cleaned out. This hole was tapped with 1in. thread, and a piece of ⅜in. gas-pipe 3¼in. long, screwed in. This piece of ⅜in. pipe was also screwed for ½in. at its lower extremity, and on to this a 1in. gas coupling screwed up. In this coupling were drilled four $^5/_{16}$in. holes on opposite sides. The bottom of the coupling was filled by a piece of hard wood driven in tight, and through this was screwed the piece of ⅜in. brass piping, which carried the burner. In the sketch B is the ⅜in. pipe, and C the coupling; so far the means of supplying and mixing the gas and air. Now for the burning. The disc A being 4in. in diameter, the circumference will be 12½in., and round the circumference 25 holes ⅛in. diameter were drilled, not exactly on the centre of the edge, but near the bottom; they were just ½in. centre to centre. The gas being turned on rushes through a No. 2 burner up the pipe B, and an induced current of air enters the holes D drilled in the coupling C, mixing with the gas both in the pipe and the head of the burner. After a few moments a light is applied



to the rim, and the mixture ignites, running all round, the holes being near enough for the purpose. The flame is pale blue, with a slight tinge of white at the tip, perfect mixture of gas and air, and perfect combustion being insured by the construction of the burner. The results are intense heat and no smell. A friend of mine, a young doctor, begged this burner from me last summer, and fixed it in his dressing-room, merely covering it with a sheet iron dome to prevent any accidental conflagration. The room is about 14ft. by 6ft. by 8ft. high, and was kept during the whole of last winter at an even temperature of 70° to 75°. The extreme consumption of gas would be 3ft. per hour, but the burner was working half power, 16 hours in 24. I also made a 8in. diameter burner, and one 12in., supplied with two No. 3 gas burners, this last generated a prodigious amount of heat, sufficient to keep a greenhouse 14ft. by 8ft. 6ft. by 6ft. average height, at a temperature of 65° throughout the winter. I shall be happy to give information touching these or any other type of atmospheric burner.

Atmospheric Burner.

HINTS ON THE CONSTRUCTION OF GREENHOUSES.

[4775.]—I was glad to see in "our" Mechanic so able a letter (4662) from our worthy correspondent, of whom we hear so often, upon greenhouses, &c., and the best adapted for the amateur, as I was myself under the same impulse to break the ice, as it were, in this matter, for the benefit and profit, I trust, of our numerous readers. Well, as our friend solicits criticism, may I be allowed to say his plan in general is very good; but shall we find all our mechanics good enough at joiner's work as to be able to put up a house after this sort, and if so, I fancy we shall not all get bricks and cartage at £1 per 1000, nor quite so easy a bargain as our friend offers for £5 in the prospectus issued, may I say.

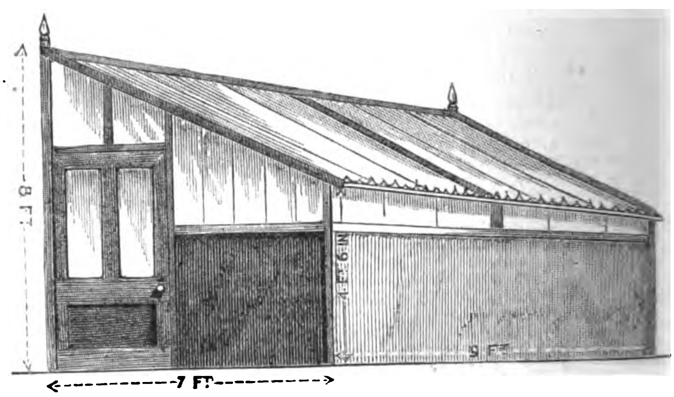
Now, would it not be better, provided it could be done, to get a building fitted complete, with bars, &c., all made into sashes or lights, ready fitted, door hung in frame, and the glass supplied us; the woodwork once or twice painted, &c., and then for us only to have the mere putting of the same together? Now, I have hinted the same to a friend of mine, and he has taken great interest in the affair in endeavouring to bring about the desired end. Thus, he will make a greenhouse for sale, say, 8ft. × 8ft., or 12ft. × 6ft., or, I think, better still, 9ft. × 7ft., as it gives one more room in front of him, and seems in better shape and form, after the following manner and costs. Two lights for roof, each 9ft. × 4ft. 6in.; two lights in front to swing as ventilators; two lights for the ends of same building, and a door hung in frame, all of which can be put up by a man and a lad in three hours complete. The glass to be all cut to a uniform size.

Thus we gain much in time and labour—a great feature to most of us, and have only to supply ourselves with a few rough boards, old packing-cases will do, or a concrete front or brick wall, as the case may be; but only reducing the same to a minimum, and one which all of us can easily manage, and erect to the satisfaction of our own minds and pleasure to our numerous friends. Thus the cost of same would come thus:—

	£	s.	d.
Six lights, fitted and framed together, to compose a house 9ft. × 7ft., with one door and frame hung complete	2	17	6
Glass for ditto, at 3d.	1	10	0
Painting for same	0	10	0
	£4	17	6

I find 16oz. glass to suit admirably, as my own house is glazed with same, and I have been within the same when heavy storms have poured down upon it with hail in abundance; but it merely gave way by bending before the storm, and did not show a flaw or crack anywhere afterwards.

I inclose a sketch of house, and trust it will be the means of moving our young friends to try their hands at this pleasurable pastime. Now, as regards heating the same. I shall be glad to hear what our friend states upon that, and then, if agreeable, I will also bring out my idea, as I have one, which will heat from 150ft. to 200ft. of 2in. hot-water pipe at the small cost of 4d. per day and night, and will go for eight or ten hours without attention, and, I think, will not cost more than another £5 to complete the whole affair, or at least enough to warm the above-sized house. As soon as I can get my electros done I shall offer them in the advertisement sheets of "our" paper, and trust they will prove the means of satisfying our long and much-desired wish of a cheap greenhouse heated sufficiently but economically. Should the same meet with approval, and



that, too, of our worthy editor, I shall only be too pleased to name it the "English Mechanic Greenhouse." As I know it has been a source of great concern how to secure our stock of bedding stuff from Jack Frost, for how many of us have had choice and valuable assortments of plants, &c., and have had the mortification to see them wither and die?

However, I think if we only endeavour to help one another, we shall overcome this difficulty as we have done many others, by the help of this our friend the Mechanic. I trust our friend "Saul Rymea" will continue to lay before us things both new and old, and enlighten us as as far as he is able.

Bro. Sam.

[4776.]—In continuation of my letter (4662, p. 538), I have now to deal with the method of heating the greenhouse, or rather of keeping out the frost, for this is all that is supposed to be attempted in greenhouses, which are thus distinguished from the stove, or hothouse proper. For very many plants just sufficient warmth to prevent the inmates of the house being frozen is all that is required, and to achieve this result two or three of the small benzoline lamps will be found to yield quite enough heat to prevent any disastrous effects from the coldest night, if they are supplemented by coverings of mats, old sail-cloth, carpets, or other non-conducting material capable of keeping the heat in. But with the half-hardy and tender plants at present used in "bedding out" it is necessary to do something more than merely preserve them from being killed outright; for if fine specimens are desired capable of yielding a tolerably long season of bloom, it is requisite that cuttings should not only be taken early, but that they should be kept steadily growing on. Once the element of artificial heat is introduced, however, the greenhouse will require all the attention the amateur gardener can bestow; for too high a temperature or a too long continuance of it will be found to cause as much ruin as will frost in its absence. With the changeable weather of spring in this climate (for instance, that of the present year) fire heat must never be allowed to meet sun-heat—indeed, this should never happen under any circumstances; and while the warmth of February induces the belief that the fire may be dispensed with, the cold, biting nights of April and even May will often disappoint the hopes of the floriculturist, and administer a check to the plants that they will not speedily recover. Again, fires once resorted to, the artificial heat must be kept up, and I have frequently known one night's neglect to result in the death of a whole house of plants, which would probably have survived the winter if artificial heat had never been given at all. I think, therefore, that, unless the amateur can devote sufficient attention to his pets to guard against the vicissitudes of the weather, that "heating" had better be left alone.

But heating being determined on, in a greenhouse of the proposed dimensions (12ft. by 6ft.) we have choice of only two methods, for, on the score of economy, hot water is said to be out of the question, and the alternative lies between an iron and a brick stove burning ordinary fuel, with a chimney carried directly through the roof or a flue running along the path. Gas has been tried, as your readers are aware, both for heating water and in what I may term the dry state, but the results, so far as have yet come under my personal knowledge, have not been of a very satisfactory nature. Nevertheless, I believe that with appropriate apparatus very satisfactory, though not, I think, economical results might be attained with it. But it must be remembered that any defect in the apparatus permitting the escape of the fumes would end in the destruction of the plants. I speak, however, with diffidence as far as concerns hot water and gas; for it by no means follows that because a method of employing either of these economically is not widely known, that it does not exist or cannot be invented. But your readers will scarcely misunderstand me. I shall have made a great mistake and certainly be much disappointed if the discussion on this subject in these columns does not lead to great improvement in the heating of greenhouses.

Between the choice of an iron stove or a brick I cannot personally hesitate. Iron is not a suitable medium for radiating heat and warming air breathed by plants, and this applies even when the stove is lined with firebrick, or a space of 3in. is left between the iron case and the bricks inclosing the fire. Therefore, I recommend what I believe to be the best and most economical, as well as neatest, arrangement—viz., a brick stove with a flue running along the pathway. To construct this flue a trench must be dug in the centre of the pathway about a foot or fifteen inches wide and about eight inches deep. This trench should have the bottom made tolerably firm, and a layer of cinder ash or fine gravel 2in. thick put in and levelled. On this the bottom tiles are laid, and bricks on edge at either side, so as to leave a passage 5in. wide and 3in. deep. The covering tiles one inch thick are then laid on, and the sides closed in with gravel or cinder ash, so that the tiles form the path. It is decidedly best to mortar all the joints closely, but it is not absolutely necessary, for if the stove and flue are properly arranged very little smoke or gas will escape into the house. The brick stove should be built entirely in the greenhouse, and should be constructed at the same time as the foundation wall is erected, so that the front of the stove may serve as part of the wall. It will be necessary to dig a hole at least 2ft. 6in. deep, for the firegrate should be at least 18in. below the level of the flue, and this must be left for ash-pit. The hole should be 2ft. square on plan, and be lined with 4½in. brickwork, the bottom courses being laid a full brick thick to form the ash-pit and to afford support to the fire-bars. The fire-place should be about 7in. wide by 7in. deep, formed of clay lumps or fire-bricks, which should entirely surround the fuel. An opening for the feeding-door will have to be left in the front or external wall above the top of the fireplace, and a hole about 2ft. 6in. deep corresponding to that in the interior, and of a breadth and width sufficient to allow of convenient "stoking," must be dug out on the outside. The feeding-door should be double, fitting very close, and the ashpit must either be provided with an equally close fitting door containing a valve to admit more or less air, or an iron plate must be made to slide in grooves just under the fire-bars, so that the supply of air can be shut off entirely or regulated to a nicety. This latter plan I certainly prefer.

In many of this description of stoves a bar of fire-clay is placed about 3in. in front of the opening to the flue, and extending about 2in. on either side of it, the object being to keep the heat in the stove and prevent a too rapid exit of the heated gas by way of the flue. This is the secret of all heating by stoves: to retain the heat at one radiating point, and to prevent it as much as possible from escaping by the chimney

The bottom of the flue as before mentioned should be not less than 18in. above the grate; and the brickwork need not be carried up more than 6in. or 8in. above the floor of the house; but I think it advisable to carry it up nearly level with the staging, and utilise the upper part as a kind of miniature forcing-pit, for raising tender seeds, striking cuttings, &c. This is easily accomplished by placing an iron plate over, so as to receive the heat of the fuel beneath, building a shell of bricks on this, and filling up with sand and compost, or sand alone if it is to be used for plunging pots. The stove would, of course, be at one end of the house, preferably the door end, and the chimney at the other, built against the wall of the garden, and connected by a short rising flue with the main flue, at the end of which (the point of connection) a tightly fitting door is to be placed to enable the soot to be removed. I believe it to be perfectly immaterial where the stove or the chimney is placed; the former might be placed in the middle of the front with a chimney rising directly from the top through the roof, or with a flue running diagonally to one of the back corners, or with a flue running all round and the chimney taken out just over the stove. I have also seen very serviceable heating arrangements in which 5in. drain pipes formed the flue, but these require careful joining, and are not more economical than the brick and tile flue. Again, the flue need not be sunk in the pathway, but may be carried along under the staging on the ground level, which will also, of course, reduce the depth necessary for the stoke-hole. And then again, it is quite possible that some one can suggest something better than what I have done. Still, I think a brick stove is not only cheaper but more advantageous and suitable than an iron one, although some very useful and portable articles of this latter description have been introduced of late years, and of course this portability is one of the principal desiderata in the greenhouse and its appurtenances I am endeavouring to arrive at. As to the management of the house when obtained, it is scarcely worth while entering into that here; let us get our hare and we will soon cook it. But I may point out that a stove of the construction indicated, and with the arrangements detailed, will consume but little fuel. The object is, of course, to get the heat up to a certain degree, and then by regulating the combustion by means of the sliding door under the firebars, a fireplace of the dimensions given will contain enough fuel to last all night, and even if it should go out towards daylight, the bricks will still radiate sufficient heat to prevent Jack Frost from doing harm. Small coke, coal, cinders damped, coal and coke dust with sawdust, peat, leaves, hedge clippings, anything almost can be utilised as fuel. For very many plants it will be sufficient to start a good fire in the evening and let it burn out; but if you want things to grow, the temperature must never be less than 40° Fahr., so that a thermometer is a sine-quâ-non. I have just read the plan of Mr. Taylor (let. 4710, p. 569). I can only say that it is rank "heresy," but not, therefore, necessarily incorrect or useless. It is against all the "doctors of heating," but it seems feasible, and is certainly convenient.

Saul Rymea.

ANOTHER REMEDY FOR THE POTATO DISEASE.

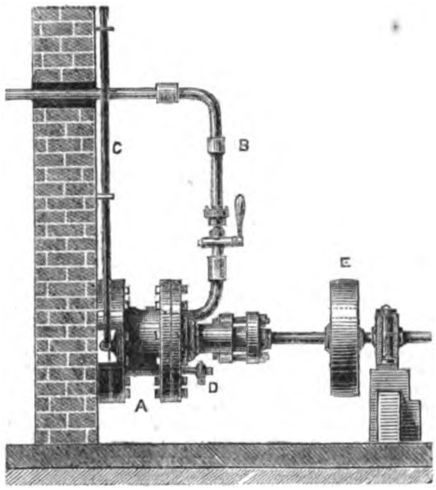
[4777.]—As I see from various reports that the potato disease is showing itself in many parts, and as every suggestion is possibly worth trial in the general absence of any radical means of prevention or cure, I send you the following cutting from the *Glasgow Herald*, the author being a "correspondent:"—"I am satisfied, from the little experience and the few experiments I have made, that the potato disease arises from a superabundance of alkaline matter, absorbed by the plant from moisture and heat. Any one may test this for himself for a halfpenny. Cut off the shaws [haulm ?], and water the ground with a watering-can, taking ½oz. of sulphuric acid diluted with 1½ to 2 gallons of water. If it has rained, examine in twenty-four hours; if not, wet the ground with plain water to carry down the solution to the tubers, and examine in another twenty-four hours, when it will be found that the disease has been arrested, and the part affected returned to its natural state, the acid counteracting the superfluity of alkaline matter absorbed. If our chemical friends would analyse the sound and unsound potato, and bring out something practical from this hint, they would confer a great boon on the human family."

I cannot understand, from this, how it is ascertained that the "part affected has *returned* to its natural state;" for unless the tubers are taken up and examined previously, I think it would be impossible to know what parts were affected, and consequently what parts had "returned" to the natural state. It seems to me that the cutting off of the haulm is the secret of this method; but the writer does not say how long after the disease is noticed in the leaves his remedy has been found effectual. Can he dig sound tubers when the haulm is black to the ground?

Saul Rymea.

NON-PACKING AND VALVELESS ENGINE.

[4778.]—The diagrams inclosed represent a unique little engine, well tested for its capability at Mr. Tyroll's factory, Deptford. It is used to drive the blowing machines, which that gentleman states requires 4 horse-power, and this it performs with such energy as to leave no doubt it possesses not only the force requisite, but something more. Fig. 2 is a transverse section through the middle of the cylinder and piston. These are 5in. deep; the piston moves on a crank, the centre of which is compelled to move round the middle circle, thus communicating a rotary motion to the pulley as marked E, Fig. 1. The steam is admitted by a pipe into the steam chest, the opening into the working part of the cylinder being covered with a plate of metal, to which the piston is firmly secured, the centre of each revolving round the middle circle before referred to. Through this plate on one side of nearly the extremity of each arm of the piston are holes to admit the steam into the cells, and so arranged as to be opened and shut by the surface of the cylinder over which it passes in its eccentric revolution with the piston. The exhaustion is effected from the bottom of the cylinder, and the escape is at the side marked D, Fig. 1. The action of the steam in giving motion to the piston A will be understood by referring to the same diagram. The cylinder and piston are perfectly steam tight; the exquisite form and workmanship

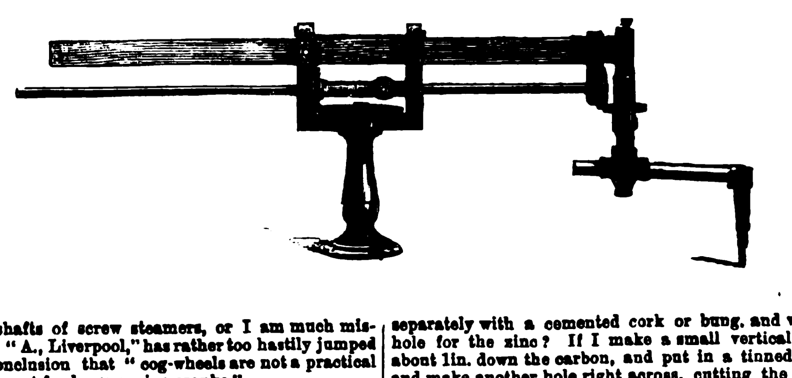


renders them so, the supply being at the top, at the bottom the exhaust, at the side the escape. This double action is continued uniformly during every revolution of the crank, and each cell continues to be steam-tight in every position of the piston. Outside diameter, 18in.; depth, 5in.; A, cylinder; B, steam pipe; C, escape; D, exhaust; E, driving pulley. This is a non-packing and valveless engine.

Joseph William Fennell.

CHANGING RECIPROCATING INTO ROTARY MOTION—ELLIPSOGRAPH.

[4779.]—The writer begs to inform "A., Liverpool," that the plan in letter 4578, p. 484, is not a modification of the one "A., Liverpool," saw working in Lincoln, but quite a different thing. There may possibly be a great backlash when cog-wheels are worked inside a circular hoop with teeth on inside rim, and all consequently converging towards a centre; but, as is shown in Rev. Arthur Rigg's article on "Mechanism," p. 533, No. 385, with well made and well fixed wheels as ordinarily used, backlash may be reduced to a minimum. As for "A.'s" idea that toothed wheels would be decidedly objectionable for use in sea-going vessels, I think, considering that in most cases where heavy work with constant and sudden variations of resistance is done by the steam-engine (such as an iron rolling, punching, and shearing mill, for instance), the power is all applied through the medium of cog-wheels, and that there is no substitute for them, what great objection can there be to their use in marine engines; indeed, they have been used to give motion



to the shafts of screw steamers, or I am much mistaken. "A., Liverpool," has rather too hastily jumped to the conclusion that "cog-wheels are not a practical arrangement for large engine cranks."

John H. Kidd is no nearer the mark than "A., Liverpool." He says the plan is fifty years old. Let him compare the poor, clumsy instrument for drawing ellipses, which he used in 1848, with its balance, its two teeth short, and its miserable show of deficiency in inventiveness (the paper having to be placed in a vertical position), with the plan of one shown on page 281, December 1, 1871, of "ours"; besides, the truth must be told, his instrument would *not* describe ellipses, *nor* straight lines: he would have to give back the two teeth he has robbed the wheels of, and then it might do its work.

Herewith I send photograph of my best instrument for describing ellipses. After over thirteen years of study in this particular matter I cannot make or find a better; if any one of "ours" knows of one he would confer a great favour by letting me have a slight description of it, or by saying where it might be seen. The drawing will explain itself to those interested in the subject, if they will take the trouble to read description of small instrument, page 281, December 1st, 1871. This instrument will describe circles and ellipses of any given diameters that the length of the main sliding bar and rod allows of; said bar and rod regulating the mean diameter of ellipses, and the small bar with pencil attached giving the difference between the mean and the major and minor axes. This instrument can also, by change of position of one wheel, and

by using wheels with different numbers of teeth as substitutes for said wheel, be made to describe a number of beautiful curves similar to those produced by Suardi's pen. (For a description of this pen see Knight's "Penny Cyclopædia.")

G. Pinnington.

BATTERIES.—To "Sigma."

[4780.]—Will this correspondent kindly give me some hints about setting up some manganese cells on the principle lately described by him in his excellent articles on "Electro-metallurgy"? Let me premise that the cells are for working electric house-bells. I propose using stone-ware jars, 4½in. diam. × 5¾in. deep, which I propose filling up within about ¾in. or ½in. of the top. I propose having the porous cell of this same height, and placing it in the centre. On one side I shall place a carbon about 6½in. long. I shall pack all round the cell with pieces of carbon about the size of a hazel nut, and a mixture of manganese and powdered carbon equal parts. A disc of cardboard soaked in paraffin will cover all, with holes for a zinc rod placed in the porous cell and for the graphite to pass through. On the cardboard will be poured melted cement. The head of the graphite will be soaked in paraffin, and a tinned copper wire will be cast into the zinc. If "Sigma" sees anything wrong about the above will he kindly correct it? Now for a few direct queries—What size should the graphite, the porous cell, and the zinc rod be? Will a few ⅛in. holes in the porous cell be an advantage? Would it be better if the porous cell came through the cardboard, and was closed separately with a cemented cork or bung, and with a hole for the zinc? If I make a small vertical hole about 1in. down the carbon, and put in a tinned wire and make another hole right across, cutting the first, and run them both full of lead, shall I have a reliable connection? Is sulphate of ammonia or chloride of ammonium best, and should I put some crystals, and should the solution be saturated or not? If not, what strength? Lastly, what does "Sigma" think of Geo. Fox's plan of graphite porous cells made with tar and pounded gas carbon and burnt?

I hope he will pardon this long list of queries, but opinions on some of the points vary so much, and others, I think, want explaining. I want a battery that will go the longest possible time with the least possible attention.

H. H. G.

FUEL FOR THE WINTER.

[4781.]—With reference to this subject, concerning which "Philo" makes some remarks (let. 4656), let me suggest that if any of your correspondents have had practical personal experience in making up coal dust into cakes for fuel they could scarcely do better service than by publishing in your columns a full description of some of the methods which are available for private families. I was in Wales last year, and intended to have taken some steps to ascertain how the Welsh go to work, but was prevented by circumstances. I satisfied myself, however, that coal dust can be formed into most valuable fuel. The points upon which information should be given for the use of English readers seem to me chiefly the following:—What are the proportions in which the clay and coal are to be mixed? What is the best agent that can be employed for binding them together? Is it necessary to intermingle with the main mass any inflammable material such as bitumen to facilitate combustion; and what is the condition into which the clay must be brought in order to make the admixture easy of performance? Some particulars as regards the manipulation generally would also be desirable. I make this last remark chiefly because I notice such a great want of detailed practical information in many of the answers sent by correspondents of the English Mechanic; they write rather as if they were performing on the spot as well as explaining, and so suppress petty details which although petty are none the less essential to be known by persons seeking at a distance to carry out as tyros the recommendations made to them. Reverting again to the coal question, I would say that my belief is that many small families could save during the winter many pounds sterling if they knew how properly to use up fuel refuse, and acted on their knowledge. Certainly, with coal at its present price, and with the prices in prospect during the next six months, every householder belonging to the upper and middle classes owes it as a duty to society to do all he can to show ~~strike-loving democrats~~ that Capital is not, and does not intend to be, at the mercy of Labour if it can help it.

G. F. Chambers.

TAR PAVEMENT.

[4782.]—A new process for making serviceable tar pavements has been recently patented in America. The purpose of this invention is to furnish a new and improved composition, whereof to make side-walks and the like, which shall be free from objectionable odours, not liable to injury from rains falling on it soon after it is put down, and which, it is claimed, has other incidental advantages. It is made principally of equal parts of coal-tar, pitch made from coal-tar, and asphalte, to which is added gum camphor, in the proportion of 3lb. to each barrel of coal-tar. The coal-tar and pitch are melted together, and the camphor added thereto. The asphalte is melted separately, and then mixed with the other melted ingredients. In laying down the pavement a substructure of about 2in. of small cobble-stones is laid, ranging in size from about the size of a goose's egg to the size of a robin's egg, and previously coated with coal-tar by pouring the tar over them and raking them about. This is rolled down first with a roller about 22in. long, weighing about 500lb., and afterwards with a roller about 24in. long, weighing about 800lb. Screened sand is next mixed with melted tar, pitch, asphalte, and camphor, till the whole forms a stiff paste, which paste is put upon the substructure sufficiently to cover it when subsequently rolled, first with the light roll and then with the heavy one, to about an inch in depth. When well rolled the surface is sprinkled with water-lime to the depth of about one-sixteenth of an inch, which is rolled into the paste with a light roll. The inventor claims that the combination of the tar, pitch, and asphalte makes the most durable composition for this purpose yet known. The proportions given will best fulfil the conditions required; but they will approach this result in any combination. The camphor deprives the whole mass of bad odours from the first. The water-lime forms a thin scale over the walk impervious to water, which will not wear away till the walk is sufficiently hardened to resist all action of the rain without this protection. These "tar" paths make excellent substitutes for gravel, and are being extensively used in one form or another for various public works.

Tages.

AXES OF THE PLANETS.

[4783.]—In let. 4449, p. 406, Mr. Proctor wishes to be informed as to the inclination of Mercury's equator to the plane of his orbit. "W. T. R." has supplied the information in let. 4536, p. 460, saying that "Schröter estimated the angle which the equator of Mercury makes with the plane of his orbit at about 20°." Schröter's determination was, I think, something more than an "estimate," for from twenty-seven drawings made May 18 to July 4, 1801, or within the space of forty-seven days, he deduced the position of Mercury's equator by a graphical process, the principles of which he details at some length. See "Hermographische Fragmente zweyter Theil, nebst den Beobachtungur des Planeten Vesta, von Dr. J. H. Schröter, Göttingen, 1816."

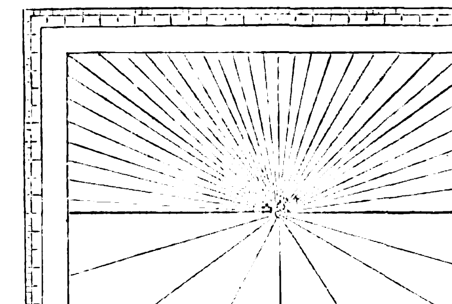
A further deduction may be made from Schröter's observations, for, as he says (p. 126), during the whole of the time from May 18 to July 4 the markings on the surface of the planet, as shown in the drawings, maintained the same invariable angle of rotation, or nearly so; whence it follows that the earth must have been all that time in the neighbourhood of one of the equinoxes of the planet. That this was the vernal equinox follows from the fact that the position of the axis of rotation was about 20° less than that of the terminator, and also that Mercury was in superior conjunction about the 3rd of June. Again, on the 10th of June, or about the middle of the series of observations, Mercury would follow the sun by about 6°, so that his longitude was about 85°, therefore the earth's longitude seen from Mercury would be 265°, and his north pole would consequently lie in longitude 355° or thereabouts. This is, of course, merely the rudest approximation; but, as Schröter himself says, when giving the inclination of the axis, it is better to know something of this element than nothing (indessen ist es doch besser, von der Schiefe der Mercurs-ecliptic etwas, als gar nichts zu wissen).

As I have seen the telescope with which Schröter mostly observed the inferior planets, it may be a valuable hint to some of your readers to know that although it was 10ft. in length its aperture was only about 3in. The powers he used were 82, 126, 206, 242, and 291.

R. C.

PERSPECTIVE.

[4784.]—I by no means lay any claim for pretensions to high art, yet, if allowed to say a few words on the subject of perspective, I will simply say that the laws as defined in most of our schools often perplex the student. I myself find the most simple means the most efficacious. I will quote the opinion expressed in the *Athenæum*:—"Perspective Simplified.—A picture in perspective is simply a plane parallel to the plane of the eye intersecting the rays that come from the surface of the objects represented. The points of these rays, at the places of their several intersections, combine to form the true perspective representations. Now, without much semi-scientific pedantry, the whole science may be understood by balancing a half-crown on the top of the forefinger of your right hand; hold it up so that its broad plane is parallel to the eye's plane, put it nearer or farther, and it seems to increase or diminish in size; turn it obliquely, and it appears an oval; put the edge on a line with the eye, and it appears a mere thin straight line. A sphere is the only geometric form that undergoes no perspective changes. The eye is able to take in any given space set at an angle of under 60 degrees. When both eyes view a scene, instead of the circle one eye sees we have an ellipse, formed by the continuation of the two circles of vision, the point of sight being opposite the centre of the space between the two eyes."



I inclose my simple plan of measuring and finding the given point in perspective, being a frame scaled out, with fine threads diverging from a given centre; the horizontal line is distinctly marked.

Joseph William Fennell.

[4785.]—With reference to letter 4654, p. 536, I beg to be allowed to state that my experiments with a plumb line and with vertical lines on a window pane are fallacious, because these lines must converge towards the zenith as well as the sides of the tower. As I feel quite sure the sides of the houses I observed were not parallel with the lines, I conclude they are not exactly vertical. The only way to test the difference between A B and C D is therefore by angular measurement. But nobody appears to deny that A B is optically narrower than C D. Therefore on the stock "pane of glass" A B must be narrower than C D. Now, as it is perfectly true that on paper or canvas we need not notice this convergency, yet as it appears on the glass two things are evident—first, that Sir David was right in stating that a photo. would show convergency; second, that I was right in stating that the pane of glass mentioned in books of perspective will not guide us to the perspective of a picture. With respect to my "cookery," I would remind "E. L. G." that pictures are very rarely viewed from the proper place, and, therefore, as according to his own showing, the perspective must be thrown out, I think we may indulge in a little departure from its rules, if we can by so doing produce some desirable effect. As "E. L. G." permits me to cook in some instances, why not in others? His observation as to the curved images on the retina seems to indicate that he supposes we see them instead of by them. Sir David knew better than that. If "E. L. G." had to paint architecture on the inner surface of a "Great Globe," he would have to paint his tower converging. I beg to say that I do not put myself forward as possessing any depth of knowledge of the matters we are discussing, far from it.

M. Paris.

NEW DOUBLE STARS.—To Mr. Bird.

[4786.]—I was glad to see your observations and notes of some of the new double stars, and I cannot but feel encouraged and gratified by the interest abroad you have mentioned. I am not surprised at your failure to see the close pair near ξ Boötis (let. 4376), even with a moderately large aperture, unless the night was a fine one, for with my instrument it is excessively difficult, and requires very favourable conditions; but then I see it perfectly. I find I have been anticipated in the discovery of this pair. Mr. Alvan Clark informs me that a year or two ago his son, Alvan G. Clark, found it with a 12in. object-glass, but that the fact had never been published. It does not seem to have been measured by any one.

Speaking of doubles in the same fields with conspicuous and well-known stars, there is a pretty but very faint pair in the field with γ Aquilæ, only 8′ south of it. I have perhaps called attention to this before. The components are nearly equal, of 10 or 11 mag., and separated perhaps 2″ or a little more, the position angle being about 40°. There is a third star a short distance preceding.

I have not been able to identify the double you have found in the neighbourhood of the pair near ξ Boötis, but perhaps I have not looked in the right direction. How far from the star marked 1 in the sketch (let. 4258) is it? It is certainly new if in the same field with any power, and I shall be glad to look it up, although it is getting rather late now. The nearest catalogued double is OΣ 288 (about which I put a query in let. 4258); but that is nearly 3½° from ξ in the direction of your star. Did you observe star 3 in reference to its present brightness?

The double star you mention as not being in the *Mens. Mic.* appears to be OΣ 261 (18h. 4m. 57s.: + 32° 53′, mags. 7, 7·8, D = 0·5″). The distance (estimated) is somewhat less, but the identity is sufficiently established. Not having an equatorial mounting, I have not been able to look it up. I may say, in passing, that my object-glass, and its tube, and everything else belonging to it except the eyepieces and finder, are about a thousand miles apart. The substitute for the tube which I am using consists of two pieces of board about 4in. wide, nailed together at the edges at right angles, the object-glass being fastened to one end in a frame and the eyepiece to the other. Though excessively unsteady, and the object-glass difficult to keep in adjustment when the instrument is reversed, (the movement is equatorial), its performance is good enough for almost any object, however difficult. The identification of doubles, when found, is laborious and troublesome, but it can be done with the aid of star maps.

You should procure, if possible, a copy of Otto Struve's catalogue of 514 double and multiple stars. The objects in this are far more interesting than those in *Mens. Mic.*, from the equal pairs being generally very close, and a very great difference in the magnitudes of the wider ones; in fact, there are very few easy stars. In this catalogue 167 pairs range in distance from 0·3″ to 1″, and more than 200 are as faint, or fainter, than the 10m. of Struve's scale. The original was published in 1843, and a revised edition in 1850, with the addition of 16 new stars. The number has since been increased to 539 by other discoveries, which will be found in *Monthly Notices*, Vol. XX., p. 8.

I would call attention to the so-called 16m. companion to α^2 Capricorni, and would like you and others to examine it with apertures of 6in. or 7in. Either this star is becoming easier, or its difficulty has been greatly overrated. Herschel, in his third catalogue of double stars, observed with the 20ft. reflector, rates it as 18 magnitude, and in the introduction to the paper says, "It is one of the most beautiful and delicate objects in the heavens, and could not be expected to be seen double in the 5ft. equatoreal, or indeed with any telescope of inferior light to that with which I observed it [20ft. reflector], unless, indeed (which I partly suspect may be the case), a very perfect destruction of aberration, by bringing the whole light to bear rigorously on a single point of the retina, and destroying all loose light in the field of view, may not in some measure compensate for a defect of quantity. But this has obviously its limits." (Mem. R.A.S., Vol. III.).

In his fourth catalogue he gave the magnitude of the companion as 15·16, and in a note says, "The small star is brighter than 18 mag., as set down in my former catalogue. The position differs greatly from my former estimation; but this is satisfactorily accounted for by the proper motion of the large star." The distance he gives now as 6″, and position as 134·8° (Mem. R.A.S., Vol. IV.). I always see it steadily in good weather, and even when a good way from the meridian, with my 6in. refractor, and could not call it a severe test for that aperture. I should rate the magnitude of the small star now as about 13, or 14 at the most, and the distance perhaps a little more than Herschel's second estimate. When it is remembered that the companion itself is a pretty close double, this object cannot be considered other than one of the most interesting. The duplicity of the companion I detected some two years ago with the Chicago glass of 18in., but afterwards learned from Mr. Alvan Clark that he had observed it with the same instrument while the glass was in his possession. He states that he can see traces of its duplicity with an aperture of 12in.

Have you seen the companion to β Aquilæ (OΣ 532)? and if so, what aperture is necessary to show it? This is one of the very few double stars I have not thus far been able to see with my instrument. I would like to inquire if ϵ^1 and ϵ^2 Cygni are regarded as forming a naked eye test. It is a more difficult object than any wide similar pair I now recall, but is very readily seen nevertheless. In this connection I may state that I can in any ordinary weather clearly divide ε Lyræ with the unassisted eye.

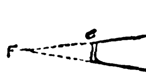
I have just been very fortunate in being able to make my double star literature almost, if not quite, complete. Prof. Young, Director of the Dartmouth College Observatory, very kindly placed his astronomical library at my service, and I have made copies of everything to be found in this department, embracing all the various catalogues in a complete set of the "Memoirs of the R.A.S.," new objects in Herschel's and South's catalogue, various objects noted from time to time in the *Monthly Notices*, *Astronomische Nachrichten*, &c. I also obtained recently a copy of Herschel's "Results of Astronomical Observations at the Cape of Good Hope," which contains a good many northern stars. So far as I know, my collection of known double stars is substantially complete. In all of these lists I find but two of my objects—one, 12 Scorpii, and another a double star in Hydra, communicated some time since—two of the easiest I have noted as new.

July 29. S. W. BURNHAM.

NEW DOUBLE STARS.—CORRECTION.—In let. 4549, p. 462, communicating the discovery of several new double stars, the description in reference to the second double should read, "About 1° from 33 Vulpeculæ," the number being omitted by the printer. The distance of that pair given as 2" is rather over-rated, I think. It is a very pretty pair, and not at all difficult.—S. W. BURNHAM, Aug. 5.

ON THE DISREGARD OF THEORY FREQUENTLY SHOWN IN THE CONSTRUCTION OF THE OPERA OR FIELD-GLASS.

[4787.]—THE opera or field-glass is an instrument of general use, yet there are numerous examples of inconsistent construction to be met with to which I would direct attention. It is a recognised fact to the initiated in optics that the limit of effective aperture of an object-glass is reached when the diameter of the glass bears to the diameter of the pupil of the eye the same ratio as the magnifying power to unity, any excess of aperture beyond this limit being useless, for the simple reason that the diameter of the cone or pencil of rays formed by the glass (where it enters the pupil) then begins to exceed the diameter of the pupil or aperture of the eye itself. Hence the cone of rays from an object-glass, whose diameter exceeded this limit, would merely cast a useless glare upon the part of the eye surrounding the pupil. An absolutely definite size cannot be given for the pupil of the eye, since it is capable of dilation within certain limits, but it may be stated with accuracy that the diameter is rarely less than ⅛in., and very seldom exceeds ¼in.; the mean diameter may be probably taken at about three-sixteenths of an inch. In the case of an opera-glass a magnifying power of two is very common, and this is in general quite sufficient for the purposes of this instrument. For this power the concave lens *e* is placed exactly half way between the virtual focus F of the cone of rays proceeding from the object-glass and the object-glass itself, as shown in the accompanying diagram.



The pupil of the eye being placed immediately behind the eye-lens *e*, it is obvious that the diameter of the pencil of rays where it enters the pupil is in this case one-half that of the object-glass itself. It need scarcely be remarked that the rays on passing through the eye-lens are rendered approximately parallel. It is clear from the above considerations that for a magnifying power of two the effective diameter of the object-glass is exactly twice that of the pupil, *i.e.*, a seven-sixteenths to half-inch object-glass would be amply large enough for this power; any larger diameter would only have the effect of casting a glare of useless light outside the boundary of the pupil, at the same time increasing the spherical and chromatic aberration of the object-glass, besides other disadvantages.

Now, opera-glasses having a magnifying power of two, with object-glasses of 1in. diameter up to even 1½in., if not beyond, are to be met with; the unsophisticated public supposing probably that increased light is thus obtained, whereas a detrimental glare which plays uselessly over the non-sensitive parts of the eye is the only result, to say nothing of the increased optical errors due to increased diameter of glass. If, on the other hand, the diameter of the object-glass were no greater than that which was efficient—say seven-sixteenths to half an inch—for a magnifying power of two, then the focal length of the object-glass might be proportionately reduced—the whole instrument would be much more portable and convenient. Instead of the clumsy affair at present too common the whole instrument would almost go into the waistcoat pocket, and its use would become more frequent. The dimensions of the lenses of some of these instruments, the focal lengths and powers of which any one may measure and judge of for himself, are, without exaggeration, utterly preposterous, and would remind one much of using a telescope of 2ft. aperture for a power of 20.

Many are no doubt deterred from using this convenient adjunct to a play or concert from the inconvenience due to its absurd size. A compact instrument, with object-glasses not exceeding ½in. in diameter, and whose length when shut up need scarcely exceed an inch, would no doubt find its way into more general use. S. T. P.

CALCULATING WAGES.

[4788.]—I BEG to send you the following observations on calculating wages:—Let a be the number of hours in a full week's work, s the shillings to be paid for it, h the number of hours actually worked; then, supposing the payment A to be in proportion to the hours worked, we have $A = \frac{h}{a} \times s$. It must be observed, however, that this formula is not suited for overtime—that is, h must not be greater than a, although it may be equal to it or less than it; overtime is, of course, as it ought to be, paid for at a higher rate. Taking a full week's work at 54 hours, and putting this value for a, we get $A = \frac{h}{54} s$. Now, the usual means of tabulating such tables is by products; this method makes the tables very long—for example, a table of products of numbers up to 50 would give 2,500 products (all not necessarily different numbers), or more than half of 2,500, if the same number was not repeated.

Now, a table of squares up to 100 requires only 200 numbers—viz., the numbers themselves 100, and their squares 100. To adapt the formula $A = \frac{h}{54} \times s$ to such a table, $A = \frac{hs}{54} = \frac{4\ hs}{216} = \frac{(h+s)^2 - (h-s)^2}{216} = \frac{(h+s)^2}{216} - \frac{(h-s)^2}{216}$. Let the squares of the numbers 1, 2, 3, &c., up to 100 or more be calculated, and, dividing each square by 216, and expressing the quotient as shillings, the fractional parts being reduced to pence, we obtain the accompanying table, calculated up to 54 hours, and wages up to 50s. a week. To illustrate its use, suppose 47 hours are wrought, and the wages for 54 hours is 38s., how much is to be paid? Adding 47 and 38 together we get 85, opposite this sum in the table is 33s. 5½d. Take the difference of 38 and 47 (no matter whether hours or shillings per week are greatest), we get 9; opposite 9 in the table is 4½d. Subtract the latter result from the former and we get 33s. 1d., correct to the nearest penny—the table is calculated to the nearest halfpenny; but if one result was nearly ¼d. too much, and the other nearly ¼d. too little, there would be an error of less than ½d. The table could readily be extended, and calculated for quarters of hours, and for every 3d. of weekly wages, instead of for every shilling. A similar table could be adapted for a week of full work, of more or less than 54 hours. The table is very compendious, and saves the trouble of turning over leaves, or finding the intersection of lines and columns. The principle might be applied to other tables.

	s.	d.		s.	d.		s.	d.		s.	d.
1	0	0	27	3	4½	53	13	0	79	28	10½
2	0	0¼	28	3	7½	54	13	6	80	29	7½
3	0	0½	29	3	10½	55	14	0	81	30	4½
4	0	1	30	4	2	56	14	6	82	31	1½
5	0	1½	31	4	5½	57	15	0½	83	31	10½
6	0	2	32	4	9	58	15	7	84	32	8
7	0	2½	33	5	0½	59	16	1½	85	33	5½
8	0	3½	34	5	4	60	16	8	86	34	3
9	0	4½	35	5	8	61	17	2½	87	35	0½
10	0	5½	36	6	0	62	17	9½	88	35	10
11	0	6½	37	6	4	63	18	4½	89	36	8
12	0	8	38	6	8	64	18	11½	90	37	6
13	0	9½	39	7	0½	65	19	6½	91	38	4
14	0	11	40	7	5	66	20	2	92	39	2
15	1	0½	41	7	9½	67	20	9½	93	40	0½
16	1	2	42	8	2	68	21	5	94	40	11
17	1	4	43	8	6½	69	22	0½	95	41	9½
18	1	6	44	8	11½	70	22	8	96	42	8
19	1	8	45	9	4½	71	23	4	97	43	6½
20	1	10	46	9	9½	72	24	0	98	44	5½
21	2	0½	47	10	2½	73	24	8	99	45	4½
22	2	3	48	10	8	74	25	4	100	46	3½
23	2	5½	49	11	1½	75	26	0½	101	47	2½
24	2	8	50	11	7	76	26	9	102	48	2
25	2	10½	51	12	0½	77	27	5½	103	49	1½
26	3	1½	52	12	6	78	28	2	104	50	1

PHILANTHROPIST.

A GIANT PLANET.

[4789.]—"G. F. H." (let. 4687) seems to be in error, the freezing point of water is 32° Fahrenheit, and 0° Centigrade. The boiling point of water is 212° F., 100° C., therefore 212 − 32 = 180° of Fahrenheit's scale = 100° of the Centigrade scale. 1200 F. is 1168 F. above freezing, or $\frac{5}{9} \times 1168$ C. above freezing = 760 Centigrade. Also $1\frac{11}{135}$ Centigrade is not equal to 1·95 Fahrenheit, but = 32° + 1·96 = nearly 34° F.

PHILANTHROPIST.

ERRATA.—In letter 4725, p. 565, "mixing and slacking" should be "mixing and stacking;" "the month's supply for three fires" should be "three months' supply for three fires."—INLAND.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[11589.]—**Dry Steam.**—I do not think it likely any experiment proving so simple a result of the third law of motion as "Philo" asks for, on p. 554, can have been specially recorded. Of course a stiffly moving piston might have such friction as to be driven only to the place of exact equilibrium between the pressures, and there stick fast; but with a large cylinder and high pressure, I should barely believe my own eyes on seeing such a movement. Now, whatever the steam expands to with the largest and most freely moving piston to drive, it surely would expand farther with no piston at all.—E. L. G.

[11887.]—**Hair Dye.**—The lotion of hydrosulphate of soda, lately discovered accidentally by Dr. M'Call Anderson to be a hair-dye, promises, it is said, to be the most perfect black one yet seen. It stains neither skin nor clothing. I have never seen it applied, and cannot tell whether it is or is not injurious to the skin or hair, but perhaps some reader of the ENGLISH MECHANIC will kindly give "Gray-Beard" this and other desirable information.—BLACK-BEARD.

[12191.]—**Surgery Abroad** (**U.Q.**).—I should have replied to this query sooner but I thought some of ours could have answered it better. I met a colonel last year who had resided many years in Adelaide, he said there was a good opening there for a surgeon, but Australia is very fluctuating, and the surgeons who go out with emigrant vessels often remain, so that openings are uncertain, and may be soon filled up. As to Canada, there are about 20 doctors in London, Ontario, to a population of less than 20,000, and besides this there is more equality in the colonies than here, and of course the professional man has not so good a position as in England. The M.D. is easier got in America, particularly in the United States, than here, and this overstocks the profession. Still, I think a doctor might do well in the States, or in Australia.—PHILANTHROPIST.

[12291.]—**Nature Printed Leaves** (**U.Q.**).—I inclose a cutting from one of the photographic journals which, I think, will be useful to "Robo" and others. I can, if required, give a more minute account of the entire process, but I should advise "Robo" to do as I did and take a lesson or two. The only skill that is required is manipulative, so that the process is best learnt by seeing it done. The Autotype Company, of Rathbone-place, Oxford-street, give instructions gratis once a week. At least they used to do so, and I suppose they do still. I should also advise that the carbon-paper be purchased ready prepared, and sensitised of the required tint, but only a small quantity must be purchased at a time, as it does not keep in working condition for more than three weeks. "The basis of the process is the action of light on bichromate of potash in contact with organic matter. Coat a paper with a mixture of this bichromate and gelatine; expose it to the light, under a photographic negative, in a common photographic printing-frame. Where the light reaches the coated paper freely — *i.e.*, in the high lights of the negative, which are the extreme darks of the picture to be printed—the bichromatised gelatine becomes insoluble. Where the light is entirely shut out from the coated paper—*i.e.*, in the deepest darks of the negative, which are the brightest lights of the picture to be printed—the bichromatised gelatine remains perfectly soluble, and may be entirely washed away. In the half tones—to be reversed, be it remembered, for negative and picture, by reading half light in negative for half dark in picture, and *vice versâ*—insolubility is attained, or solubility preserved, in proportion to the degree in which light is shut out from or let in to the coating of bichromatised gelatine. Now mix a pigment with your gelatine, and your lights, darks, and half-tones, are at once translated into gradations of that pigment, be it red or black chalk, sepia, Indian ink, common ink, bistre, or what you will. The practical difficulty in this process was to preserve the half-tones of the printed picture till they could be fixed on some durable support. They were floated away in the washing process necessary to get rid of the soluble parts of the print—its lights. It was Mr. Joseph Swan, an inventive chemist of Newcastle-upon-Tyne, who so far overcame this difficulty as to make the process commercially workable; but it was rendered practically and generally available by the patents of Mr. J. R. Johnson, the Chemical Director of the Autotype Company. Mr. Johnson has devised a new and highly-improved pigment paper; has discovered that when an autotype print is impressed on this paper it may be attached to a permanent backing, or support, without any cement. If this backing (a plate of zinc, glass, porcelain, &c.) be coated with a fatty substance (infusible at the temperature of the water used for washing away the soluble coating, but fusible at a somewhat higher point), the picture film may be readily detached from the backing. All that is necessary is, that it should be mounted on properly prepared paper by any of the many colloids that may be used for the purpose."—QUERCUS.

[12378.]—**Bat-making.**—A spokeshave is used to finish off, and they are pressed in a machine to make them hard. Scotch glue is the best.—E. M.

[12398.]—**Silver and Gilt Articles.**—"Spero" will find all he wants in back numbers. Oxidising silver is explained on pp. 311, 336, 361, Vol. XIV.; cleaning silver on pp. 394, 419, 463, 617, Vol. XIII. See indices of last four volumes.—TAGES.

[12495.]—**Watch Making.**—I regret the delay in answering this query, illness having been the cause. The horizontal escape-wheel will be included in the article which follows the next one, and, as I am unable yet to write for any length of time without rest, I hope to claim his indulgence. I am hopeful of treating his subject, "Trains," soon. I cannot find the No. of ENGLISH MECHANIC which contains his query thereon, but will order one.—SECONDS' PRACTICAL WATCHMAKER.

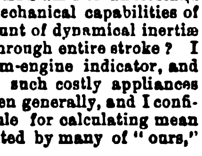
[12496.]—**Stained Scarlet Tunic.**—Scour the part with strong soap and water, in which some pearlash has been dissolved, then sponge it well with weak solution of sulphuric acid, say one teaspoonful to a pint of water.—BALCAIRN.

[12504.] — **Sketching from Nature.** — "Old Boots" gives a very nice plan on prepared glass, simple and easily got up, but is not clear in his description. What sketch is the glass to be laid over, and how is the second glass to be prepared to trace the reverse way—trace what? Explain, please.—JULIA.

[12506.]—**Power of Engine.**—If G. Valentine (p. 548) will kindly explain the following, he will confer an obligation on myself, and perhaps many others. By what arithmetical or other process does he get his 26·666 mean elastic force throughout the whole stroke? May I suggest that 26·666 looks ominously like $\frac{2}{3}$ of the 40lb. boiler pressure which is cut off at $\frac{2}{3}$ of stroke, and ask what becomes of the expansive force of the steam already in the cylinder when the supply is cut off? And am I to understand by effective horse-power the mechanical capabilities of the engine entire; or the amount of dynamical inertiæ expended against the piston through entire stroke? I understand the use of the steam-engine indicator, and the brake dynamometer, but such costly appliances are out of the reach of workmen generally, and I confidently assert that a simple rule for calculating mean effective pressure is much wanted by many of "ours," including—J. TONKES.

[12506.]—**Power of Engine.**—G. Valentine is in error when he states that the mean pressure of steam in a cylinder, cutting off at $\frac{2}{3}$, with an initial pressure of 40lb., is 26·666lb. Now, the way to find the mean pressure of steam on the piston throughout the stroke is, divide the initial pressure by the ratio of expansion, and multiply the number by its hyperbolic logarithm, plus one. In the example given it will be $\frac{40}{1\cdot5} \times (\cdot405 + 1) = 26\cdot6 \times 1\cdot405 = 37\cdot37$lb., and not 26·666lb., as stated by G. Valentine. The nominal horse-power is a name given in commerce, and is useless, as an engine is sometimes worked to six times its nominal horse-power. The indicated horse-power will be 106·7.—K.

[12537.]—**Compressing Air.**—To solve this question with perfect accuracy might be impossible; for, if we consider the fact that a quantity of air compressed into one-half its volume has its pressure more than doubled on account of the additional pressure caused by the increase of temperature. As to the temperature part of the question, I have no tables, and cannot reply to it. As to the work, I will give a reply, neglecting temperature, which does not affect its accuracy much; and, indeed, considering temperature even, if we have the requisite data, which is doubtful, it would probably give us an expression which we could not integrate, and therefore we should be forced to neglect it, or approximate to it by a series. Take rectangular axes Ox, Oy. Let the curve represent the pressure of the steam in the following manner:—The pressure varying inversely as the expansion, if B F be 1ft., and L F the initial pressure, and the piston drawn up to P, then B F × L F = P N × P M. Let P M = x, P N = y. F B = 1ft. F L = a pounds on the inch. Atmospheric pressure a known pressure. Then $xy = a$, which is the equation to a hyperbola, to a particular kind of hyperbola, the equi-angular hyperbola. The equation is generally written in the form $xy = c^2$. Now, $y = \frac{a}{x}$, and the area of the curve between the limits x = M P and x = L F will give the work done in compressing the air. To consider the case of expansion—



$$\int_{MP}^{LF} \frac{a}{x}\,dx = a \log. LF - a \log. MP,$$
$$= a \log. (\text{pressure of atmosphere}) - a \log. x,$$

giving x its value at the point P. If the air be expanded to twice its bulk, and the atmospheric pressure be 15lb. to the inch, we get work given out by expansion of the air = area of piston in square inches × (a log. 15 − a log. $7\frac{1}{2}$). Against this we have 15 (P N − 1) × area of piston for pressure of atmosphere. So, on the whole, in this case, we lose by expansion, as the pressure of the air in the cylinder is low.—PHILANTHROPIST.

[12541.]—**Fish Culture.**—Dace are not worth much for the table, being soft and flabby. They never grow to a large size, being when full grown only a few inches in length. "Green Drake" may conveniently cultivate dace for his young ducks by sinking a deep hole at the side or in the bed of the river. The fish are not fond of clear deep streams of running water like the trout, but prefer ponds and pools of rather turbid water. In this respect they are like the roach and eel, but do not wriggle through the mud or make their haunts in holes as the latter does. They feed on insects, water-worms, and shells, and may be caught with gentles, paste, moths, insects, and worms as baits.—RAT-TAT.

[12542.]—**Luminous Tubes.**—Sulphuric acid is said to have a similar effect when agitated in a glass tube in a darkened chamber, but its luminousness is intermittent and inconsiderable. Most probably, if a sufficient supply of rarefied air could be supplied at intervals to the inclosed mercury, a constant and steady light could be maintained; but "Pegasus" does not say whether the mercury is charred or rendered impure by the operation. To support the light something must be burned or decomposed, perhaps the inner surface of the glass, and if the products of combustion mingle with the mercury it would soon be rendered useless for illuminating purposes.—RAT-TAT.

[12546.]—**Protection for Steam Boilers.**—Either wood, hay, or straw, or vulcanised indiarubber can be used. The last is best, as it is a non-conductor of heat and electricity. As boilers when jacketed look unsightly and out of proportion, a thick covering as a protection ought not to be employed. Perhaps very thin laths surrounded by a light sheet-iron case, and inclosing a thin layer of air around the boiler, might be the best protection.—RAT-TAT.

[12548.]—**Flexible Black Varnish.**—This query has been answered very often in back numbers. Different proportions of rubber, boiled linseed oil, turps, lamp-black, ivory black, spirits of wine, coal-tar, naphtha, and such things, are recommended. Camphor, as a preservative, also enters the mixtures.—RAT-TAT.

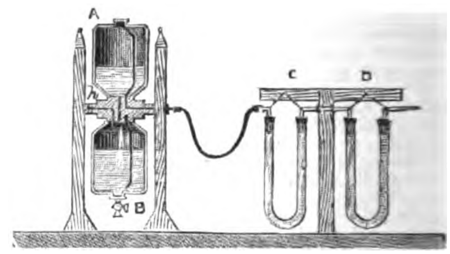
[12551.]—**Picture Framing.**—Lay the ends of the laths forming the sides of the frame over each other, and with a tenon-saw cut from the inside across the right angle formed. When the sides are cut apply a little glue with a brush to the ends intended to be joined. Join and drive a short tack through the ends near the angle from the top. Of course the sides must be planed and rabbeted beforehand, or "Jim" may glue on the face pieces cut with the others with the tenon saw.—RAT-TAT.

[12555.] — **Packfong, or Chinese White Copper.**—The Chinese packfong, tutenay, German silver, and electrum, owe their whiteness to the presence of the metal nickel, and like brass, the proportions of their ingredients—viz., copper, nickel, zinc, with occasionally a little lead or iron—are variable. Thus, the packfong contains $13\frac{1}{2}$ per cent of nickel, whilst the ordinary "German silver" contains from 20 to 25 per cent.—M. F. P.

[12566.]—**Bees.**—It would be illegal to retain the bees on the owner making application with a properly witnessed declaration that the bees which had taken possession of the empty hive were his, and that he traced them to the place. Bees can be recovered by the owner like other stray property, as cattle or sheep. —RAT-TAT.

[12571.] — **Break for Bicycle with Indiarubber Tires.**—In reply to E. B. Shaw, I know nothing with regard to the wooden block or the roller, but I think a good brake is still a desideratum; the system at present in use is simply rapid destruction of the indiarubber tire of the back-wheel. I have had a Phantom bicycle in constant use for the last twelve months, and I am much pleased with the very soft rubber which is supplied by the makers of that machine, but on the back-wheel I find that it wears away very fast. It seems to tear off in short strips: possibly a harder variety might wear better; that is, might grind away in the form of a powder. In any case, it seems to me that if you only put on the brake so as to check the wheel (but not stop it) while going down hill, the tire must grind at two points, at the part in contact with the brake, and at the part in contact with the ground; if, however, the brake is put on vigorously so as to stop the hind wheel from turning at all, then the destruction is only at the one point at the part in contact with the road. Practically, I believe the best plan would be to have very soft rubber on the front wheel, and a much harder kind on the hind one. The rubber tire on the front wheel should be as soft as possible to neutralise the irregularities of the road, which are felt by the rider almost entirely through the medium of the front wheel, to which the handle and treadles are attached; and, except for abolishing the noise, I can see no reason (as far as comfort is concerned) for an indiarubber tire on the hind wheel. I had a front wheel in use for many months over between 2,000 and 3,000 miles of all sorts of roads, and the soft indiarubber tire was as good as ever; it was cut in many places, but in consequence of the construction of the "Phantom" tires, it could not gape at the cuts, and was, therefore, practically uninjured; it gave way through an accidental fracture of the felloe. It is obvious that the brake should be applied to the hind wheel, because any check to the front wheel will cause the rider to turn a somersault over the steering-handle; but I think this might be arranged so as to make the hind wheel turn stiffly in its bearings; I can see a way of doing this after the fashion of a friction-brake without applying the skid directly to the tire of the wheel. By this means the machine might be controlled so as to run steadily at a moderate pace down a hill without grinding the tire to pieces. With the present system, the only way to save the tire of the hind wheel is to control the machine with the feet on the treadles down the steep hills until you reach a part where you can let it run at full speed, and if in good order, this will very soon be nearly twenty miles an hour when once let loose.—A. WOOLSEY BLACKLOCK, M.D.

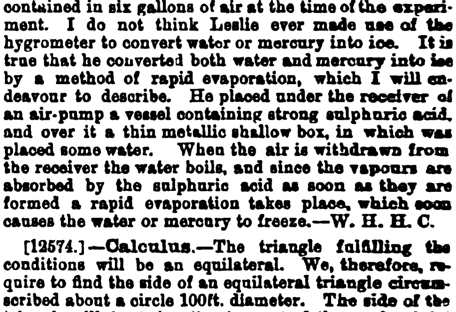
[12573.]—**Hygrometer.**—A hygrometer is an instrument for measuring the degree of saturation of the atmosphere. There are several kinds of hygrometers, one of which I will describe, called the chemical hygrometer. In this hygrometer a given volume of air is made to pass through chloride of calcium, or very strong sulphuric acid which has been previously weighed. The increase of weight shows the amount of moisture in the volume of air. Two brass reservoirs of the same construction, and holding a gallon each, are fixed on the same axis, but on opposite sides, as in the appended figure, and made to turn about it. The interior of each vessel is connected by a central tubulure, and the lower one is always in connection with the air outside by means of tubes running through the axis, while the upper one is connected by means of guttapercha tubes to the tubes C and D, which are filled with chloride of calcium or some porous substance saturated with sulphuric acid. The tube C prevents any vapour from escaping from the reservoirs to D, and D absorbs the vapour of the air which passes through it. The lower reservoir B being filled with water is inverted so that the water running slowly from it expelled the air in A through the tubulure h which con-



nects it with the air outside. The vacuum now formed in A causes a draught of air through the bent calcium tubes C and D, and the calcium absorbs the moisture in the air which passes through it. When all the water has run into B, the reservoirs are again inverted, and the same process commences again. If the reservoirs have been turned six times, it is evident that six gallons of air have passed through the tubes C and D, and have been deprived of the moisture in them. The contents of the tubes C and D are then weighed, and the increase of weight gives the amount of vapour contained in six gallons of air at the time of the experiment. I do not think Leslie ever made use of the hygrometer to convert water or mercury into ice. It is true that he converted both water and mercury into ice by a method of rapid evaporation, which I will endeavour to describe. He placed under the receiver of an air-pump a vessel containing strong sulphuric acid, and over it a thin metallic shallow box, in which was placed some water. When the air is withdrawn from the receiver the water boils, and since the vapours are absorbed by the sulphuric acid as soon as they are formed a rapid evaporation takes place, which soon causes the water or mercury to freeze.—W. H. H. C.

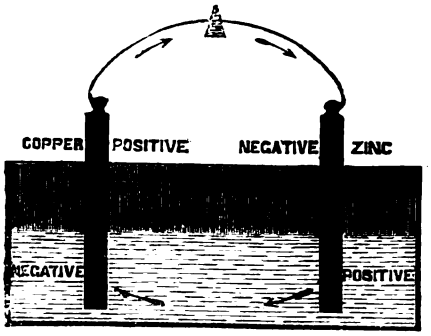
[12574.]—**Calculus.**—The triangle fulfilling the conditions will be an equilateral. We, therefore, require to find the side of an equilateral triangle circumscribed about a circle 100ft. diameter. The side of the triangle will be twice the tangent of the angle of 60° in a triangle whose cosine (the radius of the circle) = 50ft. Under these conditions the tangent will be found to equal 86·6025ft., and the side of the required equilateral triangle being equal to twice this tangent will be 173·205ft.—EXCELSIOR.

[12577.]—**The Iris or Rainbow.**—I think M. Ganot's explanation of the cause of the rainbow will suit "A Young Astronomer." M. Ganot says:—The phenomenon of the rainbow is produced by the decomposition of the white light of the sun when it passes into the drops, and by its reflection from their inside face. In fact, the same phenomenon is witnessed in dewdrops and in jets of water; in short, wherever solar light passes into drops of water under a certain angle. The appearance and the extent of the rainbow depend on the position of the observer and on the height of the sun above the horizon; hence only some of the rays refracted by the raindrops and reflected in their concavity to the eye of the spectator are adapted to produce the phenomenon. Those which



do so are called effective rays. To get a general idea of this let us refer to the figure, in which two raindrops a and c are represented extremely magnified as compared with the arc of which they formed part. The pencil of white light which falls upon a is refracted on entrance into the droplet and decomposed, giving rise to seven rays, red, orange, yellow, green, blue, indigo, and violet. At the point a, on the posterior face of this droplet, a portion of the refracted light escapes, and is dispersed in the atmosphere without giving rise to any particular phenomenon; the light which has not emerged from the droplet is collected at a, returns and emerges in being a second time refracted, and reaches the observer's eye as represented in the figure. A second droplet, *c*, placed below the preceding one, produces just the same effect, yet it does not send the same colour to the spectator. For as the different colours are unequally refrangible the coloured rays which emerge from the same raindrop diverge, and therefore are not propagated together, whence it follows that each drop sends only one kind of colour towards the observer. But from the degree of refrangibility of each ray the droplets on the outside of the arc send only red rays towards the eye and those on the inside violet rays. The other colours arise from intermediate droplets. In short, the rainbow is the circumference of the base of a cone, the apex of which is the observer's eye, and the surface of this cone is found from the outside to the inside of seven successive envelopes, red, orange, yellow, &c., corresponding to each of the bands of the spectrum. The nearer the sun is to the horizon the larger is the visible part of the rainbow; but as the sun rises the arc diminishes, and entirely disappears when the sun is 42 degrees above the horizon; hence the rainbow is never seen except morning and evening.—M. F. P.

[12578.]—**Medical Coil.**—"S. A. Z." is quite right when he connects the zinc of one cell to the silver—or what I presume to be the platinised silver—of the other cell; this would, of course, leave the terminals or poles as positive and negative ends. "S. A. Z." says, "The binding screw on the coil which connects the wire coming from the extreme silver is marked N, which I take for negative, &c." This is correct. N for negative, P for positive; but why "the wire coming from the silver" should apparently of necessity be connected with the binding screw marked N, as if there were no other alternative, I am at a loss to understand. Unfortunately, this is the first stumbling-block, and, consequently, is the cause of much confusion. The wire from the silver should be connected with the screw marked P, not N. "S. A. Z." continues to say, "Now what I want to know is if the electricity flows first from the zinc through the fluid to the copper, and from the copper to the zinc through the connecting wire above, how is it that the copper extreme is the negative?" Now, permit me to say that the copper extreme is the positive, and not negative; of course, I presume by "extremes" is meant the ends of plates not immersed. The platinised silver plate may be called a negative metal, but it, nevertheless, constitutes a positive pole, and the zinc may also be called a positive metal, yet it is a negative pole. Let me refer to the following diagram:



I think it will be evident from the above diagram that the current of electricity passes from the zinc in the fluid to the copper, and from the copper to the zinc out of the fluid, each plate assuming a positive and negative end; and here it is where a mistake is made of great importance, when it is assumed that a negative or positive plate would be the same throughout its entire length both in and out of the fluid; that, for instance, a negative plate in the fluid would also be negative out of it. It is important to recollect that such is not the case, but that each plate assumes polarity, and is, in fact, the reverse in the liquid to what it is outside of same: hence, a copper or platinised silver plate would be negative in the fluid and positive out. And, further, that "the electricity in the battery is given off into the coil," not from the zinc, but from the copper or positive pole, and this is the "extreme" which should be put into connection with the screw marked P. As to using a current of electricity from a coil for rheumatism, I would advise "S. A. Z." to put his feet, also the negative pole, into warm water, and apply the positive pole to the part affected under a strong power once a day for about twenty minutes; and, further, twice a day as opportunity offers to take the negative pole in his hand on that side which is affected, and apply the positive pole to the place where the pain exists, taking care to insulate the handle, and having within it a damp sponge. Having used electricity in many cases of rheumatism, neuralgia, debility, toothache, &c., I can testify as to its efficacy and value, if properly applied. Should "S. A. Z." require any further information, I shall be most happy to give it, so far as lies in my power.—E. O. SIMMONDS.

[12579.]—**Counting Envelopes.**—I should think a machine for counting envelopes would be almost a superfluity. If "Philanthropist" will take a packet of envelopes by the right hand bottom corner between the finger and thumb of the right hand, and hold them up, they will spread out like a fan, and count them with the two first fingers of the left, a little practice will enable him to keep pace with any machine yet invented.—A MAKER.

[12579.]—**Counting Envelopes.**—There is a machine at present in use—a babe from Yankeedom, I understand—for counting leather envelopes, *alias* boot-tops, which are cut like paper envelopes, on a block of wood upon which is made to descend a steam hammer with the cutting edges of hard steel set in suitable form on its lower face. There is one erected in a large shop in Newcastle-on-Tyne. A mechanic from the United States had to be brought over to set what we may call the counting apparatus in working order. I don't know the principle of this portion of the machine, as I have not seen it, but I suspect that the hammer or die, acting as a pendulum, touches a small cog-wheel, and at each blow passes a tooth in the wheel which sets in motion a train of wheels, one indicating by means of a clock-hand on a figured dial the number of envelopes cut. Soles are cut and the number indicated in the same way. An overseer is not necessary with this machine for looking after the workmen, as it shows at once whether they have idled by the number cut. An improvement is also in contemplation to indicate the time since starting, like an engine clock. A very light and simple modification of this machine would do for cutting and counting paper envelopes, as suggested by "Philanthropist."—RAT-TAT.

[12581.]—**Tests for Flour.**—The most reliable test for rice is the microscopic appearance of rice-starch, which is quite peculiar and characteristic. China clay, if present in the biscuits, would be left behind on ignition. Wheat flour never leaves more than 1 per cent. of ash, anything above this proportion may be regarded as mineral additions.—ALFRED H. ALLEN.

[12582.]—**Paper Clothes.**—The doorways of the galleries near the Indian Court in the International Exhibition are hung with paper curtains which have some resemblance to chintz. The fabric is the invention of Mr. Eugene Pretto, and is something like Japanese paper. In its manufacture various animal and vegetable substances are used, such, for instance, as buffalo skins, the intestines of animals, the fibres produced from the various nettles and grasses, barks of trees, and from flax, hemp, and cotton. These substances, mixed together in varying proportions, are treated much the same as the materials for paper are treated, that is to say, disintegrated, purified, bleached, rolled, pressed, and finally printed upon. The fabric produced differs, however, from ordinary paper in this, that it is not readily torn, is somewhat elastic, and soft enough to fall readily into graceful folds. The inventor claims for it, further, that it will resist the action of the weather and sun, and that damp does nothing more than make it more soft and yielding to the touch. The fabric at present has been principally applied to window curtains, roller-blinds, bed-curtains, and for the covering of walls, not so much in the way of ordinary paper-hangings, but more as chintzes or tapestries are used. The patterns are an imitation of the brocaded silks of Lyons, chintzes, and cretonnes. The inventor, however, has in view the production of a material that shall go much farther in superseding woven fabrics, in the shape of coverings for chairs, and even as carpets for floors. The colours are less liable to fade than in chintzes, as they are printed principally in body colours, and will keep clean the longer, as dust is not absorbed, but can be brushed off. The prices of the curtains vary from 5s. to 30s. per pair, complete; the material may also be bought in the piece. This application of paper is practically new so far as this country is concerned, though the Japanese have long ago found out that it could be applied to such purposes as what we call drapery is used for. Possibly this material may be utilised at no distant date in the direction intimated in "Kappa's" query.—TOPSY.

[12584.]—**Bee Keeping.**—"Phan" has not given sufficient information to enable one to give a sound opinion as to whether it is proper to put on new supers when the bees have killed their drones. A great deal depends on the size of hive and super already filled, for if they be of small sizes the chances of further surplus are very small indeed, but if the stock be large and powerful the bees may yet fill a small super if partly filled with empty comb, but will rarely take to a second one if empty. Killing the drones does not always imply that the honey season is over, but sometimes in strong stocks it is the reverse, for having nowhere else to store a glut of honey the bees turn out the drone brood and use those cells for the purpose, and having begun with the brood they finish with the destruction of the drones themselves. It is not to be wondered at that cottagers have prejudices in bee-keeping and prefer their own ignorant blindness to the blind leading of others. Let any one try "Rat-Tat's" advice to "W. T. L.," July 26, p. 494, "late in the evening, which is considered the best time," and after that say if the cottagers have not some ground for their prejudices. The cottagers' prejudice against supers is the best argument against their own system, for they practically acknowledge that the super system, or as it is called, the depriving system, leaves the stocks so strong that those saved from the brimstone pit are unable to hold their own. When a large super is removed from a strong stock of bees it must be evident that the stock hive becomes more crowded, consequently greater heat is engendered, and the bees are more robust than those left in hives which, as cottagers say, are not fit "to take," forgetting that what are not fit to take are not fit to leave. Cottagers should learn by experience, and adopt the system which gives the best results. Why, even "Pettigrew" advocates the super, although at the same time he defends the sulphur pit, and considers it no more cruel to suffocate bees for honey than to cut a sheep's throat for mutton, but if there were any other way of attaining the mutton that process, like bee-burning, would be most wanton cruelty. The cottagers' folly does not consist in charging deprived bees with robbing, for it is a fact that strong stocks will plunder their weaker neighbours without mercy, really carrying out the good old plan—"That they shall take who have the power, and they shall keep who can." It is undoubtedly a provision of nature that weak stocks should be absorbed by stronger ones, and in one's own apiary such unions are beneficial rather than otherwise, but when a cottager's bees are absorbed by another person's strong stocks the cottager ought to learn the lesson inculcated, and have strong stocks too. "The way to preserve peace is to be prepared for war," and if all are "fit" for aggression, all are prepared to resist it. The cottager's folly consists in destroying all his strong stocks, and so placing his apiary in jeopardy. My advice to all bee-keepers is—notwithstanding all that has been said about equalising stocks for winter—equalise if you can—*i.e.*, make all strong, but never weaken a stock to do so; better unite three or four than weaken one to aid another. This is, perhaps, gratuitous, but none the less valuable.—C. N. ABBOTT.

[12586.]—**Magnetine or Improved Skeuasma.**—There are three magnetic belts in the field—the skeuasma, patented by Messrs. P. W. Seymour and F. W. Darlow, in November, 1866; the amynterion, patented by Mr. P. W. Seymour, in January, 1872. In the form of the magnetic blocks it is superior to those of the skeuasma, being lighter and more flexible. Since then the magnetine has been published. The date of its patent I do not know. As to the principle of action of all these belts or appliances, I am quite in the dark. They profess to alleviate and cure by wearing magnetic iron on the body. The skeuasma is made by fusing magnetic iron filings with indiarubber; this, in small blocks, is placed at equal distances in a belt or other contrivance, inclosed within flannel on the one side and a kind of jean on the other. As these blocks are somewhat stout, I presume that in the improved skeuasma they are cut up into minute needle-like strips, so as to be more pliable, and then fastened over the whole inner surface of the belt or other appliance. I gather this from Mr. Darlow's advertisement. I may add, in conclusion, that whatever may be the principle that governs the magnetic appliances, I have fairly tried the amynterion according to the directions given me for over two months, carefully watching for symptoms daily, but felt no improvement whatever in my health, no tingling sensation, and no other difference except warmth such as an ordinary flannel belt would give. Yet the amynterion influences the needle of the pocket compass.—A WORKING B.

[12588.]—**Railway Metals.**—As the earth moves from west to east it would cause a train moving from north to south to swerve a little to the west side, which would throw a little more weight on the west rail, and more weight means more wear, the swerving would not occur in a train running east to west, or *vice versâ*, as it would then be moving in near the same direction as the earth.—STADACONA.

[12588.]—**Railway Metals.**—The earth's rotation is from west to east, and is more rapid at the equator than towards the poles, thus a train proceeding northwards has a tendency to wear the eastern rail, for in order that it may keep on the rails its velocity of rotation becomes gradually a little less, being always the same as that of the part of the earth it is passing over, but as it proceeded southwards the western rail would be more worn.—PHILANTHROPIST.

[12588.]—**Railway Metals.**—It has also been asserted that the wearing of river banks is for the same reason influenced according to their direction with regard to that in which the earth rotates.—M. PARIS.

[12589.]—**Lapidary's Wheel.**—About 10 or 12 inches diameter, from 400 to 1000 revolutions per minute. Runs horizontal.—JACK OF ALL TRADES.

[12590.]—**Glues.**—I should recommend "A Country Bookbinder," when he has melted his glue, to stir a tallow candle in it for about one minute. He will find that his glue will work better. When I was in the trade I have made hundreds of cloth cases with the glue thus served.—C. COLEBY.

[12592.]—**Silk Solvents.**—If "The Harmonious Blacksmith" wishes to find out how to dissolve silk, let him put one of his better half's old silk dresses into a basin of muriatic acid, when, if it be a pure silk dress, he will find that it has entirely disappeared. If he could manage to precipitate the silk from the above solution, and make it into threads, he could send it to the factory and get it woven, which would be a very good "spec." indeed. However, joking aside, I have found that a thick solution of silk makes a very good cement for glass plates, and when pure is entirely transparent. Perhaps some chemical correspondent can give a solution to the query of how to precipitate it.—OPALINE.

[12593.]—**Lightning and Thunder.**—Sheet lightning occurs without thunder in very warm weather. I have seen a portion of the sky beautifully lit up at intervals with sheet lightning on warm nights in Canada.—PHILANTHROPIST.

[12593.]—**Lightning and Thunder.**—As far as my reading enables me to answer I should say not. Summer lightning, as observed by "Seneca," is merely the reflection of a distant storm. Lightning without the thunder being heard may be noticed in the clouds about waterspouts.—M. PARIS.

[12593.]—**Lightning and Thunder.**—Lightning is seldom, if ever, accompanied by thunder at sea; the reason for this is that the surface of the sea does not present obstacles, like hills and other irregularities on land, to intercept the passage of the waves of air caused by the lightning.—R. D. D. M.

[12593.]—**Lightning and Thunder.**—Lightning never occurs without being accompanied by thunder. Sometimes, however, the reflection of lightning a long way off is seen, and then, of course, the thunder cannot be heard. When this summer lightning occurs, it is often followed some hours after by a real thunder-storm, as was the case at Weston-Super-Mare on the evening of July 25th, when summer lightning was observable, and at 2 a.m. on the 26th when a *bonâ fide* thunder-storm occurred.—E. Johnson.

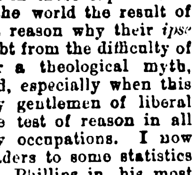
[12593.]—**Lightning and Thunder.**—We might safely pronounce, I think, a concession like any electric discharge, in air within four miles of the ground, to be impossible without noise. There is a good riddle. What is it that always starts with the train, goes and stops when the train does, is of not the slightest use to the train, but no train can go without it? By night we may plainly see either the light of lightning or the flashes themselves beyond 100 miles, and shall then suppose them unaccompanied with thunder; because I have never found, by counting seconds, that any thunder was audible quite 24 miles. One very still evening, by the coast, with a storm of lightning retiring out to sea, the last thunder I could hear was like a faint moan of not half a second duration, 119 seconds after its flash, which was a great and vivid one between cloud and sea, the wind being favourable. I doubt if thunder is ever heard much farther than this; especially as the shortness of the sound proved it to arrive from all parts of the flash almost simultaneously. Had one part been a mile nearer than another, so as to spread the sound's arrival over 5 seconds, it would certainly have been inaudible.—E. L. G.

[12593.]—**Lightning and Thunder.**—Professor Thomson, in his "Outlines of the Source of Heat and Electricity," after describing the nature and appearances of thunder and lightning, says that when no noise is heard, it is distance alone which prevents it; for there can be no lightning without thunder, any more than we can take a spark from an electric machine without a snapping noise.—Alastor.

[12594.]—**Varnish Cells.**—If "Alf." uses good copal varnish with his Brunswick black instead of gold size, I believe that he will get over his difficulty.—Jack of All Trades.

[12596.]—**Canoe.**—If "Paddler" values his life he will go by train with his canoe from Hull to Scarborough. It is just possible that the trip might be safely accomplished by sea provided you possess a thorough knowledge of the tides, and the weather is fine, and the water smooth. But how can you insure the latter conditions? The wind might rise, and the water roughen when you were rounding Sperm Point, or when you were passing Flambro' Head (where, by the way, you would find it impossible to land); and you would then speedily wish yourself on firm earth again. Begin by sailing about in the bay at Scarborough when the weather is fine. A canoe will ride safely on a good deal of swell provided the waves do not "break." Nothing materially smaller than the *Rob Roy* canoe is fit for the sea. Full dimensions are given in "1,000 Miles in the Rob Roy Canoe," both of craft and sails, &c.—W.

[12597.]—**Water-wheel Floats.**—Poncelet's undershot wheel is the best; the buckets are curved so that when the impulse of the water is expended it gives further power by running down the floats, and there is less shock in the meeting of the current with the wheel as the water runs up the float a little. I do not know the exact form of the curve; it is concave towards the stream.—Philanthropist.



[12598.]—**Age of Trees.**—The age of trees being now positively determined by the number of zones or rings in the fibre of the wood, it settles the question into one of veracity and honour in those explorers of botanical science who afford the world the result of their observations. The great reason why their *ipse dixit* is impugned arises no doubt from the difficulty of substituting a visible fact for a theological myth, which is greatly to be regretted, especially when this myth is steadily adhered to by gentlemen of liberal education, and who apply the test of reason in all matters concerning their daily occupations. I now beg to refer your intelligent readers to some statistics carefully compiled by Sir Rd. Phillips in his most useful work, "A Million of Facts," furnished to him by Mr. Don, Secretary Linnean Society: The baobab, of Senegal, 5,150 years; deciduous cypress, 6,000; yew, 3,000; olive, 2,500 years; dragon blood, 4,000. I have no doubt that the very gigantic trees of California will yield upon examination an antiquity far exceeding these above quoted. I should be grateful to any of your numerous correspondents if they could add other facts of extraordinary longevity of trees.—A Believer that One Fact is Worth a Million Myths.

[12598.]—**Age of Trees.**—Judging from the concentric rings supposed to indicate the annual growth, some of the gigantic Californian trees must have been growing when Father Abraham was a boy.—M. A. B.

[12599.]—**Dimensions of Mail Boats.**—The following are the principal dimensions of the Holyhead mail boats (they are all very much alike):—Length, 350ft.; breadth, 35ft.; depth, 20ft.; draught, I think, about 13ft.; tonnage, 2,000 tons; engines, diameter of cylinders, 90in.; stroke of ditto, 7ft.; nominal horse-power, 750; indicated horse-power, full speed, 4,300.—No. 170.

[12599.]—**Dimensions of Mail Boats.**—The dimensions of *Leinster* are—length, 360ft: breadth, 35ft.; mean draught, 12ft. 9in.; area of midship immersed section, 330 square feet; engines, 720 nominal horse-power; cylinders, 98in.; stroke, 6¼ft.; boilers, eight; with 40 furnaces; with 4,176 tubes; and 16,800 square feet of heating surface. The working pressure is 20lb. per square inch. The boilers are not fitted with superheating apparatus, nor are the engines fitted with an expansive gear, but steam is cut off by the slide valves at five-eighths of the stroke. The paddles are on the feathering principle, float boards 12ft. long. 5ft. deep.—J. B. Clay.

[12600.]—**Hydraulic Explosions.**—I have often met with explosions when preparing hydrogen by the action of sodium on water, but they have never been so violent as those described by "Dabbler," though sufficiently so to break the receiver. I never tried to fill a quart jar by the above method, but only prepared a few ounces of hydrogen. I have always attributed the explosion to a layer of sodic hydrate being formed round the metal and kept by the intense heat from contact with the water by an intermediate layer of steam (just like water on hot iron). On condensation of the steam, the water comes in contact with the hot metal and hydrate (or possibly oxide), producing suddenly a large quantity of steam and hydrogen, and thus causing an explosion. I do not feel sure, though, that the effect is not due to some impurity in the sodium used. I cannot see how oxygen could possibly be liberated in the presence of sodium, and "Dabbler" must remember that the heat required to decompose water is the same as is generated by its synthesis, so that no extra heat could in that way be evolved.—Alfred H. Allen.

[12601.]—**Tuning Æolian Harp.**—"Opaline" must tune the strings of his harp in unison to what note he wishes.—Horatio.

[12602.]—**Extinction of Fires.**—A gas for extinguishing a fire should be without smell, which neither chlorine, hydrochloric acid, nor sulphur dioxide are. Sulphuretted hydrogen is not a supporter of combustion, but is itself combustible. Carbonic acid satisfies the necessary conditions, and is used in the apparatus called the "Extincteur," which is very useful for small fires, being equivalent to so much soda-water.—Alfred H. Allen.

[12604.]—**Quill Pen-Making.**—Cut the point considerably longer than you intend to use it, then reduce it to a comparatively broad point previous to splitting. To make a good split, insert the point of your knife very gently in the broad point to start it, and then press your thumb-nail against it until you have led it sufficiently far up. This plan I have always found answers well. You can then reduce the size of the point in the ordinary manner.—Alastor.

[12604.] — **Quill Pen-Making.** — I am not an adept at making quill pens, but I have made them. The way I slit mine was this: I cut a piece of hard wood to fit the end of the quill as far as I wanted to cut, then I fixed it nice and handy to get at, then slit them with a sharp penknife, beginning at the broad part and finishing at the point.—Sting.

[12605.]—**Organ.**—If "E. J. D." purposes building an organ of four stops and one manual he can with safety begin his soundboard and bellows; they will take him some little time to make, and by the time he has them finished I shall have described, in "The Organ Built," the action he inquires about, as I intend to show a fan frame action to the great organ. The length of middle C in the clarabella is 2ft. on a scale of 1¾ × 1⅜. Why make a wooden dulciana? anything like a true tone cannot be obtained from it, for it would only be a soft clarabella without the singing tone it should have; if, however, you are inclined for it use the same scale as for the stopped diapason, making the pipes, of course, twice as long.—J. D.

[12606.]—**Submerged Forests.**—Though I know of no special work on this subject, "J. G. W. R." may like to know that he may see remains of submerged woods among other places on the coast of Sussex, between Eastbourne and Hastings. I lately visited one of these woods near Bexhill. It is extraordinary how little is known in the neighbourhood about such a natural curiosity. I found it by walking along the sands from Bexhill towards Pevensey at low water. A coastguardsman about 200 yards from the spot where the remains of the forest are knew nothing whatever about the matter. The old trees are to be found a few yards east of Martello Tower No. 52. There are few large roots and stumps left, though there are plenty of roots of bushes cropping out of the shingle. The largest stump I found was about 8in. in diameter, and about 6in. out of the sand. There is a description of the forest in the "Handbook for Eastbourne," by Mr. G. F. Chambers, F.R.A.S. (Stanford and Co., Charing-cross), with an extract from an article which appeared in the *Gentleman's Magazine* in 1814 on the subject. Since the time the article was written, however, the forest must have dwindled terribly in its proportions, probably at the hands of too inquisitive geologists. I believe there is another forest of the same nature nearer Hastings. I read in the *Morning Post* of the 6th instant, in the account of the opening of the new pier there, that submerged trees had been removed when the foundations of the pier were being laid, and that an oak had been placed by the pier authorities in S. Andrew's Gardens.—V. B.

[12606.]—**Submerged Forests.**—A great many submerged oak and other trees can be seen in the Bog of Allen in Ireland. Turf or peat is a good preservative, and the timber of the trees is as sound as before submerged. The wood is carved into bog-oak ornaments, &c., and from its hardness it can be exquisitely carved and polished. Forests of trees may be also found submerged on the west coast of Portugal, Japan, and Chili.—Rat-Tat.

[12608.]—**Bookbinder's Press.**—Substitute brass or steel male and female screws.—Rat-Tat.

[12609.] — **Packing Grapes.** — Pack between layers of their own leaves in willow baskets to preserve the bloom.—Rat-Tat.

[12609.]—**Packing Grapes.**—Pack in dry sawdust.—Excelsior.

[12609.]—**Packing Grapes.**—Let "A. B." pack his grapes in sawdust or bran, preferably bran, take the box, cover bottom with bran, then a layer of grapes, cover with bran, being very careful to fill up spaces between grapes, stalks, and everywhere; then repeat, leaving a good layer of bran on top, and nail down the lid. Do not press the grapes, but use them like little babies, very tenderly, and the bloom will stay on.—Sting.

[12611.]—**Moth in Pianoforte.**—Pack in case as air-tight as possible, and fill it with the vapour of ether, spirits of wine, tobacco smoke, fumes of sulphur, carbolic acid gas, or burnt camphor, with a blowing apparatus, and the moths will be destroyed.—Rat-Tat.

[12611.]—**Moth in Pianoforte.**—Touch the dampers with spirit of camphor.—Excelsior.

[12612.]—**Action of Oil on Waves.**—The only explanation of this which occurs to me is that oil being more viscous than water requires greater surface agitation before it is lashed into waves. To illustrate this, take a tumbler, and having about half filled it with water, rest it on a level table. A very slight blast from the mouth will cause wavelets to be formed on its surface Now add oil to the depth of 1 centimetre (⅜in.). Considerably greater force must be exerted to form similar waves on the surface of the oil. But it seems highly improbable that a similar action would take place in a storm such as Graham Young describes.—Alastor.

[12612.]—**Action of Oil on Waves.**—It prevents the ruffling by friction of the wind, but does not stop undulations propagated. You can throw a little into a breezy pond and see how the oil smooths the surface. I cannot think its effect would be very decided in a gale on shore.—M. Paris.

[12613.]—**Drying by Steam.**—If the rubber is vulcanised, anything short of a burning heat will not destroy it.—Rat-Tat.

[12614.]—**Corpulence.**—Fat, sugar, gum, starch, farinaceous food, milk, and the like, and articles of diet abounding in them, are favourable to the production of fat in the body of animals, man included. Mild ale, beer, and porter, for like reason, has the same tendency. Much exercise or labour acts in a contrary direction. Indeed, quiet and repose tend greatly to the production of both fat and flesh, but the latter is not then of a muscular character, as witnessed in feeding domestic animals. Leanness is generally caused by defective digestion or action of the stomach or bowels; often both. Cod-liver oil (the best now pale Newfoundland) has a wonderful power of increasing the weight and fleshiness of the body.—Arotes.

[12614.]—**Corpulence.**—There are some people on whom all the food they could eat would never put fat. I never saw a jolly, good-humoured, kind-hearted person, who took pleasure in making others happy, who was one of Pharaoh's lean kine, unless through disease. A selfish, uncharitable, cantankerous, nagging skinflint is always thin. Look at the late Mark Lemon and his prototype Falstaff. Compare (as the commentators say) with Pecksniff and Uriah Heep. Believe me, the proper sugar to make you fat is a sweet temper, and the milk that of human kindness. Any greasy or oily substance tends to be stored up in the system; but Wilkie Collins was wrong when he drew the silky villain Fosco as a fat man.—M. A. B.

[12614.]—**Corpulence.**—Diet is the thing for "Anti-Banting," but not inactivity. Bread and milk, cocoa, &c., for breakfast. Mutton chop, port wine and rice-milk pudding at lunch (or, if he dines late, then); bread, with Devonshire cream or thick butter at tea. Porridge may be substituted for bread and milk.—E. Johnson.

[12614.]—**Corpulence.**—"Anti-Banting" asks how a thin person may be made fat, and a fat one made lean. He little thinks, probably, how wide a subject his question opens out. We often hear people vaguely talking about getting fat and getting lean, or fattening or leaning upon this or that kind of food, but they don't know what they say. Even some of our learned (?) medicists and chemists talk about food as if a person had only to subsist upon starch, sugar, albumen, fat, &c., in different quantities, to become of the dimensions of the "Claimant," or a mere "rickle of bones," as Dr. Livingstone describes himself when Mr. Stanley found him. It is almost purely a question of *temperament*, and involves more a knowledge of this science than of dietetics or chemistry. A man's shape, form, squareness, roundness, tallness, shortness, fatness, or leanness are all dependent upon his temperament, as inherited from and impressed by his parentage and ancestry. They have little, *very little* to do with his food. To answer "Anti-Banting's" question, as regards his own case, no one could answer it truthfully unless he knew his temperament, and the different degrees in which he had the several temperaments blended in his own person. Along with this the shape of the brain has much to do with it, for certain types of brain do to a certain extent accompany certain types of temperament, or form and strength of body. The vital or lymphatic temperament is, under all circumstances, and with *any* kind of food, the most likely to become fat. Such temperaments like plenty of food, and that good, but as it exists amongst all ranks, so it gets all kinds of food, from that which an epicure might revel in to that of the poorest of the poor; both would be fat, though not, perhaps, equally so. These persons have a predominance of the vital powers, of the digestive apparatus, and their nerves are not too active, so as to become great waste producers. They are easy and content, hence get fat. A person with a pure, or even highly predominant nervous temperament, never gets fat. The most prominent and active part of his body is the nervous system; he is all alive; all nervous action; his mind is ever awake; he can't get fat, no matter what he eats, or how much. "Anti-Banting" may remember that the less motive, or bony and muscular, and nervous system there is, and the more lymphatic, the more favourable for getting fat. The less vital, and the nervous or mental high, the less likely to get fat. Cardinal Wiseman, Spurgeon, Macleod, Punshon, the "Claimant," Mark Lemon, and men of that class, have the vital temperament high, and the osseous and muscular systems less developed. In many cases the brain is large and active, yet at times lazy: such men do love their stomachs, and altogether have the natures for getting fat, and they make the best of them generally. Small, limber, clean, neatly made men, like J. S. Mill, Archbishop Manning, Mr. Gladstone, Professor Tyndall, C. Dickens, and others, have the mental or nervous temperament highest, hence their cleverness; such men are not usually thin through poverty, yet who ever sees them fat? it is not their nature, and their systems mould and modify their food, rather than their food moulding and controlling their systems. The inherent power and quality of food is much, but the inherent power of an organised animal over its food is more. Before a pig, an ox, or a horse, can become a prize for fatness, it must possess a certain blending of temperament, and this is given to it by the process of "breeding." Men like Lincoln, Wellington, Clyde, Shaftesbury, Disraeli, and others, are of another type: the bilious or motive; they don't get fat; they are too active, too industrious, both mentally and bodily; all their surplus nutrition is worked off. The lymphatic are the lazy, mentally and bodily, in different degrees, of course. The nervous are pre-eminently the active minded; the bilious the active minded and bodied; the last gives the most power of mind, as mind; the lymphatic or vital the least. In what degrees are the various temperaments possessed by "Anti-Banting"? This known, he has a greater chance of knowing his chances for fatness or leanness than all the writings ever penned upon dietetics or medicine can tell him.—GEORGE DAWSON, Sheffield.

[12618.]—**Excessive Perspiration.**—Constant ablution with sponge and cold water, especially where perspiration lodges or excoriations exist. Dry perfectly after, and dust part with prepared fuller's earth. It is put up for nursery use, and is a great boon to stout people in India.—M. A. B.

[12618.]—**Excessive Perspiration.**—In training for athletic sports, the usual mode of preventing perspiration is to leave off taking butter, potatoes, &c., and I see no other course for "A." to pursue.—R. D. D. M.

[12618.]—**Excessive Perspiration.**—Take a hot bath from 90° to 100°, and dress down either with cold dash, shower, or cold water and towel.—JACK OF ALL TRADES.

[12618.]—**Excessive Perspiration.**—Let "A." rest satisfied with his present condition and rejoice, rather than complain, that he perspires freely, or even excessively, in hot weather. Let me strongly advise him not to attempt in any way to interfere with the natural efforts of his system to compensate for the effects of immersion in an atmosphere of unusually high temperature. All he should do is to be temperate in eating and drinking, keep the bowels regular, avoid all debilitating habits, avoid the use of ices and cold drinks, and exposure to draughts of air, and indulge in daily ablutions or baths of warm or tepid water. Evaporation causes cold. Witness the effect of wrapping a wet cloth round a bottle of wine, or of the porous earthenware bottle on its contained water. The skin, moistened with perspiration, offers an immense surface for evaporation, and the consequent cooling action on the body is very considerable, and is, further, often the salvation of those who complain of it. I myself perspire excessively when I take brisk exercise in the sun, or even the shade, in hot weather, but I never feel oppressively or even unpleasantly hot, although the perspiration trickling down my face and head, and falling on my dress, often annoys me. The chief cause of the so-called "sunstroke" or summer apoplexy, is insufficient perspiration, and consequently an unnatural increase of the temperature of the body, particularly of the brain and heart, and the blood passing through them. When living under the almost vertical sun of the tropics I never felt oppressively hot, because I perspired very freely, whilst those around me who did not do so, bitterly complained that they "felt suffocated, nearly burnt up," and that their heads "felt bursting." Of the numbers of Europeans then around me who died of sunstroke, I found nearly all (most likely all) belonged to the latter class—viz., persons with dry skin, or skin scarcely moistened with perspiration. Of course the cold sweats of phthisis and other diseases of debility is another thing.—AROTES.

[12618.]—**Excessive Perspiration.**—Bathe in warm water, or apply an infusion of senna leaves.—RAT-TAT.

[12618.]—**Excessive Perspiration.**—Try 10 to 15 drops of diluted phosphoric acid in water twice a day I have used this with great benefit, and think it worth a trial.—OPALINE.

[12619.]—**Bad Water.**—Most probably the water "Inquirer" speaks of contains a trace of iron. Has not his pump an iron barrel or pipe. There may be iron in the strata the water of the well passes through; but this is very rarely the case. A mere trace of iron in his water would produce all the effects he speaks of. It is a common consequence where iron pumps or pipes are employed, and not much water drawn through them.—AROTES.

[12621.]—**Black Dye for Leather.**—Make a strong decoction of elder bark and dress with it. Treat afterwards with a strong decoction of nut-gall and a small portion of logwood, and lastly with acetate of iron.—JACK OF ALL TRADES.

[12621.]—**Black Dye for Leather.**—Nitrate of silver, or green copperas and common black ink.—RAT-TAT.

[12624.]—**Stuffing Reptiles.**—The skin of the boa constrictor must be damped to soften it, and then filled with tow. You can then, after neatly sewing up the aperture, place it in any position you choose. When quite dry the skin must be sized and varnished in the following manner. The best size is made of parchment cuttings, about a good handful boiled for an hour in a pint of water is about the proportion. The size is required in order to preserve the colour and beauty of his majesty. Apply with a dry brush three or four thin coats of size, allowing each to dry well before putting on another. When the last is dry coats of crystal varnish must be applied in like manner. This varnish may be purchased of an oilman or colourseller in any quantity. Fasten in the eyes with putty, and then your snake may be placed in a case, which should be decorated with mosses and reeds.—HORATIO.

[12625.]—**Heat Bumps.**—Take the child off flesh meat, allow it plenty of fresh sound vegetables, and sound ripe fruit. Bathe the spots with cold vinegar and water, and do not stuff the child with sweets and cakes.—JACK OF ALL TRADES.

[12625.]—**Heat Bumps.**—Give your child at bedtime 2½ grains of Dover's powder mixed in a little preserve. In the morning as much citrate of magnesia as will lie on a shilling in half a wine-glass of water. A hot bath for fifteen minutes at eleven, to be followed by warm beef-tea or mutton broth. In three days it will be well. No cold drinks or wine at present.—A. J. DAYMAN.

[12625.]—**Heat Bumps.**—Get 3oz. or 4oz. of concentrated fluid extract of sarsaparilla from a good wholesale chemist, give a teaspoonful two or three times a day in a wine-glass of water. This will also generally cure all forms of eruptions on children.—EXONIAN.

[12627.]—**Carbolic Acid as a Hair Dye.**—Carbolic acid is not a hair-dye, nor have I ever noticed that it has the slightest effect on the colour of the hair. Its use (highly diluted) as a hair-wash is now very popular. It acts by constringing and stimulating the skin, and thus tends to slightly thicken the scalp. Gradual attenuation of the scalp is one of the most common causes of failing hair and baldness. I have for many years used a wash of carbolic acid (1 part acid, dissolved in 40 parts hot water), but my hair is as silvery as ever.—AROTES.

[12628.]—**Rusty Iron Castings.**—Take 1 part sulphuric acid to 12 or 20 of water, and place your castings in this until the rust disappears; well wash and dry them; you can then treat them either to a coat of boiled oil or paint.—JACK OF ALL TRADES.

[12628.]—**Rusty Iron Castings.**—Acid is rather dear to use for such heavy work. It wouldn't pay to use it. Heat the castings, and file off the rust.—RAT-TAT.

[12629.]—**Skeleton Flowers.**—These are prepared by the old and simple, but tedious, process of "retting," the resulting skeletons being subsequently bleached and mounted, or set up. The art requires considerable patience, and some degree of taste and delicacy of touch in those who adopt it. These pretty objects can be purchased cheaper than an amateur can make them. My friend, the late Prof. Lindley, and myself, at one time devoted much attention to the subject, but we found that there was very little improvement to be made on the old methods of procedure.—AROTES.

[12629.]—**Skeleton Flowers.**—Flowers are very difficult to treat, being far more delicate in texture than leaves. They may be gathered and placed in a dry cellar for some time, then the petals or flowers are taken out and pressed between the leaves of a book prepared for the purpose. After that they are dipped in dilute hydrochloric acid, and the fibres are left behind. Leaves only require to be left in stagnant water till their substance is partly decomposed.—RAT-TAT.

[12629.]—**Skeleton Flowers.**—To obtain skeleton leaves, place the selected specimen in a plate just covered with water, and leave it in a place where it will not be disturbed until decomposition sets in, which generally takes place in about three weeks. Then carefully take the leaf out, and after placing it on a flat surface pour water on it from a watering-can, and if that does not wash away the green parts, dab the leaf gently with a clothes-brush, which will separate the particles which adhere more closely to the stem and veins.—C. N. W.

[12630.]—**Magnetism.**—If the machine is made to give shocks, like an induction coil, I see no reason why "D." should not work a vacuum tube with it. I have never heard of its being done, but I see no reason against it.—R. D. D. M.

[12631.]—**Fixing the Bloom of Scarlet Runners.**—I have some scarlet runners, and the bloom was falling off without the beans forming. I was advised to try liquid manure or sulphate of ammonia. I applied the latter in solution in water at the rate of half an ounce of the sulphate to one gallon of water. The beans have now set, and I am going to have an abundant crop.—G. W., Leeds.

[12631.]—**Fixing the Bloom of Scarlet Runners.**—I have likewise been disappointed by the falling off of the bloom of scarlet runners, and consulted the head gardener at a large garden close by, and he assured me it was caused by the heat, and that shading them would prevent it, or on the other hand if the weather became cloudy they would "set," which has actually taken place this week or ten days past, and the beans are setting and growing beautifully. My beans are planted under a high wall in a very hot situation.—OPTICAL BRICKLAYER.

[12631.]—**Fixing the Bloom of Scarlet Runners.**—If planted in drift that can be collected off the roadside, this never occurs. Draw a trench along both sides now, and put some in, or some old decayed hot bed, and well water. Cover up, and you may yet have a good sample. Nothing better for peas and beans or carrots than the drift off a turnpike road.—JACK OF ALL TRADES.

[12633.]—**Dried Yeast.**—Brewery or distillery yeast after proper purification and compressing will dry rapidly of itself. The dried yeast coming from Holland, at present, is in many cases too dry, owing to a good portion of farina or potato starch being mixed with it, partly to prevent its becoming soft on the voyage, and also a greed of extra profit. I am in possession of the entire process of manufacture of German dried yeast, and would have much pleasure in opening a correspondence with "H. W. T." if he will advertise his address.—GEO. A. DAVISON.

[12633.]—**Dried Yeast.**—If mixed with barley meal or pea meal very stiff and air dried, it can be kept any length of time if kept dry and cool.—JACK OF ALL TRADES.

[12633.]—**Dried Yeast.**—Let the yeast be kept in a dry cool place, and when pressed put it in bags at once. If at all moist sprinkle it over with a little rice flour, and it will keep firm and good.—EXONIAN.

[12633.]—**Dried Yeast.**—If "H. W. T." will wash his yeast twice in tepid (not warm) water, that has been previously boiled and cooled, before pressing it, I think he will find it will keep better. I have taken yeast, thus prepared, on several long voyages in hot climates, and found it good after six months. It should be kept as dry and cool, nevertheless, as circumstances will allow. The addition of chemicals always injures the quality of the yeast. The only thing I found that might safely be used was the addition of a little, a *very little*, common salt to the washing water. The best Dutch and German yeast is generally treated in this way. The admixture of dried pipe-clay, often adopted, injures the fermenting quality of the yeast, as well as that of the bread, &c., made with it, is unhealthy, and punishable by law.—AROTES.

[12635.]—**Transferring Pencil Drawings on Paper to other Paper.**—Take a piece of unglazed paper and treat it to one of these processes—1st, rub with a piece of cloth and lard, and after rubbing it well in smoke it over a candle or lamp; 2nd, rub the back of picture or one side of a sheet of unglazed paper with a solid block of black lead; by placing the prepared paper between the picture and paper, the prepared face upon that upon which you wish to make the transfer, and tracing the lines of the picture with an ivory style or nicely-rounded point of a steel knitting-needle, upon taking the paper off you will find a copy of it upon the paper required. This looks simple enough, but it requires great practice and care to get anything accurate and satisfactory.—JACK OF ALL TRADES.

[12635.]—**Transferring Pencil Drawing on Paper to other Paper.**—Any kind of reasonably fine paper, either thick or thin, serves to receive the copy. You simply lay it upon the drawing board, then upon the face of the drawing paper lay the transfer paper, and upon the top of the lot lay the drawing, pencil marks upwards, fasten the whole three sheets together, and to the board, by four drawing pins, one at each corner, then proceed to run over the pencil marks with a fine but dull pointed instrument. I have used for the purpose a stocking darning needle with a handle, and the point ground off, run over the marks in the same way as with a transparent slate. If the drawing is not too thick, and the carbon paper good, you may get a good copy with care and practice. I have seen copies taken by first perforating the picture with small holes along the marked lines with a needle, then afterwards laying it on the face of another sheet of paper, and rubbing it over with powdered black lead; the black lead goes through the holes and leaves a dotted outline beneath. A pencil is afterwards run over the marks, and a fair copy is produced, which can be quickly multiplied. I cannot promise instructions for taking copies of engravings as "T. H." asks for. I should be glad to hear of a method to do so. I know of none.—JOHN HOPKINS.

[12635.]—**Transferring Pencil Drawing on Paper to other Paper.**—The following, copied verbatim from an old book on "Philosophical Recreations," may, perhaps, contain some useful hints for "T. H.'s" purpose:—"A perfect copy of any print or other picture may be obtained by taking a sheet of the finest white paper, and wetting it over with clean linseed oil on one side completely. Wipe off the oil as clean as possible. Let it stand to dry a few days, otherwise it will spoil the picture: laying several sheets aside will be equally effectual to prevent this accident and render them more smoothly transparent. Lay a sheet of this prepared tracing paper on the picture to be copied, keeping it firmly down by means of weights on the corners and elsewhere; and then with a soft blacklead pencil copy over all the leading outlines of the figures, filling up the shades as may suit your fancy or be consistent with the subsequent genius to be evinced in this part of the affair. This being done, lay the tracing paper face downwards upon the paper, or other substance that is to receive the picture, when the pencil marks are to be transferred from the transparent tracing paper to this new substance. Pressure does this, and a pair of smooth boards in a common press will effect it, and is to be preferred when the copy is meant to be worked out in oil colours, for the greasy nature of the oiled paper may probably come off at the same time, a circumstance which then signifies very little. But for water colours or pencil copies, a stump made of a skewer, or a sharp pointed tracer, very smooth, is to be used, going over your former strokes of the outlines, &c., and you shall have the same very neatly and exactly copied." There is also a transferring fluid sold by a stationer in Chancery-lane. I bought a bottle; and although it brings off impressions of wood-cuts and printed matter, yet so faintly as hardly to be of any real practical service. The principal ingredient appears to be spirits of turpentine; but whether there is anything else mixed with it I cannot say; I merely go by the strong smell of turps it gives off. The directions are to saturate the picture, place it on a sheet of writing-paper, then place between the leaves of an old book and well beat with a mallet.—Hy. Taylor.

[12637.]—**Optics.**—Let x be the required distance. Then, if A be the angle the mark 8in. square subtends at 200 yards, $A = \dfrac{8 \text{ inches}}{200 \text{ yards}} = \dfrac{\frac{1}{4}\text{in.}}{x}$ nearly in circular measure. That is, $x \times 8\text{in.} = \frac{1}{4}\text{in.} \times 200$ yards. $x \times 32 = 200$. $x = \dfrac{200}{32} = 6\frac{1}{4}$ yards.

—Philanthropist.

[12637.]—**Optics.**—The apparent size of an object depends on the acuteness of the angle formed by two lines drawn from the eye to the two extremities. The angle included varies inversely with the distance of the object—that is, an object at a distance of 200 yards has its apparent height and breadth doubled at half the distance, and so on. A square having its sides 8in. is thirty-two times as high and broad as a square only ¼in. in the side. For the two to appear equal in size, the smaller must therefore be placed thirty-two times nearer than the larger. Therefore, $\dfrac{200}{32} = 6\frac{1}{4}$ yards for the distance; the ¼in. square must be placed to appear of the same size as a mark 8in. square, at the distance of 200 yards.—Alfred H. Allen.

[12637.]—**Optics.**—A simple rule of three sum. As 8in. is to 7200in. (or 200 yards), so is ¼in. to the answer required. Answer, 6¼ yards.—Quercus.

[12638.]—**Fleas in Dogs.**—Quite harmless at the proposed dilution.—Opaline.

[12639.]—**Worms in Pony.**—Get some smoking tobacco, and dry it before the fire, rub finely into dust; a teaspoonful given with the first feed in the morning will have the desired effect.—N. O.

[12639.]—**Worms in Pony.**—Give 60gr. of calomel at night, and 6oz. of castor-oil in warm gruel in the morning; you can mix the calomel with his food, giving a dose once or twice a week; don't give him much work to do when under treatment.—Opaline.

[12639.]—**Worms in Pony.**—Take green broom and male fern green, and chop small; give him a handful to eat occasionally with his food, first thing in the morning best.—Jack of All Trades.

[12640.]—**Ice.**—I believe that the cheapest freezing powders are made of two parts of common soda, and one part sal-ammoniac. The cost for freezing a gallon of water I cannot say.—Jack of All Trades.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Philanthropist" has answered, 12191; "Quercus," 12291.

12359 Sulphurous Smell after Thunderstorms, p. 443
12364 Hoist, 443
12370 Liquid Rosin, 444
12383 Electrical, p. 444
12394 Fret-saw, 444
12402 Grease on Leather Bands, 444
12403 Brass Moulding, 444
12405 Boiler for Model Steamboat, 444
12410 Chemical, 444
12411. Expansion Joints, 444
12418 Harmonium. To "Pneumatic Lever," 444
12418 Resistance of Steel Plate to Air Pressure, 445
12422 Steam Power, 444
12425 Belgian Glass Trade, 445
12426 Piano, 445

QUERIES.

[12702.]—**Photographic Enlargements.**—Will some correspondent kindly give us details of the best method of making enlargements by development?—G. N.

[12703.]—**Fuchsias.**—I should be glad to learn the reason and the remedy, if any, for the buds and blossoms of fuchsias bought at greenhouses or from the street barrows, falling off soon after they appear. I have tried a good and a scanty supply of water, indoors and out, but with the same result. I have one which has shown twenty or thirty buds the last fortnight, and now every one has dropped.—Fuchsia.

[12704.]—**Maple Veneers.**—Having a lot of sawn maple veneers in which the saw marks are very deep, I wish to know the easiest way to work them up into picture frames. Also, if there is any way of making them pliable. Any suggestion will be received by—Old Hatter.

[12705.]—**Extracting Vegetable Colouring Matter.**—Can some one inform me how to extract colouring matters from leaves or roots of plants, *e.g.*, the yellow dye in roots of *Angelica sylvestris*?—P. R. C. P.

[12706.]—**Laboratory Purification.**—An amateur chemist experiences a difficulty in removing from his laboratory unpleasant gases and smells. Passing a current of air through the room only serves to impregnate the whole house with the obnoxious vapours. Will some one kindly inform him of the usual and best methods of removing them?—Alastor.

[12707.]—**Geometrical Query.**—The following question was proposed in a recent honours' paper of the Government examinations in plane and solid geometry, and to which I should be glad to obtain the answer:—"What must be the position of a circle in regard to the picture plane in order that its perspective projection may be a parabola?" And further, I wish to know, what is the projection of a circle, oblique to the picture plane? It is certainly not an ellipse.—W. E. C.

[12708.]—**Liquid Resin for Violin.**—Will some one give an opinion on the liquid resin or colophony said to be superior to the ordinary resin?—Corelli.

[12709.]—**Soundboard Varnish.**—Will "The Harmonious Blacksmith" or any of "our" readers inform me how to make a varnish for pianoforte soundboards, &c.?—Yorkshire Amateur.

[12710.]—**Ginger Beer.**—In making aërated ginger-beer I use the essence or tincture of ginger extracted from the root by spirit, but as this makes the water quite milky and spoils the sale, I shall be glad to know if I can make a suitable essence in any other way. I have seen a dark red stuff called gingerine, prepared, I believe, from the green root. Would this do, and if so, how prepared? The aërated ginger beer sold in London is quite clear and has a cream on it, but I am at a loss to know what is used in the preparation. Any information how to get rid of the cloudy appearance will oblige.—Sodawater.

[12711.]—**Height of Mountain.**—Can any one inform me how to calculate the height of a mountain whose base is inaccessible, and the distance therefrom unknown?—Quercus.

[12712.]—**Linseed Oil.**—Can any reader tell me what can be best used to keep tin clean and bright where linseed oil is used about it? It sticks very fast to the tin, and in cleaning brings the tinning off with it.—J. G.

[12713.]—**Thermometer in the Shade.**—Thanks for inserting queries 12373, 12374, and 12375, p. 444; a slight correction is required in the first and second. For "a deep well" read "dip well," and in the second query, "with a diameter of 14ft. 4in.," should be diameter of 14in. Will some of your obliging correspondents assist me with their opinion to decide the term of shady place wherein to hang a thermometer? The definition has a wide range. In my opinion, inside a garden summer-house the readings would be higher than in the hall of a brick or stone built house, while both positions would be in the shade.—Gillem, Ontario.

[12714.]—**Echo of Sound on Water.**—A curious phenomenon was produced here on the 1st July, during the festivities to celebrate the anniversary of Dominion Day. Barrie is built at the end of Kempenfeldt Bay, an arm of Lake Simcoe, five miles long; on the above day a salute was fired from guns in Barrie, causing a momentary sound which died away, but revived again after a lapse of five or six seconds, then re-echoed as distant thunder away over the waters of Lake Simcoe; no sound whatever being heard during the interval of five seconds. How is this to be accounted for? Was the sound conveyed by air or water; if the latter, why was it not heard in the interval?—Gillem, Ontario.

[12715.]—**Ladies' Fans.**—Will some reader oblige the ladies with instructions how to make those pretty paper fans, which have little or no decoration about them, but are yet so elegant and attractive at fancy fairs?—Ada.

[12716.]—**Electrical Clocks.**—Some time back Dr. Grabham and Mr. Fox gave particulars of their electric clocks. Will either of these gentlemen kindly say what is the usual going or losing rate of one of these clocks?—No. 170.

[12717.]—**Watch Drills.**—Will any correspondent be so good as to inform me how to make watch drills small enough for pivots and hard enough for steel?—Daniel B.

[12718.]—**Potato Stains.**—Can any of your readers kindly inform me of anything that will take out the stain from the fingers caused by peeling or rasping potatoes? It seems to be a powerful acid in the skins that does so.—Anti-Acid.

[12719.]—**Medical Coil.**—I have two pint and one quart Daniell cells. Will either or all of these do for use with a coil for rheumatism, &c., or will it be preferable to abandon them, and get a quart bichromate cell for this purpose? If unsuitable for a coil, how will the above Daniell cells do to work a clock instead of Leclanché cells?—No. 170.

[12720.]—**Medical Coil.**—I shall be obliged to some of our electrical or medical correspondents if they will kindly inform me in what cases the usual interrupted current of a coil is most suitable, and in what cases a steady continuous current is to be preferred. I suppose the continuous current will be obtained by setting up the screw of the contact-breaker and not allowing the contact to be broken. If not, what will be the best way to use the coil with this current?—No. 170.

[12721.]—**Hydraulic Machine for Blowing an Organ.**—Can any one give me a description of a hydraulic machine for blowing an organ, and explain the principle on which it works? Is it on the same principle as a steam-engine, the motive power being a column of water, and what is the cost of one for a small organ?—W. B.

[12722.]—**Coal Getting.**—Having seen a little now and again relative to coal and coal getting, will some of our subscribers be kind enough to tell me the best system of getting it at the present time by machinery? I have seen a sketch of a sawing-machine, with boring-bar and cutters, working, with crank and two cylinders, by compressed air, the said bar radiating while revolving, and taking a sweeping cut. This is called Davis's, I believe. Another one was a Mattock fixed at the shaft end by a joint, and worked mid-way up the shaft by cylinder, &c., after the style of a man hewing it. These were in use some years ago; what have we now?—Inquisitive.

[12723.]—**Compressed Air.**—Having seen in the English Mechanic that compressed air is used for driving coal-getting machinery and rock-boring machinery for quarrying and tunnelling, what is the best method for getting this compressed air for the purpose?—Inquisitive.

[12724.]—**Tobacco Culture.**—Wanted to know all about the cultivation of tobacco and manufacture of cigars, Cuban principle preferred, by an old sailor, who, by wear and tear of a sailor's life, was compelled to settle on this island two years ago, and having been considerably benefited by this fine climate and God's blessing, is now desirous of earning an honest penny in the above line.—Will Watch, Jamaica.

[12725.]—**Fused Chloride of Silver.**—Can any of "our" able readers kindly inform me as to the method of making the above, to be used in conjunction with zinc plates for "Gaiffes'" battery? I have precipitated the chloride from the nitrate, in the usual manner, but have signally failed in the operation of fusing it. My fused cake presents the appearance of a gray, hard, and gritty substance; that supplied with the battery is of a brown and somewhat soft and transparent form. I should feel greatly obliged if some one can kindly show me where my error lies.—Argentum.

[12726.]—**Motion of a Sailing Boat.**—Would any of "our" correspondents kindly explain the following: When a boat is sailing as near "the wind's eye" as possible, the force (the wind) which is causing it to move is being applied in nearly an opposite direction to that in which the boat is sailing. Why, then, does the boat sail as it does—why not in an opposite direction? Also, when any thin, flat body (a slate, for example) is placed evenly on the surface of water, and allowed to sink, it does so in a zig-zag manner, and not straight down, though the attraction of gravity and (apparently) the resistance of the fluid are equal at all parts of its surface.—Tub.

[12727.]—**Circulating Library.**—Is there in London a circulating library for scientific and technical works?—Faber.

[12728.]—**Wave Pattern.**—I should be much obliged by an explanation of the wave form for ships.—Faber.

[12729.]—**Breech-Loaders.**—Would some fellow reader, who is well "up" in arms, give us some drawings similar to those of the "Berdan" in No. 326 of the more celebrated breech-loading systems now in use, both for heavy guns and small arms? I should more particularly like to see the Westley-Richards and the Prussian system for heavy guns.—Faber.

[12730.]—**Weir's Sewing Machine.**—I should feel obliged to "Jack of All Trades" if he would explain the way to set a Weir sewing machine. We have one of these machines (which, according to the advertisement, cannot get out of order), which will work pretty well for a few stitches, then either cut the cotton or drop stitches.—H. E.

[12731.]—**Hand Pad.**—Would some fellow reader be kind enough to explain the manner in which hand pads or tool handles are made for holding tools with tangs of the customary form, as I wish to make a set of tools to fit into the same handle?—H. E.

[12732.]—**Glass Paper.**—Can any practical maker give me any information as to the material used to fasten on the glass to paper for the use of cabinet makers, &c.; how it is applied; and also the cost of a machine for grinding the glass for the purpose? An answer will greatly oblige.—Stadacona.

[12733.]—**Measuring a Cob Thatching.**—Will some reader kindly inform me where are the proper places to take the measures for measuring the thatching of a round stack commonly called a cob?—W. Bull.

[12734.]—**Cement for Greasy Strapping.**—I have heard of a cement for the above which adheres quick and is ready for use in a few minutes without the aid of stitching. Would some kind reader give me the recipe?—T. T. M.

[12735.]—**Barometer and Clock Rate.**—I saw somewhere a notice of the new clock at Greenwich, in which it was stated that the influence of varying pressure on the rate could be easily allowed for. Can "F.R.A.S.," or some one connected with the National Observatory, supply the scale by which this correction is applied?—Rho.

[12736.]—**Cement on Postage Stamps.**—What is it?—Rho.

[12737.]—**Size of Globe and Speed Rate of Rotation.**—Will some of your readers be so kind as to set me right (if I am wrong) in the following? One revolution of globe in 24 hours gives 8 hours diameter; to give 8 hours diameter must travel 1,000 miles an hour, 24,000 miles in 24 hours. It makes 365 revolutions to form four seasons—spring, summer, autumn, winter—one year. It follows that the globe travels 8,7— miles a year. Circumference of globe, 24,000 miles; diameter, 8,000 miles; speed rate of rotation, 1,0— —

an hour. Circular course of globe 365 times larger than itself, being one revolution in 24 hours, gives distance 8,760,000 miles to make four seasons.—BALCAIRN.

[12738.]—**Graphite Cells.**—To GEO. FOX.—Will this correspondent tell us if his graphite cells answered his expectations of a year since?—H. H. G.

[12739.]—**Geometrical Theorem.**—Point (1) is the intersection of A D and F C in Problem XLVII. of Euclid, Book 1; point (2) the intersection of F C, B K, A L; point (3) the intersection of A E, B K; point (A) is the 4th point. Show that a circle may be described through the 4 points (A), (1), (2), (3).—THETAMU, Horsham.

[12740.]—**Lever Escapement.**—I have a rack lever and wish to detach it. It has a small escape-wheel. Would it be better to put a new escapement to it, or merely put a new fork and roller? Would any brother be kind enough to give me proper depths?—NO SOFT SOLDER.

[12741.]—**Leather Machine.**—I experience great difficulty in getting leather of one uniform thickness for covering pianoforte levers, &c. Can any of our readers give me a design or suggestion how to make a small machine for the purpose?—PIANOFORTE REPAIRER.

[12742.]—**Portsmouth Harbour Steam Bridge.**—Can any reader give me a description of the steam bridge that runs across Portsmouth Harbour?—CONSTANT SUBSCRIBER.

[12743.]—**Essence of Wood Smoke.**—Would any of my fellow readers furnish me with the recipe for making essence of wood smoke, such as is used in curing bacon, hams, &c., instead of the usual unsatisfactory way of sending them to the carpenters, &c., to be hung in their chimneys? An answer to the above through the medium of the ENGLISH MECHANIC would greatly oblige—AN ANXIOUS ONE.

[12744.]—**Martini Rifle.**—Would "Artillery Captain," or some one acquainted with the working of the Martini or Westley Richards, explain the action of the extractor, and the manner in which it pitches out the empty cartridge case? Also state whether it especially requires the bottle-neck cartridge, or could it be used with the ordinary Boxer cartridge, similar to that used in the Snider?—A. L.

[12745.]—**Hen Keeping.**—Will much feeding with dry Indian corn have any bad effect upon hens? Will it cause them to lose the use of their legs?—H. K.

[12746.]—**Screws for Woodwork.**—Will some one give me a description of the best way now in use of cutting screws for wood, metal screws, but for wood work? and the best means of making the cutters for the same?—WILLING TO LEARN.

[12747.]—**Roasting Jacks.**—Can any one give me full details how to make and fit in the spring same as in meat jacks, so as to work easily but with the greatest strength? Also if there are any other means used than the spring for the working of jacks?—WILLING TO LEARN.

[12748.]—**Transparent Cement.**—Can any one tell me of the best compound or chemical to be used as a liquid first, and afterwards to set as a hard substance; but after setting to have the appearance of water?—WILLING TO LEARN.

[12749.]—**Punching Holes in Sheet Brass.**—I wish to punch out some small circular pieces of sheet brass by hand. Which will be the best means of doing it so as to leave the pieces as clean on the edges as I can?—WILLING TO LEARN.

[12750.]—**Steam Yacht.**—I possess the only attempt at a steam yacht in the port of Melbourne. She is 28ft. long by 6ft. 4in. beam, propelled by a one-horse inverted cylinder engine (screw) bore 4in., stroke, 4½in.; propeller, 18in. diameter; 18in. pitch; pressure, 85lb.; speed, 5 knots. Boat and engine both my own (amateur) build. The boiler is of copper, and is made by a tradesman—it is 3ft. high, with rounded dome, and 2ft. diameter, vertical flue, outside of copper, 5lb. to square foot. Firebox of 6lb., crossed by two Galloway tubes. I should like to hear some comments from some of my home brothers, especially as to the pressure I may carry with safety. Would 50lb. or 60lb. be safe, and if so, what pressure of cold water would be a sufficient test?—FIRE-FLY.

[12751.]—**Improved Æolian Harp.**—Will Mr. E. B. Fennessy be good enough to answer the following queries?—What thickness is the sounding-board? What is the inside height of box above the strings? What is the distance between strings? Does one bridge at each end carry all strings, or has each string two separate bridges? Are they ordinary small fiddle-strings?—A. T. HASWELL.

[12752.]—**Nervous Excitement.**—"T. L. V." in his article on "Constipation," in last week's number, alluded to "a remedy which has the power of allaying nervous excitement and strengthening the great nervous centres." Could the writer of the article just mentioned, or any of your readers, give a professional gentleman a definite idea of the means to overcome this terrible detractor of his efforts in public as an instrumentalist?—TREMOLO.

[12753.]—**The Moon.**—I have been much puzzled to ascertain the laws regulating the moon's motions in declination, and with your permission will see if any of your astronomical readers can assist me. I have searched at least half-a-dozen books on astronomy, but fail to get from any of them an adequate explanation. If I take a *Nautical Almanac* for one year I find the declination is, say 18° north and south; if another, 25° north and south, what is the cause of this variation, and does it occur in a cycle coming to the same number of degrees north and south in a certain number of years? Is there any cycle in which the moon returns to the same position in the heavens with regard to the earth on the same day in the same month, and being also at the same time in apogee or perigee, or at the same distance. I should very much like to know whether there is any period in which the cycles of the moon's motions and positions will return to precisely the same place on the same day after a certain number of years, so that there is an exact repetition of these positions with the apogee and perigee of the moon and her positions in declination. I do not know whether I have made my meaning sufficiently plain, but perhaps some of your readers will understand my difficulty. The motions of the moon are doubtless very easy to understand to those who know all about it, but to the tyro in astronomy they are very puzzling, and the way that the so-called "popular" books set about to explain or half explain the subject, only makes what is already a confusing subject "worse confounded."—W. L. BROWN.

[12754.]—**Cheap Firewood.**—We shall feel obliged if any of your numerous readers would give us information about a cheap firewood made inflammable by the addition of rosin. We have saw mills in a very poor neighbourhood, and now that coal is twice the price it was last year, we fear the coming winter will be a very trying one. Every year coal tickets are distributed, but what is very much wanted is a firewood that would enable a poor person to boil a kettle without keeping up a fire all day. Any hints as to the mode of making such will much oblige.—OLDEN AND GIBBS.

[12755.]—**To "Jack of All Trades."**—Will "Jack of All Trades" please look at q. 11964, p. 312, and tell me why the curd soap acts quite the contrary to what he said?—J. B. SHARPLEY.

CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The great Earl of Chatham, upon being complimented on one of his finest strokes in politics, is reported to have said that "he deserved little praise, for his success arose only from having been checkmated by discovery, the day before, at chess. And in his speech in the House of Lords, on the 20th January, 1775, relative to the affairs of America, he said, "The hour of danger must arrive in all its horrors, and then these boastful ministers, spite of all their confidence, and all their manœuvres, shall be forced to hide their heads. They shall be forced to a disgraceful abandonment of their present measures and principles; principles which they avow, but cannot defend; measures which they presume to attempt, but cannot hope to effectuate. They cannot, my Lords, they cannot stir a step; they have not a move left; they are checkmated."—From "Game of Chess," by P. PRATT, published 1817.

ENIGMA I.—BY F. HEALEY.

White.

K on Q 2; Q on K Kt 2; B on Q B 7; Kt on Q 4; P on Q B 3.

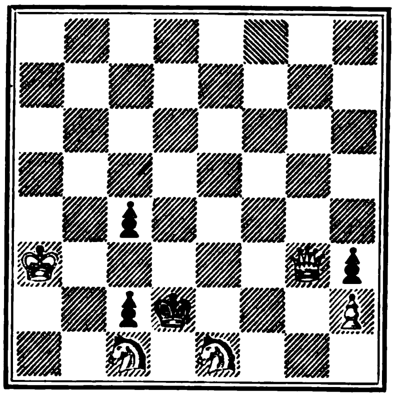
Black.

K on Q B 5; Kt on Q B 4; B on Q R 2; P on K B 2.

White to play and mate in two moves.

PROBLEM XII.—BY C. W. (Sunbury).

Black.



White.

White to play and mate in two moves.

SOLUTION TO PROBLEM X.

White.	*Black.*
1. R to Q 8.	1. Anything.
2. Kt or Q mates, acc.	

J. L. B. (Liverpool).—You cannot castle when your King is in check, and checking your adversary's King does not interfere with his privilege of castling. In reply to your other questions, we advise you to get Lowenthal's or Staunton's works, either of which will afford you ample course of study.

W. NASH.—The idea is somewhat similar, but the positions are not identical. Scores of problems admit of the same coincidence. For instance, how many times has the Indian Problem been served up, and by some of the best composers, too?

F. C. COLLINS.—The problem appears to be perfectly correct and very good.

A. W. COOPER.—The last two problems are neatly constructed, but rather easy; they are, however, marked for insertion.

M. L. MARKS (Swansea).—Wrong in both instances.

G. J. SLATER (Bolton).—Your problem (No. 27) admits of a solution in three moves—

(1) $\frac{\text{Kt to Kt 7}}{\text{K moves}}$ (2) $\frac{\text{Kt to Q 8}}{\text{K moves}}$ (3) Kt to B 6, mate.

The other is correct and good, and it shall shortly appear.

CORRECT solutions to Problem X. have been received from S. M. Barker (Kensington); A. R. Moll son (Swansea); G. C. Heywood (Great Torrington); E. T. Grays; R. L. Conderford; J. E. Lines; R. J. Pearce; James Harrison; W. Nash (S. Neot's); Aleph (Bedford); Argo (Yarmouth); A. W. Cooper; H. Cherry; W. Airey (Worsley); F. C. Collins; A. G. (Islington). All others are wrong.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

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H. S.	0	2	0
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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Tuesday morning, August 20, and unacknowledged elsewhere:—

G. C. Price.—Wm. Fryer.—J. Gadsby.—P. W. Spencer.—Bernard Davis.—W. H. Collins.—J. W. Stuchberg.—Wonder.—E. L. Daniel.—E. J. Rowley.—W. Davenport.—R. G.—F. R. Leyden.—G. Burland.—James Dine.—J. W. Willis.—John Finch.—Rimington Wilson.—Frederick Carre.—J. M. Rimington.—J. W. B.—Clotilde.—Rev. F. Salmon.—R. A. Proctor.—Tub.—Zealous.—J. R., jun.—West Cornwall.—Glasgow Artisan.—J. B. Q.—E. H.—Joe.—Kendal Saddler.—Outgenious Whitesmith.—C. M. M. B.—C. Gaudibert.—A Librarian.—E. Ward Jackson.—E. J. W.—Rev. J. M. Taylor.—R. Terret.—John Hopkins.—Tapper.—R. S.—W. D. T.—An Old Blue.—Alfred S.—W. H. H. C.—Camera.—R. C. T.—E. W. Pullen.—Harry Macpherson.—South Devon.—P. France.—Thos. Hackett.—A Country Smith.—J. Wareham.—H. J. W.—J. F. E.—J. D.—J. K. P.—Dr. Carpenter.—Cervus.—E. W. Burnham.—J. D. H.—Old Chips.—R. L. F.—R. J. B.—Optical Bricklayer.—Hants Farmer.—Athol Jack.—J. S. M.—Loach.—An Athlete.—Apiarian.—M. A.—W. M. Colles.—Linea.—S. Selwyn.—Zeta.—Alfred Thos. Jenkins.—Philo.—M. Paris.—Nitrogen.—W. Welden.—D. A. Adams.—Hugh.—A Constant Reader.—Balcairn.—Herbert.—F. Stewart.—A. J. Jarman.—Etna.—Analyst.—Stump.—One of the Edinburgh Branch.—T. Tebeck.—Spirit.—S. K. S. T.—Practical Grainer.—C. Bethell.—John Watson.—Jannifred.—R. L. S.—A., Liverpool.—Photo. Bristoliensis.—Vircas.—Levatt.—Mutual Tom.—M. P.—A. B. C.—C. B. Shaw.—Chester.—An English Mechanic.—A. Jote.—Proved.—Senecio.—John Hunt.—W. Bright.—P. L. Simmonds.—Bobo.—The Harmonious Blacksmith.—Hyrab Sen.—California.—Emigrant.—M. A. B.—A Poor Irishman.—F.W.—Clinchey.—G. E. L. S.—S. Bottone.—H. H.—H. B. E.—Science and Art.—Sigma.—Centrifugal Force.—Boctus.—Nemo.—Q. Yorke.—Associate.—V. Cambridge.—J. Snellgrove.—Fulcrum.—James Tresize.—E. R. Johns.—James Bellows.—Ramsgate Subscriber.—G. H. G.—C. H. W. Biggs.—Comus.—Jasper.—E. M. J.—R. Cuthbert.—Thos. R. B. Blindley.—Wm. Wray.—W. H. M.—Hy. Northcote.—Doubtful.—C. Lucern.—Mechanic.—Canny Scott.—A. G. Boyd.—Fred. Walton.—M. & S. Mason.—John.—W. H. F.—Philanthropist.—Salvator.—E. J. Wilson.—E. L. G.

A. B. W.—Quite impracticable, so far as we are concerned.

H. B.—Yes. Consult a solicitor.

YANKEE.—Put your question more plainly. What plates do you mean?

OUTGENIOUS WHITESMITH.—Could not say without seeing the drawings. The furnace sent this week is in principle too much a repetition of the other to be worth inserting. Kindly take a *little* more care with your sketches. The last inaccuracy was due to your indistinct drawing.

A STUDENT.—See review of Mr. Collins's book on "Perspective," on p. 527.

DESIGNER.—L. Gwilt's "Encyclopædia." 2. See back vols.

ONE THAT TRIES.—Cannot appear as a query.

H. WASHINGTON.—Write Bennett Woodcroft, Government Patent Office, Southampton Buildings, London. Your local bookseller should change his agent; there is great neglect somewhere.

H. R.—We cannot be everybody's lawyer. We should expect, if we complied with your wish, requests from subscribers to draw up their wills for them, which we could only do on condition of being allowed to insert a handsome legacy to ourselves.

SUBSCRIBER (Bristol), A. L. (Hindley), and J. Pugh, are referred to back vols.

INQUIRER.—For information on mushroom culture see letter 65, p. 400, Vol. XI.

TIM.—For description of instruments for describing ellipses see pp. 502, 548, 595, and 618, Vol. XI.

INQUIRER (Hartlepool).—Ask at any chemist's.

JAMES HURTE.—For information on ferns see reply 2417, p. 93, Vol. XI.; also indices to other back vols.

RITUALIST.—The incense used in the services of the Church is benzoin. You cannot "make" it.

APPRENTICE TURNER.—Write Lockwood and Co. or Longmans for a catalogue.

J. W. DURRAD.—Thanks for your sketches. Mr. Proctor has, however, in a contribution which appeared in our last, treated on the subject, giving illustrations of spots of a later date.

TOM-TIT.—If you will define what you mean by "point of time" in contradistinction to the time indicated by the hands of the clock, we will endeavour to answer your very hazy question.

G. W. LEEDS.—Directions for making picric acid are given in replies 4504, pp. 578 and 596, Vol. XI.

C NATURAL.—Ask a plain question embodying what you want to know about the dulcimer.

DANIEL B.—For information on six and twelve lens opera glasses see reply 4999, p. 91, Vol. XII.

D. P. L.—For information on the construction of the metronome see p. 161. Vol. XI.

John Rae (Sydney).—Vol. XI. is out of print. We have sent you for your friend Vols. XII., XIII. and XIV., and three blank cases. The cost of these, deducted from the sum remitted leaves enough to pay Mr T.'s subscription up to April 11, 1873. Vols. and cases sent to firm named in your letter on Aug. 15.

Careful, Bertha, David Long, and G. S. are referred to indices to back vols.

C. H. W. Biggs thinks that "a mathematical column would be an estimable boon to many." He says, "I am supposing that such a column should not degenerate into mere puzzle pages and catch questions, but that the questions and solutions should be valuable to the many, not the few." "If no better one, like to Mr. Proctor or 'E. L. G.' would undertake the responsibility, I offer my services. I know I cannot compete with these gentlemen, yet I think I know what would be valuable to the student, both theoretical and practical."

Hyrab Sen.—The reason mentioned was not the only one that stood in the way of the insertion of your letter. A love of truth, for its own sake, independent of personal considerations of any kind, should be the primary and prevailing consideration in scientific controversy. We cannot comply with your request as you do not give your address.

Johan.—You were referred, as you are now, to indices of back volumes.

Guinevere, J. Wallis, Ibid, Hannibal, Wm. Millard, W. Hindley, Publican, W. B. M., your queries are advertisements. See Hints to Correspondents.

W. Millard.—Your query is rather beyond our line.

Ed. H. M.—First query not in our way. Second query, Sheridan was the author of "School for Scandal."

J. T. H.—Pray consult a medical gentleman.

A. G.—The Metropolitan Institution for Diseases of the Ear, 32, Sackville-street, London.

Next Week.—We have an unusually large number of contributions standing over for next week from many of our esteemed correspondents, including F. R. A. S., Sigma, Mr. Proctor, E. L. G., J. K. P., Saul Rymea, The Harmonious Blacksmith, W. R. Birt, S. Bottone, Jack of All Trades, and dozens of others.

Anti-Flattite.—We do not intend to permit another discussion with those who believe that the earth or the moon is flat and not round. We believe Charles Rabache has some theory of the moon being egg-shaped, or something of the kind.

Ch. Rabache.—Your letter (both for its matter and its manner) on the moon is unsuited to our columns, and, in our opinion, to the columns of any scientific paper. The same remark applies to your letter on centrifugal force.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING AUGUST 13, 1872.

2266 R. Milburn, Whitechapel, and H. Jackson, Leeds, for improvements in apparatus for drying or pulverising, or for drying and pulverising sewage deposit, manure, cement, chemicals, grain, malt, and some other matters or materials.

2267 T. Bean, Liverpool, for improvements applicable to folding machines for perforating, puncturing, indenting, separating, or dividing newspapers and other like sheets during the process of being folded.

2268 W. Morgan-Brown, Southampton-buildings, for improvements in apparatus for raising water. A communication.

2269 H. S. Flood, San Francisco, U.S., for an improved corset.

2270 C. Dreyfus, Radcliffe, Lancashire, for improvements in dyeing and printing textile fabrics.

2271 A. Friedmann, London-wall, City, for improvements in injectors for feeding steam boilers, and for raising and forcing fluids.

2272 F. Jackson, Whinlatter, Cumberland, for improvements in slide valves for steam engines.

2273 F. Jackson, Whinlatter, Cumberland, for improvements in slide valves for steam engines.

2274 G. Rydill, Dewsbury, for improvements in machinery and apparatus for dyeing or staining animal and vegetable substances, also suitable for drying the same, and for bleaching purposes.

2275 R. Hutton, Whitby, Yorkshire, for improvements in the construction of stove pipes for blast and other furnaces.

2276 W. B. G. Bennett, Nichols-square, Hackney-road, and J. C. Watt, Lancaster-road, Notting hill, for improvements in the preparation of asphalte, and in the application thereof to the construction of roads and footpaths, and other purposes.

2277 E. P. H. Vaughan, F.C.S., Chancery lane, for improvements in the treatment of phosphates of lime. A communication.

2278 J. F. Meakin, Baker-street, Portman-square, for an improved method of readily and effectually securing to sliding window sashes platted line or other material now in partial use, and which he calls a tubular sash-line holder.

2279 I. Brown, Edinburgh, for improvements in the treatment of sewage and in the manufacturing of manures.

2280 J. H. Johnson, Lincoln's Inn-fields, for improvements in water meters. A communication.

2281 A. M. Clark, Chancery-lane, for improvements in breech-loading fire arms. A communication.

2282 G. Haseltine, Southampton-buildings, for an improved process of converting cast iron into steel. A communication.

2283 B. J. B. Mills, Southampton-buildings, for improvements in rotary engines and pumps. A communication.

2284 W. H. Dilnutt, Old Kent-road, for an improved construction of furnace fire bar.

2285 T. Whitehead, Holbeck, Leeds, for improvements in machinery for combing wool, cotton, flax, and other fibrous substances.

2286 A. Browne, Gracechurch-street, City, for improvements and modifications in the treatment of phosphate in general, and in the production and purification of phosphoric acid and its combinations. A communication.

2287 P. A. Dormoy and F. A. Paget, Seymour-chambers, Adelphi, for improvements in puddling furnaces.

2288 T. Laycock, Skipton-in-Craven, Yorkshire, for improvements in the construction of sewing machines.

2289 C. Levey, Sussex-road, Holloway, for improvements in steam-engines.

2290 A. Crowther, Lockwood, Yorkshire, for an improved means or apparatus for the drying of yarns, which improved means or apparatus are also applicable in the use of tentering machines.

2291 B. J. B. Mills, Southampton-buildings, for improvements in the manufacture of match and other boxes of paper, pasteboard, thin wood, or other flexible material, and in machinery for manufacturing the same, and in apparatus for sanding match boxes. A communication.

2292 A. Tylor, Newgate-street, City, for improvements in apparatus and arrangements for the water supply of water-closets and baths, and preventing waste, applicable also in whole or in part for controlling, regulating, and arresting the flow of liquids and fluids, and preventing waste.

2293 J. Young, Kelly, Renfrewshire, for improvements in obtaining motive power.

2294 A. Pringle, Bessbrook, Ireland, for improvements in the treatment of flax and other fibrous substances.

2295 W. S. Hudson, New Jersey, U.S., for improvements in locomotive engines.

2296 G. Haseltine, Southampton-buildings, for improvements in machines for the manufacture of gas. A communication.

2297 J. Fletcher, Ashton-under-Lyne, and S. Fletcher, Tailsworth Lancashire, for improvements in indicators or yarn-counters for mules and actuated by the cam shaft of mules.

2298 G. F. James, Salford, Lancashire, for improvements in the manufacture of fuses, and in the machinery employed therein.

2299 A. C. MacLeod, Cumberland, for improvements in the means of imparting motion to drills churns, and other machines where a rapid alternating rotary motion is required.

2300 E. Norman, Bayswater, for an improved sewing machine.

2301 J. Fielding, Manchester, for improvements in apparatus for conveying signals from one person to another in railway trains.

2302 D. Greig and T. Gillott, Leeds, for improvements in coal-cutting machines.

2303 E. G. Banner, Billiter-square, City, for improvements in traps for preventing the passage noxious gasses from sewers or drains through pipes communicating therewith.

2304 W. A. Boyden, Harrisburg, U.S., for an improvement in axle-boxes for railway bars.

2305 H. E. Towle, Budge-row, Cannon-street, City, for improvements in machines for turning screws, bolts, and blanks for wire or rods. A communication.

2306 A. H. Hart, Gresham-street, City, for improvements in the manufacture of fasteners for binding papers and other materials, and machinery for the same.

2307 E. T. Hughes, Chancery-lane, for improvements in bed bottoms. A communication.

2308 C. F. Galand, Paris, for an improved revolving pistol, which may be dismounted without tools.

2309 C. Richardson, Gracechurch-street, City, for improvements in looms for weaving.

2310 J. Douglas and J. Scott, Sunderland, for adjusting compasses, correcting the same, and taking bearings by day and night.

2311 D. Whittemore, Boston, U.S., for improvements in machinery for pegging boots and shoes. A communication.

2312 G. G. André, Dorking, Surrey, for improvements in raising or forcing water from mines, wells, or other places, and in apparatus therefor.

2313 N. Thomas, Glasgow, for improvements in motive-power engines.

2314 N. Thomas, Glasgow, for improvements in heating feed-water supplied to steam-boilers and in generating steam.

2315 W. Husband, Hayle, Cornwall, for improvements in steam hammers and stampers.

2316 A. L. Fyfe, Noble-street, City, for an improved scarf box or holder.

2317 W. Brown, Gray's Inn-road, for an improved apparatus for tilting casks and barrels

2318 J. Henderson, Glasgow, for improvements in converting cast iron into steel and wrought iron, and purifying cast iron for foundry and other purposes.

2319 H. C. Lobnitz, Renfrewshire, N.B., for improvements in generating steam and in the apparatus employed therefor, which improvements are also applicable for heating fluids and for heating or evaporating liquids.

2320 E. Russ, Winchester, for an improved package box or receptacle for keeping or holding wines, spirits, or other liquids during transport or otherwise.

2321 G. Haseltine, Southampton-buildings, for improvements in reed organs. A communication.

2322 W. E. Gedge, Wellington-street, Strand, for a new or improved manufacture of cordage and of woven fabrics from the textile material of the hop plant. A communication.

2323 J. C. Michelet, Dieppe, France, for a new system for converting a slow alternate circular motion into a rapid continuous circular motion.

2324 W. E. Gedge, Wellington-street, Strand, for an improved portable pump. A communication.

2325 E. T. Hughes, Chancery-lane, for improvements in machinery or apparatus for dressing lithographic stones. A communication.

2326 C. Catlow and W. Overton, Lancashire, for improvements in looms for weaving.

2327 E. A. Calahan, Southampton-buildings, for improvements in telegraphic printing instruments, and in apparatus connected therewith.

2328 E. Packard, jun., Ipswich, for improvements in the manufacture of superphosphate of lime and artificial manure.

2329 G. Haseltine, Southampton-buildings, for improvements in machinery for manufacturing cigars. A communication.

2330 G. De Lara, Fleet-street, for an improvement in the manufacture of all descriptions of blotting articles, and the utilisation of blotting paper.

2331 C. M. T. du Motay, Paris, for an improved mechanical and chemical method of epurating the cast irons in order to allow the same to be directly or indirectly tranformed into iron or steel.

2332 J. Deere, Glamorganshire, for improvements in the manufacture of artificial fuel.

2333 T. Wrightson, South Stockton-on-Tees, for improvements in hydraulic hoists.

PATENTS SEALED.

350 J. C. Calvert and J. Taylor, for improvements in apparatus for heating water, steam, or other fluid.

361 J. G. Cunningham and J. Corbin, for an improved agent to be used in the preparation or production of baths.

362 A. G. Bell, for an improved galvanic belt.

364 A. Oldroyd, for improvements in the manufacture of india-rubber and other tobacco pouches and purses.

368 E. Seyd, for an improved method of casting bars or plates of silver and gold, and the moulds for such purpose, also an improved method of rolling such said bars to reduce them to the proper thickness for manufacturing into coins and medals.

374 J. Edwards, for improvements in locks.

377 G. W. Lamb, for improvements in the manufacture of boots and shoes, and machinery or apparatus to be used therein.

384 J. Phillips, for improvements in ships' signal lamps.

385 W. S. Sutherland, for improvements in welding or uniting plates, tubes, and other forms of iron or steel, and in means or apparatus employed therein.

395 G. Smith, for an improved instrument for clipping hair or wool from horses or other animals.

400 E. Jones, for an improved construction of military spade or shovel.

403 W. Willoughby, J. Willoughby, S. Willoughby, for improvements in steam stamping machines for ores and other hard substances.

407 T. Gibb and C. Gelstharp, for improvements in the construction of furnaces for carbonating or drying alkaline salts and other substances, and in the method of working the same.

416 A. Cresswell, for improvements in apparatus for straining or filtering liquids.

446 T. McM. Wilson, for improvements in the mode of and apparatus for refining or purifying oils.

475 R. Edwards and T. Robinson, for improvements in the construction of furnaces for heating, puddling, or melting iron steel, or other metals.

519 W. F. Heshuysen, for an automatic water or other fluid regulator.

531 S. Nuttall, for improvements in shuttles for looms.

559 W. J. Murphy, for an improved system or method of "rifling" applicable to fire-arms and ordnance.

631 C. H. E. Brandauer, for improvements in metallic pens.

1141 F. Alekan and I. Alekan, for improvements in screw studs for shirts, cuffs, and similar purposes.

1270 W. Morgan-Brown, for improvements in steam generators.

1350 W. Morgan-Brown, for improvements in centrifugal machines.

1508 J. Imray, for improvements in apparatus for working brakes in railway trains.

1512 J. A. Turner and G. Davies, for improvements in the manufacture of waterproof packing material.

1611 A. C. Hobbs and J. M. Hart, for improvements in safes and other depositories for property and other articles of value, and in door for such and other places, and in locks or fastenings for the same, part of which improvements is applicable to other structures.

1695 J. Stevenson, T. Carlile, and J. Stevenson, for improvements in the manufacture of bichromates of soda and potash.

1710 W. Morgan Brown, for improvements in dyeing animal or vegetable textile fabrics or yarns aniline black, or other fast colours derived from coal tar.

415 J. Kiloh, for improvements in manufacturing groats, and in apparatus therefor.

418 C. Hodgson, for improvements in apparatus or appliances to be used in connection with wire tramways.

425 R. F. Smith, for improvements in obtaining yellow and red prussiates.

431 J. Hastie, for improvements in ship-steering apparatus.

433 W. E. Gedge, for an improved horizontal boiler.

412 T. J. Smith, for improved means of and apparatus for dividing the fleece in carding engines.

497 G. Williamson and W. H. Williamson, for improvements in the construction of the travelling wheels of traction engines, road rollers, steam carriages, or other traction vehicles, and in the construction of wheels, pulleys, or drums for transmitting power in connection with such vehicles, or where power is required to be transmitted by means of cords, ropes, or belts.

529 B. Hunt, for improvements in leather or other stiffenings for boots and shoes.

625 F. W. Lawson, for improvements in batching jute.

648 G. G. Tandy and J. A. Dryden, for improvements in lamps.

704 E. W. Elmslie, for improvements in the manufacture of hermetically-closed cases, and the opening thereof.

721 W. Gray, for improvements in rotary engines and pumps.

744 W. Gray, for improvements in steam-boilers.

752 E. Watteau, for improvements in explosive compounds.

950 W. Morgan-Brown, for improvements in the manufacture of horse-shoe nails, and in the machinery for that purpose, applicable also to other articles.

968 W. R. Lake, for improvements in paper-rag engines.

1018 J. H. Johnson, for improvements in heating and in apparatus employed therefor.

1064 W. R. Lake, for improvements in the manufacture of sieves.

1080 J. J. Bodmer, for improvements in the manufacture of iron and steel.

1122 P. Jensen, for improvements in the construction of ovens, in the utilisation of the waste heat therefrom for the manufacture of refined salt and in the apparatus therefor.

1271 J. S. Richard, for improvements applicable to warping or beaming machines and to other machines in which excess or slackness, breaking, or exhaustion of a thread, other than a warp thread, necessitates the stopping of such machines, and also to cases where an expanding comb is required.

1310 R. Coddington, for improvements in printing presses, partly applicable to other machines.

1355 J. E. Walker and J. W. Cole, for improvements in apparatus for screening coals.

1409 J. H. Johnson, for improvements in the treatment of ores, more particularly iron ore, for the manufacture of cast iron, wrought iron, and steel therefrom, and in the apparatus to be employed therein.

1470 J. H. Johnson, for improvements in the manufacture of shoes, and in machinery and apparatus connected therewith.

1537 E. A. Calahan, for improvements in electric telegraph signal or alarm apparatus.

1555 W. Lockwood, for improvements in safety valves for steam boilers.

1617 J. Pickup, for improvements in grate bars.

1554 C. Turner, for improvements in machinery for scudding or puri[illegible] skins or hides.

16[illegible] E. R. Hollands, W. Maker, and C. H. Jefferies, for improvements in meters for measuring water and other fluids.

1735 H. P. Holt, for improvements in machinery and locomotive engines for driving tram cars and other road vehicles, parts of which improvements are applicable to other steam-engines.

1776 T. A. Weston, for improvements in differential pulleys, portions of which are applicable to other chain wheels.

1799 J. H. Johnson, for improvements in the manufacture of iron.

1801 G. Haseltine, for improvements in the manufacture of iron and steel, and in apparatus employed therefor.

1818 W. Campion, for improvements in the mode of securing stitching together the seams of looped or knitted fabrics, and machinery or apparatus to be employed for such purpose.

1837 T. Hampton, for improvements in the manufacture of Bessemer steel ingots.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 30, 1872.

ARTICLES.

OCEANIC CIRCULATION.

By Richard A. Proctor, B.A., Hon. Sec. R.A.S.

Author of "The Sun," Light Science," "Essays on Astronomy," &c.

IT is impossible but that on a subject so difficult and complicated as that of oceanic circulation, different views should be entertained by students of science. And it is clear that in the present stage of the inquiry no useful purpose could be fulfilled by making the problem a matter for controversy. Dr. Carpenter himself has shown that much more is to be gained by observation than by reasoning on imperfect knowledge. If I venture to remark that his deep-sea researches have led to the most important contribution which has been added for many years to our information respecting oceanic circulation, he will not, I trust, consider that I am passing beyond the bounds of controversial courtesy. But I am, indeed, not anxious to treat the matter as one for controversy in any sense. It will be perceived by those who have read my remarks on the subject, that I have rather put them forward as suggestions than as indicating theories which can be maintained with any degree of assurance, far less with conviction. Nor does it seem to me likely that one explanation can suffice to account for all the phenomena recognised in oceanic circulation. This is a case, if ever such case were, in which more causes are in operation than one; so that it may very well happen that excellent arguments can be adduced in maintenance of different views. If, therefore, I enter on the defence of what I have already written on this subject, it is not with the wish to show that one particular explanation of oceanic circulation is correct, and all others erroneous. If I am desirous of dealing with the considerations urged by Dr. Carpenter, it is not because they seem to him to militate against the views I have to some extent advocated. What I wish to show is that I have not addressed your readers on the subject of oceanic circulation without making myself familiar with the facts which bear upon that subject, and at the very least, with those comparatively fundamental facts to which attention has been invited.

And here I would remark that one who writes so much and so often as I have had occasion to do on this and kindred subjects, is placed to some degree at a disadvantage. He cannot on the one hand assume that the readers of any particular essay have also read all that he has written on the subject; yet, on the other, he cannot assume that none have done so, and that he is therefore free to repeat (in a more or less modified form) much that he has formerly urged. I was, perhaps, somewhat too careful in writing for your pages to avoid touching at any length on any parts of the subject which I had more particularly dealt with elsewhere; and accordingly I have laid myself open to a method of attack, which in reality involves the suggestion that I have written without due consideration even of the elements of my subject. I have no doubt that Dr. Carpenter has no wish to imply this directly, yet indirectly it is implied in every paragraph of his reply. I shall be able to show, however, that every one of the points touched on by Dr. Carpenter had been fully considered by me—and, for the most part, several months before he had turned his attention to this subject.

First there is the remark that I have left out of view the circumstance that if there is excess of evaporation in the intertropical area, the excess ought to show itself, as in the Mediterranean, in an *increase* of specific gravity, whereas the specific gravity of the equatorial water is *lower* than that of tropical water. Now, it is unquestionably true that the effect of evaporation is to increase the specific gravity of sea water; but it is equally true that the effect of the heat which causes the evaporation is to diminish the specific gravity. The point is considered in my essay entitled "Is the Gulf Stream a Myth?" which forms part of my "Light Science for Leisure Hours." "We recognise," I there say, "two contrary effects as the immediate results of the sun's action. In the first place, by warming the equatorial waters it tends to make them lighter; in the second place, by causing evaporation it renders them salter, and so tends to make them heavier." And I proceed to inquire which cause is likely to be the more effective; arriving at the conclusion that the water is made lighter. The case, indeed, appears to me to be altogether different from that of the Mediterranean Sea cited by Dr. Carpenter. In the Mediterranean we have the same heating action as on the Atlantic in the same latitudes, but not the same relatively enormous quantity of water freely communicating with the region so heated. We have, then, in the Mediterranean evaporation as everywhere else, and evaporation to the same degree, appreciably, as elsewhere in similar latitudes; but evaporation *not* compensated as in the open Atlantic by the effects of free communication with surrounding water. Hence we have in the Mediterranean an increase of saltness; in other words, an increase of specific gravity. And precisely because this increase takes place in the Mediterranean, whereas the water of the Atlantic in the same latitudes, exposed to the same average degree of heat, is not rendered heavier, it may be maintained not unreasonably that the water of the equatorial Atlantic being unconfined will in like manner not be rendered heavier by evaporation. It seems to me that we have here a positive argument of great weight in *favour* of my views. But independently of this I would ask whether it can be questioned that enormous evaporation *does* take place over the equatorial area. This is what I contend for, and I should have imagined that few would undertake to deny the proposition.

In passing, I must remark that I do not adopt the distinction between equatorial and tropical water which Dr. Carpenter appears to recognise. I have in view the evaporation over an enormously larger area than he considers—no less an area, in fact, than the whole ocean between latitudes 40° north and south of the equator (at the equinoxes, and varying according to the season). It by no means follows that because the equatorial current does not cover this enormous area, that therefore the relation which I have suggested as the mainspring of oceanic circulation has not that extent. On the contrary, while it is on the one hand certain that there is an excess of heat over this enormous area, it is on the other almost a necessity of my theory that the resulting current should be found running along the middle only of the great region of evaporation.

This brings me to Dr. Carpenter's second objection, that if the removal of equatorial water draws in polar water from the *bottom*, the whole intermediate stratum should first rise towards the surface. I do not hold the view thus demolished, but simply that the inflow is from below. The question whether the inflow would be from above or below was dealt with by me in a paper on "Oceanic Circulation" in the *Student* for July, 1868. I do not urge this as a proof that Dr. Carpenter's objection is invalid. My reasoning may admit of being refuted. But I wish to show that the objection is not a new one to me. The inflow may be from below without being from the bottom. If it were from the bottom it would not have the effects I have ascribed to it, that is, it would not result in a westwardly-flowing current. What I conceive is that since the whole tropical and equatorial area is a region of excessive evaporation (as surely no physicist will deny), there is over the whole region a depression of the ocean level. This depression may be, or rather must be, exceedingly minute; but the total quantity of water thus, as it were, wanting, must be enormous. The difference must by the laws of fluid equilibrium be supplied, and though the immediate supply in equatorial regions may come from tropical regions, the actual source of the total supply must be sought for in higher latitudes. That the water drawn in under these circumstances would traverse the surface of the Atlantic, is by no means proved by the fact that the eminent mathematicians cited by Dr. Carpenter consider that an in-draught to replace water "swept off from the surface," by trade wind action would be a surface current. The two cases are wholly dissimilar. I must, however, admit that *my* case is one of extreme difficulty regarded as a problem in hydrodynamics. It is so difficult that I do not believe it can be solved even after the very imperfect fashion in which hydrodynamical problems have hitherto perforce been dealt with. When the physics of hydrodynamics have been treated by mathematicians like the physics of astronomy—or rather when they *can* be so treated, it may be possible to deal with this problem. Unless I greatly mistake, however, in such a *then* we shall find a *never*.

I do not see how the action of the cause I have considered is affected by the circumstance that the equatorial heat does not show any effects below 200 fathoms; for the cause is in its very nature a surface one. But I would remark that so far as continuity of action is concerned, the equatorial heat seems at least on a par with the polar cold. For as the aqueous vapour rises it finds its way to regions where the atmospheric circulation is at work to carry it away (it is only the surplus quantity which is condensed into clouds, and even these are in great part carried away); and thus the process of evaporation can hardly be exhausted. Even at night, though in a modified manner, the evaporation must continue. But the action of the polar cold, though it is continuous in the sense that the increase of cold extends to great depths, yet has this great difficulty to contend with that the descending water must perforce wait until room is made for it by the slow removal, the *creeping away*, as it were, of that which it replaces. That this cause, *per se*, can ever become one of sufficient activity* to generate a complete system of vertical oceanic circulation seems at the least open to grave question. It appears to me also that when applied to the North Pacific this theory fails. Very little water can pass through Behring's Straits, and beyond Behring's Straits there is an island-locked and shallow sea of enormous area, altogether unlike the deep North Atlantic.

I would further point out that the interesting fact above mentioned, namely that the equatorial heat exerts no perceptible effect at a depth exceeding 200 fathoms, is in reality almost a necessity for my theory. For if the whole of the equatorial ocean were heated, and, therefore, of reduced specific gravity, the water arriving from higher latitudes would flow to the bottom, and so have to force up the intervening strata, in order to produce the observed effects; and this may be regarded as impossible. As it is, such colder and heavier water would be in dynamical equilibrium within a very short distance of the surface.

Next, as to the question of rainfall. Dr. Carpenter considers that I have overlooked the considerations (1) that the rainfall of Europe and North America may be accounted for by the evaporation in the Mid-Atlantic, beyond the region of the trade winds, say between 20° and 40° north latitude; and (2) that there is an enormous rainfall in the region of equatorial calms, which Sir John Herschel attributes to the deposit of waters taken up by the N.E. and S.E. trades. To this I must reply that in my essay on Rain in the "Intellectual Observer" for December, 1867, I have weighed the whole question of rainfall at least with great care, and with constant reference to the best sources of information. One circumstance I there note which seems at a first view (or rather viewed as Dr. Carpenter appears to consider the matter) much more fatal as an objection to my theory than either of those noted by Dr. Carpenter; viz., that according to the observations of Humboldt and others, the annual rainfall is at a maximum at the equator, and diminishes with increase of latitude. But the whole question is, where does all this rain come from? If it comes from tropical and equatorial evaporation it will surely not be argued that what falls in or near the place of evaporation itself, represents the total amount of such evaporation. It is unquestionable, I conceive, that the rainfall is only the excess of the aqueous vapour poured so copiously into the air from the whole of this region. It is the quantity which the air, as it were, rejects. It is a matter of little importance where the rainfall of higher latitudes comes from, though it should be noticed that the views of Dové, Kaemtz, and other leading meteorologists respecting the winds and rains of high and low latitudes, support my remark about the great rivers.

Now we have in the phenomena of the zone of calms a crucial test of Sir J. Herschel's theory as to the origin of the equatorial rains. It appears to me that this test altogether negatives Herschel's theory. If the moisture to which these equatorial rains are due came from the trade-wind regions, we should certainly not expect the fall of these rains to be associated in any

* In passing I may notice that I did not suppose Sir J. Herschel to be humorous in reference to the intensity of the polar action, but in his use of the word "emphasis." I should not have touched on the point did I not thoroughly sympathise with the emphatic utterance of speculative or theoretical opinions.

marked degree with the progress of the equatorial day; or, if at all, then the cooler parts of the day, when the point of saturation is lower, would be the time of precipitation. With the mid-day heat would come a cessation of precipitations. As a matter of fact the contrary is the case. The sun (we are told by Dové, Kaemtz, Humboldt, Maury, Buchan, and many more) rises commonly in a clear sky in equatorial regions. As the day proceeds clouds form, and towards mid-day they grow dense. It is at noon that heavy showers fall, and towards evening the skies again become clear. Now, any one who has noticed what happens on calm summer days in any well-watered region can see that the equatorial phenomena represent the same processes on a greatly enlarged scale. On a summer's day in such regions we see how scattered cumulus clouds begin to form in early morning, become larger and more numerous as the day proceeds, and in the afternoon begin to be transformed into cumulo-stratus. The explanation is simple. The sun's heat has caused aqueous vapour to rise into the air, until there is so much that not very far above the earth's level the saturation point is reached. The further rise of the vapour is followed by the process of condensation into clouds, much heat being given out in the process, causing the air to expand in the neighbourhood of the clouds so formed, and thus giving to these clouds their peculiar rounded tops. (At least this feature seems better explained thus than by De Saussure's theory.) Now suppose the conditions changed to those existing at the equator. The supply of vapour is very much greater, the saturation point is very much higher near the sea-surface, and the contrast between the conditions prevailing there and in the region where condensation begins is very much more marked. The air above the equatorial and tropical seas contains, in the form of invisible aqueous vapour, an enormous quantity of water; this vapour rises and extends itself, its place being continually supplied by fresh evaporation. What must happen when the process has continued for several hours, but precisely what is observed to happen? There is an overflow, so to speak, resembling, only much more marked, that which causes the formation of our summer clouds. Enormous cloud-masses are formed, which cannot be carried away by the atmospheric circulation (very high above the calm zone), so fast as they are formed. Hence follows excessive accumulation, presently resulting in precipitation, accompanied by remarkable electrical phenomena.

But to suppose that the whole quantity of water evaporated at the equator, and in tropical regions, is precipitated *there* in the form of rain, corresponds to such a supposition as that the water overflowing a dam includes all that has risen to the level of the dam.

I should not be greatly concerned if the result of the experiments I spoke of should not accord with my prediction. But merely to put ice in water capable of melting it, is not in any sense to represent the conditions of the actual case. The addition of water from the ice as it melts is not in accordance with these conditions. It cannot surely be maintained that the oceanic circulation depends on the addition of water from the melting of ice; and yet I apprehend that the melting of ice is no unimportant feature of Dr. Carpenter's experiment. At any rate, the ice does melt, and the movement comes to an end when all the ice has melted away. Let the ice be packed outside the arctic end of the canal, so as merely to produce a refrigeration corresponding to what actually takes place with water carried into arctic latitudes, and I conceive that a very feeble circulation would result. Under the actual circumstances, the melting of the ice produces effects much more nearly corresponding to those due to rainfall than to the mere effects of arctic cold. The very activity of the circulation shows that the water which moves towards the ice does not undergo refrigeration. Water does not cool quite so quickly. It is the melted ice-water which descends; and nothing takes place in the arctic regions which corresponds to this continual addition of water to that already circulating. Otherwise, the arctic ice would be continually diminishing, which, of course, is not the case.

It will be gathered that I agree entirely with the opinion which Sir W. Thomson expressed, as to the reason why heat is necessary for Dr. Carpenter's experiment. Heat is necessary, because the ice *must* be melted to make the experiment succeed. But comparing the effects of heat and refrigeration (*not* of heat and the continual inflow of ice-cold water), I conceive that heat would be found altogether the more effective.

Lastly, as to the wind theory of the Gulf Stream, Dr. Carpenter remarks that, so far as he knows, I am "the only man of science in this country agreeing with Captain Maury in attributing the Gulf Stream to some other cause than the impelling force of the trade winds." He must be aware that there are not half a dozen students of science in this country who have expressed definite opinions on the subject after a thorough and independent inquiry into the evidence. Amongst those who maintain the wind theory there is not one, so far as I know, with whom Dr. Carpenter is in agreement. Mr. Laughton disputes the very principle of Dr. Carpenter's reasoning, holding that the change of temperature from equator to poles proceeds too slowly mile for mile to produce the effects which Dr. Carpenter indicates. Mr. Croll, in like manner, has expressed his complete dissent from Dr. Carpenter's reasoning. So also has Mr. Findlay. I believe these gentlemen to be mistaken, and I conceive that I have been able to put my finger on the precise point where their respective lines of reasoning fail. But, if Dr. Carpenter is to take general consent as an argument, and to maintain that I am wrong because he knows of no one who agrees with me, I may as well point out that he is entering into a very questionable alliance so far as his special views are concerned. So far as I know, all the continental students of science who share our common views as to vertical circulation, reject the wind theory as *solely* sufficing to account for the Gulf Stream. Again, he sets Sir J. Herschel's opinion (30 years ago) that "the Gulf Stream is *entirely* due to the trade winds" as almost conclusive against me. It is, at least, not new to me, since it is cited in every paper I have written on the subject. But is there no evidence to show that Sir J. Herschel abandoned the view he formerly entertained? I would ask what Sir John Herschel implies when, in his letter to Dr. Carpenter, he writes "The action of the trade and counter-trade winds, in like manner, cannot be ignored; and henceforward the question of ocean currents will have to be considered under a twofold point of view." The word "henceforward" implies very distinctly that Sir J. Herschel was entertaining a new opinion—that is, an opinion new to him; and I think Dr. Carpenter would find it difficult to demonstrate that this new opinion would not have enforced the omission of the word *entirely* from the sentence quoted by Dr. Carpenter.

I need hardly say that I do *not* agree with Captain Maury, whose theory of oceanic circulation appears to me to be wholly untenable. Nor do I for a moment assert that the winds play no part in producing oceanic circulation. I may have been mistaken in attaching so much weight as I have to Maury's evidence as to the trade wind zones, though it is known that science owes more to him than to any man for our present knowledge of the winds prevalent in certain regions; and when I first wrote on the Gulf Stream there was no evidence on the subject even approaching Maury's (or that collected by Maury) in accuracy and completeness. But there is one argument which those who have adopted the trade winds as the primary cause of the Gulf Stream appear to me to have overlooked, and it is on this argument that my own view has been chiefly based. The trade wind zone of the northern hemisphere is not constant in position; but travels northwards and southwards with the northerly and southerly motion of the sun in declination. The change in the position of the zone of calms is not, indeed, so great as is stated in Buchan's meteorology, where it is said to travel from 25° north to 25° south of the equator; but it is considerably greater than was supposed by Dové, Kaemtz, and others. If we set the extreme shift of the northern trade-zone at ten degrees we are certainly not over-rating it. Now, taking this zone as extending in spring or autumn from 10° to 25° north latitude, we should have it in winter extending from 5° to 20°, and in summer from 15° to 30°, the only part common to these two ranges being that from 15° to 20°—that is to say, the northern five degrees of the winter zone, and the southern five degrees of the summer zone, each zone being 15° wide. Now, if any one will mark these zones on the North Atlantic, he will find that while the zone of winter trades would produce a current flowing into the southern half of the Gulf of Mexico, the zone of summer trades would produce a current flowing into the northern half. The former would produce a current flowing as the Gulf Stream actually flows; the latter would produce a current flowing precisely in the opposite direction. This being the case, I do not find the evidence for the trade winds as the sole or even the main cause of the Gulf Stream altogether convincing. The case does not, for instance, seem quite "as clear as the rotation of the earth." It seems, also, not undesirable to mention that the equatorial current and the Gulf Stream are not mere drift-currents, and that on a careful estimation of the frictional action of such winds as the trades on the surface of the ocean, the action will be found quite unequal to the propulsion of so vast a body of water as is actually carried westwards (not, by the way, *before* these winds). Until difficulties such as these have been removed from the trade wind theory *as solely sufficient* to account for the Gulf Stream, I think I would rather be the only student of science opposing that theory, than one of a phalanx, however large, maintaining it. There is, however, no such phalanx; the subject being regarded by nearly all students of science as a very open one.

NOTES OF COMMUNICATIONS TO THE ACADEMY OF SCIENCES, PARIS.*

PHYSICS.—OPTICAL PHENOMENON OBSERVED AT GRAND CHARTREUSE.—The description of the phenomenon observed in the balloon by M. Tissandier† recalls to mind an identical circumstance observed by me four years ago. On the 3rd September, 1868, towards 5 p.m., I was, with several other persons, upon the narrow platform which terminates the Grand Som (2,033 metres high), and of which the walls form themselves into a peak at the Grand Chartreuse. Clouds enveloped us each instant; the sun, nearly setting, cast our shadow, and that of the cross planted upon the summit, upon them, somewhat enlarged, surrounded by a rainbow-coloured circle. We could distinctly see our movements reproduced by the shadow; it appeared to be distant a hundred paces, and a little below us; a circle presenting all the colours of the spectrum, violet on the interior, red on the outside, completely surrounded it. The phenomenon appears to be analagous to that known under the name of the Spectre of the Brocken. I have not observed the white rainbow, or circle of Ulloa, beyond the irridescent circle which formed the frame of the picture.—M. J. GAY.

THE PRIMARY SPECTRUM OF IODINE.†—The emission of red light by the vapour of iodine strongly heated appeared to me to present sufficient interest to engage me in studying yet closer the spectrum of that metalloid. MM. Plücker and Hittorf have not succeeded in producing with iodine, by help of the Geissler tubes, a spectrum of the first order that would correspond with the spectrum of absorption; I have been more happy in employing a sheathed tube, and have been able at will, and in the same apparatus, entirely constructed of glass, to obtain a spectrum of lines described by Plücker, and a new spectrum of which the least refrangible part reproduces, so to speak, the negative proof of the beautiful spectrum of absorption, so well studied by M. Thalén; it is accompanied by bands excessively diffused at the commencement of the blue and the extremity of the indigo; these bands become more luminous on increasing the tension of the vapour, but then the lines of the secondary spectrum will appear. The light of the tube is of a bronze-yellow with cold; it becomes a violet-blue with heat. To obtain the new spectrum it is necessary to employ a source of electricity having little tension, as the bobbin of induction with a jar; it is but little luminous, unless one employs a particular artifice to observe it, presenting only to the spectroscope the section of the narrow tube. Each bright band, on being brought under the reticle of the glass, is replaced by a black band when the vapour is illuminated from behind. We perceive in this a new example of multiple spectra. One cannot suppose that the body which furnishes the new spectrum is a compound of iodine, for this would be the compound that gives the well-known bands of the spectrum of absorption; in other words, the characteristic coloration of iodine, from which it derives its name, would be due to an impurity. It seems to me, then, proved that the same elementary body may have two spectra, as it can have two allotropic states, which is the old opinion of Plücker. It became interesting to know whether the continuous spectrum of iodine heated to redness would present signs of the primary bands, as the theory of the proportionality of emissive and

* Translated and abstracted for the ENGLISH MECHANIC.

† ENGLISH MECHANIC, 2nd August, 1872, p. 507.

absorbing powers demands. With better conditions and by employing strong dispersion I have succeeded, in fact, in recognising the principal of them.—M. G. SALET.

ON A NEW ELECTRIC PILE OF ECONOMIC CONSTRUCTION.—[The object of the author was to construct a pile of common materials in every-day use, that might be made anywhere, without the intervention of special workmen, and which should possess the essential quality, constancy in effect.] The pair which I have adopted, after some trials, recalls in its form that of Calland, employed some years since on telegraph lines; but its elements are different. It is composed of a vessel in which is plunged a sheet of lead and another of zinc; that of lead descends to the bottom of the vessel; that of tin is one half shorter; the bottom of the vessel is occupied by a bed of minium; the exciting liquid is water mixed with chlorhydrate of ammonia in proportions 10 to 100. The electro-motive force of this pile is about one-third of that of Bunsen; its interior resistance is weak and varies little, and the resultant compound does not materially change the conductibility of the exciting liquid; its constancy is great, and the expenditure is almost nothing when the circuit is open.—M. GAIFFE.

JOHN J. LAKE.

ASTRONOMICAL NOTES FOR SEPTEMBER.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE right ascension of the Sun at Greenwich mean noon on September 1st is 10h. 43m. 32·22s., and his declination north 8° 5' 15·6", so that he will be found in the constellation Leo, almost close to the small double star 179 Piazzi X. He rises in London on the 1st at 5h. 15m. a.m. and sets at 6h. 44m. p.m., thus being obviously 13 hours and 29 minutes above the horizon, and only 10 hours and 31 minutes below it. He is, however, travelling rapidly down towards the equator, which he crosses at 5h. 53m. on the afternoon of the 22nd. At this instant he is technically said to enter Libra, and autumn commences. He is really at the time in the constellation Virgo, a little to the south of a line joining β and η, and rather nearer to the latter. The time of his crossing, or being *on* the equator, is very evidently that of the equinox, but the nearest practical approach to the equality of day and night will be on the 25th, when he will rise at 5h. 53m. a.m., and set at 5h. 52m. p.m. Subsequently to this the nights will gradually become longer than the days, and on the 30th sunrise will happen in London at 6h. 1m. a.m. and sunset at 5h. 39m. p.m. The equation of time is subtractive during the whole of September, and increases very rapidly from only 0m. 17·12s. on the 1st o the 30th, when 10m. 10·73s. must be taken from the instant of apparent noon to give the time which a properly regulated chronometer should indicate. The semi-diameter of the Sun at the instant of his crossing the Greenwich meridian on the 1st is 15' 53·7", and this occupies 1m. 4·38s. of sidereal time (convertible into mean time by the subtraction of 0·18s.) in its transit. The semi-diameter increases to 16' 1·2" by the 30th, and this occupies 1m. 4·33s. of sidereal time (convertible as above) in its transit. The sidereal time at Greenwich mean noon on September 1 is 10h. 43m. 49·35s., and on the 30th 12h. 38m. 9·39s.; the mean time at sidereal noon, or mean time of transit of the first point of Aries, being 13h. 14m. 0·22s. and 11h. 19m. 58·9s. on those days respectively. An abnormal number of spots continue to diversify the solar disc.

The Moon will be new at 53·5 minutes after midnight on the 2nd; enter her first quarter at 2h. 8·3m. in the afternoon of the 10th; be full at 5h. 4·7m. a.m. on the 17th; and enter her last quarter at 1h. 21·5m. p.m. on the 24th. She is 28·1 days old at noon on the 1st, and 29·1 days at the same hour on the 2nd. On the 3rd, at Greenwich mean noon her age will be 0·5 days; and so increasing by one day *de die in diem* until the end of the month, will, on the noon of the 30th, be evidently 27·5 days. At 5 a.m. on September 8 libration will bring an additional portion of her S.E. quadrant into view; while more of her S.W. quadrant will be perceptible at 11 o'clock on the night of the 20th. The south-eastern libration will very evidently occur when the Moon is beneath our horizon. The Moon will be in conjunction with Mercury at 7h. 58m. a.m. on the 2nd; with Venus at 2h. 39m. a.m. on the 4th; with Saturn at 10h. 42m. a.m. on the 12th; with Uranus at 6h. 43m. a.m. on the 27th; with Jupiter at 5h. 38m. in the afternoon of the 28th; and, lastly, with Mars at 11h. 54m. on the same night.

There will be seven occultations of fixed stars by the Moon during the months of September. Firstly, at 8h. 27m. on the night of the 14th, B.A.C. 7550 will disappear at the Moon's dark limb, reappearing at the bright limb at 9h. 21m. Then on the 15th, ι^1 Aquarii will disappear at the dark limb at 11h. 29m., to reappear at the bright one 33 minutes after midnight. Subsequently, at 12h. 46m., ι^2 Aquarii will disappear at the dark limb, reappearing at the bright limb at 1h. 50m. At 1h. 33m. a.m. on the 20th, B.A.C. 728 will be occulted by the bright limb, and will emerge from behind the dark limb at 2h. 46m. On the night of the 23rd 132 Tauri will be occulted by the bright limb at 11h. 45m. This star will reappear at the dark limb exactly one hour afterwards, or 45 minutes after midnight. ϵ Geminorum will be occulted by the bright limb of the Moon 27 minutes after midnight on the 24th, and curiously (as is the case of the star previously named) reappear exactly one hour afterwards at the opposite one. Lastly, at 4h. 45m. in the early morning of the 26th, κ Geminorum will be occulted by the bright limb to reappear at the dark limb at 5h. 33m.

Mercury is a morning star during September, and may be caught before sunrise towards the middle of the month. At 16 minutes after midnight on the 15th he attains his greatest western elongation, 17° 52' from the sun. At this date he appears above the horizon in the morning nearly an hour and three quarters before the sun. The beginning of the month, however, will be preferable for viewing him should the observer possess an equatorially mounted telescope, inasmuch as his apparent diameter is now decreasing daily. He continues in the constellation Leo until the end of the month, when he passes into Virgo. On the 15th, at Greenwich mean noon, he will be close to ρ Leonis and slightly to the north-east of that star, while at 6 23 a.m. on the 24th he will be in conjunction with σ in the same constellation. His conjunction with the Moon at 7h. 53m. in the morning of the 2nd has been before spoken of.

Venus is an evening star in the sense of setting after the sun, but she is much too close to him to be favourably observed. Moreover, her apparent diameter is exceedingly small, and she is very nearly round. She is travelling through Virgo during the whole of September, but never passes near any conspicuous star. Her conjunction with the Moon at 2h. 39m. a.m. on the 4th has been previously noticed.

Mars is a morning star too, but is such a wretched little object as assuredly not to repay the trouble involved in pointing a telescope at him; his diameter never subtending an angle of 5" during the entire month. He rises soon after 2 o'clock in the morning at the beginning of September, and a little earlier at the end of it. He is moving across the face of the heavens from Virgo into Leo, and at the end of the month will be pretty near to Regulus. α Leonis is not a pure white star, but it will be seen to contrast markedly with the sullen red of Mars, small as the planet now appears. Mars will be in conjunction with Jupiter at 4h. 36m. in the afternoon of the 21st, but both planets will be close to their setting in bright sunlight. We have mentioned his conjunction with the Moon at 11h. 54m. on the night of the 28th under another heading.

Jupiter is a morning star, rising about 3h. 7m. a.m. on the 1st, and about 1h. 46m. a.m. on the 30th. This planet is travelling across a barren part of the constellation Leo, and will be pretty close to that very curious variable star ψ Leonis at the end of the month. His apparent diameter continues very slowly to increase, subtending an angle of 32" at the beginning, and one of 33" during the latter part of the month. The conjunction of Jupiter with Mars at 4h. 36m. p.m. on the 21st, and his conjunction with the Moon at 5h. 38m. on that of the 28th have been adverted to before.

Of the phenomena presented by Jupiter's satellites, some few will be visible during September, but many of them will occur at times when the low altitude of the planet, or the brightness of the twilight, will render their observation problematical. Firstly, during the early morning of the 2nd, the eclipse of satellite 3 may possibly be witnessed at 4h. 27m. 6s. So again may the reappearance of satellite 2 from occultation at 3h. 40m. a.m. on the 5th. The ingress of the shadow of satellite 1 will be visible at 3h. 51m. a.m. on the 8th, and that of the satellite itself afterwards at 4h. 26m. The same satellite (1) will reappear from occultation at 4h. 8m. in the early morning of the 9th. During that of the 13th the egress of satellite 3 will happen at 4h. 30m. It is possible that the eclipse of satellite 1 may be witnessed at 3h. 7m. 50s. on the 16th; as also the egress of the shadow and that of the same satellite at 2h. 34m. and 3h. 16m. respectively, on the 17th. An eclipse of satellite 2 will be visible at 4h. 51m. 27s. on the early morning of the 19th; while at 5h. 11m. on the next, satellite 3 may just possibly be detected in its entrance on Jupiter's limb. The egress of the shadow of satellite 2 may, perchance, be seen at 2h. 53m. a.m. on the 21st.; that of the satellite casting it will be visible at 4h. 26m. An eclipse of satellite 1 can also be seen at 5h. 1m. 32s. a.m. on the 23rd. Before sunrise on the 24th the ingress of the shadow of satellite 1 will happen at 2h. 7m., followed by that of satellite 1 itself at 2h. 56m. Then at 3h. 34m. satellite 4 will enter on to Jupiter's disc. After this the shadow of satellite 1 will leave the planet's opposite limb at 4h. 27m.; as will the satellite which casts it at 5h. 16m. Perhaps satellite 1 may be detected as it reappears from occultation at 2h. 37m. a.m. on the 25th. The ingress of the shadow of satellite 2 will begin at 2h. 32m. a.m. on the 28th, the satellite itself not following its shadow until 4h. 16m. The egress of the shadow may possibly be perceived at 5h. 28m. Finally, although pertaining (according to civil reckoning) to the early morning of October 1, we may, astronomically speaking, consider the reappearance from occultation of satellite 3, at 3h. 36m.; the ingress of the shadow of satellite 1 at 4h. 1m., and that of the satellite itself at 4h. 55m. as belonging to this month.

Saturn may still be seen during the early part of the night, but is just as wretchedly placed as ever for observation. He is still in Sagittarius, and during the whole of it just to the south-east of π in that constellation. He rises on the 1st about 4h. 21m. in the afternoon, souths at 8h. 19·3m., and sets about 17 minutes after midnight. On the 30th his rising, southing, and setting occur at 2h. 27m. p.m., 6h. 25m. in the evening, and 10h. 23m. at night respectively. We have mentioned his conjunction with the Moon at 10h. 42m. a.m. on the 12th (of course beneath our horizon) above.

Uranus is a morning star, is situated in Cancer, and is gradually coming into a more favourable position for the observer. He rises on the 1st about 50 minutes past 1 a.m., souths at 9h. 41·4m. (of course in bright sunlight), and sets at 5h. 34m. in the afternoon. Then, at the end of the month, he rises about 4 minutes after midnight of the 29th, souths at 7h. 53m. the next morning, and sets in the afternoon of the 30th about 3h. 43m. He is in a somewhat barren part of the heavens. His diameter increases from 3·6" at the beginning of the month to 4" at the end of it. His conjunction with the Moon at 6h. 43m. a.m. on the 27th has been previously spoken of.

Neptune must also be called a morning star, in so far as he is not on the meridian until nearly 3 a.m. at the beginning of September, and about 1 o'clock in the morning at the end of it; but he rises about 7 minutes past 8 in the evening on the 1st, and about 6.15 on that of the 38th, so that he is fairly visible during the working hours of the night. He is situated in the constellation Pisces, close to the 5th magnitude star o, and will be almost due south of it, and in the same field of a high-power eyepiece, upon the nights between the 5th and the 9th. The planet will require considerable magnification to demonstrate its nature satisfactorily. His apparent diameter is very slightly increasing.

Showers of shooting stars have been suspected at the beginning of September, and between the 18th and 25th of the month; but there is no definite confirmation of this. Observers may look out, though, as such confirmation would possess a considerable degree of interest.

INFLUENCE OF LIGHT ON ANIMAL LIFE.

IN a paper in the *Revue des Deux Mondes*, M. Papillon communicates the following facts:—Certain Infusoria, in stagnant water, receive carbonic acid from the liquid and give out oxygen (like the green parts of plants). The oxygenation thus produced varies throughout the day, having a minimum at sunrise and a maximum about four p.m. It takes place by night as well as by day, but with less intensity; and in clear weather it is greater than in cloudy. Light accelerates the vital movements in animals, especially those of nutrition. Fowl and cattle are fattened in partially darkened chambers. In these vital action takes place more slowly, and the nutritive matters are more readily deposited in the organs. Continued absence of light sometimes kills animals, sometimes produces a marked change in their organisation. There are, in some subterranean caves of the Basse-Carniole, certain curious reptiles resembling salamanders. They are nearly white, and have only rudimentary eyes. When exposed to light they seem to suffer, and their skin colours. It is probable these animals have not always lived in the darkness, and that their skin and vision have been affected by the absence of light. The appearance of animals in such conditions presents a striking analogy to the case of etiolation in plants.

Edwards, in 1820, studied the influence of light on animal development. Frog's eggs and tadpoles, exposed to light, developed regularly, while growth was retarded or hindered in the case of others kept in darkness. M. Moleschott, 30 years later, found the carbonic acid gas expelled by frogs in the light was a fourth more than the volume expelled in darkness; also that the production of carbonic acid was proportional to the intensity of light. He thinks the action of light on batrachians is transmitted partly by the skin, partly by the eyes.

M. Beclard has more recently studied the effects of glass receivers of various colours on flies' eggs contained in them. Maggots were produced in each case, but, in four or five days there were perceptible differences of growth; those in the violet and blue rays had developed most, those in the green much less, while red, yellow, and white rays had an intermediate effect. He examined, also, the quantity of carbonic acid produced by birds and mice in the various coloured rays, but found no difference; the hair or feather covering, possibly, obscuring the effect. Frogs, similarly treated, produced more carbonic acid in the green than in the red rays. The difference is generally about a third or a fourth. When the skin is removed, the effect is reversed. The cutaneous exhalation of water vapour in frogs was found a half less in darkness than in light, and in violet rays it was nearly the same as in white light.

M. Bert has made some curious experiments on the predilection of animals for various coloured rays. He put a number of *Daphnia* (a minute fresh water crustacean), in a glass vessel placed in the dark. When the spectral colours were thrown on it, the little creatures, which were dispersed throughout the vessel, grouped themselves, chiefly in the yellow and green rays, and in diminishing quantity towards the more refrangible end. On interposing a screen they were again dispersed. The more luminous parts of the spectrum appeared the most agreeable to them. M. Bert thinks also that, like ourselves, they have no ocular perception of ultra-red or ultra-violet rays.

The change of colour in the chameleon has been variously explained. M. Brucke's recent researches show that it is due to varying dispersion of solar light in the coloured cells; a phenomenon of the same kind with that observed in soap-bubbles and thin plates. The tint of the animal passes from orange to yellow, from green to blue, by a series of shades dependent on the state of the diurnal radiation. M. Brucke thinks temperature has no influence on the phenomenon.

The hair and feathers of animals are of a darker colour on the back than on the belly and breast. Their colours are also more intense in summer than in winter. Butterflies of the night never have the brilliant tints of those which appear by day, and of the latter those of spring are much brighter coloured than those of autumn, showing a congruity with other colouring in nature. Night birds also have a darker plumage and a softer tegument than day birds. We have, again, a striking difference of colouring between the animals of cold regions and those of the torrid zone. The influence of light on organic forms, as well as colour, is also seen in the gradually increasing abundance and variety and beauty, from pole to equator.

The influence of light on the human system presents many interesting points. An infant instinctively seeks the light, turning in the direction whence it comes. The organ most affected by light is the eye, and the excitability of the retina is very variable. Prisoners in dark dungeons have been known to acquire a wonderful distinctness of vision in the dark. The eyes of such also become sensible of very slight changes in intensity of light. Lavoisier, in 1766, wishing to acquire a greater delicacy in perceiving the relative intensities of certain flames, shut himself in the dark for six weeks. Dionysius the Tyrant constructed an inclosure with bright illuminated chalk walls, into which he introduced prisoners who had been kept long in darkness, whereupon they became blind. Travellers to polar regions speak of the injurious effect which the reflection of light from the snow has on vision. When the impression of light on the eye is powerful and instantaneous, the retina suffers most. If less energetic and more prolonged, the humours of the eye are altered. The phenomena of sunstroke arise from the action of light, not from elevation of temperature. A very intense artificial light (such as the electric) may produce it. The rays causing it appear to be the violet and ultra-violet, and those studying the electric light often employ glass screens which absorb these rays.

The skin is evidently affected by light. The hands and other uncovered parts have a darker colour than the covered. Country people are browner than those in the town. In latitudes little distant from each other are to be found variations in colour of skin corresponding to solar luminous intensity. In Europe several varieties are perceptible; but the same phenomenon may be observed among darker peoples. For example, the Hindus of the Himalayas are nearly blind; those of Malabar and Ceylon are darker than some of the negro tribes. The Egyptians present an ascending chromatic scale as you advance from the mouths of the Nile towards its sources. Again, the women of certain coloured races, being kept constantly under cover, become whiter, so do the Esquimaux in their long winter. And many other facts might be given. Doubtless, many other influences co-operate in such effects, but the effect of luminous radiation is incontestable.

All the organic functions benefit by light. Darkness seems to favour the preponderance of the lymphatic system, the susceptibility of the mucous membranes to catarrhal affections; the flacidity of the soft parts, swellings, irregularities in the osseous system, &c. Miners and others are subject to these disadvantages.

Certain spectral rays influence animal life as darkness does. M. Bert found the orange rays hinder the development of Batrachians. Now, these same rays are favourable to plant growth; and, on the other hand, green light, which is hurtful to plants, is very favourable for animals. M. Dubrunfaut hence divides the rays of the spectrum into two complementary groups, a green and an orange, manifesting antagonistic qualities in nature. Green light being a powerful stimulant of the animal functions, makes the spring time specially enjoyable.

The relation between perfection of form and exposure to light is also seen in the case of human beings. Light tends to develop the different parts of the body in harmonious proportion. Deformities are most rare among the coloured races. Men who live naked have all their parts bathed in light, whence arises regularity of functions and development. It might further be shown how the functions of the mind are affected by light. A mind that has been dull and sluggish throughout the day, in a sombre room, will in the evening become lively and active in the brilliantly lit hall or drawing-room. And every one is familiar with the opposite effects of a cloudy and a bright day upon the spirits. A. B. M.

MEASUREMENT OF WAVES.

A PAPER on this subject was read at the meeting of the British Association, by Mr. C. W. Merrifield, F.R.S., Principal of the Royal School of Naval Architecture. The author was induced to look into this matter in consequence of a question put to him by Mr. Francis Galton as to whether it was possible to arrive at any definite estimate of the "roughness of the sea," at present recorded for meteorological purposes at a very coarse guess from mere inspection. He considered it was desirable to confine the measurement to the two points of ascertaining the aggregate height of the waves and their number during measured intervals of time; and he had devised simple and compact machinery for this purpose, as well as for obtaining profiles of waves when desired. The machinery could consist of a float sliding up and down strained wires on a platform like Brighton or Scarborough piers. A line from this float could pass over a pulley, the motion of which, transmitted through its shaft, would give all the required measurements. The measurement of the aggregate height of the waves would be effected by simply connecting a ratchet wheel, pawled so as only to turn one way, with the float pulley. A projecting stud on the ratchet wheel would record the aggregate height of the waves by means of any mechanical counting arrangement. In order to count the waves it was simply necessary to record the number of times the float pulley reversed its motion. This was effected by a reciprocating frame connected with a ratchet wheel by a pawl which the wheel could reverse by lifting the reciprocating frame. The method of counting which he proposed was to make a pencil which, if undisturbed, traced a straight line on a long slip of paper, such as a Morse telegraph coil, and received a slight shake at stated numbers. Time would be marked on the same paper by a clock giving a similar shake to another pencil at stated intervals of time. In this manner a permanent and continuous record of the number of waves and aggregate height at all times would be automatically made. The machine might be perfectly boxed in, with no other communication with the external pulleys and float than a shaft passing through a stuffing box. The recording machinery would thus be secure from injury. It would, moreover, require attention only once a day. Mr. Merrifield also described an arrangement by which the same machine might be made to trace the profile of waves whenever required. But this additional apparatus would require to be specially set at work when required, the waves of the sea being far too numerous for it to be possible to take portraits of all of them. He suggested that it would be very interesting to establish such an apparatus at Brighton Pier.

Mr. Hawkshaw suggested that observations should be made with the view of ascertaining the motion of waves with special reference to force, which would be a matter of practical importance to engineers; but Mr. Merrifield explained that his experiments had been for meteorological purposes rather than to discover the character of waves in the open sea.

DEEP-SEA SOUNDING-LINES.

A PAPER was read at the British Association meeting by Sir W. Thomson, F.R.S., on "The Use of Steel Wire for Deep-sea Soundings." The great difficulty of deep-sea soundings consisted, he said, in the resistance of the water to the material used for letting down and raising the weight, and that the only way in which that difficulty had ever been overcome in very deep soundings had been by employing extremely heavy weights. When the depth of three hundred fathoms was passed, the ordinary lead line ceased to be available, or at all events convenient; and until very recently the difficulty of calling up a long line and heavy weight from considerable depths was so great that it had become the practice to leave the weight behind, simply bringing up the specimen of the bottom. The Admiralty had made great improvements in deep-sea soundings, but even with the rope now used its resistance to the water when drawn up by hand at considerable speed was so dangerous as to necessitate the use of steam power. When there was great resistance to the line, and the currents carried it away to a distance, it was difficult to know when the bottom was reached. However, he believed that with so great a weight as 3 cwt. the depth of the water might practically be perceived within a few fathoms, and although it must be difficult to stop the line all of a sudden, he did not think the error in the sounding could be considered to be serious. To many it had occurred that wire rope would be a great advantage, inasmuch as it would occupy much less space and, therefore, create less resistance to the water. The objections which had been raised to wire were that it was liable to rust, that the men could not handle it, as it would kink, and it would go down in a heap over the weight; but he believed all those difficulties might be overcome by proper care. It had been considered necessary to have a great deal of mechanism, but all that he deemed to be essential was a wheel, which would operate like a brake, and around which the wire should be twined, the wire used being No. 22 gauge, of the quality known as the homogeneous steel wire, which could be manufactured in great lengths, was ·03in. in diameter, weighed 12lb. per statute mile, and broke with a weight of 252lb. To the end of the wire was attached a piece of hemp cord, which carried the weight, and by that means the wire was prevented from touching the bottom at all. He had made an experiment in mid-ocean, at a depth of 2,700 fathoms, experiments with the apparatus and materials he had indicated, and it having been attended with the most perfect success, he was sanguine that if wire were allowed to take the place of cord in deep-sea soundings, it would be far more economical, and the calculations themselves would be more accurate. Mr. Hawkshaw thought it would be a great pity if our deep sea sounding expedition completed its labours without adopting Sir W. Thomson's recommendations; and in the discussion which ensued it was generally conceded that wire would more effectually resist water than a porous material such as rope; a doubt was, however, expressed whether any plan could be adopted to altogether remove the danger of wire breaking when the soundings were being conducted in rough weather.

DR. CARPENTER ON CHALK.

THE following is the substance of the lecture delivered by Dr. Carpenter to working men, at the close of the meeting of the British Association at Brighton. After alluding to the fact that many persons were disappointed that he had not in his opening address, as it were, "cooked up an old dinner," by referring to his own researches, the lecturer said:—

You all know what chalk is. I need not tell you Brighton men what chalk is—that is to say, I need not tell you what it looks like, but I shall have to tell you what it is. If I were to say to you, "Do you know what chalk is?" "Oh, of course we do! Don't you suppose we know a piece of chalk when we see it?" But then I think I can tell you a little about this chalk. In the first place, where do you see it? You see it forming cliffs on your coasts; you find it forming downs in your interior; you find it wherever there is a little removal of the surface grass; you find plenty of chalk pits in various parts of the ridges of your downs. Where there is an exposure of the cliff, you will see, if you observe, that there are certain indications of what we call stratification—that is, that there are regular strata or layers one above another. And these are separated more or less distinctly from each other. Sometimes by distinct lines, and sometimes by lines of flint, for example, but you will not see them always horizontal: sometimes they are inclined, and sometimes vertical, but they were all horizontal once. These are the lines which intimate the successive deposition that took place at the bottom of the deep sea; for there is no question now but that the whole of the chalk formations of this part of England (which you see at Dover and Folkestone higher than in this neighbourhood, and at Alum Bay and the Needles) were once at the bottom of the sea. Some of these layers were horizontal, and some of them tilting up; but it would carry us too far if I were to carry you to consider the causes for this tilting-up. I want you to understand that these layers of chalk one above another indicate their successive ages. What position does this chalk occupy with regard to the other strata, to the great series of stratified rocks which geologists tell you of? It is a comparatively new formation (that is comparatively). The general series of stratified rocks were first studied in England; for it happens, by a most fortunate thing for science, that in Great Britain we have a sort of comprehensive pocket edition of the great series of stratified rocks. Beginning in Scotland and Cumberland and North Wales we have the oldest of these rocks; then, in the middle of Wales, we have those rocks called the Silurian system by Sir Roderick Murchison. In the Midland counties and the west of England, in Shropshire and Devonshire, we have the Devonian and the Silurian, all of them inclined—all of them shelving towards the east. And then you have that great and most important formation, the carboniferous limestone under which the coal-basin lies. Then comes the end of the series; all these lie more or less regularly on one another; and then again we find animal forms passing from one another. This series we call the Palæozoic, which is a Greek compound meaning ancient life. We come at the end of that to a great break; and I wish you to understand that the break occurs in this country, in America, and in every part of the continent of Europe. But it does not follow that it occurs everywhere else; but we find an apparent great break in the series being marked by this in the next strata, where we find no animals at all; the fossils of the new red sandstone are rather scanty, but there is the beginning of a new set of types. It generally lies unconformably with two different degrees of slope, and that makes great changes between the mountain limestone and the magnesian limestone. We do not use the term primary now for the old period, because that applies to a still older set; but the secondary is a term still in use, and we sometimes call it the Mesozoic, or middle-life period. Then we have the lias—the formation of the middle counties, and Dorsetshire and Bristol. There is a band of lias crossing the middle of England. Then we have the oolite which gives us our Bath stone and Portland stone. Then we come to the greensand and the chalk. The chalk is the last of that strata. There is this very beautiful type of life, the Pentacrinus. Mr. Willett has a beautiful specimen in his collection, which, I am happy to hear, will henceforth belong to Brighton. It passes up from the lias into the chalk. Then there is a similar great break to that at the end of the Palæozoic series, before what are called the tertiary. These deposits generally lie unconformably upon the chalk, and the types of life are mostly new. They cannot be traced distinctly from the chalk. There seems to have been a dying out of the animals of the chalk, and we begin with a new set of the animals of the tertiary strata. It is very curious that both London and Paris are situated upon the great bases of chalk of a subsequent formation, some of them fresh water and some of them local deposit. Now, the clay in our own area in the neighbourhood of London—that stiff clay which lies immediately over the chalk—is the local representative in that area of a very different formation in the south of Europe, namely, that great limestone which makes hills and even mountains in some places, and which runs along both the south of Europe and the north of Africa, and into India. The London clay was formed where clay was plentiful. There are no means of determining whether it is nummulitic, but we know it is of the same period, because we find in it nummulites representing the great nummulitic series. It will be seen, on examining a specimen of nummulitic limestone, that it is a chambered shell, and divided into an immense number of partitions. It is of this nummulitic limestone that the pyramids of Egypt are built. I had the pleasure of visiting the pyramids last autumn, and brought home a beautiful specimen of this limestone. I will now just give a general sketch of the position of the chalk. It is the highest of the secondary series, and it is usually considered that there is a great gap between the chalk and tertiary formations. Every geologist who is interested in the progress of modern science knows that, more and more, as we examine it carefully and minutely, there are in this formation great gaps, but if we find a gap here, there is a continuity there. A gap is caused by the formation being covered by sea; it remains here for ages; and, therefore, when it sinks, a fresh deposit takes place, but this deposit represents altogether different conditions. But then, during that period, deposits take place elsewhere. In Russia, there are immense areas covered with new red sandstone. I speak under correction, because I do not profess to be a geologist, but merely a zoologist, when I say this, but I believe large areas in Russia have never been under water since the old red sandstone deposits. Supposing they were to sink, a fresh deposit would cause an enormous gap. Now, you see it is entirely a question as to whether a particular area has been above the sea or not, and I believe all the modern geologists are now coming to the conclusion that, if there is an interruption in one place there is continuity in another. Only two days ago I had the pleasure of a conversation with one of the most distinguished French geologists upon this very point, and I said, "It is my opinion that, if there is an interruption here there is continuity there." He said, "I am entirely in accordance with you," and he came to the conclusion that where the interruption seems the greatest it is bridged over by what we have found, or what we shall hereafter find, in some other part. I will give you an illustration. This is not a proved fact yet, but it will show you the kind of knowledge that we may get. I daresay many of you have heard, with great regret, that the health of Professor Huxley broke down at the beginning of the present year. He was obliged to go to Egypt to recruit it, and he went up the Nile a great deal further than I did. I asked him "Did you follow up the curious nummulitic limestone?" "Yes," he said, "and as far as I could see, it rested conformably upon the chalk." Now, in the south of Europe and here, the London clay does not lie conformably on the chalk, nor does the nummulitic limestone of the south of Europe generally. Now, we come back to the question, what is chalk? Chalk is an aggregation of either very minute shells, or the remains of very minute shells, which we call Globigerinæ. Hundreds of them would only weigh a grain. What is the nature of the animal? It is a little lump, or rather a series of lumps of jelly, with no mouth, no stomach, no nothing, except that it can send out long threads, the minuteness of which is something hardly conceivable to you. They are not the ten-thousandth of an inch in diameter. They go out in clusters; they diffuse themselves through the water, lay hold of particles still minuter than themselves, and they draw these particles back: there is a continuous restless movement. I have sometimes described these as a sort of animated spider's web. It is always sending out some of these threads and other threads are being drawn into it, and in this manner, without any distinct mouth or stomach, the nutrient particles are constantly being drawn in, and in this way the animal is supplied. Now, when I tell you that there is a greater quantity of this life at present existing than of all other kinds of life put together—you will see what an important part they play in nature. The whole bottom of the Atlantic, except where cold currents come down, is covered with these animals and masses of decayed and broken shells. There is so much in the Atlantic that I cannot pretend to form an idea of how much there can be. In dredging the Atlantic at one mile in depth, we brought up nearly half a ton at one time, and at three miles depth we brought up 1½ cwt., besides our three miles of line and a heavy dredge. I shall give you a little history of this remarkable inquiry. Some years ago, my friend Professor Williamson, of Manchester, had an opportunity of examining some mud brought up from the Levant, and he found, by the aid of the microscope, that there were a large number of these organisms there. These all belong to the same general group, and are called Foraminifera, which means many-holed; and as these shells are filled with small holes, you will see that this name is applicable to them. These holes are pores (as you see in the diagrams). All these shells are composed of carbonate of lime, and now you see why geologists believed that lime, which is found in limestone rocks, at one time or another formed parts of this animal, which has the power to draw lime from the water and then pour it out again in the form of shells. Geologists have come to the conclusion, very advisedly, that all the lime that is found in various limestones has at one time formed part of an animal. Here we have this mass of chalk, which has all formed part of these Globigerinæ, which have drawn into themselves the lime from the sea water, and exuded it from these shells, just as shrimps, or lobsters and oysters. All these have lime. Oysters form layer after layer. The lobster forms a new shell. Some of you know what are called "crab's eyes" in the stomach, which are little accumulations of lime stored up against the time when the crab wants to make a new shell. Then these disappear from the stomach. I give you this illustration to show you how lime passes from sea water into shells. We have long known that chalk was made up of this and deposited in the deep sea. There are certain minute particles which I won't speak of, because we do not know the meaning of them, but we find certain other curious particles which will afford geologists study for a good while, and these we find in our chalk mud. I have here two lumps of dried mud which we brought up from the bottom of the Atlantic, and not one of you would know these from pieces of chalk, except that they are a little grayer, and they have a little more sand. But the important point is that these coccoliths in our chalk are precisely the same as those which are found in the old chalk itself. There is, therefore, a precise correspondence between the mud which we have brought up from one mile and two and three miles from the bed of the Atlantic and the whole of those cliffs. Now, as to animal life. We have found a great number of types most distinctly characteristic of the cretaceous period. The most remarkable we met with—it was our great prize—was a wonderful sponge, of which I have a drawing. Now, I will just mention to you the fact, as I think it may interest you, that I have been knocking about the North Sea making some deep-sea explorations. Our first vessel was not suited for our purpose. It was a most antiquated steamer, being the first that was built for her Majesty's service in the year 1825. We had very rough weather, and for several days we were knocking about doing a little work now and then. But one day we had a most successful dredge, and I rather glory in it because it was done on a Sunday. I glory in it because it was a study of one of the most important and most wonderful of the works of nature and of the works of the Creator. After several days of knocking about we had a fine Sunday. I said to the captain that I was very unwilling to work the men on a Sunday, but that we must not miss the opportunity, for it was a good and a holy work to do. Reward was given us. The discovery of this sponge was, to all scientific men, one of the most remarkable that has been made. Many of you have seen the wonderful and beautiful works of Mr. Gould, the ornithologist, who went to Australia, and expended £8,000 in his visit and in the production of his work; and when he saw this specimen he said, "Dr. Carpenter, I envy you. If I had only found such an interesting specimen, it would have been a reward to me for all my toil and expense." You may suppose, therefore, if this excites such an interest among those who are not of my own line of inquiry that it must have created feelings of intense pride in my breast. This specimen is of great interest in itself, and it is one of a type of skeleton. The skeleton of the ordinary sponge is horny, and is useful because it has no flint in its composition. It has needles in it which will run into your hands, but in this particular type of sponge the skeleton is composed of flint. Now, the great interest of this is that it is a new specimen of a most remarkable group of sponges. This sponge represents the whole type of chalk fossils. Professor Huxley one day came to my house to see it; he knelt down at the table to look at it, and, turning to his wife, said, "Now, do not speak; this surpasses the love of woman." Last Saturday I was on Lewes Downs, on Mount Harry, and I was asked to say a few words about the chalk. I just adverted to this, and my friend Mr. Crosskey, a very able geologist, who was born and brought up at Lewes, at once said, "Why, the whole of this hill is full of Ventriculites. I have got them over and over again in the chalk in this hill." Now, I think you will understand what a point of extreme interest this was to us. Here we found the type of the old Ventriculites, which was supposed to be extinct, still going on in the deep sea, and not only the sponge, but a great number of other animals; and the more we have examined them the more curiously they correspond to the old chalk forms. One of the last we got was a most singular specimen of the urchin tribe. You know the globular form of the common sea-egg, but this most singular specimen, instead of being like a box shell, was like chain mail, a number of separate pieces, all flexible; and it flattened itself out when laid on the hand, and I said to my friend, Mr. Wyville Thomson, who is a little heavy sterned, "This looks as if you had sat upon it." One or two imperfect specimens had previously been found, and may be seen in the British Museum, but here we had the animal actually existing at the present time. I will not descant further upon this, but will just go, in the last place, to the general question of what this means. Now, the credit of the suggestion is entirely due to Mr. Wyville Thomson—but it devolved upon me to publish it, as I was the reporter of the expedition, and I entirely fathered it—that really there has been no cessation in the production of chalk from the old cretaceous period to the present time. Perhaps the form in which we put it out was open to a little exception. We said that we might be considered to be still living in the cretaceous epoch. Very eminent men, such as the late Sir Roderick Murchison and Sir Charles Lyell, have taken exception to that statement, and perhaps not unreasonably, but it all depends upon what you mean by the words "cretaceous epoch." Sir Charles Lyell says the meaning of the words is that period which was terminated by the disappearance of a great number of types of animal life that you do not find in that chalk. Where, he asks, are the chambered cephalopods, where are the fishes that were characteristic of the old chalk? Do you find any other? The shells of the nautilus type, the animals of the cuttle-fish kind? Well, we hide our diminished heads and say, "Certainly we do not find them, but still we think that the evidence favours the actual continuity, that there has never been a break or cessation, and the ground we go upon is this, that during the whole of the tertiary period there is no evidence in this north-western portion of Europe, nor is there any evidence on the other side on the corresponding latitude, that the bed of the Atlantic has ever gone up more than about 2,000ft." Now, what is 2 000ft. to 15,000ft.? Why it only leaves you 13,000ft. instead of 15,000ft. We find tertiary shells from 1,500ft. to 2,000ft. on Welsh mountains and elsewhere. There is evidence that the land has been lifted up 2,000ft. or near it, in the tertiary period, but there is no evidence that it has been lifted more, and, if not, the bed of the Atlantic must have been the bed of the Atlantic from the time of the commencement of the formation of the tertiary strata. We have every reason, therefore, to believe that our modern chalk formation goes back to the commencement of the formation of the tertiary strata. Now, may not we go a little farther? Mr. Darwin taught us first that there are great areas in the Pacific ocean at the present time in course of elevation and of subsidence; that there are parts where by the condition of the coral we can surely assert that the bed of the ocean is slowly, slowly sinking down, and that there are other parts in which we can as surely say that the bed of the ocean is as gradually rising. Very well: now I apply that doctrine to this formation of chalk. I believe that at the time when the area of Europe and Britain, and what was formerly chalk lying at the bottom of the deep sea, that then occupied a great part of Europe, had been formed, when the elevation gradually lifted it up above the sea, the bed of the Atlantic was going down, and that the chalk animals migrated from what was then the old chalk sea of Europe into the new chalk sea of the Atlantic; that certain species that would bear the migration went along, and others that would not bear it did not go, and died out. But now, then, comes my friend, Mr. Prestwich, who, in his presidential address to the Geological Society last year, adopts that view, and gives us the rationale, and a most beautiful rationale I think you will consider it. Mr. Prestwich, on other grounds, quite irrespective of any hypothesis of ours, believes that the old chalk sea of central Europe was a warm sea, that it did not communicate with the Polar Sea. He believes that at the end of the chalk period a communication was opened between the Polar Sea and the sea of central Europe; that that let in a great quantity of polar water; that the temperature of the old chalk sea was considerably reduced; and that the reduction of temperature killed off fishes and these higher molluscs, but left us those lower forms which could survive the reduction of temperature. I think you will say this is one of the most beautiful of geological speculations (it is no more than a speculation) ever put before the world. In the greensand, which is all silex, composed of siliceous minerals, you find these little particles. Professor Aaronberg, who is one of the greatest microscopic discoverers, has shown that the greensand which occurs in the geologic period contains abundant internal casts of Foraminifera, and I can assign each one of those on the diagrams to one or other of the order named by Professor Aaronberg. What we now know to be chalk does not always retain its present condition as chalk. In the cliffs of the Giant's Causeway, in Ireland, you will find what we know to be chalk, by the series of its strata, &c., converted into white crystallised marble, and this marble was once animal life, as chalk was; and we know it was so by the course of interpretation which geologists are accustomed to employ. There we find great masses of carboniferous limestone which forms the bed on which the coal-measures are deposited; and there we also find coral reefs, and other beds which geologists, like Phillips, have concluded to be deep sea beds. I believe it will prove that these beds were formed like chalk and converted to the condition they at present are by the subsequent process of metamorphosis. I must now speak of the newest of the limestone formations—the lowest stratified series now known as the Laurentian, which is abundantly developed in all the countries of Europe. In this series there has been found to be serpentine limestone, composed of layers of lime and serpentine. Professors Lowman and Davidson have been enabled to decide that these serpentine layers are of organic structure like that of the internal casts found in the greensand. Sir Roderick Murchison had been enabled to make out that the Laurentian series in Canada is 90,000ft. thick, and the azoic is at the bottom of that. Now when you think what that 90,000ft. represents, you will see that we naturalists and geologists do not let astronomers have it all their own way. You hear about the immense lapse of ages that must have existed before we got the light of Sirius, and that, if Sirius were extinguished now it might be some millions or billions of years before we should see it again. I believe that these inquiries carry us as far backwards in geological time, as the inquiries of the as ronomers carry them back in distance and time in their way. There is something romantic in this. You know it has been said that reason carries us where imagination scarcely dares to follow. The spectroscope is the greatest romance, and goes beyond all the beyonds, if I may use the expression. But I think those matters which have been placed before you to-night are not altogether behind them in interest, and that they will have your thoughtful consideration.

INSTINCT.

An interesting paper on this subject, interspersed with anecdotes, was read by Mr. D. A. Spalding at the meeting of the British Association. With regard to instinct we have yet to ascertain the facts. Do the animals exhibit untaught skill and innate knowledge? May not the supposed examples of instinct be after all but the results of rapid learning and imitation? The controversy on this subject has been chiefly concerning the perceptions of distance and direction by the eye and the ear. Against the instinctive character of these perceptions it is argued that, as distance means movement, locomotion, the very essence of the idea, is such as cannot be taken in by the eye or ear; that what the varying sensations of sight and hearing correspond to, must be got at by moving over the ground by experience. The results, however, of experiments on chickens were wholly in favour of the instinctive nature of these perceptions. Chickens kept in a state of blindness by various devices, from one to three days, when placed in the light under a set of carefully prepared conditions, gave conclusive evidence against the theory that the perceptions of distance and direction by the eye are the result of associations formed in the experience of each individual life. Often at the end of two minutes, they followed with their eyes the movements of crawling insects, turning their heads with all the precision of an old fowl. In from two to fifteen minutes they pecked at some object, showing not merely an instinctive perception of distance, but an original ability to measure distance with something like infallible accuracy. If beyond the reach of their necks, they walked or ran up to the object of their pursuit, and may be said to have invariably struck it, never missing by more than a hair's-breadth; this, too, when the specks at which they struck were no bigger than the smallest visible dot of *i*. To seize between the points of the mandibles at the very instant of striking seemed a more difficult operation. Though at times they seized and swallowed an insect at the first attempt, most frequently they struck five or six times, lifting once or twice before they succeeded in swallowing their first food. To take, by way of illustration, the observations on a single case a little in detail:—A chicken at the end of six minutes after having its eyes unveiled followed with its head the movements of a fly twelve inches distant; at ten minutes, the fly coming within reach of its neck, was seized and swallowed at the first stroke; at the end of twenty minutes it had not attempted to walk a step. It was then placed on rough ground within sight and call of a hen with chickens of its own age. After standing chirping for about a minute, it went straight towards the hen, displaying as keen a perception of the qualities of the outer world as it was ever likely to possess in after life. It never required to knock its head against a stone to discover that there was "no road that way." It leaped over the smaller obstacles that lay in its path, and ran round the larger, reaching the mother in as nearly a straight line as the nature of the ground would permit. Thus it would seem that, prior to experience, the eye, at least the eye of the chicken, perceives the primary qualities of the external world, all arguments of the purely analytical school of psychology to the contrary notwithstanding. Not less decisive were experiments on hearing. Chickens hatched and kept in the dark for a day or two, on being placed in the light nine or ten feet from a box in which a brooding hen was concealed, after standing chirping for a minute or two, uniformly set off straight to the box in answer to the call of the hen, which they had never seen and never before heard. This they did struggling through grass and over rough ground, when not yet able to stand steadily on their legs. Again, chickens that from the first had been denied the use of their eyes by having hoods drawn over their heads while yet in the shell, were, while thus blind, made the subject of experiment. These, when left to themselves, seldom made a forward step, their movements were round and round and backward; but when placed within five or six feet of the hen mother, they, in answer to her call, became much more lively, began to make little forward journeys, and soon followed her by sound alone, though of course blindly. Another experiment consisted in rendering chickens deaf for a time by sealing their ears with several folds of gum paper before they had escaped from the shell. These, on having their ears opened when two or three days, and being placed within call of the mother concealed in a box or on the other side of a door, after turning round a few times ran straight to the spot whence came the first sound they had ever heard. Clearly of these chickens it cannot be said that sounds were to them at first but meaningless sensations. One or two observations favourable to the opinion that animals have an instinctive knowledge of their enemies may be taken for what they are worth. When twelve days old one of my little protégés running about beside me gave the peculiar chirr whereby they announce the approach of danger. On looking up a sparrow hawk was seen hovering at a great height over head. Again, a young hawk was made to fly over a hen with her first brood of chickens, then about a week old. In the twinkling of an eye most of the chickens were hid among grass and bushes. And scarcely had the hawk touched the ground, about twelve yards from where the hen had been sitting, when she fell upon it and would soon have killed it outright. A young turkey gave even more striking evidence. When ten days old it heard the voice of the hawk for the first time, and just beside it. Like an arrow from the bow it darted off in the opposite direction, and, crouched in a corner, remained for ten minutes motionless and dumb with fear. Out of a vast number of experiments with chickens and bees, though the results were not uniform, yet in the great majority of instances the chickens gave evidence of instinctive fear of these sting-bearing insects.

NEW METHOD OF OBTAINING STEARIC AND PALMITIC ACIDS.

Mr. W. Lant Carpenter read a paper on the process of removing albumen in fats. In the International Exhibition of 1871 there were exhibited several specimens of stearic acid, &c., manufactured by Professor J. C. A. Bock, of Copenhagen. It was stated that they were produced by a new process, which possessed very many advantages over any other known method. Mr. Carpenter having twice visited Copenhagen to study the process, and having extended its application to neutral fats other than tallow, in England, thought an account of the scientific aspects of the subject might not be uninteresting. Professor Bock was led up to his invention by patient microscopical and chemical study of the properties of neutral fats, and reflection upon the reasons of the disadvantages of methods hitherto practised. These disadvantages Mr. Carpenter pointed out at some length. Hitherto, when fats were decomposed by alkali, a considerable excess of alkali above the theoretical quantity was required, unless the operation were conducted under very great pressure, when the risk of explosion was great. When they were decomposed by sulphuric (or any other strong) acid, as was usually the case in England, much of the fat was lost by being charred and burnt, and the remainder was so black that it was necessary to distil it to render it good enough in colour for manufacturing purposes. The risk of fire, and of explosion, in this operation, was considerable, and the expense great. Professor Bock had shown that most neutral fats were made up of minute globules of fat, surrounded by albuminous envelopes, which form 1 to 1·5 per cent. of the weight of the fat, and he considered that the excess of alkali, of pressure, or of heat required to decompose fats, was really used in the destruction and removal of these albuminous envelopes, which also attracted to themselves the colouring matters contained in the fat, or those produced therein during its decomposition. The existence of the albumen could be demonstrated in the laboratory by dissolving the fat in ether or benzole, and precipitating the solution by water, or by boiling the fat on a strong solution of oxalic acid. In both cases the albuminous envelopes collected at the plane of junction in the two liquids. In Professor Bock's process, the albuminous envelopes were broken and partly destroyed by the action, for a limited time, and at a given temperature, of a small quantity of strong sulphuric acid. The neutral fat then poured out from the envelopes in a state ready for decomposition by water in open tanks, an operation which required several hours for its complete performance. Its progress was judged of by microscopical examination of the crystals of the fat, or fatty acid, formed by slowly cooling a thin layer upon a glass slip. When it was completed, the glycerine, which was dissolved in the water used for the decomposition, was drawn off, purified, and concentrated for sale. The fatty acids, amounting to 84 per cent. of the original fat, were at this stage of a very brown or blackish colour. The next operation was to eliminate the albuminous envelopes, and with them most of the colouring matters. This was done by submitting the fatty acids in open tanks to the action of dilute solutions of certain exidising agents, by which the black matters were partly oxidised, and their specific gravity greatly increased, so that when the oxidation had proceeded far enough, they readily subsided to the bottom of the tank, leaving the fatty acids comparatively good in colour. After two or three washings with dilute acid and water, the fatty acids were cold pressed and hot pressed in the usual way, and the result was a stearic acid higher in melting point and greater in quantity than could be produced in any other way, and an oleic acid excellently fitted for the manufacture of soap and other purposes. One of the greatest advantages of the process was, that all operations were conducted in open tanks, with steam not exceeding 35lb. pressure. Mr. Carpenter stated that he was at present engaged in applying this process to palm oil and other vegetable fats, and he illustrated his paper with specimens of the various stages of manufacture from Copenhagen, and from the factory in which he was a partner.

MECHANISM.*

(Continued from p. 584.)

THE use of wrapping connectors is very old; it was one of the earliest modes adopted for driving machinery, and here is one of those lathes which has given the name to the tool we now have, though our present lathe bears no more resemblance to it than do substances that never were like each other. Although in a course of lectures on mechanism so universally useful a machine as a lathe could not avoid notice, yet the primitive form of the instrument seems to have been "improved out of existence."

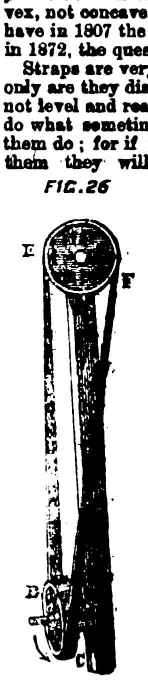
In Clerkenwell, however, the original lathe is still in use, and the construction of one is this:—A long lath, or elastic branch of a tree, is put over a beam, one end being held firm; at the other end, therefore, is an elasticity similar to that in a bow. A cord from the end of the lath passes round a piece of wood roughly shaped cylindrically with a hatchet, thence it passes to a treadle, which, in the one before you, is nailed to the floor by a piece of common shoeleather. The whole tool is thus complete, and motion is given by pressing the treadle. When the pressure is withdrawn the spring of the lath takes the cord back again, and so a backward and forward motion is obtained. Whatever may be the amount of time occupied in turning one way, there is an equal loss of time in turning backwards. Whilst so returning the workman withdraws the tool, replacing it as the work comes forward again. Therefore half the time of the man is lost, while the work goes backwards. There are two trades, and perhaps only two, in which this antiquated lath-lathe cannot be dispensed with. No mechanism has yet enabled the artisan to replace what we should call the rough-and-ready varying travel of that lathe. The two trades in which it is used are the watch-case makers and that of making brass water or steam taps. On looking at the case of a watch you will find in the rim one or two hinges. These hinges are steps to the turning tool. Hence very short arcs of circles have at times to be turned or "milled," too short and too varied to permit of special adjustments. Hence, chucks for segment-turning are not available.

No doubt mechanism might be invented, but the time lost in setting the mechanism would be more than the time now occupied in doing the work. Therefore, a man skilled at the trade—and one man told me he had been working at one of these lathes 30 years—can turn half-an-inch, or two or three inches, or not a quarter of an inch, of a circumference of 8in. or 9in.

Emerson, for whom a mechanic ought to have great respect, suggests another mode of retaining cords in pulleys, that knots should be put upon the cords in order that the pulley might be driven, and the cord instead of being smooth would be covered with knots, which would hold in the roughnesses of the pulley and so drag it round. As to the smooth pulley F, Fig. 24, (p. 584) here is Young's book, entitled "A Course of Lectures upon Natural Philosophy and the Mechanical Arts," delivered in the Royal Institution of Great Britain, and printed in 1807. Now, let us see what Young in that day wrote. He says (Vol. 2, page 183), "When a strap runs on a revolving cone, and is sufficiently tight, it advances towards the base of the cone and does not slide towards the point; for the edge of the strap nearest the base is driven more rapidly than the other; and the portion advancing towards the wheel is driven towards the base. Therefore, in order that a strap may remain on the middle of a wheel, it must consist of two portions of cones joined at their bases, and if rounded must be convex, not concave at its circumference." Thus we have in 1807 the true principal laid down, and yet, in 1872, the question is still occasionally discussed.

Straps are very peculiar in their behaviour. Not only are they disposed to stop on a pulley that is not level and reach the highest point, but they will do what sometimes mechanics try in vain to make them do; for if you observe the laws that govern them they will most willingly "drive" round corners. Nothing is more easy, and nothing is more difficult—if not done in the right way. Here is a pulley at the bottom of a shaft and one at the top, at right angles; as you see, there is no difficulty in making the strap turn this right-angled corner. There is nothing to hold it on, but it keeps its place. Yet, if the driving pulley be turned in the other direction the strap will not keep on. The principle is very simple, and applies to shafts oblique to one another as well as to shafts at right angles to one another. The mode of operation to secure the strap remaining on is this—Ascertain the point where a perpendicular to the two shafts could be drawn. Draw a line, in fact, from one shaft to another, at right angles to the two shafts. The upright, in Fig. 26, is clearly perpendicular to both shafts. Now, take from that perpendicular a distance for the top pulley equal to the radius of the lower pulley, and for the lower pulley a distance equal to the radius of the top pulley. The radii of the pulleys are the portions involved. If the distance from the perpendicular of either pulley be too great, then you will observe that the point on the pulley where the strap enters is not in the plane of the other pulley. All that is needed to retain a strap in its position is that it should leave one pulley in the plane of the pulley on which it is to travel. It must be entering in the plane of the pulley to be moved. It may leave a pulley in any plane, but it may not enter in any plane.

FIG. 26



In Fig. 26 the direction of the motion of the strap is shown by the arrows. Remembering the previous explanation, it will be noticed that the point E in the upper pulley projects or overhangs so far as to be in the plane, passing through the lower pulley D C. Therefore, when the strap is entering on the lower pulley, there is no tendency to run off. Again, the lower pulley D C is so placed that the point C is in the plane E F, and therefore the strap does not leave E F. Not only so, but a small deviation from the true planes may be permitted. For there is, as it were, a contest between the curvature or rounding, as in F, Fig. 24 (p. 584), of the pulley, and the tendency to run off. If, now, the direction of motion of the driving pulley be reversed, then the strap immediately falls off, in accordance with what the preceding reasoning led us to suspect. It is discreditable to a mechanic to hold straps or pulleys, or to use guide pulleys under many circumstances in which these are placed. Whoever does so may perhaps be a good mechanic, but he is a poor mechanician.

(To be continued.)

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

CAVE EXPLORATIONS.

THE report of the Settle Cave Exploration Committee was brought up by Messrs. Boyd, Dawkins and Tiddeman. Both geologically and historically, the results of the labours of the Settle Cave Exploration Committee in the Victoria Cave during the last three years are of great importance. The cave is situated to the north of Ingleborough, and consists of several large chambers, often nearly filled up with earth and stones. Work commenced by cutting a trench through a layer of stones broken from the cliff above, which proved to be resting on a dark layer composed of burnt stones and bones, fragments of pottery, and a few Roman coins. Following the layer right into the cave several bronze gilt ornaments of Roman workmanship were found, and others, certainly not Roman, but bearing a strong resemblance in design and execution to Irish or Celtic works of art preserved in various museums. The Celtic shorthorn, the goat, horse, and pig seem to have been the principal food of the dwellers in the cave, from the great quantity of their bones which were discovered. The strange mixture of articles of luxury and ornament in so wild a place seem only accountable by the supposition that the cave was inhabited, as a place of refuge, by some well-to-do Romano-Celtic family, who carried off with them into their place of retreat many of their valuables, cattle, and other property. The date of this occupation seemed to be between the fifth century, as shown by the barbarous imitation of Roman coins, and the first quarter of the seventh century, when the kingdom of Strathclyde was conquered by the Angles. But besides this evidence was found of a much older occupation. Underneath the Romano-Celtic layer, at the entrance, pieces of chipped flints, broken bones of ox and bear, and rude bone instruments, proved that animals other than man inhabited the cave at a lower level, and therefore before the accumulation of the talus on it. A subsequent shaft being sunk, the discovery was made of a still older occupation of the cave by hyænas. Their broken bones, teeth, and coprolites showed that they must have lived there in large numbers, and the gnawed bones of rhinocerous, cave bear, mammoth, reindeer, &c., showed on what animals they preyed.

In the eighth report of the committee for the Exploration of Kent's Cavern, Torquay, for which an annual grant is made by the Association, Mr. W. Pengelly stated that, during the past year a tooth of the great cave tiger (*Machairodus latidens*) had been met with in the cavern. Flint implements, the undoubted work of man, had also been met with in a bed below the cave-earth, and the oldest stratum yet worked. On this tooth Mr. Boyd Dawkins read a short paper, affirming its true character, after which Professor Phillips stated his belief that many of these bone caverns might be preglacial. In reply, Mr. Dawkins showed that many of the animals which occupied the European area before the glacial period, returned after the cold had passed away. He thought the entire evidence of the Kent's Cavern pointed out that it was of preglacial age, and that man might have been living in Europe at that time. In this Mr. Pengelly concurred.

THE WASTE OF COAL.

THE following is the address delivered by Mr. F. J. Bramwell, President of the Mechanical Science Section of the British Association. After a few preliminary sentences, Mr. Bramwell said:—I have thought over many subjects connected with mechanical science, but I cannot discover any thing more practically important than "Coal." Very few matters are of greater real interest at all times to the nation at large, and very few are more prominently before the minds of the public at the present time; and certainly no subject can be more appropriate for a mechanical engineer, if for no other reason than this, that the steam-engine is still the very crowning glory of mechanical engineering, and that coal is the staff of life and, so to speak, the breath of the nostrils of the steam-engine. . . . . The increase of consumption and the rise in price are startling facts, and force us seriously to reflect upon the use and also upon the abuse of coal. These reflections will make us remember that whatever the known store may be, and whatever new discoveries of other beds may be made, the supply after all is but a finite quantity; that, unlike the fuel wood, which grows year by year to replace the annual consumption, the fuel coal is given to us once and for all; that we are therefore dealing with a store that knows no renewal; that if we waste it, the sin of that waste will be visited upon our children; and that it becomes us to look upon coal as a most precious, valuable, and limited deposit, of which we are the stewards and guardians, justified, no doubt, in using all that we require for legitimate purposes, but most criminal in respect of all that we waste, whether that waste arise from wilful indifference or from careless ignorance, an ignorance culpable as the indifference itself. This being so, let us see how we do deal with coal in those cases where coal must be used; how we might deal with it in such cases; and how we might in certain instances substitute other sources of power for the coal which we now consume.

Utilisation of the Power of the Tide.

And let us first of all consider this question of finding sources other than coal for our motive power. Before the steam-engine was so extensively used as it now is, the wind, the force of streams, and the force of the tide were all employed to give motive power. With respect to the power of the wind, it is to be feared it is too irregular to enable any manufacturer to rely upon it in competition with the steam-engine. With respect to the power of our streams, the altered condition of the soil, due to increased drainage and cultivation, has so materially interfered with the regularity of their flow, that their efficiency as sources of constant power is seriously diminished, while competition with them by steam has become much greater than it was when the water-mills themselves were better off. This state of things, however, might be cured, and, in fact, has been cured in certain districts by the union of a large number of mill-proprietors to form storage reservoirs, from which the water can be delivered with regularity, so as to give a uniform supply to the mills. But the third source of water-power, the tide-mill, which at one time was used to a considerable extent, is now almost wholly discontinued. The causes of this discontinuance are sufficiently obvious. The tide-mill, as formerly constructed, could work for only a limited period in each ebb; and, to obtain the full effect, it had to utilise both the night and the day tides. But while tide-mills laboured under these disadvantages, they possessed the great merit that their power, such as it was, was one that could be depended on, and one which, although it fluctuated, fluctuated regularly and within known and definite limits.

I would suggest that in those cases where there are large manufacturing districts within a few miles of the sea, and where there is a large rise and fall of the tide, coupled, in the outset at all events, with natural indentations of the coast, which might be comparatively readily dammed up for the storage of the water, there such storage should be made that the water should be put to work. Turbines of the best kind (turbines which will work with very nearly the same percentage of the total power given out by the water at any particular moment, whether they are immersed or whether they are not); that these turbines should be employed in pumping water at a high pressure into Armstrong accumulators, and that pipes should be laid on from those accumulators to the neighbouring manufacturing town, and should there deliver their power to the consumers, requiring it to be used by them in water-pressure engines. Suppose a beginning were made with the city of Bristol, which is no doubt a very favourable instance for the application of this suggestion. Here the rise and fall of the tide might safely be taken at 24ft. Half a square mile of water inclosed would, after the most lavish deductions for loss, yield in Bristol at least 5,000 horse-power, probably sufficient to replace the whole of the power of the stationary engines now at work in Bristol.

I will not detain you by further dilating upon this subject; but it does appear to me, looking at the opportunity which good turbines give of utilising the power residing in water under constantly varying conditions of head, looking at the fact that by Sir William Armstrong's arrangements this power may be transferred to an extremely small quantity of water under high pressure, and that therefore such water may be transmitted for many miles through pipes at low velocities, even although those pipes be of no great size,—looking at these facts, I say, I cannot help thinking that there is here open to the talent of the mechanical engineer a new field of enterprise, and one which, if successful, would tend to economise the fuel we so much value, and to leave more of it for consumption in metallurgical operations and in other operations requiring heat.

Before quitting the subject of finding sources of power other than steam, the Section will perhaps permit me to remind them of what has been done in the town of Schaffhausen by a public-spirited inhabitant in the way of utilising the water-power of the Rhine, and of laying it on, so to speak, to every man's door. This has been accomplished by erecting turbines, which are worked by the river, and deliver their power to endless wire ropes carried over pulleys placed alongside the Rhine, the rope extending nearly from one end of the town to the other. This rope gives off power at the end of each street abutting on the river-bank, and that power is conveyed along those streets by a shaft in a channel under the paving. Each manufacturer can make his own communication with these principal shafts, and thus obtain the power he may require. I believe that no more is charged than is just sufficient to pay for the current repairs and for depreciation.

Waste of Coal in Mines.

I will now consider the question how coal is wasted in its use; but before doing so I will say a few words upon the loss that occurs in the coal-mine itself. Happily this loss has for some years past been greatly reduced. More economic systems of working have prevailed, plans of dealing with small coal by washing away its impurities, so as to render it fit for cokeing, have been largely adopted, and thus a great deal of that coal which a few years since would have remained buried in the mine, as not justifying the expense of raising it to the surface and of paying royalty upon it, is now brought to light and is utilised. Nevertheless, we know that at ordinary prices of coal it is to the advantage of the colliery proprietor in many instances to leave a considerable percentage of the seams that are worked, rather than to endeavour to lessen that percentage by the use of a more expensive system of artificial support for the roof; and, further, that it also pays him to leave altogether unworked very thin seams of coal. Thus, in the very outset, we are wasting fuel. But the prevention of this source of waste is a question quite as much for the mining engineer and the political economist as for the mechanical engineer. I have, however, mentioned it before this Section, because the mechanical engineer may contribute to such prevention by devising new modes of extracting coal in places where hand labour would press too heavily upon the men engaged in the work, and where, therefore, their labour would be too costly.

Domestic Waste.

I now come to the question of the way in which waste occurs in the use of the coals that are brought to the surface. This use may be divided into two great branches, the domestic and the manufacturing. I will consider first the domestic use. This is a highly important branch of the subject. It is believed that out of the total of 98 or 99 millions of tons of coal which in 1869 were retained for home use, 18¼ millions of tons, about one-fifth of that quantity, were consumed for domestic purposes (about 10 millions being exported). We all of us know so intimately the way in which coals are burnt for domestic purposes, that I fear it will seem an idle waste of time to describe it. Nevertheless, I really must occupy a few moments in so doing. We put a grate immediately below and within a chimney, and as this chimney is formed of brickwork, by no possibility can more than the most minute amount of heat be communicated from the chimney to the room. On this grate we make an open fire: fire cannot burn without air, and we provide no means whatever for the air to come into the fire; this is a provision that not one architect or builder in a thousand dreams of making. The consequence is that the unhappy fire has, as it were, to struggle for existence. In a well-built house especially it has to struggle; for the doors and windows shut tightly. The result is that the fire is always smoking, or is on the verge of smoking. We breathe the noxious gases and we spoil our furniture and pictures; nevertheless, happily for us, the fire does succeed in getting supplies of air which, even although insufficient for the wants of the chimney draught, do renew the air of the room. If to satisfy the demands of the chimney and to stop its smoking, a window is left a little open or a door is set ajar, we complain of draughts, and we complain of the unhomely look caused by sitting in a room with an open door; so that there we are, with an asphyxiated fire, our smoky rooms, and our draughty rooms. Moreover, the fire being immediately below the chimney, the main part of the conducted heat inevitably goes up it and is wasted, leaving the room to be warmed principally, if not entirely, by the radiated heat; and we do and suffer all this in order that we may see the fire and be able to poke it. For myself I must confess that if there was no cure for the evils I have described other than the close stoves of the Continent, with the invisible fire and with the want of circulation of air in the room, I would rather put up with the whole of our present domestic discomforts, and even with the loss of heat, than resort to the stove as a remedy. But there are modes by which freedom from smoke, freedom from draught, efficient ventilation and utilisation of the heat may all be combined with the presence of the visible pokeable fire. Some members of this Association may recollect the paper that was read before it at the Norwich Meeting in 1868 by Captain Douglas Galton, in which he so clearly described his admirably simple invention of fire-grate.* This consisted in putting a flue to the upper part of the fire-grate, which flue passed through a brick chamber formed in the ordinary chimney, which chamber was supplied with air from the exterior of the room by a proper channel, and then the air, after being heated in contact with the flue in the chamber, escaped into the room by openings near the ceiling, so that the room was supplied with a copious volume of warm fresh air, which did away with all tendency to draughts from the doors and windows, and, moreover, furnished an ample supply for the purposes of ventilation and combustion. These fireplaces, I regret to say, have been but little used in England, from a cause I shall have to advert to hereafter, a cause which, as I believe, stands in the way of the adoption of improvement generally. The merits of these fireplaces were at once acknowledged by the French, who made the most careful and scientific investigation of their working; and they found that, with such fireplaces, three times the effect was obtained from a given weight of coal that could be got with those of the ordinary construction. No doubt there are many other plans by which the same end as that attained by Captain Galton may be arrived at, and yet we go on year after year building new houses, making no improvement, exposing ourselves to all the annoyances, and worst of all, wasting the precious fuel. Suppose that we could reduce the total consumption both in summer and in winter by 50 per cent., what an enormous boon that would be even in the one matter of a pure atmosphere.

Waste in Manufactures.

The other way in which we use coal is for purposes of manufacture; and this, again, may be divided into two branches at least, namely, the coal that is employed for obtaining power, and the coal that is employed in metallurgical and other operations not immediately connected with the production of power. To treat of these latter cases first, they are far too numerous to be dealt with in detail, and a few of the principal therefore only must be considered. Take the subject of coke-making. How much coal is heated in clamps and in kilns to be converted into coke, and in how few instances is any use made of the whole of the heat residing in the gaseous parts of the coal which are driven off. This heat frequently amounts to 30 per cent. of the whole of that which is in the coal. We come next to the smelting of iron. Take the preliminary process of calcining the ore. In those cases where the ore is "black band," the ore so common in Scotland, the calcining is done by the combustion of the carbonaceous matter mixed with the ore. Far more than the quantity of fuel requisite for the calcination is associated with this ore; but the whole of it is burnt off, and no effort whatever is made to utilise the surplus heat. Then, with regard to the blast-furnaces for smelting iron. Here still, almost universally in Scotland, that large seat of the iron manufacture, and to a considerable extent in England, the waste gases are suffered to issue from the furnace-top, illuminating the country for miles, and bearing testimony to the indifference of the owner of the furnaces to a waste of our store of fuel. Upwards of 60 years ago, viz., in 1811, the utilisation of these gases was suggested in France; but not much was done for 30 years. About 1840, however, their use became not infrequent in that country, and their manufacturers and chemists taught us that the gas thus recklessly wasted might be collected and utilised, and made to replace the fuel expended in heating the hot blast-stoves and in raising steam for the blowing-engines. But, for the cause which has been and will be alluded to, the adoption of this plan was very slow indeed in England. It has now been in use, however, for many years in our best conducted works; but, as a proof of the slowness of its introduction, the furnaces of Scotland, as I have already said, are even to this day almost universally worked upon the wickedly wasteful principle of allowing these gases to burn idly away. Take, again, the melting of steel in crucibles where the heat issues from the furnace of necessity hotter than the heat of the melted steel (for were it not so it would cool it), and of this issuing heat, as a rule, no use whatever is made. Take again the heating-furnace and puddling-furnace of our ironworks; very commonly from these heat at a greater temperature than that of welding iron escapes up the chimneys disregarded, as though it had cost nothing for its generation.

In many works, it is true, a portion of this heat is utilised for generating steam; but far more steam can be obtained than is required, even with the most unnecessary and lavish consumption of it, and thus in great ironworks boilers in which the steam is generated by the waste heat of the furnaces may be seen constantly blowing off large volumes of steam at the valves; and many furnaces are in use to which no boilers are applied, for the simple reason that they would be absolutely superfluous. This waste of heat in steel-melting and in furnaces for iron and for other metallurgical operations is by no means necessary, although it might be urged that it is; and it might be said that if a furnace is to heat a body to 3,000 degrees, you must of necessity allow the heat to escape at that temperature, or rather at something above it, or else in lieu of heating the body you will be cooling it, and that you can no more trap escaping heat than you can trap a sunbeam. But one of my predecessors in this chair, Mr. Siemens, has, as we know, shown us that you can trap the heat, and that you can so lay hold of it and store it up, that the gases as they pass into the chimney from the furnace in which there is, say, even melting steel, shall be lowered in their temperature down to that which will not char a piece of wood; and he has shown us how this stored up heat may be communicated to the separate streams of incoming air and gas of his gas-furnaces, so that they shall enter the furnace at a high temperature, that temperature to be increased by their union and combustion in the furnace. So beautifully can this trapping of heat be carried out, and so successfully can the heat be retained by very trifling attention on the part of the workmen to the apparatus, that Mr. Ramsbottom, the late Locomotive Superintendent of the London and North-Western Railway, knew he should not be applying too delicate a test when he inserted the ends of pieces of wood through openings into the outgoing flues of the steel-heating furnaces at Crewe. These pieces of wood were padlocked in their places, were taken out periodically, and if they were found to be burnt it was known that the man in charge of the furnace had been negligent in his duty of saving fuel and had misused the Siemens apparatus. But although this invention has been before the public for very many years, and although it has had the approval of Faraday and of every other distinguished scientific man who has investigated the question, and, I am glad to say, the approval of the leading minds among the users of furnaces, nevertheless, for the general reason I shall have to allude to, the progress of this invention has been by no means commensurate with its importance; and it is not too much to say that manufacturers would rather waste cheap coal than embark capital in new furnaces, and more than all, be at the trouble of instructing and of watching over their workmen.

Waste in Steam-Engines.

Next, let us consider how we are dealing with coal when we use it for obtaining motive power in our steam-engines. Steam-engines may be divided into the four great heads of marine, locomotive, portable, and fixed. Including within the term steam-engine, the boiler as well as the engine, waste may arise in a steam-engine in two ways, either in one of them or in both combined. It may

* An improved form of this fireplace was illustrated and described in the *Building News* of August 16.—Ed.

arise from an imperfect utilisation of fuel in the production of steam, that is, a waste due to the boiler and to the firing; or it may arise in an improper use by the engine of the steam provided for it by the boiler. There can be no question but that the boiler waste is, as a rule, very large indeed. A pound of fair coal is theoretically capable of evaporating from the boiling-point 13lb. of water. I do not believe that I shall overstate the case when I say that on an average not more than from one-third to one-half of this quantity is obtained from the whole of the boilers in use.

This poor result varies from a variety of causes:—1st, bad firing, which means bad combustion; 2nd, insufficient surface to absorb the heat; 3rd, an unclean condition of that surface, either from internal or external deposit, or both; 4th, a faulty proportioning of the parts of the boiler to each other and to the work to be done, which cause heated water to be carried over with the steam,—a cause of deficiency of evaporation, which, however, so far from being at a rule detected, goes to swell the apparent duty of the boiler. Bad firing may result in the fire being too thick, or too thin or irregular. If too thick, the carbonic acid that is generated by the combustion of the lower part of the fuel with which the air first comes in contact is changed in its passage through the upper part of the fuel into carbonic oxide, by absorbing from the fuel a second equivalent of carbon. If this gas, carbonic oxide, does not meet with free atmospheric air, and meet with it at a suitable temperature in the upper part of the furnace, it must remain unconsumed, and will pass through the flues or tubes of the boiler and make its escape into the air, carrying with it the valuable unconsumed carbon of the coal in a gaseous form. It is commonly said that smoke is unconsumed fuel. This is true; but it is not commonly recollected that there may be invisible smoke arising (even from a coke-fire) which shall contain the highly combustible ingredient carbonic oxide gas. When it is remembered that every pound of coal burnt into carbonic acid is capable of evaporating, as has already been said, about 13lb. of water from 212°, while a pound of coal, converted only into carbonic oxide, is capable of evaporating but 4lb., it will be seen how necessary it is that no mismanagement of the fire should cause a portion of the fuel thus to escape unburnt up the chimney. Another defect in the management of a fire (an opposite defect, as it were) by which coal may be wasted, is the admission of too much air; and this arises when the fire is too thin in relation to the chimney-draft, or when (a more common evil) it is thin in places, owing to the negligence of the firemen in keeping it properly levelled.

The way in which waste arises from these causes is, that unnecessary air is introduced into the fire at a temperature of, say, 60°, and that this air has to be heated, and then (even if the heat be abstracted from it, as far as practicable by the boiler) it will escape up the chimney at a temperature of from 200° to 800° in excess of that which it had; and the whole of this excess represents wasted coal. Thus, on the one hand, it is of importance that there should be a proper amount of air to secure the perfect conversion of the carbon into carbonic acid; and, on the other hand, it is most desirable that this amount should not be exceeded, involving the necessity of uselessly heating air not wanted for combustion. Such a happily balanced state of things it is almost impossible to secure by hand firing, almost impossible, but not absolutely impossible, though only attained at competitive trials, and when these trials are conducted by highly skilled men.

In such trials of portable engines before the judges of the Royal Agricultural Society of England, the firemen will put coals upon the fire as frequently as forty-five times in an hour, the quantity put on at each time being, as may be supposed, little more than a spoonful. Writers on the management of the steam-engine usually advise that the fire-doors should be opened as little as possible, and that the firing should take place about every quarter of an hour. Under ordinary circumstances they may be right; but when it is desired, regardless of the amount of manual labour, to obtain every particle of useful effect out of the fuel, it is then found to be remunerative to open the door, not four times an hour, but more than forty times an hour, taking care, however, that it is only opened for the fraction of a second. It is by this frequent feeding of a small quantity of coal, distributed over the fire, that the competitors are enabled to insure a uniform condition of that fire to receive the action of the air. They know precisely the amount of draught they have got, and by experience they also know what thickness of fire will exactly balance, as it were, the air that comes through, so that the combustion may be perfect, and yet there may be no free air. But in ordinary hand-firing, done at intervals of a quarter of an hour, it is obvious that the thickness of the fire at the end of such an interval must be very different from that which it was at the beginning of it, and thus if that thickness be right in relation to the draught at one time it must be wrong at another. At one time, immediately after firing, there may be a distillation of the coal, producing black smoke and carbonic oxide; this will go on till the fire burns thin and burns into holes, when there will be a passage of free air. I do not wish to be understood that I am advocating the attendance of skilled firemen to fire forty-five times in an hour. Coal must be far dearer than it now is to make it pay so to occupy a man, or rather watches of men; for no one man could submit to such continuous labour for more than from four to five hours. But my observations tend to call your attention to the subject of mechanical firing. I believe that the high evaporative duties that have been obtained by the use of liquid fuel, duties approaching very closely indeed to the theoretical power of that fuel, are largely due to the fact that the air and liquid can be injected in definite and regular proportions, insuring perfect combustion. Again, in the use of powdered fuel by Mr. Crampton, where the powder is blown into the furnace by the very air which is there to enter into combustion with it, very high evaporative results have been reached even under the disadvantageous circumstances attendant upon early experiments; and this also I believe to be due to the power of accurately adjusting the quantity of air to the fuel to be burnt.

The same power of adjustment may be obtained in those instances where the fuel is previously converted into gas, as practised by Mr. Siemens; and nearly similar control can be got with ordinary fuel by reverting to some of those systems of mechanical fire-feeding which were in use from twenty-five to thirty years ago, but which have been to a great extent abandoned in consequence of the more general adoption of internal fires and high-pressure boilers. The fires of such boilers are in furnaces of small diameter, which do not admit of the introduction of the apparatus, for which room was readily found below the bottoms of the waggon-shaped boilers formerly used for low-pressure steam. Other modes of fire-feeding, however, have been devised, and have come, to a certain extent, into use. I am perfectly certain there is hardly any subject more worthy the attention of the engineer than the replacing the stoker by some mechanical arrangement which shall afford absolute uniformity of firing, and therefore absolute uniformity of the conditions of the fire; and this is a subject not only worthy of attention on account of the saving of coal, but also on the ground of putting an end to a most laborious, exhausting, and, it is to be feared, unhealthy occupation—viz., that of the steamboat fireman, more particularly when he is working in a hot climate. If perfect combustion were obtained in the fire, I do not think there would be much difficulty in properly utilising by the boiler the heat evolved. All that is necessary to attain this end is to give a sufficient amount of surface to absorb the heat and to transmit it to the water, always bearing in mind that, above all, the form of the boiler should be a safe one, that there should be proper water-space within it, and an adequate water-surface from which the steam could escape, that it might do so with tranquillity, and so as not to give rise to the spray technically known as "priming," and that all parts of the boiler should be accessible for cleaning.

I am aware there is a temptation on the score of saving expense and of saving room to make the boiler of small size in relation to the amount of coals burnt under it, and to the quantity of steam required from it; but this is a most extravagant economy—it is a saving in the outset, but it is a perpetual source of loss in the working. Temperatures as high as 800° and even 1000° of heat have been known to exist among the products of combustion escaping from the boiler. Now, when it is recollected that every 100° of heat in the outgoing products of combustion represent $2\frac{1}{4}$ per cent. of the whole heating power of the coal, even if only the minimum amount of air to insure perfect combustion is admitted, it will be seen how necessary it is that there should be sufficient surface in the boiler to absorb the heat of the gases, and to bring them down to a few degrees above the temperature of the water in the boiler itself. I have mentioned the temptation to use boilers of inadequate size on the score of expense and on the score of room. It is this latter reason, no doubt, which induces shipowners to endeavour to diminish the size of their boilers as far as practicable, because they argue that the space occupied by the boilers and machinery is all waste room, as it cannot be filled either with coals or with cargo. With short-voyage steamers, voyages of a few hours only, this argument may be a valid one; but for the long-voyage vessels to India and elsewhere, where fuel has to be carried for from twenty to thirty days' steaming, and where on the homeward voyage the ships have to be supplied with coal that has been brought from England by sailing-vessel at a large cost for freight, the true space deducted from the cargo and passenger-carrying power of the steamship is clearly not that occupied by the engines and boilers alone, but that occupied by the engines, the boiler, and the coal for those boilers. Even supposing that if, after enlarging the boilers to diminish the consumption, the space to be given up to the engine, boilers, and coal were still the same, in consequence of the increase in the size of the boilers being equivalent to the coal-space saved, manifestly it would be to the advantage of the shipowner that that space should be occupied by the boilers rather than by the coals. The expense of the boilers is a first outlay, and has not to be repeated for years until the boilers wear out; but the expense of coal is an outlay that has to be made at every voyage, and therefore it is a short-sighted policy to restrict the amount of absorbing surface in a boiler on the plea that a boiler with full surface takes up a greater space in the ship, if by doing away with such restriction a saving can be effected in the fuel.

The beneficial results which are attained by the greater size of boiler in relation to the coal burnt and to the horse-power required, can be shown not only by calculation, but by example. In H.M.S. *Briton*, fitted with extremely economic compound engines of Mr. E. A. Cowper's design, close upon 2lb. per horse-power per hour were burnt when the ship was making thirteen knots; but on being worked at ten knots the consumption fell to $1^{3}/_{10}$lb. of coal for the lesser horse-power then used.

Good and Bad Engines.

I will now say a few words upon the engines. The locomotive engine has for many years past been doing very fair duty. This has arisen, I believe, first, from the fact that since the introduction of coal the furnaces have been to a considerable extent gas-furnaces, with a free admission of air through open fire-doors to the surface of the fuel. Second, from the fact that the boilers have large absorbing surfaces. From these causes as much as 9lb. or 10lb. of cold water are commonly evaporated per lb. of coal, while the engines working with high steam and considerable expansion make a good use of that steam.

In marine engineering there has within the last ten years been an enormous improvement. The old-fashioned engine working at 20lb. steam, and with injection condensers, is being abandoned for engines generally on the compound-cylinder principle, working at 60lb. and 70lb. steam highly expansive, and fitted with surface-condensers. The result is a reduction of the consumption of fuel in the same vessels on the same voyages, and performed in the same time, of from 40 to 50 per cent. of that which was previously burnt; but I believe that a large field for improvement in marine engines still remains, especially in the firing and in the size of the boilers.

Among the best instances of what can be done in the way of economy may be mentioned the rapidly increasing class of portable agricultural engines. These engines, like the locomotive, are, from their migratory condition, incapable of being fitted with condensers, and thus must be worked as non-condensing engines, exhausting their waste steam into the air—a most serious disadvantage. Nevertheless, so great advances have been made by the unremitting attention of the extremely skilful mechanical engineers who construct these engines, that at the late Cardiff meeting of the Royal Agricultural Society of England, one of the engines ran for five hours and one minute with 14lb. of coal per horse-power, being therefore a little under $2^{8}/_{10}$lb. of coal per horse-power per hour; and this horse was the horse-power of the dynamometer brake, and not the mere indicated horse-power by which marine engines and other engines are ordinarily judged. The indicated horse-power is, of course, in excess of that developed upon the brake, as the indicated power includes all the engine-friction and brake friction; and if this latter horse-power be taken as a standard, the best of the engines tried by the Royal Agricultural Society this year at Cardiff will offer favourable comparison with even very good condensing engines, and will be found to give a duty far beyond that which ten years ago would have been thought obtainable in any but the very best.

It may be mentioned that the Cornish pumping-engines, which used to be looked upon as the most economic of all engines, are, according to the June monthly report, doing only an average duty of $53^{3}/_{10}$ millions of lb. lifted 1ft. high for 1cwt. of coals, and that the very best of them is doing only $71^{7}/_{10}$ millions of lb., while the brake horse-power, developed by the engine at Cardiff, gave a duty of $79^{1}/_{10}$ millions of lb. This large duty was due to the great ability in the management of the fire (as has already been hinted at) and to the proper proportion of the boiler in obtaining the steam, and to its thorough cleading in preserving it in the first instance, and then to the efficient utilisation of that steam by high expansion in a cylinder steam-jacketed around its circumference and at the ends. But at the very same show there competed for the prize an engine which, to the eye of the uninstructed (the ordinary purchaser for example), was as likely an engine as the prize engine; and yet this engine burnt 10lb. of coal per horse-power per hour, or nearly four times that which was burnt by the prize engine; and, moreover, it must be remembered that this wasteful engine was one which the maker thought worthy to be sent to trial.

It may be said that hitherto my observations upon consumption in steam-engines have contained quite as much of praise as of blame, and I am glad to say that it has been so; but it will be found that these praises have referred to the engines of railways, which are under the especial charge of educated mechanical engineers who carefully watch and tabulate all their results, and who have funds at their disposal for the purchase and maintenance of good engines; that they referred to the recent improvement in marine engines, which engines, being as a whole in the hands either of powerful companies or of large capitalists, enjoy the advantages of due outlay and of proper superintendence, and that they referred to the prize engines and to the better competitive engines of the portable class, while admitting the existence of a large number of such engines which were most destructive of fuel. But there remains the great class of fixed engines used for driving manufactories, which engines are, as a rule, of the most disgraceful and scandalous character. In the first place, enormous numbers of them are non-condensing engines—as an excuse for this it is in many instances alleged that water is scarce and that there is not, therefore, the means of providing condensation. To meet such excuses it should be remembered there are appliances well known to scientific engineers—at all events that have been in use for many years—by which condensation can be effected with no more water than is required for the feed of a high-pressure engine. I allude to the ordinary cooling-ponds for injection-water, and to the surface-evaporative condenser. In every instance these may be employed; and thus, in lieu of sending steam into the atmosphere at a pound or two above atmospheric pressure, that steam might be condensed, and a pressure of 12lb. or 13lb. additional throughout the whole stroke of the piston might be obtained; moreover, the interior of the boiler would be kept clean, and thus its surface would be in the best state for transmitting heat.

But passing by this question of the repugnance to the use of condensing engines, and admitting, for the sake of argument, that non-condensing engines may be allowed, what does one ordinarily find as a type of the non-condensing engine? One finds the cylinder with a cubic capacity far too great for the work required; where steam is used throughout the stroke, one finds that this capacity is not utilised as it might be by the employment of high pressure steam and considerable expansion, and that while the steam, even in the boiler, is probably at only 40lb. above atmosphere, the governor is flying out nearly to the full width, the throttle-valve is all but closed, and there is a continuous wire drawing off the steam, so that its average pressure throughout the stroke of the cylinder is only some 15lb. or 20lb. above atmosphere. Now, when one recollects that it requires one portion of coal to get steam up to atmospheric pressure, and that this portion may be looked upon as practically constant, whatever pressure of steam above atmosphere may after be attained, and that if, therefore, steam at 15lb. above atmosphere be used, half of all the fuel is lost, while if at 30lb. above atmosphere, ⅓ only is lost, and if at 120lb. above atmosphere, one-ninth only will be lost in getting up steam to atmospheric pressure, one can understand how essential it is that in non-condensing engines the steam should be used at a really high pressure; and yet, as I have said, I believe that if the large number of 10 or 20-horse horizontal non-condensing engines, employed by manufacturers throughout the kingdom, were examined, and indicator diagrams were taken, it would be found that their pressure upon the pistons did not average much more than 20lb. above atmosphere; and it is a lamentable fact that many makers of steam-engines, men who cannot be properly called engineers, men who are mere manufacturers, not knowing the principles of the art they follow, will boast that their engine is doing very well, it drives the whole of Mr. So-and-so's work and does not require more than 30lb. steam in the boiler, not understanding that if they would raise that steam to 120lb., and then work it non-expansively in a small cylinder, they would thereby be obtaining a great economy, and if they would work it expansively in a large cylinder, that cylinder being properly steam-jacketed, would obtain a still greater economy.

I think there is so little reliable information as to the total horse-power at work in the United Kingdom, as is evidenced by the fact that very recently the number of boilers has been estimated before a Parliamentary Committee as low as 50,000, and as high as double and even close upon quadruple that number, that I feel it would be an unwarrantable waste of the time of the Section if I were to invite them to follow me into calculations, or rather speculations, as to the exact saving that would be made in the consumption of coal, consequent upon improving the whole of our steam-engines up to the present highest standard. It will, however, be quite sufficient, to show the importance of the question, for me to say, and I am sure I should be perfectly safe in saying, that such saving would have to be estimated by millions of tons. Such a saving, as I have said, is one that might be made with our present knowledge; but when we recollect that an engine burning even as low as 2lb. of coal per indicated horse-power per hour is still developing only one-tenth of all the power which, according to calculation, resides in that coal, there is manifestly a vast scope for our mechanical engineers in the exercise of their talents for further economy.

But let not consumers of coal remain indifferent to savings on their present consumption until those improvements are discovered by scientific men; on their power to reduce the consumption to the extent to which present science and, in some instances, present practice show the consumption can be reduced. One is apt, at first sight, to marvel that users of steam-engines should be so blind to their own interest, and should permit waste to go on day after day and year after year—a waste not only prejudicial to the community at large and to succeeding generations, but a waste causing constant expense to those who commit it, and a waste, therefore, that one would think such persons would only be too ready to stop; but the fact is there are several reasons why manufacturers and others permit the waste to go on.

The so-called "Practical Man."

In prosperous times those engaged in manufactures are too busy earning and saving money to attend to a reorganisation of their plant; in bad times they are too dispirited and too little inclined to spend the money, that in better times they have saved, in replacing old and wasteful appliances by new and economical ones; and one feels that there is a very considerable amount of seeming justification for their conduct in both instances, and that it requires a really comprehensive and large intelligence and a belief in the future, possessed by only a few out of the bulk of mankind, to cause the manufacturer to pursue that which would be the true policy as well for his own interest as well as for those of the community. But there is a further and a perpetual bugbear in the way of such improvements, and that bugbear is the so-called "practical man;" and he was in my mind when, in previous parts of this address, I have hinted at the existence of an obstacle to the adoption of improvement.

I do not wish the Section for one moment to suppose that I, brought up as an apprentice in a workshop, and who all my life have practised my profession, intend to say one word against the truly practical man. On the contrary, he is the man of all others that I admire, and by whom I would wish persons to be guided; because the truly practical man is one who knows the reason of that which he practices, who can give an account of the faith that is in him, and who, while he possesses the readiness of mind and the dexterity which arise from the long-continued and daily intercourse with the subject of his profession, possesses also that necessary amount of theoretical and scientific knowledge which justify him in pursuing any process he adopts, which in many cases enable him to devise new processes, or which, at all events, if he be not of an inventive quality of mind, will enable him to appreciate and value the new processes devised by others. This is the truly practical man, about whom I have nothing to say except that which is most laudatory; but the practical man, as commonly understood, means a man who knows the practice of his trade and knows nothing else concerning it—the man whose wisdom consists in standing by seeing, but not investigating, the new discoveries which are taking place around him, in decrying those discoveries, in applying to those who invent improvements, even the very greatest, the epithet of "schemers," and then, when he finds that, beyond all dispute, some new matter is good and has come into general practice, taking to it grumblingly, but still taking to it because if he did not he could not compete with his co-manufacturers, the aim and object of such a man being to insure that he should never make a mistake by embarking his capital or his time in that which has not been proved by men of large hearts and large intelligence. It is such a practical man as this who delays all improvement. For years he delayed the development in England of the utilisation of the waste heat of blast-furnaces; and he has done so so successfully that, as I have already had occasion to remark, that utilisation is by no means universal in this kingdom. It was such men as these who kept back surface-condensation for twenty years. When the Siemens's regenerative gas-furnace was introduced, what said the practical man? "Turn your coals into gas, and burn the gas, and then talk of regeneration! I don't know what you mean by regeneration except in a spiritual sense; I am a practical man, and if I want heat out of coals, I put coals on to a fire to burn them;" and for fifteen years the practical man has been the bar to this most enormous improvement in metallurgical operations.

The practical man is beginning slowly to yield with respect to these furnaces, because he finds, as I have already said, that men of greater intelligence have now in sufficiently large numbers adopted the invention to make a formidable competition with the persons who stolidly refuse to be improved. The same practical man for years stood in the way of the development of Bessemer steel. Now he has been compelled to become a convert.

As I have said, the practical man derides those who bring forward new inventions, and calls them schemers. No doubt whatever, they do scheme; and well it is for the country that there are men that do so. It also may be true that the majority of schemes prove abortive; but it must be recollected that the whole progress of art and manufacture has depended, and will depend, upon successful discoveries which in their inception were, and will be that have been, and will be, unfruitful; but the successful discoveries, because they are successful, are taken out of the category of schemes when years of untiring application on the part of the inventors have, so to speak, thrust them down the throat of the unwilling practical man. Take the instance of Mr. Bessemer, who was beset for years by difficulties of detail in his great scheme of improvement in the manufacture of steel. As long as he was so beset, the practical men chorused "he is a schemer, he is one of the schemers; it is a scheme." It is a species of profanation to suggest, but I must suggest it, for it is true, that Watt, Stephenson, Faraday, and almost every other name among the honoured dead to whose inventive genius we owe the development that has taken place within the last century in all the luxuries, the comforts, even the bare necessities, of our daily existence, would in their day, and while struggling for success, have been spoken of as "schemers," even in respect of those very inventions of which we are now enjoying the fruits.

A Society to Reward Economy.

One word in conclusion. Can we not devise some means by which consumers of coal may be instructed in, shamed into, or tempted to the economical use of that most valuable material? The Royal Agricultural Society of England, by its judicious efforts for many years past, by the institution of trials and the giving of prizes for the best engines, has brought the consumption of coal down from 10lb. per horse-power to a little over one quarter of that quantity. Could we not institute a society which should devote itself to the recording and the rewarding of the performances of steamboats, and of fixed engines for land purposes. I am aware it is supposed there is a difficulty in these cases which does not obtain in the case of portable engines that can be brought for trial upon a dynamometer, and that is that the power exerted by marine engines varies during the voyage, and is not that which is developed at the measured mile, while in a manufactory it varies according to the conditions of the trade, and to the extent to which the British workman condescends to attend to his work. But there are implements which record the horse-power exerted from moment to moment, and register it on indices as readable as those of an ordinary counter of an engine, or as those of a gas-meter.

I believe that one of the very greatest incentives to economical working which the owners of steamboats could offer to their engine-builders and engineers would be the application of such implements as these. Were they employed, the ship-owner would know at the end of the voyage so much horse-power had been exerted as a whole, that so much coal had been burned, and that the result therefore, was a consumption of so many pounds per horse-power per hour. All excuses of head-winds, and all the aid of canvas to the engine-power, would be eliminated from the calculation. The continual indicator would register truly the work the engine had to do, whether that work was made excessive by contending with head-winds, or was rendered light by favourable breezes and the assistance of canvas. In the same way the proprietor of the engine for manufacturing purposes, the cotton-mill, the woollen-mill, the corn-mill, and even the highly irregularly-working rolling-mills and saw-mills, would be able at the end of the quarter to say—"Notwithstanding all the variations of my trade and rate of manufacture, I know that my engines have exerted so much power, I know that I have burned so much coal, and that, therefore, such and such have been the economic results." Assuming that steamboat proprietors and the owners of fixed land-engines would go to the expense of applying such continuous recording implements as these to their engines, and would become members of an association for the purpose of visiting and inspecting, and of reporting upon their machinery, and of giving prizes to the men in charge for careful attention, prizes to the manufacturers for original good design and workmanship of the engines, and prizes to the proprietors for their public spirit in having bought that which was good instead of that which was bad and cheap, and for having employed ,intelligent and careful workmen instead of ignorant and careless ones, I believe, within a few years, as great an improvement might be seen among the marine and manufacturing class of engines as has been effected by the laudable exertions of the Royal Agricultural Society of England among the portable ones. I think the initiation of some such society as this would be a practically useful result from the meeting of section "G."

Orange-Coloured Spectacles.—In a note to the *Journal of Chemistry*, Dr. Stearns, Surgeon at the U.S. Asylum for Disabled Soldiers, at Milwaukee, Wis., referring to the photographic use of orange-coloured glass to exclude the actinic rays of light, expresses his surprise that no optician has had the genius to see that orange is the proper colour for spectacles, instead of green or blue, for persons of weak eyes. Dr. Stearns states the interesting fact that a room in the hospital with which he is connected is lighted through orange-coloured windows, and is used, with very satisfactory results

BRITISH ASSOCIATION GLEANINGS.

Friction of Immersed Substances.—This formed the subject of an elaborate paper by Mr. Froude, F.R.S., who had made experiments with the sanction of the Admiralty, with the view of determining the law of resistance of surface friction, as effected by speed, by quality of surface, and by the length of the rubbing surface operated on. The results generally were that the resistance varied as the power of 1·8 of the velocity with surfaces painted or varnished with any of the ordinary compositions; that with a polished surface of tinfoil it varied as the power of 2·2 of the velocity; that there was a very sensible difference between the resistance per square foot on a plane 50ft. in length, and one 10ft. in length, but the same in circumference; that between a plane of 10ft. and one of 6in., the difference was very much greater; and that the resistance per square foot on a plane 10ft. in length, travelling ten knots, was about ·65 of a pound per square foot of painted or varnished surfaces. That agreed very nearly in what was called Beaufoy's Coefficient.

Aerial Navigation. — Mr. C. A. Bowdler read a paper on this subject which, he thought, would become an important element in military science. Hitherto, captive balloons only had been used, but it was by no means improbable that circumstances would occur where it would be most desirable to pass over the enemy's position, and it would then be important to have the power of severing or deflecting the balloon from the wind course, either to right or left as required. Captive balloons could not be used in safety in high winds on account of violent rocking of the car. He thought that aërial navigation was practical to a certain limit by simple mechanical means. Of the practicability of applying steam power he had no hope, the weight of a steam-engine made as light as possible, consistent with due strength, being much too great for any gas balloon to support. The power he proposed was manual. But propulsion having been secured, the question arose how the power of direction could be acquired, that being of the utmost importance in actual warfare. That was accomplished by rotating the balloon to any required position, and then holding it from further motion, the rotation was completely under the control of the aëronaut. A rudder was the instrument to be used for that purpose, a vertical disc fixed in a line with the axis of the propeller. By turning the plane of the disc the current of air forced from the fan on the rudder caused the whole machine to rotate right or left precisely as the rudder of a ship guided the vessel. Mr. Reynolds said he had found it impossible to get, by manual power, more than two or three miles an hour with a balloon large enough to live. The great difficulty with regard to a flying machine was that its increase of power was in advance of its capacity of carrying.

Rolling of Ships.—Mr. Froude made some remarks on the mode of recording the rolling of a ship in a seaway, and elaborately and ably explained apparatus he employed, which apparatus also indicated the form of the waves. A revolving cylinder, covered with paper, and turned by clockwork, received the marks made by several pens. One of these pens recorded time, jerks being given to it by an exact clock. The apparatus being placed at the centre of gravity of the ship, a pendulum oscillating in a plane transversely with the keel, recorded continuously by a second pen the angles which the ship at each moment made with the mean or effective surface of the wave. Another pen, actuated by a rocking arm, kept level by an observer on deck, who pointed it to the horizon, recorded by a third pen the angle the ship made with the horizon. From the records thus obtained the amount of rolling of the ship was at once shown, and the form of the wave could be easily worked out graphically. Mr. Froude added that he had completed an apparatus in which he employed a heavy stationary wheel so delicately supported as not to receive any rotation from the motion of the ship. This wheel, placed transversely in the ship, would remain still without rotating, and thus supply the place of the horizontal bar above described, held level by the observer on deck.

Variation of Pulse-beats.—Professor Sanderson made a communication on the rhythmical variation of arterial pressure. He pointed out the rhythmical irregularities observable in the pulsation of certain animals, stating that the periods of fast beating correspond to inspiration, and that the periods of slow beating correspond to expiration; and explaining how this is recorded by a graphic method. Discussing the question of the relation of these phenomena, he showed that, when the muscles are subjected to paralysis, so that respiration almost ceases, there is no variation in pulsation, whence he concluded that the phenomena in question are not related as cause and effect, but are results of the same cause. A communication was also made by Mr. A. H. Garrod on Pulse Frequency and the Forces which vary it. Mr. Garrod detailed some experiments with a view of showing that the rapidity of the pulse varies inversely as the resistance to the flow of blood from the arteries; that variations in the amount of blood in circulation do not vary the rapidity of the pulse, and consequently that the pulse rate is not dependent on the blood pressure, as many supposed.

Action of Sunlight on Glass.—Mr. T. Gaffield, of Boston, U.S., read a paper on "The Action of Sunlight on Colourless and Coloured Glass." He showed that most samples of glass, especially those containing manganese, became coloured more or less by the action of light, also that the glass in the stained windows of cathedrals had changed somewhat from the original colours; these colours, however, could be restored by subjecting the glass to the action of sufficient heat. M. Bontemps said that he had found glass containing manganese no good for lighthouse lenses, but that glass containing lead—even as little as five per cent.—did not change colour at all. Mr. Wenham said that traces of carbon would colour glass, but the mixture of a little nitre with the materials would get rid of this colouration in a marvellous manner. He believed Mr. Gaffield's discovery of the restoration of the original colour of glass by heat to be a new one. Dr. De La Rue said that the nature of the action of light upon some of the constituents of the glass appeared to be one of disintegration and decomposition, as the glass appeared to become in all cases more coloured; there was, he supposed, never any bleaching action. M. de Fonvielle had just suggested to him that this action of light upon glass might, in future experiments, be accelerated by means of a lens.

Mirage.—Lecture Experiment.—In the course of a paper read by Professor Everett on this subject he described an experiment devised by Professor Clerk Maxwell, F.R.S. In this experiment the beautiful effects of mirage were obtained by means of three liquids in a cubical vessel with plate-glass sides 6in. square, the lowest liquid being a saturated solution of alum, the highest pure water, and between them a thickness of about a ¼in. of Scotch whisky, containing enough sugar to make its specific gravity intermediate between those of the other two liquids. It is much more refractive than either of them. Triple images were obtained, with great distinctness, of all the objects in an extensive landscape, the middle image being inverted, and either elevated or depressed according to the position of the eye. The range of triple vision extended to objects as far as 10° from the horizontal direction, either above or below, and all three images were sufficiently distinct to show whether white blinds were up, down, or half way down in a row of houses distant 700 yards.

The Colour of Fishes. — M. Georges Pouchet contributed a paper on the mechanism of the changes of colour in fishes and crustacea. The author referred to the fact that fishes often change in colour according to the colour of the objects by which they are surrounded; but he explained that this does not take place when the fish is deprived of the nerves that preside over the peculiar corpuscles to which the colour is due. The change does not take place in blind turbots; and in the seeing turbot, if the nerves are divided which communicate between the eye and the skin, the change does not occur. If the fifth nerve is divided the change takes place all over the body except the part to which that nerve is distributed. These experiments, M. Pouchet said, show that the change of colour is dependent upon impressions received by the nervous system through the organs of vision.

Tame Wasp.—Sir J. Lubbock exhibited a tame wasp which had been in his possession for about three months, which he brought with him from the Pyrenees. The wasp was of a social kind, and he took it in its nest formed of 27 cells in which there were 25 eggs, and had the wasp been allowed to remain there, by this time there would have been quite a little colony of wasps. None of the eggs, however, came to maturity, and the wasp had laid no eggs since it had been in his possession. The wasp was now quite tame, though at first it was rather too ready with its sting. It now eats sugar from his hand and allowed him to stroke it. The wasp had every appearance of health and happiness; and, although it enjoyed an outing occasionally, it readily returned to its bottles, which it seemed to regard as a home. This was the first tame wasp kept by itself he had ever heard of.

Precipitation of Silver by Copper.—Mr. Alfred Tribe communicated an interesting paper on this subject. He stated that in the course of experiments on a rather larger scale, it had been found that silver obtained by precipitation from solution as nitrate, by means of metallic copper, always contained the latter metal, however well the silver might be washed. The constant presence of this metal was considered due to dissolved oxygen in the silver solutions, or to the absorption of that gas from the air by the produced copper nitrate during or subsequent to the precipation. In practice it was found that the presence of the copper was not due to dissolved oxygen in the silver solutions, but to oxygen absorbed from the atmosphere; in one experiment as much at fifteen per cent. of copper was obtained by an exposure of forty-eight hours, and the author expressed it as his opinion that in this way almost any quantity of copper might thus be added to silver. When carbonic anhydride was caused to bubble through the solution during precipitation, the quantity of copper was diminished to a very great extent. It was also found that where an excess of silver remained in the mixture the merest traces of copper were found, but, on the contrary, when the silver was on the point of exhaustion, the proportion of copper increased considerably.

The Fusion of Arsenic.—Professor Mallett, of Virginia, U.S., reported some experiments undertaken by him in view of the generally repeated statement that arsenic cannot be fused, but passes directly from the solid to the vaporous state, and that an attempt to secure increased perfume by using a sealed tube only results in the bursting the tube. He succeeded in procuring fused arsenic by filling narrow strong glass tubes (barometer tubes), which was again inclosed in an outer tube of iron, and heated in a charcoal fire. Arsenic thus treated was found on cooling to have fused into a perfectly compact crystalline mass, of steel grey colour and brilliant lustre, having a specific gravity of 5·709 at 19° C. Specimens of the metal were exhibited to the meeting contained in glass tubes filled with coal gas, and the temperature of fusion lies between the fusing points of antimony and silver.

Meteoric Iron.—Professor Mallett exhibited three specimens of iron from Augusta Co., Virginia. One had been cut from the original mass by a planing machine, and without further preparation had been forged into a tolerably perfect blade for a paper knife. Another had been heated to redness in a vacuous porcelain tube (for the purpose of examining the occluded gases), and had then been with great difficulty forged into a blade of similar kind, in which cracks and flaws were visible. The third had been heated in like manner in vacuo, but to a white heat, and this specimen could not be forged at all. The conceivable causes of this difference were briefly discussed, such as the more or less complete removal of the occluded gases, changed state of combination of the phosphorus and sulphur, and melting out of phosphide of iron, leaving the metal porous.

USEFUL AND SCIENTIFIC NOTES.

Telescopic Walking-Sticks. — Mr. Barnes Richards, of Penzance, has recently patented an improved telescopic walking-stick; *i.e.*, a walking-stick which may be made simply to shut up like a telescope, but may also in addition be furnished with lenses, and employed for all purposes to which the ordinary tourist-glass is applied. In order to arrive at the best design and the most substantial as well as convenient arrangement of the parts he has offered prizes for the construction of telescope walking-sticks in any suitable material, the particulars of the competition for which will be found in our advertisement columns. A serviceable stick, capable of being reduced to pocket size, will be handy in many ways, and its utility will be still further enhanced by furnishing it with lenses.

Fireproof Wood.—Wood may be rendered nearly as capable of resisting fire as brick or stone, without great labour or expense, by soaking the dried timber a short time in a solution of soluble glass, a silicate of soda or potash, and afterwards immersing it in lime water, by which the pores of the wood are filled with a silicate of lime. This substance is fire-proof, and cannot be dissolved in water, and its presence and effect in the fibre of the wood are therefore permanent.

Science in Birmingham.—Through the liberality of Mr. Josiah Mason, who founded the orphanage at Erdington, a science college is to be established in Birmingham. The words of the trust-deed are worthy of publicity:—"Being deeply convinced, from long and varied experience in different branches of manufacture, of the necessity for, and benefit of, thorough systematic scientific instruction, specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pursuits of the Midland district, and particularly of the boroughs of Birmingham and Kidderminster," Mr. Mason "hath determined to devote a portion of his remaining property to the foundation of an institution wherein such systematic scientific instruction may be given." With this object, Mr. Mason assigns certain freehold and leasehold property, estimated at not less than £100,000. Instruction is to be provided by means of classes, in mathematics, physics, chemistry, the natural sciences (especially geology and mineralogy, with their application to mines and metallurgy), botany, zoology, languages, mechanical drawing, and architecture.

Japan.—Much interest has been excited in the United States and England by the movement among the Japanese looking toward the introduction of the English language and its literature into the Japanese empire; and it has even been stated that there is a possibility that our mother-tongue may in time become their national language. The principal difficulty in the way of this desirable consummation lies in the peculiarities of the English language, and the number of irregular verbs characterising it, as also the want of uniformity in its pronunciation. The idea has been suggested of forming an improved English language for the benefit of our Oriental friends by making all the verbs regular, and improving the orthography. The choice of a new language by the Japanese lies, it is said, between the English and the German, and the selection of the latter is warmly urged by the Germans. Indeed, that language appears to be quite a favourite one in Japan, as attested by the existence of an extensive German bookstore there doing a large business, and by the establishment of a number of schools for teaching the tongue.

Economical Cooking Apparatus.—A cooking apparatus, to be used during the Autumn manœuvres, by the 9th Queen's Royal Lancers, was recently tried at Woolwich, under the direction of the Colonel commanding the regiment. The apparatus, which has been invented by Sergeant Mayell, master cook of the regiment, consists of seven kettles or boilers, six saucepans, a frying-pan, gridiron, lantern, and baking tins, all fitting within the largest boiler, which is but 20in. square. A fire was lighted in a trench hastily dug in the open air, and by a judicious economy of fuel, 132 gallons of water were boiled in twenty minutes after the fire was lit; the saucepans being afterwards boiled in 4½ minutes. The present daily consumption of fuel in a cavalry regiment is five cwt., but with this apparatus it is said that six ounces will be sufficient. Two sets can be carried on a horse, fixed in Moody's pack-saddle, and will cook rations for 600 men.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

THE MOON.

[4790.]—In answer to W. L. Brown (qy. 12753), it is to be noted that the moon's path being inclined on the average about 5° 8′ to the ecliptic, she passes alternately north and south of the ecliptic by this amount. Now the effect on her range in declination will depend on the position of the points where the moon crosses the ecliptic ascendingly or descendingly. If her rising node coincides with the rising node of the ecliptic on the equator she will be 5° 8′ north of the ecliptic where the ecliptic is 23° 27′ north of the equator, so that she will be in all 28° 35′ north of the equator in this part of her orbit, and (obviously) as far south at the opposite part. If her descending node coincides with the rising node of the ecliptic she will be 5° 8′ south of the ecliptic where the ecliptic is 23° 27′ north of the equator, or she will be only 18° 19′ north of the equator at the part of her orbit where she has her greatest northerly declination; and obviously she will have no greater range south of the equator. In intermediate positions of the rising node an intermediate range of declination will result. (The whole subject wants illustration, however, and detailed explanation.)

The rising node of the moon's orbit performs a complete circuit of the ecliptic in a mean period of 18·5997 years; always regreding on the whole in each lunation, though not always at the same rate, and always advancing for a greater or less portion of each month. The regression is greater when one or other node is 90° from the sun, and least when one or other node is in conjunction with the sun, but it need hardly be said that this condition never prevails throughout a lunation. The inclination also varies, attaining a maximum when the one or other node is in conjunction with the sun. The range of change is about 8′ on either side of the mean value.

There is no cycle in which the moon "returns to the same position precisely with regard to the earth on the same day in the same month, and being also at the same time in apogee or perigee." Nor are these conditions *all* even approximately fulfilled save in cycles of very great length, quite useless for ordinary purposes. In the cycle called the Saros, invented by the Chaldeans, some of the conditions were nearly fulfilled, but this cycle had no reference to the year. It continued 6585⅓ days, or 18 years and nearly 110 days. It thus contained 223 lunations, 242 nodical months less 89 minutes, 239 anomalistic months (or mean intervals between lunar passages of perigee) less 5 hours, and 241 sidereal months less one day.

The lunar perigee on the whole advances in each year (the mean advance being about 40⅔°), but recedes on the whole in some months, advancing on the whole in others, and always both recedes and advances alternately during the course of each month. It performs a complete circuit in a mean period of 3232·575 days. The mean interval between successive conjunctions of the sun and perigee is 411·761 days, the mean interval between successive conjunctions of sun and the moon's rising node 346·6 days. The mean advance of the perigee from the node is accomplished at the rate of about 59° 58′ 4·8″ per annum, so that the interval between successive conjunctions of the perigee and rising node is slightly greater than 6 years.

I may take this opportunity of noticing a slight mistake in Mr. Birt's paper on the moon's libration, in the English Mechanic for July (I think), 1871. The successive returns of the moon to her perigee do not take place in a less time, but (on the average) in a longer time than her successive returns to her rising node.

Richard A. Proctor.

DOUBLE STARS.

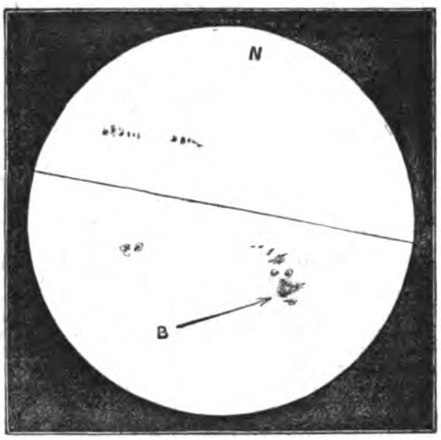
[4791.]—Let me thank Mr. Proctor for his remarks with regard to my "way of classifying" double stars. Nothing was further from my thought than to speak disparagingly either of Mr. Webb's invaluable work, "Celestial Objects," &c., or of Mr. Proctor's no less useful atlas. The only reason I can give for thus speaking is that these two works are the only ones I possess on double stars, and, therefore, I could not say whether such stars are in other works or not. To those of your readers who may have supposed that I was indicating flaws or blemishes in those two works, I will say that whenever I survey the starry heavens with my telescope, Mr. Webb's work is my constant companion; and though I possess another atlas, yet I find Mr. Proctor's so much easier, and superior, that it is the one I exclusively use.

I am very much obliged to Mr. Knott (let. 4748, p. 567) for giving the measures and positions of μ^2 Boötis and δ Cygni. Though the difference of the state of the atmosphere, when the observations were made, may have much to do on so delicate objects, yet, I believe, ξ Cancri more difficult at present with my aperture than μ^2 Boötis. I cannot account for the difference of positions in both instances, but in this way. I have adapted to the eye-tube of my telescope a brass circle with divisions of five degrees each, and it is to these divisions I refer the position of companions in double stars. I am afraid this circle is not in the exact position. Moreover, when I observed the above-named stars, I was obliged to move my telescope out of its usual place, and doubtless its axis was not in the exact direction of the meridian, hence the error.

C. Gaudibert.

SUN SPOTS.

[4792.]—At 6.30 p.m. on the 17th inst., the surface of the sun did not present so particularly interesting an object as it has done for some time past, and I should not have taken note of its appearance had it not been for one particular feature which engaged my attention on careful examination. I may mention that there were but four clusters of spots visible (as the accompanying sketch shows), and each cluster or group required some considerable power to be applied to bring out details. On examining each group separately my attention was drawn to an exceedingly luminous spot in the centre of the dark nucleus shown by the arrow B on the sketch. I examined this group carefully, and in order to avoid any possible mistake which might arise from optical illusion or otherwise, I made use of four eyepieces of different powers, and found the same luminous appearance was presented, more or less distinctly, as the different powers were applied. I am sorry I was prevented from examining



this particular group with a glass of larger aperture consequent upon a tall elm-tree obstructing the view, and I have not had an opportunity since of noting any possible change in its appearance. The spots are drawn somewhat larger than they should be in proportion to diameter of the circle, but they present the same relative aspect they exhibited when viewed at the time mentioned.

James H. Whistle.

THE SOLAR CORONA.

[4793.]—Will Mr. Proctor permit me, as one greatly interested in his able astronomical works, to ask him if he still holds the opinion that "the solar corona is due in great part to the existence of millions of meteoric systems having their perihelia close to the sun." From Mr. Lockyer's spectroscopic observations of the total eclipse of December, 1871, it would appear that it consists of "glowing gas." I can understand that this gas could be produced by the meteorites being vapourised by the intense heat to which they are subjected in their perihelion sweep round the solar orb; but Mr. Lockyer's observations seem to point to the conclusion that the portion of the corona close to the sun's limb derives its substance from the prominences which consist of hydrogen gas; as other elements are known to exist in meteorites I cannot reconcile the two theories. Will Mr. Proctor kindly say which he considers the most probable explanation of this wonderful solar appendage? and oblige

J. E. Gore.

Kussowlee, Punjab, 20th July, 1872.

STARS IN AQUILÆ.

[4794.]—Thanks to "F.R.A.S." (let. 4653, p. 536) for his prompt reply to my request respecting 263 P. Aquilæ. (By a stupid mistake I signed my letter "Epsilon.") I had seen the asterism he points out as that object, but as the "faint comes" he refers to showed very prominently in my object-glass (by Wray), I did not imagine it would not be included with the two closer components and classed as a triple star by Smyth. I see another fainter comes at nearly the same angle (say 20°) as the one mentioned by "F.R.A.S.," and at about three times the distance. Now, with reference to the faint group inquired about in my previous letter, I was led into the error from paying more attention to Mr. Webb's directions given in the first paragraph in taking the object as "closely following ι" (the word "closely" would have been better left out), and I found the faint group the nearest following that star, though it is not so far south in the field as 263 P. I see a faint comes (this immediately follows ι) at about 20° angle, and probably 70″ distance from the triple group, and also another comes rather closer at about 75° angle, all rough estimations. Having no equatorial mounting to the instrument, I use Mr. Proctor's larger star-atlas in connection with Mr. Webb's "Celestial Objects" to assist me, and, with the above exception, I never found any difficulty in identifying objects.

Lamda.

AUGUST METEORS.

[4795.]—I send you a list of the meteors I observed on the evening of August 8, hoping you will publish it, as some of them may be recognised by other observers.

No.	Time.			Mag.	Direction.	Position.
	h.	m.	s.			
1	11	0	32	β	9·5	ι Ursæ Min.
2	11	4	0	γ		
3	11	5	0	γ		
4	11	7	0	γ β		
5	11	9	0	β γ	7·5	δ Boötis.
6	11	19	17	γ		
7	11	20	17	γ	5·5	α Aquilæ.
8	11	24	7	β		
9	11	24	22	γ		
10	11	26	33	γ		
11	11	28	0			
12	11	35	17	β	8·0	α Delphini.
13	11	38	3	β γ	4·5	20 Pegasi.
14	11	46	28	γ	8·0	54 Andromedæ.
15	11	55	33	β	4·5	55 Pegasi.
16	12	6	4	γ	6·2	α Aquilæ.
17	12	11	29	β	6·7	28 Vulpeculæ.
18	12	11	30	γ	7 or 8	About α Pegasi.

The magnitudes are estimated from α to γ. α is the very largest kind, with a long train; and γ the faintest, having no train. Those with two letters are intermediate. The direction of the path of the meteor is estimated by supposing the meteor to start from the centre of a clock-face, of which the 12 o'clock is in the zenith, and the numbers represent the hour towards which it moves. The stars mentioned in the fifth column were in or near the path of each meteor respectively. Numbers 12 and 17 being quite accurate; 5, 7, and 16 nearly so; and the rest more or less so. 17 and 18 were simultaneous, and so 18 was at the best very doubtful as regards direction and position. As I had no assistance, I found it impossible to observe and record more particulars than I have done. Indeed, none of them I saw had trains long enough to need two observations. It will be found that the radiant point of the above meteor is somewhere near 22 Andromedæ. Number 12 appearing to be hardly conformable. The rest converge, however, pretty accurately. After 12 o'clock the sky became overcast, and so it remained on the three following nights. I fear I cannot rely upon the time given; but believe the greatest error to be within 15 seconds of Greenwich mean time.

I have given the above particulars as a guide to others who may wish to record something more than the mere number of meteors they see. Of course those that possess a meteoroscope save the most difficult part of the task—viz., that of recognising some star in or near the path of the meteor. If Mr. Denning cares to have my observations of the meteors on the 12th and 13th of last November I shall be happy to forward them by post.

Wennington, Lancaster. W. Davenport.

A GIANT PLANET.—RING-NEBULA IN LYRA.—ALT-AZIMUTH STAND FOR REFRACTORS.

[4796.]—Referring to my let. 4275, in No. 375, p. 283 (May 31), regarding Mr. Proctor's quotation from two narratives by eminent observers of "dark transits" on Jupiter, mentioned in his paper on "A Giant Planet," and not having seen any reply, I presume Mr. Proctor has overlooked the letter, as he has replied to other correspondents who made objections to his theories.

Might I ask Mr. Proctor (should he have the time at his disposal) to give us some instances from the records of the Royal Astronomical Society (of which he is hon. sec.) of the first and second satellites being seen in "dark transit," with the dates of the observations, and any peculiar features noticed during transits.

In the *Mechanics' Magazine* for July 27, under "Astronomical Notes for August," by Mr. Proctor, he states (p. 53): "The ring-nebula in Lyra may be now studied to advantage with the 4⁷/₁₀in. telescope belonging to the Astronomical Society; the present writer sees it as an oval ring *with the interior as dark as the sky outside the ring* [the italics are mine]; but with larger telescopes (one of Browning's 12¼in. reflectors, for example), the gauzy light inside the ring can be clearly recognised."

In Mr. Proctor's "Half Hours with the Telescope," he says, "It is seen as a ring of light with very moderate telescopic power. In a good 3⅔in. telescope, the nebula exhibits a mottled appearance and a sparkling light; larger instruments exhibit a faint light *within* the ring." Now, with a 4·23in. object-glass by Wray, I see a "glimmering light" within the ring, and cannot suppose the 4⁷/₁₀in. telescope above-mentioned to be so deficient in illuminating power as not to exhibit this fluctuating light. I also see the 11 magnitude (Herschel) closely following the nebula, and stated by Mr. Webb as being seen with his 5¼in. object-glass. Is this star brightening?

I am sure many readers of "ours" will acknowledge with me that we are indebted to Mr. Proctor for much valuable instruction derived from many of his writings. The alt-azimuth tripod stand I use was constructed after the plan illustrated in his "Half Hours with the Telescope," p. 17, with some modification in the details. It is principally made of cast iron, with a brass quadrant, and two screw motions, and cost me a little over £5 (including the cost of patterns). It could be made for a less sum by any amateur mechanic who has a lathe, though the quadrant would likely require to be cut in a machine shop. The stand is very rigid, and I find it very easy to keep a star in the field of view even with the high power of 420. The telescope can be directed to any point of the sky in an instant, with the exception of a circle overhead of about 15° diameter. Should any of "our" readers request it, I will send a drawing of the stand for illustration.

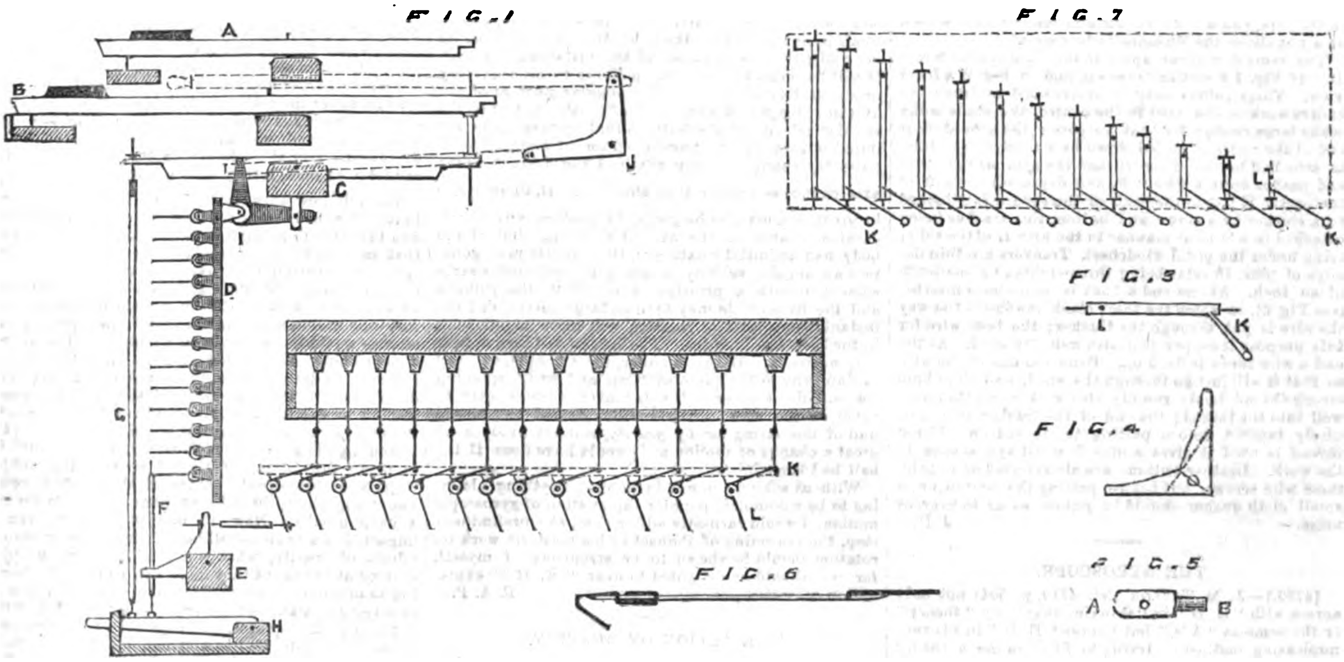
LINEA.

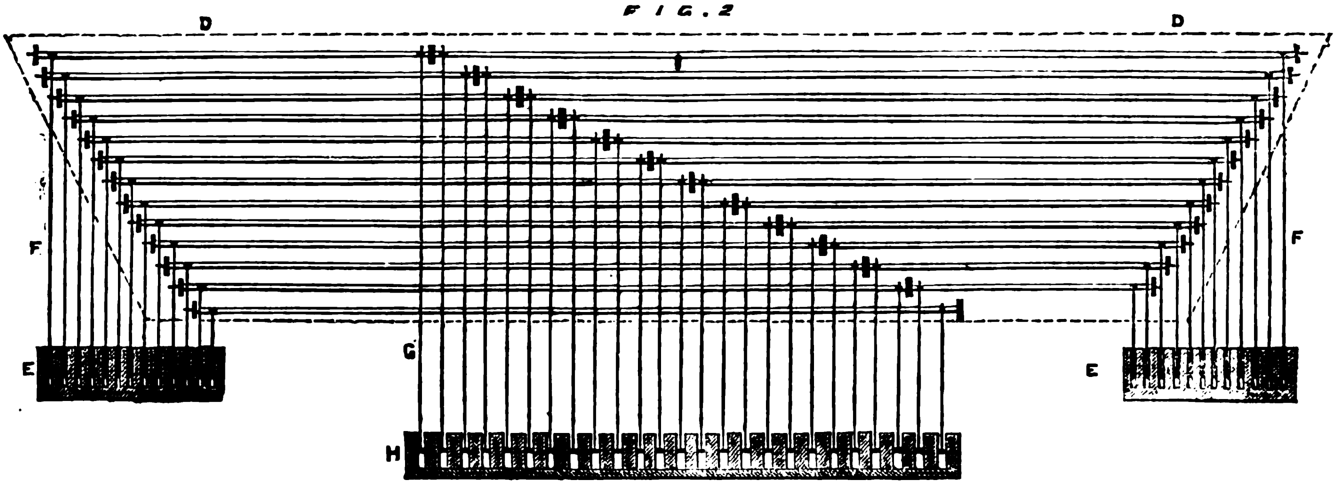
IMPROVEMENTS IN OMNIBUSES.

[4797.]—OCCASIONALLY, whilst passing along our roads in these conveyances, it has occurred to me to what an inconvenience passengers are put in giving the conductors notice to stop when they wish to get out. One is obliged to shout to the conductor, poke him with your umbrella or stick, or trouble one's fellow passengers to stop him. Why cannot there be a bell placed close to the conductor's stand at the end of the omnibuses and tramway cars, attached to a rope or strap running the whole length of the carriages, either inside along the roof, or at the back of the seats, so that each passenger by simply pulling it gives the conductor immediate notice where they wish to be set down. A similar plan might be adopted on the roof for the outside passengers. I think a mode somewhat resembling this is in use in Paris and other parts of the continent. It is a curious fact that matters of this kind are generally managed much better abroad than they are at home. NATHANIEL WATERALL.

THE ORGAN BUILT.—X.

[4798.]—HAVING now got the pedal board made, fix it in its proper position under the keys; the keyboard should project about nine inches over the pedals. Some, however, prefer more and some less; it is quite a matter of fancy. The middle C of the pedal board must be directly under the middle C of the keyboard, although that will throw a two octave pedal board a little to the left of the centre of the instrument. Now fix the lever board H, in Fig. 1, to its place, and find the length of the backfalls in the pedal coupler C, the front end of the backfalls being exactly over the front loop of whipcord in the pedal levers, and the back end of the backfalls under the end of the keys; get a piece of board the length of the pedal board, the width to be the same as the distance between the front and back of the backfalls, and on this board carefully mark the position of the backfalls. Now cut a piece out of the board down the middle the same width as the backfall rail, and





fasten the pieces of board to each side of the rail, so that the surfaces of all three pieces are level, and mark the positions of the backfalls on the rail. From these marks cut the grooves in the rail one inch deep; before, however, cutting the grooves, mark where the wire that the backfall works upon will be, and make a bradawl hole on each side of the wire for a small wire staple to be driven in. Each backfall should have a separate centre wire three quarters of an inch long, and a staple on each side. The hole in the backfall should be bored at right angles to the wood and not sloping in any way. The backfalls are thin bars of mahogany 1⅛in. by ¼in., and shaped as shown in the engraving. They all vary in length, which length will be got by placing them on the marking board. A hole must be bored through at each end large enough for the wires to go through; the holes should be enlarged on the under side to allow play for the wire, but should only be large enough on the upper side to just allow the wires to go through easily. The coupler is thrown in and out of action by raising or depressing the rail. At I in Fig. 1 is a roller of two-inch stuff, having an arm at each end attached to a short stud projecting from the coupler rail; another arm on the roller at right angles to the first arms is connected by a rod to the square J, the other end of the square being attached to the draw stop. The engraving shows the coupler in action, the stop knob being drawn; by pushing the knob in, the front end of the square is raised, and the coupler rail with its backfalls drops down, and consequently out of action. The coupler rail works between guide pins, which are fixed to the frame on which the keyboards lay. The next parts to make are the squares, Fig. 4. They should be made either of mahogany or American birch, a quarter of an inch thick and mitred at the joint; to give the necessary strength a saw cut is made in the back as deep as the dotted lines show, and a piece of veneer well glued in. A hole is bored through as shown for the centre wire, and bushed with cloth; holes are also bored at the ends for the pulls and stickers.

Twenty-five of these squares are required, they are fitted in two rails similar to backfall rails, thirteen go into one rail and twelve into the other; the distance between each square is three-eighths of an inch. Now make the roller studs, Fig. 5. The easiest plan is to get a piece of ⅜in. mahogany, cut off the end of a board, 1⅝in. long, round one end of it slightly as at A; next, with a gauge, run a line down 1in. from A., leaving ⅝in. to form the pin B, and reduce that part to ⅜in. thick. By this means one end of your board will show a section of a roller stud, then cut your board into lengths of three-quarters of an inch, plane off the marks of the saw and round the end for the pin, bore holes an eighth of an inch in diameter, as shown in sketch, and bush them.

Where two rollers work in one stud, as shown in Fig. 2, the studs must be 1¼in. long. The roller boards will be the next part, and it will be better to begin with a horizontal one under the pedal windchest. Rollers may either be made of wood or iron; if of wood they may be made of white pine bars one inch thick and octagon shaped, if of iron make them of quarter-inch gas tubing. The directions for making the rollers will apply equally to iron or wood, but if wood is used wooden arms may also be used; if iron the arms must also be iron, and iron arms may be used with wooden rollers. Get out a board the same length as the windchest, and as wide as the length of the rail in which the squares are fixed. Place a row of roller studs in a line near one edge of the board, Fig. 7. Then mark on the board lines corresponding with the squares, and one inch farther from the roller studs already fixed will be the place for the other studs, which fix in. Next cut the roller rod into lengths to fit each place. If iron rollers, it is now necessary to drill the holes for the arms; they must be $\frac{1}{8}$in. diameter, and carried right through the tubing. After drilling drive a peg of wood two inches long into each end of the roller, and insert the arms in their places. The arms are made of thick iron wire, of a size to fit the holes prepared for them, and for these pedal rollers must be three inches long. They are flattened at one end, and a hole drilled for the pull wires to go through. The arm L is inserted at right angles to the roller, but the arm K is placed as shown in Figs. 8 and 7. Drive a wire pin into the wood at one end of the roller for a centre, and make a bradawl hole at the other end for the pin to go in. Put the roller into its place, and drive the pin in through the stud; the pin should project a quarter inch beyond the stud, so that it may be readily withdrawn if it is necessary to take the roller out. The arm K is attached to the pull of the pallet or screw, or "tapped wire" going through the hole in the arm, and a cloth washer and leather button used as a nut allows the distance to be regulated.

The same directions apply to the large roller board D. In Fig. 1 a section is shown, and in Fig. 2 a front view. These rollers may be either wood or iron; two rollers work in one stud in the centre, the studs being made large enough for that purpose; the arm at that end of the roller is pulled down by a *tracker* G, which is attached to the lever H, and the arm at the other end pushes down a *sticker* F, and depresses one end of the square E; the other end of the square is attached to a tracker by a screw and button, this tracker being attached in a similar manner to the arm L of the roller lying under the pedal windchest. Trackers are thin flat slips of pine, the size being three-eighths by one-tenth of an inch. At one end a hook is sometimes inserted (see Fig. 6), in which the thick black line shows the way the wire is put through the tracker; the best wire for this purpose is copper bell wire well stretched. At the end a wire screw is fixed on. Bend one end of the wire so that it will just go through the wood, and then bind strong thread firmly round; also work some thin glue well into the thread; the end of the tracker should be nicely tapered before putting the thread on. If red thread is used it gives a nice finished appearance to the work. Leather buttons are always used as nuts on these wire screws, but before putting the button on, a small cloth washer should be put on so as to prevent noise. J. D.

THE GYROSCOPE.

[4799.]—J. M. Taylor (let. 4719, p. 564) not only agrees with "E. H." in "thinking that" my "theory" is the same as "A.'s," but follows "E. H." in his very unpleasing method of trying to fix upon me a theory which the merest tyro in dynamics would reject. I have *not* said about "a top flung through the air" what J. M. Taylor asserts—viz., that the top's weight only "eventually changes the direction of flight," and is "insufficient to change the direction in a brief interval." Any one who will be at the pains to refer to my letter (4310, p. 326) will see that the latter words are applied to the rotating top; and that in speaking of a top "flung through the air at a high velocity," I say "its weight would be insufficient to change the direction of the top's motion *appreciably* in a brief interval." There is all the difference in the world between this statement and that which J. M. Taylor ascribes to me. Then *follows* the remark which includes the word "eventually," and every one must perceive that the word "appreciably" extends to that remark also. Surely one may write that when a body is moving at a high velocity, its direction of motion does not change appreciably in a brief interval, but that eventually it does (so) change, without being supposed to support the egregious theory that gravity does not act on a swiftly moving body. It is, of course, easy to cavil at the remark, just as one may cavil at the remark that the sun rises; but it is as absurd to interpret the remark into a statement violating one of the fundamental laws of mechanics as it would be to assert that I believed in the Ptolemaic system, if I chanced to say that the sun rose or set. Richard A. Proctor.

P.S.—As my remarks in reply to "E. H." (let. 4717, p. 563) may seem to imply that I think it possible he may be able to give a popular explanation of gyroscopic motion, I must state that I am convinced that it would be utterly impossible even for a mathematician with ten times the skill of a Newton to effect such an achievement.

It is commonly admitted that Poinsot has done more than any other mathematician to make the mathematical solution interpretable in its entirety. But his treatment of the subject is far beyond the range of any who have not thoroughly mastered the principles of rigid dynamics.

Now, I do not for a moment fear that any of those skilful mathematicians who are to be found among our readers will interpret my remarks in let. 4310, p. 326, otherwise than as they were intended. It is only those who have but lately, as it were, begun to know what the laws of motion mean, who can conceive it possible for these laws to be overlooked even by the tyro. In fact, I wholly acquit "E. H." and J. M. Taylor of intentional rudeness (so far as their original mistake was concerned), since neither of them can be aware how utterly absurd it would be to suppose that such a blunder as they charged to me would be made even by an intelligent schoolboy.

Nevertheless, I shall venture to quote from Routh's "Rigid Dynamics" (a fine work, which I would recommend to "E. H.'s" careful perusal) a passage which presents in mathematical terms the general feature which I indicated in popular words. Readers of Poinsot's papers on Rotation will not need to be told the meaning of the words polhode and herpolhode. In passing, however, I may remark that since in the case of the gyroscope, or of any top, the two principal moments of inertia are equal, the central ellipsoid is one of revolution, the polhode is a circle about the axis of this spheroid, and the herpolhode is a circle about the fixed axis of the couple of impulse. Moreover, the ellipsoid of gyration, being the reciprocal surface of the momental ellipsoid, is also a spheroid.

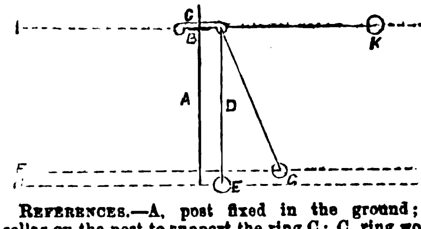
Thus, then, writes Routh, about the stability of rotating bodies:—"It is well known that the steadiness or stability of a moving body is much increased by a rapid rotation about a principal axis. The reason of this is as follows:—The instantaneous axis describes a polhode in the body, and a herpolhode in space. If the body be set rotating about an axis very near the principal axis of greatest or least moment, both the polhode and the herpolhode will generally be very small curves, and the direction of the principal axis of the body will be very nearly fixed in space. If, now, a small impulse act on the body, the effect will be to alter slightly the position of the instantaneous axis. It will be moved from one polhode to another very near the former, and thus the angular position of the axis in space will not be much affected. Let Ω be the angular velocity of the body, ω that generated by the impulse, then by the parallelogram of angular velocities the change in the position of the instantaneous axis cannot be greater than $\sin^{-1}\frac{\omega}{\Omega}$. If, therefore, Ω be great, ω must also be great, to produce any considerable change in the axis of rotation. But if the body had no initial rotation Ω, the impulse may generate an angular velocity ω about an axis not nearly coincident with a principal axis. Both the polhode and the herpolhode may then be large curves, and the instantaneous axis of rotation will move about, both in the body and in space. The motion will then appear very unsteady. In this manner, for example, we may explain why in the game of 'cup and ball,' spinning the ball about a vertical axis makes it more easy to catch on the spike. Any motion caused by a wrong pull of the string *or by gravity*, will not produce so great a change of motion as it would have done if the ball had been initially at rest."

Without asking you not to publish anything claiming to be a complete popular explanation of gyroscopic motion, I would earnestly advise that, as a preliminary step, the reasoning of Poinsot in his masterly work on rotation should be shown to be erroneous. I myself, for one, should be delighted to hear "E. H.'s" explanation *after that preliminary process.* R. A. P.

THE ACTION OF GRAVITY.

[4800.]—I don't feel any inclination to take part in the discussion on spinning tops and gyroscopes now going on in your columns; but as some of the disputants seem to have got into a muddle on the subject, perhaps I may be allowed to set some of them right on one or two points regarding the action of gravity. If I refer to two letters (4594 and 4691) of "A., Liverpool," they will be sufficient for my present purpose. I will refer in the first place to an error into which "A." has fallen, and which your other correspondents have not noticed, and have been rather led astray as to "A.'s" real meaning. He evidently thinks that if a body is set in motion, and the propelling power is not kept up, that the natural inertness possessed by that body will resist its motion, and ultimately bring it to a stand. (See let. 4691.) The fact is that if a body be once set in motion, the tendency of that body is to go on in the same direction and at the same speed for ever.

In let. 4594, "A." observes that "the question is if a cannon-ball be fired horizontally, how is the resistance to change of plane of motion so nullified that it becomes of no effect?" &c. So far as I can see, there is no resistance to any change of the *line* of motion. (See Mr. Proctor's correction, let. 4618.) "A." may think I am contradicting myself because I have just said that the tendency of a moving body is to go in a straight line. This is not a contradiction, however, for a moving body possesses this tendency merely because that is the direction in which it was sent, but as soon as any power is brought to bear on that body to make it change its course, the whole of that power is utilised, and its course changed in proportion to the power applied, consequently there can be no resistance to change. In the same letter he refers to a weight attached to a string and swung round with such force as to attain a horizontal position, and says that the cord has nothing to do with holding the weight up. To make this remark apply to his theory, he must mean neither the cord nor that which supports the cord has anything to do with holding up the weight. I would ask him how is it that but for the string the weight would never rise to a horizontal position? In proof of this, let him study the following diagram:—



References.—A, post fixed in the ground; B, collar on the post to support the ring C; C, ring working loose on the post; D, cord fastened to ring; E, weight attached to cord.

Apply a small force, and the weight E will describe a circle in the plane F at G. By increasing the force the weight may be brought to describe a circle in nearly a horizontal position in the plane I. From the above it will be seen that the length of the string governs the height to which the ball shall rise, for if the string was lengthened sufficiently at the same time that the force was increased, the weight would continue to describe circles in the plane H that it occupies when at rest. But if the string be not lengthened, then part of the power applied is used to raise the weight sufficiently to allow it to describe a circle of the required diameter. I think this will be sufficiently plain to show "A." that the shortness of the string, and not a horizontal force overcoming gravity, is sufficient to account for the weight being raised to nearly a horizontal position. If "A." is not satisfied with this explanation, let him attach a similar ball on each side the ring C, so as to balance each other, and so diminish the friction of the ring on the post. Now apply sufficient force to bring the balls to a horizontal position. Now apply still greater force, and then let him explain why on the force being raised the balls do not rise still higher, and lead the ring off the top of the post. Let him also try another experiment: when he has applied force enough to bring the balls horizontal let him lower the collar B, and then, if his theory be correct, the balls will remain in the same position a short time, and will gradually drop as the motion decreases. But if he be wrong the balls will drop as suddenly as though they were not in motion.

We will now turn to let. 4691, in which "A." says that "if a body be propelled with sufficient velocity and that this propelling power be kept up continually, that said body would maintain a straight course in spite of gravitation." He evidently falls into the error of supposing that the said body would under these circumstances maintain a uniform rate of speed. Any one well schooled in the elementary principles of science would know that such a body would move with a continually accelerated motion. The velocity of a cannon-ball diminishes only on account of the resistance offered to it by the air. If that resistance could be done away with, the ball would reach the ground at the same moment, but as the speed would be kept up it would go farther. One illustration will be sufficient to prove the fallacy of "A.'s" view of this subject. Objects at the equator move at the uniform rate of something like 1,000 miles an hour (rather faster than a cannon-ball). Now, if motion such as can be imparted to a cannon-ball be sufficient to overcome the effects of gravity, what would be its effect on objects moving at the speed they do at the equator? According to this theory, an object which would weigh a ton in a spring balance at the poles would weigh less than nothing at the equator. In regard to the experiment of the light globe tied to a string, "A." would find if he could run with it in a vacuum that the effects would be the same as though he had a ton weight at the end. It is the resistance offered by the air to the passage of a light bulky body which causes it to rise to a horizontal position. Why does "A." use a light globe? would not the same weight of lead do as well if his theory be correct?

Science and Art.

OBJECT-GLASSES.

[4801.]—I have again to thank "F.R.A.S." for his communication, and beg yet once more to trouble him. I have first to observe that it is years since I read the Ross article he alludes to (and which, by the bye, has done much harm to science, for instead of affording information on the vital point of objectives, it dwelt upon a minor matter, the refraction of covers, obviously in order to retain a monopoly of object-glass making, and this he succeeded in doing, although he had very little indeed to do with the invention. Had he explained Mr. Lister Jackson's improvements, hundreds of inventors would have applied their powers in perfecting the instrument long ere this. With the exception of Mr. Wenham's papers in the *Microscopical Journal*, there are no books extant, on the microscopic objective, and amateurs as a rule are wholly in the dark on this all-important head. I consider it both impolitic and barbarous to retain as a trade-secret an invention borrowed from a scientific man. I have spent years in glass grinding, and in the study of optics, but having Montaigne in view, I am diffident as to the quality of my acquirements. Not having filched from Ross, "F.R.A.S." will naturally ask where from, then? Euler, Boscovich, Hugyhens, and lastly Potter, but none of those quite satisfy me, and I would like the proprietor of a first-class Powell and Lealand microscope to apply it both binocularly and otherwise, with various powers, as an eyepiece to a mirror as perfect as may be, and give us the result.

"F.R.A.S." accurately concluded that I considered reflectors better than refractors. I conceive it possible to perfectly figure a speculum (although we are far from that as yet), at the same time I cannot see perfection attainable from refractors. Admirable glasses exist unquestionably—comparatively admirable, that is—but so long as their correction is based on a compromise, they never will bear high eyepieces without distortion. I conceive that instead of two or three lenses an objective ought to consist of many, to give a prospect of perfect correction, and the difficulties are to me insurmountable.

Although foreign to this subject, I beg to point out to my fellow contributors "Hyrab Sea," and "E. L. G." particularly, that they utterly ignore Montaigne's advice, as is apparent to more old women than Betsy Summerhight.

PERSPECTIVE.

[4802.]—I MUST confess I thought you were closing the discussion on this subject rather early; but I now recognise the wisdom of the course you adopted.

The letters of "Bobo" and M. Paris (4702 and 4708, pp. 560 and 561) show that further reasoning would be thrown away; since the former believes that a picture, to be strictly accurate, should show a "vertical line in nature" as a *curve*, "that singular curve" too (as though there were not myriads of such curves, named and unnamed, as the *hyperbola*, *cissoid*, *Witch of Agnesi*, both the *conchoids*, the *quadratrix of Dinostratus*, and a host of others), "that eternally approaches a straight line, but can never cross it," while M. Paris speaks of plumb lines "*converging* in the zenith."

Lest, however, your younger readers should be confused, and imagine that there is a conflict of opinion where in reality no mathematician can entertain the slightest doubt, I would recommend those who may be thus perplexed, to wait, before forming an opinion, until they have mastered the elements of what is commonly called "solid geometry." The first eight definitions and the first nineteen propositions of the eleventh book of Euclid will suffice for a beginning. In reading the propositions the young student should take care to avoid the mistake of regarding the lines in the *illustrations* as those whose equality, parallelism, &c., are referred to in the demonstrations. He must try to conceive the lines and planes in *space* which are meant to be pictured in these illustrations.

The matter which has recently been under discussion may be taken as a "rider" to Proposition XVI., a rather easy rider no doubt, but still not a bad exercise for the young student. It could be worded thus:—

If there be two planes, one containing a given line, and the other parallel to the given line, the planes intersect in a line parallel to the given line. Prove this; and apply the property to show the fallacy of the idea that the perspective view of a tower equally wide at top and bottom should be bounded by lines converging towards the top of the picture.

Such a deduction would, of course, not serve for the tripos at Cambridge, or for like examinations; but for junior classes it would not be wholly unsuitable.

Lastly, in this and other subjects, the learner should work steadily onwards from the beginning towards the end. This is the approved method. By reversing it the learner may be led to all manner of strange misapprehensions. It is in this way that circle-squarers *et hoc genus omne* are generated. For example, we may be sure that the gentleman who believes the three angles of a triangle to be less or greater than two right angles (I forget which) has never gone farther back than Proposition XXXII., Book 1, of Euclid. If he could only work his way thence to the axioms, he would be set right; but there is now small hope of this.

RICHARD A. PROCTOR.

CO-STORES.—TO OTHERS, NOT "HARMONIOUS BLACKSMITH."

[4803.]—WHEN I first undertook to answer the query of "Babbet" (9819, p. 81, volume before last) on "co-operative societies" (not mere "stores"), which I still hold the most important of the 12641 queries yet broached,* and very far from being yet duly treated—when my reply appeared as let. 8044, p. 248, our "Harmonious" friend was as speedily down upon me as at present (let. 8165) with very loud but far from articulate complaints about "superlative madness," my "bad imitation of Thomas Carlyle's stuff," with instead of "an infinite deal of method, precisely what mathematicians term a quantity less than 0"—it is "no use to abuse competition" (which I had been showing how to stimulate and use for good), and so forth; the main or sole intelligible complaint being my not letting "such holy things as co-operation" alone. "Had its injudicious advocates only strength of mind enough to let it alone, at least as far as regards preaching out of season about it (silence is golden, sayeth the sage of Chelsea), we might perhaps have heard less and seen more," &c. Surely, by the way, such complaint directed at me entirely glanced off on the Editor. If it is not presumable that whatever queries he prints are matters in season to be treated, why are they admitted? It was his place, if any one's, to "let it alone," surely not mine after the query had appeared. Well, the "Harmonious" now interposes on the same subject, and in identical style (let. 4670, p. 540) to inform us he is ignorant of this, ignorant of that, and is "also ignoramus in relation to" the other. I often think it necessary, in stating something I know, to distinguish plainly that such and such points connected with it I am quite ignorant upon; and the space thus taken on a late occasion raised "Sigma's" wrath; but I presume there was *something* positive after all, not a whole letter of "ignoramus" like this. Has "Harmonious Blacksmith" ever read the motto from Montaigne that heads every batch of these letters? And if he is *now* so ignorant on these two subjects, "co-operative stores and coins," then in the name of golden silence, "sage of Chelsea," and all other thingummies, to return his words, "can't *he* let it alone," and could he not have let it alone those months ago?

Suppose equal space taken to inform us what particular things, now on the tapis, Mr. Proctor is ignorant of, and so on with other contributors, would the ENGLISH MECHANIC be worth its salt? He does not even favour us with one word of what he says appeared in No. 1 of the *British and Foreign Mechanic*, which he cannot suppose very easily obtainable. I find the British Museum possesses no copy. "The trader," he admits, is "possibly not, as such, a product of Providence;" but he finds it "hard to conceive to what other productive energy we owe his existence." Conception, then, is hard where it ought to be particularly easy, as two letters prefixed give him the cause in question—*im*providence. Why am I (and every Londoner at present) unable to get one pennyworth of food, fuel, or any necessary, without at least another penny going to blast wretched traders' souls, increase all degradation, and pile up pestilent funds for the furthering all iniquity, and hastening every way my nation's and race's ruin? Simply because, in this utter disintegration of what was once a society, a city of two millions does not contain *one hundred* individuals neighbourly or *provident* enough to allow such a paramount duty so much as one hour's thought or discussion! Divine Providence created man. Human *im*providence alone created and creates this ruinous canker. If my querist objects that "improvidence" is not a "productive energy," it is nevertheless the releaser of the evil energies of greed, concealment, and various "Satans" (whether he likes the term or not), that alone are "productive" of cankers like this; as physical corruptions are *productive* of cholera and small-pox, or of maggots and flies; doubtless not of the germs of either. As for an "all-Father," I know not where the term comes from, but in the only writings of recognised authority on such a matter among us, He who taught men to address His Father as "our Father" very plainly tells many others that they are of *their* father, *not* His, because the lusts of *their* father they will do; which seems to exclude at present any "*all* Father;" and I do not see a syllable of the creator of adventure-traders as such (or of adventure-trading), and the Creator of man being aught but enemies to each other. When a type of the latter hears of the appearance, in his field, of types of the former, he says, "An enemy hath done this," but orders both to be let grow together till the harvest. That harvest I infer to be now beginning, because everywhere this manner of products are very visibly being gathered and bound into bundles. And this is just what the harvesters were *first* to do, "gather out all things that do offend, and bind them in bundles to burn them." But afterward (soon, we hope), the wheat to begin also being gathered into the garner. Very "melancholy mental crazes," doubtless, with quantity of method mathematically "less than 0."

For reply to "how the thingummy" those who have things to exchange, and make them, can make a medium of exchange, I will simply copy the back cover of Josiah Warren's pamphlet "Equitable Commerce" (1852, Fowler and Wells, 131, Nassau-street, New York), which professes to be a specimen of notes current in one of the earlier settlements, since greatly multiplied

Cost the Limit of Price.
FIGURE OF JUSTICE.

Seven Hours.	NOT TRANSFERABLE.	7 × 12 Pounds.

Due to *Jacob Smith*,

SEVEN HOURS' LABOR

in House Rent,

OR SEVEN TWELVE-POUNDS OF CORN.

Mary Jones.

Labor for Labor.

The frontispiece is another specimen with similar engraving and side mottoes—

Three Hours.	NOT TRANSFERABLE.	8 × 12 Pounds.

Due to *Sarah Johnson*,

THREE HOURS' LABOR,

in Carpenter's Work,

OR THREE TWELVE-POUNDS OF CORN.

Joseph Peters.

Full explanation of these and the working of the system is given, in 120 closely printed pages, for 25 cents. His later work "True Civilisation an immediate necessity, and the last Ground of Hope for Mankind" (1863, J. Warren, Boston, and A. C. Cuddon, 73, Falkland-road, Kentish-town, London, N.W.) gives a more elaborate form of note for "One Hour's Labour in Carpentering, or 8 pounds of corn," with 184 pages of explanation, and most interesting historical details of the movement. Carpentering, therefore, seems to have declined in real value in those 11 years, probably from the immigration of skilled Europeans.

As near England as one of the Channel Islands, I believe a market-house was built some years ago without the use of other money than such notes. "Certes," I would conclude with our "Harmonious" friend, "it could not" (therefore *cannot*) "much facilitate exchanges if all purchasers were compelled to exchange one form of wealth—which especial form might not be in local demand—for another they needed;"—that is, precisely what the European coinage system (which, above, he denies to be "necessarily oppression") *does* compel all to do! and moreover to keep all the gold and half the silver (the two most physically valuable metals in nature) sunk, idle, and in a perfectly useless form. Of all the badges imposed by conquerors, this is at once the most flagrantly oppressive (except permanent chattel slavery), and the most blinding, without even *that* exception. Talk of "dark ages," let us hope they are at their darkest, but they are certainly though an end only to be attained by true co-operation, among operatives and wholly against "employers" as now defined, wholly for the superseding and elimination of them as a class, is yet a very minor end of this great holy war and true Armageddon to which Heaven calls us all; an end not to be attempted at the outset, but only after far more important results. At least, though reformers situated as in America may begin with it, we can only hope to end with it. In no truly civilised society will weights of metal "stamped and certified" to save "the trouble of weighing and assaying" be found a bit more requisite than weights of cheese or soap so "certified."

E. L. G.

DESCRIPTION OF A CONCRETE BUILDING CONSTRUCTED OVER THE METROPOLITAN DISTRICT RAILWAY.

[4804.]—I HAVE latterly read with much interest the letters of "Khoda Bux," "M. G. C.," and others on the interesting subject of concrete, which I, alike with "M. G. C." (let. 4692, p. 542), firmly believe will, in time, outdo bricks and mortar, when truth has overcome prejudice, which it certainly will. Our friend "Khoda Bux's" personal experiments show its cheapness and durability, and I may safely state concrete building in every particular, whether monolithic or not, drives the soon-to-become old bricks and mortar plan into the shade. To prove conclusively the largely-discussed question as to the reliable character of concrete exposed to compressive strains, I will bring before "our" readers the tests applied to the experimental concrete bridge, set in cement, erected over that branch of the Metropolitan District Railway which forms one of the junctions between the Inner Circle and the West London Extension. The structure experimented upon spans the open cutting between Gloucester-road Station and Earl's-court-road. It has a flat arch of 75ft. span and 7ft. 6in. rise in the centre, where the concrete is 3ft. 6in. in thickness, increasing towards the haunches, which abut upon concrete skew-backs. The concrete of which the bridge is made is composed of screened gravel and Hilton's Portland cement, mixed in the proportions of about seven to one, carefully laid in mass upon close boarding, set upon the centreing, and inclosed at the sides. The concrete was mixed by hand labour, as many men being employed to mix and wheel into place as there were room for. The bridge was formed in three portions, the centre portion, 12ft. wide, being first made and tested. Each portion was formed in one operation. The amount of concrete employed in the centre portion was about 4,800 cubic feet, which, weighing $1\frac{1}{4}$ cwt. per cubic foot, gave a gross weight of 300 tons for the structure alone. The centre of gravity in the half span being 16ft. 6in. from the abutment, the weight of the same 150 tons, and the rise of the arch 7ft. 6in., the thrust at the crown is equal to 330 tons. The arch being 3ft. 6in. deep in the centre, and 12ft. wide, a sectional area of 42 square feet is available to resist the thrust, which is consequently equal to 7 tons 17 cwt. per square foot. The additional strain imposed upon the concrete in the arch for every ton per foot run of distributed load is equal to $2\frac{1}{4}$ tons per square foot, and the maximum strain for a rolling load of 1 ton per foot run is about $8\frac{1}{4}$ tons per square foot. It occurs when the load covers about five-eighths of the span. In testing the centre portion of the bridge, rails were laid upon sleepers over the arch, which brought a load of $^{2}/_{75}$ths of a ton per foot run upon the structure. Seven trucks weighing, with their loads, 49 tons, were formed into a train, having a wheel base of 57ft., hence the rolling load amounted to $^{49}/_{57}$ths of a ton per foot run. The deflection produced by the passage to and fro of this train four times was noted with a spirit-level upon a standard cemented to the sides of the arch at a distance of one-third the span from the abutments. When one side of the bridge was loaded the extreme rise of the haunch on the opposite side was about $^{1}/_{16}$th of an inch, which was produced by a maximum strain of 10 tons 14 cwt. per square foot.

At a subsequent trial a mass of gravel 10ft. wide, 3ft. thick at the crown, and 6ft. deep at the haunches, was laid over the bridge, and upon this ballast was placed the permanent way. After an interval of a few days the trucks, loaded as before, were passed over the bridge, at first in pairs, and finally altogether. In his test the strain upon the concrete was as follows:—

	tons.	cwt.
The weight of the arch as before......	7	17
170 tons of ballast	4	8
Strain per square foot from dead load	12	5
Strain per square foot from passing load	2	17
Total strain per foot................	15	2

After repeated transit the load was left on the bridge all night, and upon examination showed no signs of failure or distress under the severe strains to which it had been exposed. That a very small stress was developed upon the underside of the arch was evidenced from the fact that none of the comparatively loose pebbles on the inner surface of the arch became detached, the interior of the structure was much denser than the outside, and at 6in. from the outer surface was excessively hard. The exterior of the work was rendered in Portland cement to represent ashlar. Some fine cracks appeared a few months afterwards, attributed to the further shrinkage of the concrete by drying, but these have not extended. Nevertheless, the porous nature of even such good concrete as that used in this bridge is shown by the fact of rain passing through it in the course of a few

* We have once before corrected "E. L. G." as to the number of queries. There have been about three times 12641 queries inserted. We began to number the queries

REPLIES, &c., FROM "SIGMA."

[4805.]—I HAVE to apologise to several querists for not replying, owing to having had my time wholly engaged on business requiring a good deal of absence from home. I will now note the various matters calling for attention in the last three numbers, so far as my present time permits.

"T. H." (let. 4601, p. 488) has not even yet extricated himself from the old confusion of "quantity and intensity." The statement of mine which puzzles him is strictly true, and he should try it; interposed resistance does not affect the weight of copper deposited by a given consumption of zinc, it only prolongs the time and generates heat in the wire; of course, there is the same total heat or energy developed in both cases, but it is differently employed and distributed: of course, also, the excessive consumption of zinc by local action must be allowed for, as it has nothing to do with the deposition. "T. H." should read again my paper in No. 355 dealing with this. The primary of his coil appears to be too long and too small wire, therefore has too much resistance to develop full magnetism in the core; and the cotton covered wire secondary is not good, as it does not lie close enough to get full effect.

INTERNAL RESISTANCE.—My opinion on this matter, to which "Pi" (p. 490) rather objects, relates to general use by our readers, chiefly amateurs, rather than to electricians possessing Thompson's reflecting galvanometer and perfectly arranged resisting coils; they can take care of themselves. My advice is mainly given to those who do not possess these costly appliances, and it is for such I try to devise and select the easiest processes, and most convenient instruments.

I cannot at present go further into the points named by "Beacon Lough," p. 491, because having changed my abode within the last fortnight, and spent most of that away, my books and instruments are unavailable at present, being as yet in a state of chaos.

For the same reason I cannot answer T. Sinclair (12509, p. 497); possibly the carbolate of lime may suit him, but I am not sure.

ACARUS CROSSII.—This was a mistake, the acari were not generated as supposed, but were a well-known creature. The whole of the experiments were described in a previous number at full length. I cannot give the number for the reason just stated.

(12533.)—MAGNETIC MACHINE.—It is only necessary to solder short pieces of wire at the several lengths and bring them out for connecting to studs, so that any of the lengths may be connected to the terminals. My diagram, p. 502, is sufficient aid for so very simple a matter.

(12558.)—ELECTRO-MAGNETISM.—Probably a separate circuit would put an end to the trouble of "Contact Breaker," such as a length of fine platinum wire, or better still, a voltameter through which the extra current at breaking circuit should pass, instead of forming a spark: I suspect a battery of too great force is used. The spare coil tried, to some extent absorbs the extra current; covering the electro-magnets with copper or brass cylinders would do so still more effectively.

(12554.)—GRAPHITE BATTERY.—The glass tube is for adding and removing liquid without disturbing the loose particles or moving the cell; with manganese, saline solutions should be used.

I beg to assure "A., Liverpool" (let. 4691, p. 542), that I have not done anything so absurd as he supposes; nothing I said could be tortured into asserting that a body discharged—horizontally—"with any conceivable velocity would maintain a straight course in spite of gravitation." I said it would do so *but for gravity*, and that a part of the energy was consumed in slightly raising the bullet and so prolonging its time of falling to some small extent. The velocity of the motion has nothing at all to do with either time or rate of fall due to gravity. As to "A.'s" extraordinary illustration, the ball, be it a hollow indiarubber one or a 68-pounder, could by no possible velocity of rotation ever rise to a true horizontal plane, and the cord does most certainly hold it up, by transmitting to it that energy which continually lifts it as fast as gravity tends to make it fall, and before any one troubles to answer "A.'s" pathetic "where, and oh where," it will be as well to have considerably better evidence than a guess of "A." against perfectly proved facts. SIGMA.

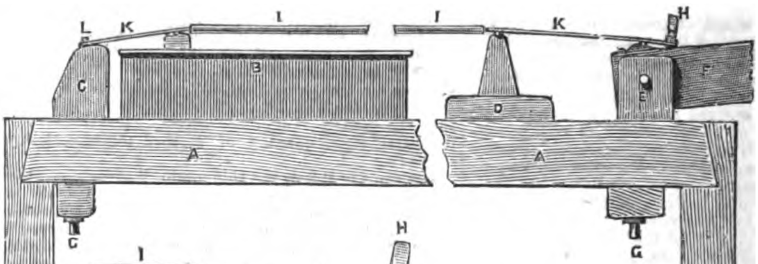
TUNING KEYED INSTRUMENTS.

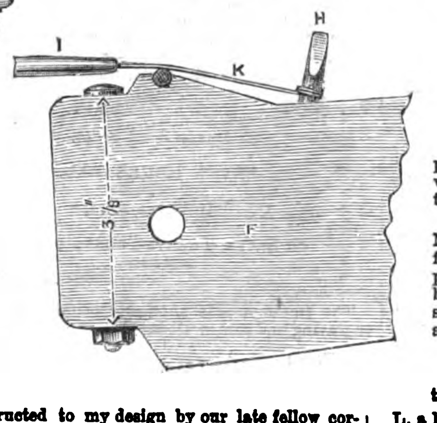
[4806.]—"FIDDLER'S" idea respecting the tuning of keyed instruments could never, I fear, be carried into effect, for the difficulties in the way are very great. At the same time, if anything could be invented to enable such instruments to be played equally in tune in all keys it would increase their value to a marvellous extent, and be the greatest improvement that the musician could desire. But I do not think "Fiddler's" arrangement will accomplish this, for the following reasons. First, he proposes to make the key which plays the tonic of each scale play the leading note also, by a difference in the force of touch, and justifies this, on the ground that the discord of the diminished second is scarcely ever employed, except in a few instances by Beethoven and Mendelssohn. This is quite true; but as these great masters do sometimes introduce it, such an alteration would prevent the works in which it occurs from ever being played. A more serious objection to "Fiddler's" plan is that the difference of tone is produced by so indefinite and uncertain a thing as the varying strength with which the note is struck. Suppose, for instance, that we are playing in the key of C; we must always play B very softly and the tonic loudly, for an increase of power would turn the former note into the latter. What, then, would become of delicate shades of expression? Fancy the result, if in a rapid crescendo passage, the slightest amount of undue pressure would throw all out of tune! Verily, I think, "Fiddler's" remedy worse than the disease, and it would make the piano twice as difficult to learn as it is at present.

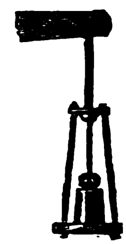
Though the discord of a diminished second is very rarely employed, that of the major seventh, which is practically the same thing, is not at all uncommon, and on "Fiddler's" piano that chord could only be sounded by playing an apparent octave, and striking one of the notes harder than the other. Then, again, the reduction in size of the instrument, which he considers an advantage, is to my mind a mistake, for it would greatly increase the difficulty of performance. Who could play the chromatic scale with smoothness and ease, when he would have to repeat the touch on every note? None but the finest performers could do it satisfactorily, and I doubt if even they could, in this manner, equal the rapidity with which the same thing may be readily done on the ordinary keyboard. In fact, to halve the number of notes, is to double the difficulties in the way of the player rather than to reduce them. Besides this, how are we to manage when we wish to play an accidental flat, say B? The note A will only produce itself, and A sharp, and surely that is not to be used instead of B flat, for if so, what becomes of the improvement? If not, an additional note will be required, and then the keyboard will remain of the same dimensions as at present. I am afraid this notion of "Fiddler's" leaves us as far from the desired goal as ever. VERTUMNUS.

MONOCHORD WITH SOUNDBOARD AND OTHER MUSICAL STRING TESTING MACHINES.

[4807.]—I INCLOSE drawing of very simple apparatus for ascertaining the amount of tensile force—expressed in pounds weight—required for causing a string of given length and thickness to produce a sound of given pitch. Many years ago, about 1850, a far more costly machine







was constructed to my design by our late fellow correspondent "W. T.," but having quite got over my early prejudice in favour of expensive apparatus, also well knowing that most of my friends in the pianoforte trade share "W. T.'s" quite justifiable terror of the probable cost of uncustomary iron work, I have designed this affair to be almost entirely constructed of wood, consequently, any pianoforte-maker (who being unhappily afflicted with the same form of disease which myself and my late friend formerly suffered severely from, to wit curiosity, is desirous to know what he really is doing, and is not quite content with the customary "rule of thumb") may make it for himself at a very trifling cost, certainly not exceeding 20s., if he does what I did—viz., make the back of one of his benches serve for its bed. This he may do by bolting to the bench a piece of (say) beech wood the same thickness as its top, about 4in. or 5in. wide, which also forms a very tolerable makeshift bed for a rough lathe.

In testing piano strings, no very great accuracy is required. In practice, it is sufficient to be able to ascertain the straining force within 1 per cent., which this apparatus is quite capable of doing. If, in consequence of the friction of the lever on the ¼in. round iron pin on which it works, and other causes, the lever acts rather sluggishly, a few gentle taps of the mallet soon, by jarring, cause it to assume its true position under the influence of the weights suspended to it. When great accuracy is needed, probably some such apparatus as that described by the late General Perronet Thompson—which he constructed for facilitating the tuning of his celebrated enharmonic organ—would be about the best that could be employed. In this the string being tested had the straining weight suspended to it directly (the string being perpendicular), and no amount of downbearing on the two bridges which could sensibly affect results was suffered to exist; in fact, a pressure of only 4lb. sufficed to keep the string in contact with its bridge, and even this small pressure was not applied until after the weight which strained it had been in operation for a few seconds of time. Had the pressure been applied in the same plane as that of the bridge's inner surface, it could not have increased the tensile force, because it would then have acted on the string like a mere clip.

I have a rather strong impression, if the covered strings of ordinary cottage pianos were tested, the results would surprise some of their makers. Those commonly employed for FF—if subjected to the same straining force and thickness (I mean the under wire) as middle C—might possibly be heard to sound A, if not B; "I guess," their pitch would rise "pretty considerable." I think I see the look of blank astonishment some of my clever friends in the trade would exhibit, and hear them exclaim, "Well, I could not have believed it if I had not heard it, and yet my covered strings are exactly the same as those of Messrs B., C.," &c., mentioning the names of one or two first-class manufacturers, whose real names I, for obvious reasons, forbear mentioning, and leave the riddle to the reader.

DESCRIPTION OF THE FIGURE.

AA, bed or bench on which the standards E and C are fixed. N.B.—If it be desired to make this apparatus independent of an ordinary bench, the wooden bed of a common lathe, or a similar bed formed of two pieces of common spruce deal 8in. × 4½in., or even 2½in. × 3½in., placed about 1½in. apart, will serve.

B, a soundboard about 16in. to 18in. square, fixed on a rectangular frame, which may rest on the bed A without being clamped thereto.

C, a standard fixed by the bolt G at any required distance from the standard E; of course, the distance these two standards are apart depends on the length of the string which is being tested.

D, a standard which need not be fixed, but may only rest on the bed A.

E, a forked standard fixed to the bed A by the screw bolt G. This standard supports the lever F.

F, a lever, whose two arms are in the proportion of ten to one, by which the straining weight in the scale pan suspended from it is transmitted to the string to be tested.

GG, screw bolts for fixing the beads EC. N.B.—Two of the screws out of my matrimonial four-post bedstead answered admirably for this purpose, and they had the advantage of having been well tried, and not "found wanting." Possibly, in these day of iron bedsteads, such things as bed-screws may be almost unpurchasable.

H, a common wrest-pin inserted in the lever F.

II and KK are the uncovered and covered portions of the string being tested.

L, a hitch-pin in the standard C.

To use this machine proceed as under. Ascertain—by means of a weight suspended at exactly the same distance from the centre which the wire bridge on the lever F is, or by a thin cord carried over a rather large pulley—the weight required to counterbalance the lever F and the empty scale pan, assuming this to be 10lb., that weight must invariably be added to whatever weight is put in the scale-pan, unless it be preferred to counterbalance them permanently.

1. Pass the end of the string through the hole in the wrest-pin H, and coil it twice round it.
2. Put the eye of the string on the hitch-pin L—put a weight equal to about one-quarter the straining force you design to subject the string to in the scale-pan, and fix the standard C sufficiently distant from E, to cause the lever F to incline upwards about 10 or 12 degrees.
3. Place the soundboard B so that the wire bridge is about ¼in. from the end of the covered portion of the string.
4. Place the standard D so that its wire bridge is about ¼in. from the other end of the covered portion of the string.
5. Put the weight into the scale-pan, which subjects the string to the amount of tensile force you desire, and on plucking, striking, or bowing the string, the pitch of the sound it produces will instruct you which note on the instrument it ought to be used for. N.B.—Should the lever descend much below the horizontal position, it may be raised by turning the wrest-pin H.

When this apparatus is employed for ascertaining the force of tension required to cause a string of given length and thickness to produce a sound of given pitch, all that is requisite is to place the bridges on the soundboard, and on the standard D at the required distance apart, and put weights in the scale-pan, which is suspended from the lever F, until the string produces a sound of the required pitch.

Par example, experiment No. 1. Having put a No. 24 steel-wire string on the monochord, place the bridges 24in. apart, and load the lever until the strain is equal to (say) about 290lb., which, I believe, will cause the string to sound middle C of our philharmonic pitch. N.B.—Under the circumstances mentioned below, this would require a weight of 28lb. to be placed in the scale-pan.

No. 2. Increase the distance between the bridges to 26in. = $^1/_{12}$ more, and the straining force will require to be increased about 18 per cent., approximatively.

No. 3. Increase the distance to 28in. = $^1/_6$, and the straining force must be increased about 36 per cent.

No. 4. Increase the distance to 32in. = ⅓, and the straining force must be increased about 78 per cent.

No. 5. Increase the distance to 36in. = ½, and the straining force must be increased about 125 per cent.

If desired to ascertain the amount of tensile force which any string—in any instrument—is subjected to, place the bridges on the soundboard B, and on D the same distance apart those are on which the string rests in the instrument, and put weights in the scale-pan until the string produces a sound of the same pitch as it did—or as a string which is a counterpart of it does—in the instrument.

Should it be desired to judge of the timbres or varying qualities of the sounds obtained from strings of equal lengths, but of different thicknesses (when connected with the same soundboard, and producing unisonous sounds), this apparatus may be slightly modified for that purpose. By inserting three hitch-pins in C, and three wrest-pins in F, the sounds produced by three strings of different thicknesses may be compared, always assuming the apparatus be made strong enough to bear the additional strain of two more strings. Of course, it will be needful to prevent the lever F from rising by putting additional weights in the scale-pan, or otherwise, say by strutting or by tieing it down. I think it would be preferable to substitute for the lever F a spare standard which would do duty for a temporary wrest-plank; but, after all, such experiments are of doubtful value, because in practice the soundboard most suitable for long covered strings is not most suitable for comparatively short uncovered strings, and these results—although far from valueless—not to be depended on equally with trials in the instrument itself for which the strings are designed.

THE HARMONIOUS BLACKSMITH.

PHONOMETERS.—COLONEL PERRONET THOMPSON'S MONOCHORD.

[4808.]—PROBABLY the most accurate instrument ever constructed for "weighing sounds"—to borrow its designer's expression—was the phonometer designed by the late General Thompson. In this the straining force required to bring a string up to a given pitch (and the change of its length needed to produce a given alteration in the pitch of the sound produced by its vibrations) could be ascertained to the greatest nicety. His purpose in having it constructed was to facilitate the tuning of his celebrated enharmonic organ, in which sounds differing in pitch less than one-tenth of a comma were required. The last I heard of the organ was that it had been doing duty in a school attached to a chapel in or near Jewin-street, Aldersgate, but was then—and had for some time been—superseded by an harmonium, the complex key-boards of the enharmonic organ being too difficult for performance by untrained players. My informant could not tell me where the phonometer was. If any fellow reader can, he will greatly oblige me? I think this organ and its phonometer would be valuable additions to the educational department of South Kensington Museum, if only for the purpose of demonstrating that performance in tune is preferable to performance out of tune, which is just what all performances on instruments with fixed tempered scales must be, and which, alas! some performances on the violin—and voice whose intonations are not fixed—have seemed to me distressingly to resemble.

THE HARMONIOUS BLACKSMITH.

RIFLE TARGETS.

[4809.]—WHEN at Hastings a few weeks since I noticed what seemed to me a great improvement upon rifle targets. These were made with two plates of thick steel, fixed on a stalk before an ordinary target, a large plate representing the centre and a smaller one in front the bull's-eye. If either of these plates be struck with a bullet a loud sound like that of a bell is heard, by the tone of which it is known which plate is struck, so that no marker need be exposed to any risk. It is true that the risk is very small if proper attention be paid to signals, but scarcely a season passes without a fatal accident from want of such attention. I do not know whether the cost of such substitutes for markers is considerable, but think it cannot be more than is well worth paying; I should, however, like to know. Perhaps some of our correspondents can give the information.

PHILO.

SINGLE *VERSUS* DOUBLE-CYLINDER ENGINES.

[4810.]—Now that this subject is exciting considerable interest, I send the following extracts from Bourne's "Recent Improvements in the Steam Engine" (p. 51, &c.):—"For all pressures employed in the ordinary class of existing steam-vessel, engines of the common single cylinder type are as efficient as any other, and in practice such engines are found to work quite as economically as engines with any greater number of cylinders, while they are manifestly simpler in construction." "But if the pressure be raised to 60lb. or 70lb. per square inch it will be advisable to double the length of the stroke, and halve the area of the piston." "If such pressures be employed as 150lb. to 200lb. per square inch, it may be proper to introduce double-cylinder engines." "The gain in power producible by a given amount of expansion is equally attained, whether such expansion is accomplished in one cylinder or fifty." Double cylinder engines, however, enable expansion to be carried further without interfering much with the uniformity of the motion.

PHILANTHROPIST.

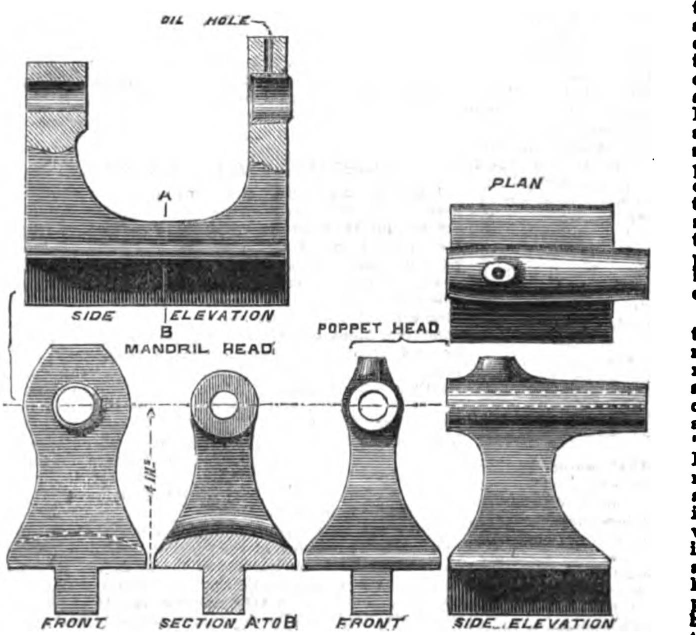
FALL OF BULLET.

[4811.]—WITH respect to Francis Lewis' letter (4682, p. 541), it must be evident that the fall of a bullet can only be regarded as an example of the second law of motion when the earth is considered as a plane; but the earth being a sphere, there are two points that will theoretically affect it. In the first place, when a bullet is projected horizontally, that is at a tangent to the earth's circumference; but as the tangent increases the secant increases, therefore it will take as long reaching the earth as the secant exceeds the radius. And, secondly, as gravity acts inversely as the square of the distance, therefore being further off the attraction will be less, and it will take longer to reach the earth. Therefore, for two reasons, it will theoretically take longer to reach the earth than a bullet dropped from the same height.

ZETA.

LATHE CONSTRUCTION.

[4812.]—I AM sorry to have kept "C. N. M." (qy. 12354) waiting so long, and now send sketches of both heads for a small lathe. The mandril head would be better if it were a little longer, say another inch in a 5in. lathe, and the mandril should be as long as possible, provided you can get it



into its place. The screw of nose of mandril for a tiny lathe such as "C. N. M." wants (only 2¼in. centres) may be ⅜in. or $^7/_{16}$in. diameter, and then the fixed collar may measure about $^9/_{16}$in. or ⅝in. inside in front. I have shown the fillet that goes between the beds nearly 1½in. deep, as it is extremely convenient occasionally to be able to raise the heads from 4in. to 5in. height of centre by the insertion of parallel pieces of wood under them, and if these are not more than 1in. high there is still plenty of the fillet remaining between the beds, to hold the heads true while they are being bolted down. Such a deep fillet to the mandril head has also the effect of stiffening it materially in its weakest place. I should not temper the collar more than to boiling-water heat; both in shrinking it in to the casting and in japanning there is some risk of its being tampered too much. I must refer "C. N. M." to my previous letters on this subject if he wants any more information. The sketches sent are from templates made many years since for a 4in. lathe, and I think for proportion, with the exception mentioned above, will make as pretty a lathe as need be, whether enlarged or diminished as regards actual size. If "C. N. M." resides in or near London, my old address, Pitcairn's Library, King's College-road, N.W., will enable him to appoint a meeting.

J. K. P.

HEATING BY HOT AIR.

[4813.]—IN reply to "E. C. G." (let. 4635, p. 518, No. 384), I beg to refer him to the volumes of the *Gardeners' Chronicle* for 1847-49 (as nearly as I can remember) for an account of a system of hot-air heating called Polmaise. He will find that it is too late by 25 years to claim a first success for hot-air heating of plant houses in 1872. Polmaise forced its way into use by its well proved merit under the able guidance of Mr. Meek, and with the cordial approbation of Dr. Lindley. Having no opportunity of consulting the *Gardeners' Chronicle* for some years after that date I cannot say for what reason or in what manner the system ceased to spread itself or to be spoken of. I speak from much practical experience of its great merits when I say that I know no other argument against it; and the force of this objection is greatly diminished by the fact that in all the cases in which I was personally engaged in its application, where I have been able to ascertain by inquiry, it continues in operation to this day. Its disappearance from the public view may be chiefly accounted for by the fact that the system is represented rather by a principle of hot air circulation than by an apparatus. It can hardly, therefore, form part of the stock-in-trade of high class tradesmen. In other words, men wishing to adopt Polmaise as a system proved to be thoroughly efficacious for hot-houses, churches, &c., would find great difficulty in getting hold of any who should understand it.

The work is that of a common bricklayer, and falls, therefore, into the hands of a class of men who do not trouble themselves generally with the laws of pneumatics. It was very observable too, at the time of the introduction of the system, how very frequently the principle of Polmaise was misunderstood. Those interested in opposing it used to represent it is only a new form of the useless hot-air appliances already in existence, and even of those tradesmen who took up Polmaise and advertised it, some would be changing it into a mere apparatus of iron pipes and hot-air flues, to the neglect of the leading principles and features of the system. I applied the system to a small hot-house of my own construction, and its complete efficiency and remarkable cheapness, both in construction and in use, induced others to try it for the same purpose, and I never heard a word from these friends other than those of commendation. I applied it to a large parish church, and it was applied by plans and instructions furnished by me to several other churches, and in all cases with excellent results; one of these I will specify. A church in Kent was heated at a cost of £45 on the Polmaise system, while another of similar dimensions had a hot-water apparatus supplied at a cost of £200. The fuel bill in the latter case reached the sum of £20, against £5 in the Polmaise for the same period, the two churches being comfortably and efficiently warmed.

With the advantage of the experience already referred to to assist me, I notice points favourable and unfavourable to success in Mr. Housman's apparatus as described in "E. C. G.'s" quotation. He is quite alive to the need of pouring in warm air by cubic feet or yards into the houses to be warmed, instead of niggling with tubular stoves and small pipes. I have known a complicated apparatus of small pipes heated to whiteness—through which nothing short of a steam-engine and fan could have driven heated a into their building (a church) sufficient in volume to warm it—and utterly fail to produce any result. Extensive surfaces for the absorption of the furnace heat is a good feature in the system, but highly heated surfaces imply extravagant consumption of fuel, if they are extensive. They are also injurious to plant life; the great advantage of extended surface residing in the power thus gained for warming large volumes of air moderately. It is much easier also to speak of rapid currents passing over such surfaces than to obtain them, when they have, as in Mr. Housman's system, to pass through lengths of horizontal hot-air flues, every yard of which is an obstruction to the current. The power at command to create a draught through a hot-air apparatus and system of hot-air flues is just that of a chimney of the height of the plant house, a very imperfect chimney indeed.

So far as Mr. Housman's system is described in the quotation of "E. C. G.," it is on the principle of inflation as contrasted with circulation which characterises the Polmaise system. In the former case the whole contents of the house have to be driven out to make room for the heated air. In the Polmaise system the cool air of the house is actively employed in producing or promoting the circulation of the heated air. I have written at sufficient length, but if "E. C. G." or others should desire it, I will illustrate the plan of circulation, and describe the system of Polmaise more perfectly, and point out in what case it is most suitable for plant houses.

J. M. TAYLOR.

Seer Green Vicarage, near Beaconsfield.

OUR COAL SUPPLIES.

[4814.]—WHEN I was a boy at school one of our teachers, a most intelligent man, used to read to us from various treatises, and among the rest from Parkes'

"Chemical Essays," published, if I recollect aright, in four pretty thick 8vo. volumes. In these essays it is stated that on the south coast of England, Sussex possibly, after a heavy gale of wind coal rubble was washed up in such quantities on the beach as to yield very seasonable supplies of fuel to the poor, who, on such occasions, eagerly gathered it. It is very odd that in all the discussions on the subject of possible subterrene supplies of coal in the southern counties this fact, if it be a fact, has never once been adverted to. To me it seems as clear as possible, if the averment in Parkes be correct, that coal crops up in the Channel bed, and consequently, or presumptively extends beneath the contiguous land.

IXION.

DEAR COAL—HOW IT MAY PROVE A BENEFIT.

[4815.]—At p. 564 I described one mode by which meat may be very nicely cooked with very little fuel, and very much better cooked than it commonly is when far more coal is burnt. If, therefore, the dearness of coal has the effect of inducing many to cook their food in a better and cheaper manner, the permanent benefit arising from a temporary loss will be very great. The waste of food from bad cooking is a far greater loss than by the waste of fuel, and as it so happens that meat as well as coal is just now exceptionally dear, it is to be hoped that more attention than usual may be drawn to the great waste of both, that by a little common sense may easily be saved. Some may be deterred by the first cost of Warren's cooking apparatus from using it, though that first cost is quickly repaid by the food and fuel it saves. I will, therefore, describe other simple modes of cooking that answer very well, but require more looking after. First, if the meat to be cooked be suspended or supported upon a trivet in a common pan above water covering its bottom, kept boiling gently, and the steam kept in by a well-fitting lid, the meat may be cooked in the steam constantly maintained by a very small fire or by a gas jet. I do not think meat thus cooked is quite so tastey as when cooked in the hot air of the Warren, and instead of rich gravy we get rather weak soup. Still, it is better than meat boiled in the still too common way by which most of the juices of the meat are extracted by the water, and, to those who do not like broth, lost. This common way is to put the meat into a pan of cold water, which is gradually heated, and then kept boiling until the meat is done, generally too much near the surface and too little within. Few know, or if they know act as if they knew, that the proper way to boil meat is not to boil it at all, but to place it in a pan of boiling water (the temperature of which it immediately reduces) and never to allow the water to reach the boiling temperature again, but only to simmer gently until the meat is cooked throughout. The effect of putting the meat at once into boiling water is, by coagulating the albumen in its surface, to confine the juices inside, while, by the gentle heat afterwards continued, the fibres of the meat are separated, the red blood globules rendered brown, and the meat made tender and digestible with very little loss of nutritive matter. The water is so poor it is hardly worth anything as broth, while meat, which if cooked in the common way would be scarcely eatable for toughness, is made tender and toothsome.

Many cooks seem to think that water boiling violently is hotter than that which boils gently, and acting on this belief waste much fuel in driving off steam uselessly, and making the kitchen uncomfortably hot. It is to be hoped that the dearness of coal will induce many to try if they cannot, as they certainly can, boil just as well without this waste.

Though boiling in some form is the easiest mode of cooking economically, and though I for one prefer it to all other modes, we need not confine ourselves to it. As I have already said, at p. 564, meat cooked in the Warren and browned before the fire, or in a well-ventilated oven, is only distinguishable from roasted meat by its greater tenderness, but those who prefer it may easily have their meat roasted in an oven, the top and sides of which are heated as well as the bottom, and if the air in the oven is not too much confined, meat so cooked is, in fact, roasted, with less risk of being scorched. No gravy or fat must be allowed to fall on the hot bottom of the oven, or the meat may acquire an unpleasant flavour.

I have not tried roasting with gas, but intend to do so by placing the meat to be cooked on a trivet, covered by a beehive-shaped gas stove top made of earthenware, 2in. thick. A small quantity of gas burnt will keep the inside surface of a thick fireclay cover very hot, and I expect that the radiant heat from that surface will roast the meat within the cover nicely. The gravy and fat will fall into a plate below the gas jets, where it cannot possibly get overheated or burnt.

PHILO.

WARMING RAILWAY CARRIAGES.

[4816.]—The plan of warming the feet described in let. 4685, p. 542, by Mr. Menz, is very old, except, possibly, the form in which the fuel is used. It is a very old plan to burn charcoal in a sort of footstool, but now a vessel of hot water is, I think wisely, commonly substituted. What is called chemically-prepared charcoal is, I suspect, common charcoal powdered and formed into a brick, with clay enough to hold it together, which is, I dare say, convenient, but will have no chemical effect. I do not think either burning charcoal in movable vessels of hot water so good a plan for warming railway carriages as blowing waste steam through pipes beneath the floor would be, as was described in "ours" a few months since. The common feet-warmers are too hot at first, and do not keep warm long enough; they would be more comfortable at first, and useful longer, if covered with felt or thick drugget to prevent the heat passing away too much and too quickly. It is remarkable how little discomfort is caused by even very cold air if it be nearly still, and if the feet be kept warm. I believe if the floor of a church were warmed, the air need not be.

PHILO.

LIGHTNING CONDUCTORS, &c.

[4817.]—"J. K. P." (let. 4750, p. 568) is perfectly right in his remarks as to the advantage of a solid rod over the much more costly gas tube recommended by the writer in the *Times* to whom he refers. That writer, no doubt, supposed there was some advantage to be got from the larger surface of the tube, a very natural and common error among those who, knowing little of the subject, confuse in their minds the wholly distinct subjects of capacity for charge and faculty of conduction.

"J. K. P.," however, does not quite apprehend my remark as to the preference of copper. The fact is that a copper conductor need have only one-sixth the sectional area of an iron one, to be equally efficient, and possesses the advantage of not rusting. It is, however, purely a matter of cost and convenience; and I do not in the least doubt that a galvanised iron wire, such as recommended by Mr. Preece, p. 559, would be a cheap and ample protection, if applied to all the prominent parts of buildings, and safely led to earth—*i.e.*, the gas and water mains, not to the mere service pipes.

In reference to "Canada Bear's" suggestion to me, p. 566, to visit Canada to investigate the matter of electric sparks, I doubt if I should much admire a Canadian winter; I had some idea of going over for a month or two this summer had not other engagements prevented. However, as to the special subject, I have had enough for one spell of electric sparks. I do not say this because they happened to serve in these pages the purpose of a false scent, but because a few days ago one selected my next door neighbour's house as the "line of least resistance," thereby sending his chimney-stack down through my roof to my considerable inconvenience, though happily with no further worse effect than a general panic, and its usual accompaniments among the feminines of the establishment.

SIGMA.

LIGHTNING FROM THE EARTH.

[4818.]—"Amateur" (let. 4751, p. 568) reopens a vexed and very interesting question. Without denying the possibility of the flashes he saw proceeding from the earth, I should rather be inclined to think they were discharges from a lower to a higher cloud, discharges between clouds being quite as frequent as between earth and cloud. It appears to me that the discharge of electricity from the earth would be not from one point but from many, and in the form of brush discharge. This quiet mode of discharge is exceedingly common, and is especially so during "thundery weather" on mountains. At sea, it is known to sailors by various names, and was one of the alarming incidents in "The Tempest." "Arago" thinks that these brush discharges are probably rarely absent from elevated points during thunderstorms, and are not seen because not looked for. "Arago" does not deny the existence of upward strokes; he thinks, however, that the evidence is insufficient.

There was near my house during a recent storm an extraordinary instance of the force of lightning. The chimney of a cottage isolated in the fields was struck. The bricks were thrown all round the house with such force that those which hit outhouses twenty yards off were pulverised, and the weather-boarding looked as if covered in places with red powder. Nearer, palings were cut as if by rifle balls; and the masons told me that out of two cartloads of bricks composing the chimney, not one whole one could be found for use again. The pieces flew over the fields to a distance of more than thirty yards, and most of them were no bigger than an egg. The cottagers were numbed for some time, and told me they heard no noise except the falling of pieces of brick upon the roof. They must have been insensible, for I heard the crash of the thunder. What was very odd, the lightning ran down an iron pipe which did not quite reach the ground, and instead of passing straight into the earth from it (the distance being but 8in.), "jumped" on one side to a corner a foot off, and passed down there, making a hole an inch in diameter. The cottagers said they were nearly suffocated by "sulphur," and a baby was stiff for a long time, and unable to move its mouth when its mother offered the breast. If the chimney had not been so utterly smashed, but had been only knocked down, the whole family would probably have been killed, as they were all huddled together in a little room just under it.

M. PARIS.

CHANGES OF LEVEL IN LAND AND SEA.

[4819.]—In one of "E. L. G.'s" remarkable letters (4540, p. 461) he says in effect that it is not worth while to refute Lyell's estimate of the possible antiquity of man based on the idea that land rises so many inches in a century, because Lyell himself speaks of Chili and New Zealand being thrust up 10ft. at a jerk, and the Aleutian Isle 3,000ft. in a year. Unfortunately, I have read but little of Lyell's book, and certainly no recent edition; but I should be glad if "E. L. G." would explain how the instances cited render Lyell's arguments not worth "stooping (!) to refute." In doing so, I hope he will keep clear of the Sacred books, of Nephilim, Deluges, and the like, for they are in no way concerned with what I want to arrive at. It appears to me, then, that land which has been gradually rising out of the seas, or from which the latter has been gradually receding, would present a far different coast-line, both in shape and composition, to that jerked up at the rate of 10ft. at a time. It is beyond dispute, I believe, that portions of our own island have been raised from the sea while others have become submerged—or the sea has receded from or encroached upon the land. Raised beaches and submerged forests are not so remarkably uncommon, and it appears to me that if the contour of the coast, from the water-line to the raised beach, is a gradual or even sharp rise, without abrupt breaks that cannot be accounted for, there is *primâ facie* evidence that the elevation of the land or the recession of the sea has taken place slowly and without jerk; while if the surface of the land only presented beaches at intervals, and did not exhibit uniform water-wear from the water-line upwards, it would conclusively show that the land had been lifted by jerks. At any rate, I cannot conceive but that there must be some difference enabling geologists to arrive at an opinion whether the land had been slowly raised or at intervals and by jerks.

I find in a paper read by Mr. Howorth at the recent meeting of the British Association, some particulars of the rising and falling of the land at different parts of the globe, and I send an extract which may interest your readers; but it does not give the information I want. Mr. Howorth said: "The conviction has been gradually strengthening that the term terra firma is a misnomer, and that the land no less than the sea is constantly moving. The importance of ascertaining and mapping out the areas of rising and subsiding land both for geologists and geographers, and for engineers and practical politicians, can hardly be overrated, yet little has been done in this field, and the best maps show the empirical way in which the question has been treated. The author had collected all the facts he could find bearing on the areas of upheaval. These when arranged are very interesting. The relative height of land and water being our gauge, the coast-line is the only test we have. Judging from this it follows that all Scandinavia except Scamo is rising; this upheaval extends to Siberia and all northern Russia, including Nova Zembla. The coast-line from the White Sea to Behring's Straits is all rising, the same is true of the eastern coast of Asia from Kamtschatka to Formosa, including the Amour country, the Yellow Sea, the islands of Japan, and Loochoo. Siam and the Malay Peninsula are rising, so are all the islands of the eastern archipelago from Borneo to New Guinea. The peninsula of India is probably sinking, so is Ceylon, but we meet with rising ground again at Meckran and trace it along the coasts of Persia and Arabia, including all the Red Sea. Asia Minor is probably rising; so is Syria; so is Europe east of the Adriatic. West of a line joining the Memel in Prussia, Europe is apparently more or less sinking, so is Britain, except the mountainous portions of Scotland. In North and South America all the land is apparently rising except a portion of the United States' coast from Florida to the S. Lawrence and the coast of Brazil. Africa is rising from the Cape to the latitude of Zanzibar. North of this there is an area of depression on either coast, extending on the eastern as far as the Somali country; and, on the western, to the Cameroons. North of this it is again rising, except the northern border, which joins in the movement of depression that is progressing in the Mediterranean, Australia, Tasmania, New Zealand, New Caledonia, and the Chatham islands are all rising. These facts favour the conclusion that all the great masses of land are now rising, and that the probable force of the rising of the land are the two poles of the earth. The areas of subsidence are apparently grouped about the equator." This is at least to me an interesting question, and I should like to know on what portions of the earth the estimates of Lyell are based, and whether the rising is at the same rate at different parts—save, of course, volcanic districts.

SAUL RYMEA.

THE "ENGLISH MECHANIC" GREENHOUSE, AND HINTS ON ITS CONSTRUCTION.

[4820.]—I have read with much interest our esteemed correspondent's plan for a cheap and durable greenhouse ("Saul Rymea," letter 4662, p. 538). It appears to me to be an excellent plan, one that could be erected by all our horticultural and persevering English mechanics; but I do not think, painting and all included, it could be done at the present time, considering the high price of materials, for £5. As to the law of fixtures, which he has correctly explained, I need say nothing, but would strongly advise him and others not to be done with "tenants' fixtures" houses. I think the house should be named, with Mr. Editor's sanction, the "English Mechanic greenhouse," and I hope some more of "our" friends will contribute to its construction. I think the proportions will do admirably, but the floor I should advise to be on the ground level, as sunk floors do not always answer. With regard to the heating, I have found the most economical plan to be the old flue and crystal lamps. Of course hot-water and gas apparatus are the most efficient, but would be too expensive for this purpose. "Saul Rymea's" remark as to the situation—viz., S.E., is correct, as every one knows the morning sun is best for vegetation, but with reference to its being as near to the house as possible, this makes no material difference, as long as the aspect is good. No one can do better than follow "our" friend's instructions as to building—in fact, myself being in want of a small house, I have half a mind to erect one to his directions. Good 21oz. glass is preferable to 16oz. I have never found 16oz. to be better for a hailstorm

—can "our" friend say why? but glaze it on the old putty system, well sprigged and bedded. I am a large owner, and a great opponent to glazing on the iron and other similar new and costly systems. In fact, I denounced it in rather strong terms a few months back in "ours." As I said above, I fear it could not be effectually erected for a £5 note. In the first place, 21oz. or 16oz. sheet could not, at the present fabulous and unprecedentedly high price of glass, be bought for anything like 3d. I should put it at 6d., which would be a fair price; this would double the item to £3 12s. The other items are at a good price; but "Saul Rymea" has not included the painting and glazing, which would cost 50s. to be done, primed, stopped, and painted four coats, and glazed as I have mentioned. I make the cost of the house would be:—

	£	s.	d.
21oz. glass at 6d. per foot	£3	12	0
Other items, as priced by "Saul Rymea," p. 538	3	4	0
Painting and glazing	2	10	0
	£9	6	0

Of course I have allowed, like "Saul Rymea," a good price, and they should think any respectable builder would do it complete for £7 10s. As to the wood and iron, I am of opinion that wood houses, when erected substantially, drive iron into the shade, especially when economy is considered. Nevertheless, an iron house the dimensions he gives would be cheap at £4 4s. 8d.

H. B. E.

CENTRIFUGAL FORCE.

[4821.]—When I read my note on this subject I thought myself too egotistical. I am glad most of your correspondents have taken the right view of the matter. I deemed the term erroneous; and, as such, wished to see an alteration. We mathematicians should be exact. If, therefore, any term is inexact, let us attempt, at any rate, to agree upon some other term, and some other way of explanation. M. Paris rather mistakes me. Many of our text-books devote a chapter to the consideration of centrifugal force; I would have it explained, in the chapter devoted to the "Laws of Motion," not as centrifugal force, but as rectilinear tendency or whatever name we agree upon. Surely, if public opinion is favourable to this change it must be made. I don't say that I agree with the term proposed by M. Paris. C. H. W. B.

DISTANT SIGNALS ON THE MIDLAND.

[4822.]—Many thanks to "C. E. S." (let. 4688, p. 541), for the information respecting the Midland distant signals. Would he say if there is any really practical advantage in this particular form of signal—*i.e.*, an oblong board turning on a perpendicular pivot, over the ordinary kind of an arm on the left of the post? It always seems to me that even with the alteration mentioned it must be more difficult to know if it is the front or back of the board, than it is to remember that unless the arm is on the left of the post it must be the back of the arm, and, therefore, of no consequence. Again, if the ordinary signal answers for the semaphore, why should it not for the distant signal? It seems an unnecessary complication to have two kinds of signals if one would answer the purpose, as the simpler signals are, the better for the drivers.

A. G. Boyd.

Diseased Potatoes.—The Prime Minister has requested the Director of Kew Gardens to give publicity to the method successfully introduced by the late Rev. Professor Henslow into certain villages in Suffolk and elsewhere for utilising diseased potatoes. He says:—"This method depends on the fact that the starch of the potato is not affected by the disease, but retains its nutritive properties, and consists in rasping the peeled tubers upon a bread-grater into a tub of cold water. In a few minutes the starch will be found to have sunk to the bottom, and the diseased matter, woody fibre, &c., will be suspended in the water, and should be poured away with it. Fresh water should then be added, the starch stirred up, and again allowed to settle. Two or three of such washings will remove all impurities, and render the starch fit for use. If thoroughly dried it will keep for any time, and can be used as arrowroot, for puddings and cakes, or, mixed with flour, as bread. A flat piece of tin, prepared as a grater, may be had of a tinsmith for a trifle, and nothing else is required but a knife and a tub of water. But this temporary measure cannot be all that scientific resources may supply. Surely some method (by desiccation or otherwise) is applicable and available to the cottager by which the sound tubers and the sound parts of diseased tubers may be so treated that they may be preserved for winter use; and I cannot doubt but that chemists will suggest such. Lastly, this season, which has favoured potatoe disease, has also favoured an abundant crop of green food; and I would urge upon the clergy, medical men, and intelligent classes of the country parishes, combined action, in the way of precept and example, in introducing the beetroot, the foliage of the turnip, and various other vegetables, as an article of daily consumption. Now, too, is the time for laying in stores of such nutritious articles as dried haricots, calavances, and various other pulses and beans which form the cheap, agreeable, and most nutritious food of the populations of many tropical countries."

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[12234.]—**Hairsprings** (U.Q.).—"Jack of All Trades" is a little out of his element in watchmaking. Watchmakers do not use a gauge for hair springs. The wire of which hairsprings are made can certainly be purchased, but having the wire you are a long way from possessing a spring. Hairsprings are not made by hand now so much as formerly. They may be purchased beautifully coiled up and ready for use. In selecting a spring the diameter is determined by the distance of the curb pins from the pivot hole, and the strength by the size and weight of the balance, and number of vibrations wanted per hour, this necessitating an amount of experience by no means inconsiderable.—West Cornwall.

[12272.]—**Electrotyping** (U. Q.).—To fill up the back of copper electrotypes use pewter solder and lead. Dissolve some zinc in muriatic acid, and well cover the back of the electrotype with the solution; place some very small bits of pewter solder on the back which you have covered with the solution, put the electrotype on a lump of charcoal, and apply flame with a blowpipe until the solder has penetrated into the crevices. Afterwards you can use lead, which is cheaper, and will strengthen the electrotype. This is a simpler process than using a fusible metal, the recipe for which I have already given you. You might make a mould of the engraving of the alloy if you can devise a means of doing so without injuring the engraving, and then give it a coating of copper.—W. H. H. C.

[12314.]—**Bleaching Tanned Goods** (U. Q.).—Try a bath of sulphuric acid, one part to from twelve to twenty of water, and afterwards use strong bleaching liquid in the shape of chloride of lime, or subject it to the action of the gas.—Jack of All Trades.

[12324.]—**Spoiled Hams** (U. Q.).—To about every 12lb. of salt put 1lb. of coarse sugar with 2oz. of saltpetre; with this you can use either 2oz. of juniper berries, or ½lb. of coriander seeds in powder, or if smoked flavour, a few drops of creosote; with these well rub your hams and place them upon a wood grating over a pan or cistern of water in a cellar or cool place. Afterwards when had two days of this, give them four more in brine, take out, dry them thoroughly with either bran, pollard, or sawdust, and hang them up to dry.—Jack of All Trades.

[12324.]—**Spoiled Hams** (U.Q.).—Hams or bacon rusted or spoiled, not rotten, cover them in linen cloth, dig a hole three or four feet deep or more, put the hams or bacon in, let them stop there twelve days and nights, then take up, and they will be then as fine to eat as any you can buy.—Outgenious Whitesmith.

[12326.]—**Collodio-Bromide** (U.Q.).—Ordinary bromo-iodised negative collodion may be converted into collodio-bromide by the addition of an alcoholic solution of nitrate of silver; but is not likely to give good results, as a special collodion is required. "Tripod" had better procure a pamphlet, published by Messrs. Mawson and Swan, Newcastle-on-Tyne. — Photo. Bristoliensis.

[12327.]—**Horn** (U.Q.).—I believe this can be done by subjecting them to a bath of potash and water.—Jack of All Trades.

[12342.]—**Pouncing Pattern on Printing Blocks** (U.Q.).—This is, I presume, wanted to transfer the patterns upon blocks for either cutting or pricking out. Brush your block over with either some size or gum water. Having pricked your pattern paper through with a stout pin or needle, fix it to your block with some drawing pins, then take some whiting and tie it up in a piece of muslin, dust it through the holes over the pattern, take your paper off, invert your block over a boiler of water, and steam it; put by to dry; your pattern will be fixed for working. —Jack of All Trades.

[12345.]—**Ontario** (U.Q.).—As to where extremes of heat and cold are least, I should think west of Toronto; as you go west the climate gets milder. The winters are more severe in Lower Canada than in Ontario (Upper Canada). In London, Ontario, where I have been for four years, the heat of an average summer day is about 85° in the shade; the nights are warm, about 18° is the cold of an ordinary winter day. As you go north the winters become colder in a greater ratio than the summers. I do not know about the lake district of Simcoe. Canada is not very like a park. The cleared fields have zig-zag fences of timber, called snake fences. Nearly all the land is forest until it is cleared. The trees vary in different places. A farmer would do well, particularly if he had a family who could help him, as labour is dear. He would have very hard work in the spring, and would have to rough it for a while. The spring season is short. When the snow melts the hot weather comes in with a rush. The people are quiet and sociable enough. There is not much formality; general invitations are usual. Those who have no houses usually live in boarding houses or hotels in the continental fashion, all taking their meals together. Fish and game are abundant. Further information if desired.—Philanthropist.

[12348.]—**Spanish Pronunciation.**—"E.L.G.'s" last interesting note at p. 515 of "ours" (No. 385) will be read with pleasure by all interested in such matters. As I am asked the question by our learned friend, I may answer that I do not believe in any other pronunciation than *blanco* and *bacho*, *hecho*, for the words *blanco* and *bajo*, *hijo*, the guttural sound of the *j* in Spanish being identical with the Scottish sound *ch* in the word *loch*, and not differing at all in quality from the Spanish *g* before *e* or *i*. I do not think the sound of the Hebrew letter *heth* would perfectly represent the Spanish gutturals *g* or *j*; but I am not much of an orientalist. Will "E. L. G." kindly inform me whether the Sanskrit gutturals *kha* and *gha* are sounded in a similar manner? I have Wilson's grammar, but the equivalents given are as in the words *Khan* and *Afghan*. I should also like to know whether the compound letter *kha* is merely a strong aspirate or a weak guttural—if the former, Sanskrit would seem to be deficient in the peculiar guttural sound in question, the same as it is notably so of our soft *s* or *z*, and still more extraordinarily of the short vowel *e*, as in our word *met*. Like the Spanish, however, this "perfect language" is phonetic, and the alphabet with its 47 letters is the key to correct pronunciation, provided its European equivalents are correctly stated.—W. Wray.

[12352.]—**Centrifugal Pump.**—The reason which induced me to criticise "Rat-Tat's" proposed pump was that it was evident he had not tried it himself, and was violating Montaigne's precept by recommending the pulling down of a machine which is known to raise a large quantity of water with a proportionate expenditure of power in order to try a proposed arrangement which has been already tested in several ways and found wanting. The results of some trials which I made in a similar direction are that there is enormous waste of steam in proportion to the quantity of water raised. As some correspondents are recommending a trial of compressing air in a similar manner, it may be useful to state that the result of my experiments in this direction is, that the quantity so compressed, and the pressure obtained, is exceedingly small compared to the amount and pressure of the steam so used.—A., Liverpool.

[12355.]—**Fermenting Bread with Starch.**—If when "Dough's" ferment is alive, he adds some starch from either rice or potatoes, with a small portion of sugar, he will find his dough light enough, and go ramping mad. Potato starch is to be got somewhere, as it is used to a great extent for the adulteration of arrowroot.—Jack of All Trades.

[12378.]—**Bat-Making.**—First question, use a file; second, scrape, then glass paper on a piece of flat cork, &c. For hardening (without special tools) lay the bat on your knees, or on something soft, such as a cloth, rolled in a knob; get your shoemaker to lend you his round-faced hammer, and then hammer the face all over well to shape; if done properly no marks need be seen. For glueing, get the best; the secret lies in making the top of the splice pinch the handle, a good joint cannot be obtained without. Rub a little burnt cork on the V sides of the handle, it will greatly assist in fitting, and put plenty of glue; also warm the joint before glueing. The cane can be got at any basket-shop; you will have to glue some dozen pieces together. I have no doubt these outside tips will be understood, if not, ask again.—A Weymouth Athlete.

[12388.]—**Onions.**—I have some over a foot in circumference, similar to "M. W. G." (p. 493). I planted in September, and transplanted beginning of April.—H. B. E.

[12401.]—**House Painting.**—This is a peculiar question. For 15lb. of "genuine" white lead take 1 pt. of oil, 2oz. dryers, ½ pt. of turps. Don't use turps for outside work. No good painter would do this, or he would have a colour you could see through.—H. B. E.

[12406.]—**Worm-eaten Violin.**—Rub the violin inside with methylated spirit.—H. B. E.

[12408.]—**Quill Pens.** — They are first passed through hot cinders or ashes to purify. This makes a profound stench, but removes all moisture, oil, and fat. They are then washed and dipped in alum water, and afterwards placed on a hot plate to dry, sufficiently cool not to split.—H. B. E.

[12409.]—**Transferring Pencil Drawings on Paper to Boxwood for Engraving.**—I thank "Sarah," "Xylographer," and "John Hopkins" for their kindness in answering my query. I find tracing a finished drawing on paper very tedious, but with outline it suits admirably. When I reverse it on the prepared block, the great difficulty is in filling in the shading as it is on the paper before being transferred —the burnishing process has a blurred, indistinct appearance, which makes it very difficult to engrave properly. Can "Xylographer" tell me of any solution, &c., that by applying to the paper before or after the drawing is made on it, then by placing on the block and damping the back of it, take a facsimile of the drawing as it is on the paper?—E. B.

[12424.]—**Preserving Green Peas and Gooseberries.**—A good plan to enable one to have green peas for Christmas dinner is to put them in an air-tight jar and imbed in the earth about a foot deep. Gooseberries can be done in the same manner for the same time. I have seen this done and the fruit and peas eat as well as at spring time.—H. B. E.

[12441.] — **Ants.** — Lay quicklime or powdered camphor down. They will soon beat a hasty retreat.—H. B. E.

[12448.]—**Wall Papers.**—The most healthy way of decorating walls is undoubtedly "distemper;" it is also, to my taste, the most artistic. Any amount of ornament can be put on by this means. The wall can be divided in panels with gilt lines, and various plans of decoration can be seen in any first-class modern house. The danger from wall-paper can be obviated by covering with paper varnish.—E. M.

[12449.]—**Gnats.**—The query of a "Constant Subscriber" is, to say the least, a very modest one, and I therefore waited till the last minute before answering it, thinking that some one would confer a boon on the civilised world by giving us not only a remedy for gnat-bites, but also a "preventative." Well, arnica has been the best remedy in the cases I have seen; but as to a "preventative" the only one I know of is to kill the *female* gnats (the males don't bite). In the mean time let us rejoice that this "horrid" climate has some advantages over the more favoured countries where the mosquito abounds.—Saul Rymea.

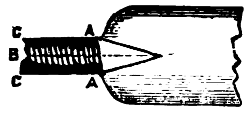
[12451.]—**English Concertina.**—The vibrators which have "gone flat" are probably cracked; if not, scraping or filing the free end will sharpen them. How to get at the inside screws is a doubtful question, for I don't know what "T. W." means. The ends of the instrument can be removed by taking out the screws, when the vibrators will be seen on their frames, slid into grooves in the "soundboard." These slip out easily. I cannot think this is what the querist meant, though.—Saul Rymea.

[12455.]—**Water Supply.**—Apply at the office of the East London Waterworks, Gt. S. Helen's, Bishopsgate-street, for prices, &c. You can obtain their Act by applying to the Queen's printers, or possibly, to Hansard's, Gt. Queen-street, W.C. The water is supposed to be used for domestic purposes only, and if you keep horses, cows, or other animals, or require water for business or garden purposes, you will be charged extra according to the report of the surveyor sent by the company. You can, however, insist on being charged by meter.—Saul Rymea.

[12457.]—**Geometry.**—"E. L. G.'s" answer is imperfect and incorrect. He omits to state that the triangle in which to inscribe the rhombus must be equilateral. In any other triangle his mode of procedure would only produce a rhomboid. He is also incorrect in stating that "P. W. H. J." (p. 546) produces a rhomboid—what is there produced is only a trapezium.—Bobo.

[12504.]—**Sketching from Nature.**—The objection to Wollaston's camera lucida is doubtless, as "A Working B." said, the difficulty of seeing both the image and the pencil at the same time, but not owing to their different distances, which "E. B. H." (p. 570) knows not how to obviate, though it is perfectly easy to do so. All instruments for sketching require that either the object's image be brought to the apparent distance of the paper by a concave lens, or else the paper and pencil magnified and thrown out to the apparent distance of the objects by a convex lens. The concave lens, if used, must be between the landscape and the reflector. The convex one, if used, must be below the reflector, between it and the drawing. In either case, if the solar focal length of lens be a little more than the distance from eye to drawing—or more exactly, if it exceed this distance by the same fraction thereof that this distance is of the object's distance—the eye will focus the two at once. But a lens where "E. B. H." places it, between the eye and instrument, can never be of the slightest use, as it acts on both object and pencil alike, merely making you long-sighted for both or short-sighted for both. The defect of Wollaston's instrument has therefore nothing to do with this matter of focussing, but only with the use of the upper and lower halves of the pupil; one to receive light from the reflector, the other past its edge. This requires a quality of eye that most of us do not possess. I am convinced that no knack or practice can be acquired by the generality of eyes to see in this manner. It is as much a physical endowment as ventriloquism. Amici's modifications of the instrument, therefore (one of which "E. B. H." has figured in p. 570), are really the only ones available for eyes in general, the rays from paper and pencil coming through a parallel glass that at the same time reflects the rays of the object, and both kinds of rays entering the whole pupil at once. But there is no real need for more than this parallel glass, and the lens (concave in front of it, or convex below it), if we are content to trace either a reversed or inverted image. The whole purpose of a second reflection, either in Wollaston's or Amici's forms, either from metallic speculum or within a prism, is merely to get the image at once right-handed and erect—*i.e.*, neither topsy-turvy nor turned right for left. Not finding any necessity for this, I have always used with success a mere fragment of good plate-glass, 1in. by ½in. If there be, in the nature of the scene, a necessity for having the right and left unreversed, you have merely to draw on transparent paper, and turn its back over to finish it. I should observe, however, there is, and always will be, a difficulty in so adjusting the illumination of *white* paper that the pencil thereon and the reflected scene may be well seen at once. The real, and I believe sole, remedy, as I told a querist two years ago, but have never seen stated elsewhere, is to trace with a *white* crayon on a *black* or *dark* surface. Transparent tracing paper may be laid on a black board or slate, and drawn upon with a fine pen or brush and Chinese white (from the bottle undiluted, or rather stiffened with more white). Then turn it over, and retrace the other side with black or colours, finally mounting it on white.—E. L. G.

[12507.]—**Cricket-bat Making.** — Cricket bats should be made from the best seasoned willow which has been kept four or five years. The bat is roughly shaped, much larger than the required size, and kept another year, then the blade or pod is laid in an iron mould, and hammered with a wooden mallet to nearly the required size. The piece is then fixed in a lathe and the handle turned. The bat is then finished by hand and strung in the lathe. The tools used are the paring or draw knife, a spoke shave, and lathe chisels. The bat should on no account be varnished unless on the back,



as otherwise oil cannot soak into the wood. Some bats have cane or willow handles. The cane handles are made of the small cane, ⅜in. diam., to be got at a saddler's, cut square, and glued up, and then turned and strung. These handles are let into the bat as in the accompaning sketch. Two pieces of willow, A A, part of the blade, go a few inches under the string, and sometimes a piece of ash is glued up with the cane as at B, or on the sides, at C C. If this is not clear I shall be glad to give further information.—C. B.

[12515.]—**Mowing Machine.**—"Old Ploughman" is right as to the cause of the sickle bar of "A Countryman's" machine breaking. If the eye of the sickle bar and connecting-rod is worn, rimer them with a square rimer with a taper half round piece of wood at the back, and use hard wood sickle pins; this is how I have treated one of Samuelson's machines.—Hants Farmer.

[12515.]—**Mowing Machine.**—"A Countryman's" machine should have a long roll. This is the cause of breaking, I should imagine.—H. B. E.

[12517.] — **Mathematical Machines and Tables.**—In the *Mechanics' Magazine* for June 16, 1855 (No. 1662, old series), "Tables for Facilitating Addition" are described, by means of which addition, which is certainly the fundamental and also the most tedious operation of arithmetic, may be performed without any machinery and in a manner described by the author as "a mechanical way of making additions as simple as possible, allowing great rapidity of operation, giving results perfectly trustworthy, and requiring no labour of the mind for its application."—C. J. R.

[12518.] — **The Island of Hayti.**—Is "F. S. M. W." sure (p. 571) that the Domingans have been reunited to Spain? They sued for readmission some years ago, but the last I heard was that Queen Isabella's Government refused to have them. They are less purely black than the French-speaking Haytians, but one hears less of them. The Haytians, ever since their independence, faithfully copy the last Paris fashions political, twice a republic, twice an "empire," and now, I suppose, republic for the third time. In the intervals of these changes, they amuse themselves with hitherto fruitless attempts to subjugate their brown co-islanders, of the eastern and flatter half. Such continues the nineteenth century state of the finest land Columbus set foot on; the island second in size, and by universal consent first in richness and natural splendour, of the western world! Glory to thee, O Century!—E. L. G.

[12528.]—**Hay Asthma.**—"Kate" is really entitled to sympathy under this attack. A friend of mine has had it every year for many years, and has tried all kinds of treatment—three years ago he went under homœopathic treatment, and got a little relief from their medicines, the principal of which was "Extract of Hay," but it does not appear to have been lasting, as he has gone back to his old doctor. His latest experience is that he gets the most relief from gentle expectorants, which clear the chest and allow more freedom in breathing.—Johan.

[12528.]—**Hay Asthma.**—I am sorry to see a correspondent, "Lambda," recommend the inhalation of creosote for this complaint. I can assure "Kate" that the use of creosote in any shape or form will inevitably cause violent nervous twitching and even paralysis. But she will find that bathing the chest with vinegar and water every morning, together with the use of Epsom salts and eau-de-cologne, and sea-bathing, will cure the very worst case in a short time if persisted in. I would be glad if "Kate" will communicate the result for the benefit of others similarly afflicted.—Alfred S.

[12529.]—**Improved Machine for Making Aerated Drinks.**—I did not state that the gas for all machines for making aërated drinks was made of sulphuric acid and common whiting. It is in the machine I described, and would appear to be very advantageous from its economy (see reply to "E. L. P. G." last week). The proportions I don't know, but should imagine it would depend on the number of bottles required. No doubt gas for other machines can be made of other compounds. Perhaps "Sodawater" or "L. W. D." can answer this part of the question. I may add full directions are given with the machine for everything. I will forward name of maker on any one advertising address in "ours."—H. B. E.

[12537.]—**Compressing Air.**—On what basis does Dalton's hypothesis or theory rest? The temperatures given appear rather low for the corresponding pressures. I have before me the results of experiments that scarcely seem to bear out Dalton's views. With air-compressing cylinder of 3ft. stroke, area of piston 814·16 square inches, and outer temperature 40° Fahr., 30 strokes per minute for 30 minutes, or 30 × 30 = 900 strokes, each stroke halving the volume and doubling the pressure. That is, the air was allowed to escape at each stroke through a safety-valve, weighted to 15lb. per square inch. At the end of the 30 minutes, when 900 strokes were completed, the temperature of the cylinder was 108° the gain of temperature being 108 − 40 = 68. Second experiment, under similar conditions, except that the escape-valve was weighted to 30lb. per square inch. Result—temperature 158 − 40 = 118° of temperature gained. Third experiment, under similar conditions, excepting that in this the outer temperature was 50°, and safety-valve weighted to 45lb. per square inch. Result—202 − 50 = 152 = the gain of temperature. The safety-valve was now weighted to 58lb. per square inch, and the experiment continued for other 78 minutes, at 26 strokes per minute, further gain of temperature being = 296 − 202 = 94°. An experiment of over two hours' duration, showing the ratio of increase of temperature for every ten minutes, is interesting, commencing at 10.30. Safety-valve weighted to 45lb. per square inch during the whole of the time.

Time.	Registered temperature at cylinder.	Outer. temperature.	Strokes per minute.
10.30	38	38	24
10.40	133	38	24
10.50	166	38	23
11.00	186	38	23
11.10	202	39	24
11.20	214	42	24
11.30	221	40	25
11.40	231	40	26
11.50	237	40	26
12.00	242	41	26
12.10	245	41	26
12.20	250	44	27
12.30	255	44	27
12.32	256	43	27
12.40	256	43	27
12.44	256	42	27

Some portion of this temperature is, no doubt, due to the friction of the piston; but surely not the difference between the above quantities and those given by means of Dalton's formula. I think "E. L. G." forgot to show the work expended in doubling, trebling, &c., the pressures; this is important, as will afterwards be found. Knowing this, and the generation of heat, we shall have secured an important position. I should like "E. L. G.'s" opinion on the resulting temperatures. My object in commencing and sustaining this discussion is merely to elicit the truth, because several querists have lately sought for information about compressed air, but they have asked for too much information at once, more than any one individual can give. By combination, however, and working—*i.e.*, discussing—co-operatively, we can, I think, supply the desired information. I am possessed of the results of very valuable experiments. "E. L. G.," by giving the mathematical parts, and by other correspondents casting in their two mites, we may, I think, secure a general improvement to our knowledge, both theoretical and practical, respecting the use of compressed air as a medium for the transmission of power, and to make this more certain I propose holding that comestary fellow in abeyance, if "E. L. G." will kindly oblige. Our common object is the economical haulage of coal.—Mechanical Equivalent.

[12543.]—**Light Shifting Hoist.**—I beg to thank our editor for his courtesy in inserting my query, and "Sting" and "Vireas" for kindly replying thereto (Aug. 16). Either plan would answer well, but would "Vireas" kindly inform me whether there could not be some better contrivance than pulley blocks, the rope of which would be rather in the way, while a chain, as in Weston's, might knock against and break the bottles? I fancy a modification of the compound wheel and axle with a rotary motion might better suit. It could be inverted, the differential roller being at the bottom, and working in a strap having one or two hooks for lifting. The pulley would then be at the top and inclosed in a strap, the hook of which might be inserted into the eye of the strap D ("Vireas's" diagram). The rope, which would be as it were endless, might, when not in use, be with the roller wound up out of the way. Being no draughtsman, I am unable to give sketch, but "Vireas" will doubtless understand, and will much oblige by aiding me further therein; also, in a mode of dispensing with the trolley as he suggests.—S. Selwyn.

[12551.]—**Picture Framing.**—As the usual way of making cheap frames of German moulding in about ten minutes has not been mentioned, it may be as well to describe it for "Jim's" and others benefit. The tools necessary are a fine-toothed tenon saw, a mitre-block, a mitre-board, a trying plane, a stout vice a light hammer, and a spring bit or two. The saw and plane must be kept very sharp, as the plaster foundation of the moulding speedily takes off the edge, and then the gilding snips off. As most mechanics would know what a mitre-block is, it seems unnecessary to describe it, but the mitre-board may be ... as follows:—Take a piece of board, say 30in. ... 1in., plane up truly, another piece ⅝in. ... thickness of the distance of edge of plan... side of plane, and about 3½in. narrow... board. Nail on securely, now glue on, a... accurately at an angle of 45°, a piece... broad, and as high as the upper edge of t... reaches when the plane is lying upon ... pressing against the straight edge of the ... which is the way it is used, keeping the pl... ing firmly against it with thumb of left h... tried all the ends, catch one in the vi... left hand (this is the most critical pa...

feeling that it is a little higher up than its ultimate position by means of forefinger, bore a small guiding hole with spring-bit, lift up, put a dab of thickish glue on back side (don't cover the whole surface), put in place again, and drive down the spring gently until both mitres correspond (this requires great caution, or the edges will snip off, it must be nicely humoured); other two sides are then done similarly, and lastly, these two are united at opposite corners, which divides any error in the mitreing, if put together continuously the last joints will not coincide.—A., Liverpool.

[12557.]—**Nickel Silver.**—A. H. Allen will find, I think, that contrary to his statement, p. 578, "pure nickel unmixed with other metals" *is* employed, for coinage, and makes the hardest and fittest material yet applied thereto. The Belgian sous are the example nearest to hand; and as they nearly balance two of our groats, the nickel seems to pass for about a fifteenth its weight of silver, making a far more convenient small currency than bronze. Its yellowish tint, closely resembling platinum, will not allow it to be mistaken for silver.—E. L. G.

[12558.]—**Boot and Shoe Making.**—I fancy that "Irish Mechanic's" shoemaker cannot be up to the mark in his trade. He can put in as many fittings as he likes on the toe of the last, without fastening them to it. The last would then come out as easily as possible, and the fittings be taken out with the hand afterwards. As the greatest room is required about the joint of the great toe, these fittings should be pitched in from the toe of the boot when lasting, and not from the top as usual.—J. ROBERTS.

[12568.]—**Smoke and Light.**—If there were any kind of smoke or translucent body that presented the same colour when seen against a dark background and when intercepting light, this would be a truly difficult phenomenon to explain. The general rule is that they reflect one part of the spectrum and transmit the rest, consequently the opposite tint to that which they reflect. The atmosphere at large acts in this way very like tobacco smoke, and renders the sun's transmitted rays more and more orange-coloured, the greater thickness of air they traverse, for the very same reason that it makes distant dark objects more and more blue, and the sky bluest of all. Many liquids and even solids—as opal-glass (made milky by bone-ash or phosphate of lime) and the commoner kinds of real opal—do the same. It is *most natural* for whatever tinges transmitted light yellow or brown to appear before a black background gray or blue.—E. L. G.

[12571.]—**Brake for Bicycle with India-rubber Tires.**—Mr. Shaw will find that the roller has not the same disadvantage as the block brake, presenting as it does a round or curved face instead of an edged or angled surface to the rubber tire. It, therefore, does not bite or wear it away by resting on any particular part, but causes the frictional resistance by merely rolling against the tire. If he thinks, however, that it wears it away he may make the roller revolve horizontally, touching the side of the felloe when brought into action by a lever, handle, or other arrangement. To prevent the wheel wobbling or getting out of position, by using this kind of brake at one side of the wheel, Mr. Shaw can employ a double-action brake. This may consist of two iron rods pivoted in the centre like a pair of scissors, the pivot standing upright behind the saddle in the spring or framework supporting it. Two small wooden rollers, a couple of inches in diameter, are fixed in forked bearings in the ends of the crossed levers. These are the brakes, and to bring them into action the arms, or front parts of the levers, are put farther apart, which may be done by the arms of the rider, or a slight inclination of the body backwards. As either kind of brake may be objectionable, a hoop or spring brake may be employed as in horse-rakes and agricultural machines. It consists of a hoop of thin iron or steel passed round a fixed pulley on the axle, the ends of the hoop being fastened to a hand lever, but a small pedal will do in this instance for a light bicycle. A ground-slide attached to a lever can also be used, and brought in contact by the action of the hands or feet, or simple inclination of the body; or a curved flat rod of steel can be attached underneath the saddle, hanging a small wheel or roller a few inches from the ground in forked bearings. To employ the brake the steel is straightened by the pressure of the feet on an iron pin passed through the rod at a convenient distance from the bottom. A coiled spring, as in the "Phantom-wheeled" bicycle, may be placed underneath the rod supporting the handle, elevating it a few inches. By pressing down the handle a small roller-brake, attached to a rod underneath and fastened in a race or groove to the axle bearings, is brought in contact with the ground. In this last arrangement the position of the hands or feet need not be changed; or the handle may be cranked, having connecting rods with the crank pins of the front wheel, and the power of the hands may be thus brought to bear either in propelling the bicycle, which can be turned as readily as before, or in stop- its motion.—RAT-TAT.

[1]2595.]—**Boat Building.**—Having been out of I could not reply to this sooner, and beg to inform . D." that I do not know of any practical work boat building; also that I am not a ship or boat r by trade, but have built several boats, and will py to give any information in my power. Lee I have only met with upon Dutch galliots, and that from their small size, compared to the of the vessel, they can be of much utility. keels I have seen at New York, but have understood that the quantity of seaweed which lates upon them renders them undesirable in these waters. A sliding keel is contained in a watertight case, carried up, as I presume, from one side of the keel to level of gunwale, and could not be applied to a small boat, as there would not be room to move in her. In order to build a boat about 14ft. keel, erect keel, stem, sternpost and sternboard as described by me in reply 12397. The rebate is to be made as much as convenient with a plough plane, near ends worked up with a chisel after the stem and sternpost are half checked and riveted together. Note: Rivet copper nails wherever possible, as they don't hold well without; use a very light hammer, they are very bad to drive straight or to rivet unless previously hardened by hammering upon an anvil. The keel, stem, and sternpost ought to be two inches thick, as the rebate on each side weakens them so much; it is also advisable to put an elbow or knee piece at each end inside to strengthen the junction of stem and sternpost with keel. Erect the frame as described in 12912, and satisfy yourself that it is the shape you wish the boat to be in the widest part. Note: I began with the tongs as described by "H., Belfast" (reply 12397), but found that the clamp (which I believe is used by bookbinders), is much more convenient to use in adjusting the various boards. It is made thus: Two pieces of ash about 16in. × 2in. × 1¼in., with two wood screws about eight inches long, acting upon opposite sides, leaving the jaws about six inches long at one end, and close to the other end, the screws to be about one inch diameter. The garboard strake I used was American oak soaked for a couple of days in a pond to prevent splitting, as I required a flat floor. This was in one piece from end to end, all other strakes were scarfed, the scarf to be the length of the breadth of strake, and white lead applied when riveting up. Prime each part as you proceed. It will be necessary now to form some idea as to the relative breadth of the strakes at the widest part, and at the stem and stern, as this is influenced by the breadth of the boat, and be particular that each strake lies up close to the guiding frame, by bevilling off the edge of the one it overlaps, or the boat will become much wider than intended. In another letter I will give some more particulars as to steaming, &c.—A., Liverpool.

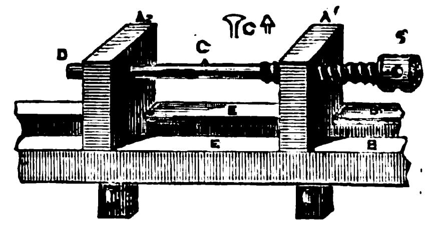
[12596.]—**Canoe.**—As to the safety of canoeing from Hull to Scarborough, it depends on three things—viz., the weather, the craft, and the man in it. Now, the first we presume is settled, as it is not to be imagined any one would be insane enough to attempt such a cruise unless the day was both calm and clear, with a prospect of its continuing so. Then, as to the second—viz., the canoe—I would recommend the *Nautilus* type, the features of which are: good beam, very flat floor, and good sheer and camber. The dimensions of the craft I would prefer for the purpose would be as follows: Length, 16ft.; beam, 28in.; height amidships, 18in.; height at bow, 20in.; at stern, 18in.; camber of keel, 2in., with watertight compartments at bow and stern, and the well with a timber hatch instead of an apron. The great sheer is given to prevent diving into the seas, and is, I think, necessary for any sea going canoe. Now, thirdly, as to the man. I think, from "Paddler's" query, he has not been to sea before in a canoe, and he admits never having tried a sail; then my advice would be not to commence canoe sailing in a sea cruise. Every one that can sail a boat knows it requires practice and skill to do it properly and with safety, and every one that can sail a canoe knows it is more difficult to sail than a boat, and much more dangerous; and again, every canoeist that has sailed a canoe in lumpy water knows the dangerous propensity of the craft to dive when running before the wind with sails, and the difficulty of managing it properly. Canoes of the *Rob Roy* type are not fitted for sea work; and though I cruised for miles along the south coast of Ireland in one of the *Rob Roy's* dimensions, only built of spruce, fir, and canvas-decked, it was simply foolhardiness. From this, "Paddler" can see I would be inclined to dissuade him from the attempt; but if he *will* go, I shall be happy to give him any more information in my power.—CANOEIST.

[12599.]—**Dimensions of Mail Boats.**—I abridge the following from "Recent Improvements in the Steam-engine," by Bourne, page 139:—"The example of modern engines by these makers that I shall select is the oscillating paddle engines of the Holyhead steamers *Ulster* and *Munster*, for although I might have selected a more recent example, I could not have selected a more perfect one, &c. These vessels are each 328ft. long, with 35ft. breadth of beam, 21ft. depth of hold, and they each measure about 2,000 tons, builder's measurement. Each vessel is propelled by two oscillating engines of 96in. diameter of cylinder, and 7ft. stroke; the pressure of steam in the boiler is 26lb. per square inch. The nominal power of each pair of engines by the Admiralty rule is 750 horses. They make 23 strokes per minute, and they work up to 4,100 actual or indicated horses' power. The draught of water when ready for sea and complete with stores and 75 ton of coals was, forward 13ft., and aft 13ft. 4in. The paddle wheels are feathering 33ft. 9in. in diameter to the inner edge of the outer ring. These vessels, and two similar vessels, the *Leinster* and *Connaught*, the engines of which were constructed by Messrs. Ravenhill, Salkeld, and Co., have realised a speed of upwards of 20 miles an hour, and an average speed in all weathers during the first six winter months of 18 miles an hour." Further information, principally about boilers, &c., if required.—PHILANTHROPIST.

[12602.]—**Extinction of Fires.**—I have made no experiments on the subject; but reasoning from analogy, I should be inclined to give the preference to carbonic acid. As to employment of some salt which would generate an uninflammable and fire-extinguishing gas, I believe a strong solution of bicarbonate of ammonia would be of great service, if it could be produced at a sufficiently low price.—S. BOTTONE.

[12603.]—**Acoustics.**—In "Tyndall on Sound," I read:—"We have now to examine how sonorous motion is produced and propagated. When a flame is applied to this small collodion balloon, which contains a mixture of oxygen and hydrogen, the gases explode, and every ear in the room is conscious of a shock, to which the name of sound is given. How was this shock transmitted from the balloon to your organs of hearing? Have the exploding gases shot the air-particles against the auditory nerves as a gun shoots a ball against a target? No doubt, in the neighbourhood of the balloon, there is to some extent a propulsion of particles; but air shooting through air comes speedily to rest, and no particle of air from the vicinity of the balloon reached the ear of any one present. The process was this:—When the flame touched the mixed gases they combined chemically, and their union was accompanied by the development of intense heat. The air at this hot focus expanded suddenly, forcing the surrounding air violently away on all sides. This motion of the air close to the balloon was rapidly imparted to that a little further off, the air first set in motion coming at the same time to rest. The air, at a little distance, passed its motion on to the air at a greater distance, and came also in its turn to rest. Thus each shell of air, if I may use the term, surrounding the balloon, took up the motion of the shell next preceding, and transmitted it to the next succeeding shell, the motion being thus propagated as a pulse or wave through the air."—W. M. COLLES.

[12608.] — **Bookbinder's Press.**—There surely must be some mistake, or "Dublin Subscriber's" men must be phantoms; he must mean a 8½in. screw. If he has a lathe, let him fit up two heads of wood according to sketch, and he will make what was formerly hard work easy. AA are two head-stocks; S is a hard wood screw the same as you are going to cut; it screws into



A 1, and is plain in A 2; C is a cutter which is made the shape of thread. Now, if the cutter is made to work out and in, and the block bored and bolted upon the lathe bed at EE, with the hole in a line with S and D, when you put the screw into A 1, and screw it through, it is evident that it must cut a thread in the piece at EE; you may afterwards finish with the tap.—JACK OF ALL TRADES.

[12609.] — **Packing Grapes.**—The mode universally adopted in Italy is to divide an egg-box into little compartments about 6in. square (with thin wooden partitions). In each compartment place one or two bunches of grapes according to their size. Now fill in each compartment with fine old sawdust or linseed. The grapes must not be over ripe.—S. BOTTONE.

[12612.]—**Action of Oil on Waves.**—If you place a piece of silk cloth upon a polished table, and press the table obliquely with your finger, the cloth yields, and glides over the table, which is thus in a great measure relieved of the effect of the push. So also when water is covered with a layer of oil which does not cling to it, the oil acted upon by the wind glides over the surface of the water, and thus lessens the action of the wind upon the surface. It is true, oil cannot level down the larger waves when they have been once formed, but the sides of large waves are always ridged and furrowed by smaller ones, which render the large ones rough, and thus enables the wind to act upon them with greater power. The oil hinders the formation of these smaller ones, and by thus lessening the friction, diminishes the effect of the wind. Graham Young can experiment for himself by going on a windy day and pouring a little oil on the windward side of a pond.—VIRCAS.

[12613.]—**Drying by Steam.**—I think if T. King uses steam of a high temperature he will never finish mending joints if made with indiarubber washers. By far the best material for such joints is Charlton's vulcan cement, which is obtained in a powder and mixed with boiled oil and a little spun yarn cut fine; it must be mixed just before using; if this joint is well made, not too thick and well screwed up, there is nothing to beat it for standing heat. I would recommend T. King, if possible, to have his flanges planed, and to make his joints as thin as possible, and not to have his cement too stiff. In making the joints with planed flanges a piece of twine similar to that used by railmakers should be laid round the flange inside the bolt holes and bedded in the cement. Red and white lead is the next best thing, but vulcan cement will stand any heat, and if T. King has many joints I should advise him to get a small cask of this cement from the manufacturers.—VIRCAS.

[12614.]—**Corpulence.**—Get "Banting on Corpulence," a good work on the subject. The book, with others of its class, is published by booksellers in Paternoster-row, London, price 1s. In many people the physical organisation prevents them from growing stout. Those who are loose in frame and the bones are not, as the saying is, packed closely, are inclined to be corpulent. Others, again, from trying to grow stout, generate fat on the liver, which is the most susceptible to obesity in delicate constitutions. As the querist is an "Anti-Banting," he must have heard or read of the book recommended, but the work may be useful to others. Let "Anti-Banting" try another. There are several pamphlets on the subject.—Rat-Tat.

[12614.]—**Corpulence.**—No procedure will enable you to acquire bulk that does not aim at promoting the general health of the system—at improving the tone of the digestive apparatus and establishing a healthy state of the blood; disordered digestion will result in defective nutrition, by causing a deficiency in quantity or quality of the chyle, and an unhealthy state of the blood may be the immediate cause of defective nutrition by interfering with a certain nice adaptation existing in healthy nutrition between the blood and the tissues. It is no precise regimen that I would lay you down:—Common sense and experience will teach you what is best adapted for you. The ordinary every-day diet is adequate, but avoid excesses in tea or coffee. I beg to submit a few directions, all of which aim at promoting the general health, and which, I believe, will serve your end:—Take regular and general but not fatiguing exercise; it is well known that inactivity of a limb invariably leads to its attenuation. Walking is the best exercise; it calls into play more muscles than any other. Fresh air is positively necessary, that your blood may be in a healthy condition. Let your walking be in the country as much as possible, and I would suggest early morning. It is not so much the kind of food, as that you masticate it well. Never hurry over a meal—no "bolting." Eat when you are hungry, and not because it is meal hour; you are certain to derange digestion if you impose work upon your digestive organs when they make no call by hunger. Take very light suppers, if any. If you obey these directions, you will seldom have a disturbed night's rest; sound sleep being all important in the process of "bulking." Drink a tumbler of cold water each morning on rising, in sips; it will prove an efficient tonic for your stomach. Avoid constipated bowels; regulate by enema rather than by drugs. Sponge your body each morning with cold water, and rub with a coarse towel. Avoid excessive smoking; it enfeebles digestion, and the spitting accompanying it proves a great draught upon the system. Thus you may invigorate your system and facilitate nutrition.—Ventricosus.

[12621.]—**Black Dye for Leather.**—If "R. M." does not wish to dye leather on a large scale, the following is best plan: 1d. worth of potash to one pint of warm water, let it dissolve, then brush the leather over with the solution; when nearly dry, sponge over with writing-ink, when it will be a good and permanent black. If on a large scale I can send recipe for black dye.—Saddler, Kendal.

[12628.]—**Lampblack.**—I cannot say the quantity of tar, pitch, &c., required for one ton of lampblack, but any one can see that it is a profitable business, though not a very enviable one. The accompanying sketch will easily be understood. The tar, &c., is burnt

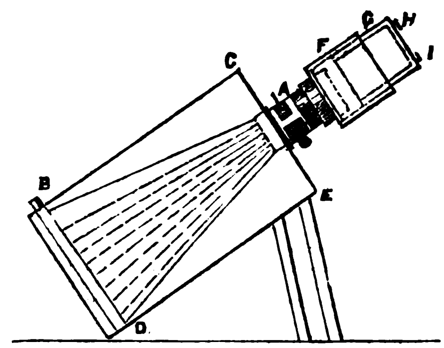
in the iron furnace, and the dense smoke passes into the chamber, which is lined with either sacking or sheepskins. The interior is swept from time to time and sold without any further preparation. The hollow cone of sheet iron inside has a small hole in the top to allow the smoke to escape slowly after it has deposited the greater part of its carbon; by raising and lowering the cone it scrapes the sides of the canvas or leather, and detaches the lampblack.—Saddler, Kendal.

[12634.]—**Photography.** — "Art Photo." had better try the "Collodio-Chloride Process," which gives splendid results on either opal glass or porcelain. For full particulars of the process refer to a manual, to be procured of the publishers of the *Photographic News*.—Photo. Bristoliensis.

[12634.]—**Photography.**—One very good plan to produce photographs on opal glass, or porcelain, is to take a transparency in the camera. This admits of altering the size of the picture, and I have found it to give very fine results. Of course, a plate of opal glass or porcelain must be used for taking the picture on instead of the ordinary glass. If the picture wanted is to be the same size as the negative it can be done without the camera. The prepared plate is placed behind the negative in a printing frame, as a piece of paper would be if wanted to print the picture on it. The plates, however, must be kept from touching, or the surface will be spoiled. A small slip of folded paper placed at each end will do this if the pressure of the springs is light. I don't bother with a frame, but hold the plates together at the ends with my fingers. Care must be taken that all the light falling on the negative comes at a right angle to it, or the picture will not be sharp, as the two surfaces are not in contact. I find that standing about 6ft. back from a window, and keeping the plate perpendicular, is a good plan. If artificial light is used, the plate should be held about 1ft. from it for a small negative, and farther for a large one. There is also the collodio-chloride process for getting a picture on opal glass, which gives very fine results. I think that a carbon print transferred to a porcelain or opal plate, would have a very fine effect, and would probably take colour well. I have never tried either of the two last methods, nor do I know anything about colouring them; at least, not practically, and therefore cannot write from experience.—Occasional Photo.

[12634.]—**Photography.**—Take a smooth sheet of opal glass, coat it in the ordinary "albumen process" mode. When dry, place a negative in contact, and expose for a few seconds to diffused daylight. Develop the image by gallo-nitrate, fix, and if desired tone in gold; varnish. Any of the dry collodion processes may be used instead of the albumen. I can give no information with regard to colouring.—S. Bottone.

[12636.]—**Enlarging Photographs.**—The inclosed sketch will show "Industrious Will" my method of enlarging photographs from small negatives. A is an ordinary ¼-plate portrait lens, which is affixed in a long bodied camera B C D E, taking a 10in. × 8in. plate in the dark slide at B D. On the hood of the lens A is fitted a square deal box F, in which slides a slightly smaller box G, blackened inside with lampblack; H and I are two small catches holding the negative to be enlarged with the film side towards the lens. On pointing the camera to a clear sky, an enlarged image of the negative will be thrown upon the focussing screen at B D, the size and sharpness of the image being regulated by sliding the inner box backwards or forwards as required. A collodion plate 6in. × 5in. is now prepared in the ordinary way and inserted in the dark slide; the negative at H I is now covered with a dark



cloth, whilst the dark slide is placed in the camera, and the shutter raised. Expose by removing the dark cloth for the time required, which may vary from thirty seconds to fifteen minutes, according to the intensity of the light, density of the negative, and state of the chemicals, but be careful not to under expose, rather go wrong on the side of over exposure. Develop with ordinary protosulphate of iron, as for negatives, but do not intensify. The resulting picture, is, of course, a transparency; to procure an enlarged negative the 6in. × 5in. transparency is placed in the box G, in the same way as the original small negative, and the operation repeated, this time enlarging to the full size of 10in. by 8in.; the resulting picture being a negative, which, if the operations have been properly conducted, should be equal in sharpness to the original small picture. Great cleanliness is, of course, indispensable, as every spot and speck is, of course, enlarged tenfold. —Photo Bristoliensis.

[12638.]—**Fleas in Dogs.**—Refer to Vol. XIII., No. 328, p. 387.—N. O.

[12639.]—**Worms in Pony.**—An old man near me often came and begged "box" from my garden for this purpose, telling me that he chopped it up and mixed with the food. The man is now dead, or I would have made particular inquiries, and been fully satisfied.—Benenoke.

[12642.]—**Ice Creams.**—Various ingredients are used as well as refrigerators, the most general consist of milk thickened with some ingredients, and flavoured with some of the essences. The freezing apparatus consists of two pewter cylinders and a bucket when ice can be got; ice and salt are used in the outer bucket, and a freezing mixture of sal-ammoniac and soda between the cylinders. The smaller one is furnished with a piston that fits slack, and is worked up and down by this. The thin film of ice is thrust down to the bottom, and continues accumulating until all is frozen. If wanted solid it must remain a few minutes after it feels firm under the piston, otherwise it is like finely divided snow. Whether there is any improvement upon this I know not.—Jack of All Trades.

[12643.]—**Dictionary of Scientific Terms.**—There is a book published by Lockwood and Co., in Weales' Series, called "A Dictionary of Technical Terms used in Civil and Naval Architecture, Building and Construction, Early and Ecclesiastical Art, Civil and Mechanical Engineering, the Fine Arts, Mining, Surveying, &c." to which are added explanatory observations on various subjects connected with applied art and science, price 4s.—Vircas.

[12643.]—**Dictionary of Scientific Terms.**—Buchanan's "Technological Dictionary" is a useful book, and will probably suit "Plough-Driver." Having reached the shady side of fifty, I find its small type a disadvantage.—R. S.

[12643.]—**Dictionary of Scientific Terms.**—Simmonds' "Dictionary of Trade Products and Technical Terms," Routledge and Co., is the most recent, cheap, and portable work of reference.—P. L. Simmonds.

[12645.]—**Utilising Old Paper.**—The process of moving ink from printed paper and working it into pulp has been in operation some ten or twelve years, and R. Lambert (the inventor's) process was adopted, I think, by Bradbury & Evans, at the Kennet Paper Mills. I do not know if it is still worked at the Sheffield Mill, Theale, near Reading.—P. L. Simmonds.

[12646.]—**Alcohol.**—If methylated spirit be distilled, the shellac or other resinous matter which it contains remains in the retort. If it be necessary to obtain a spirit richer in alcohol, redistil this with lime. I consider that good methylated spirit redistilled will give a product pure enough for "J. A's" purpose.—Analyst.

[12646.]—**Alcohol.**—Put it into a still and draw over two-thirds.—Jack of All Trades.

[12648.]—**Moisture on Tin Surface.**—The phenomenon which "Tintub" has observed is most easily explained. Water is one of the products of the combustion of coal-gas, arising from the hydrogen which it contains. This vapour of water is, of course, condensed when a cool surface is exposed to the heated gases produced by that combustion, and remains there until the heat is sufficient to re-volatilise it.—Analyst.

[12648.]—**Moisture on Tin Surface.**—In the process of combustion, the hydrogen and oxygen of the atmosphere combine and form water, which, in the shape of vapour, is condensed by coming in contact with your cold tank.—Jack of All Trades.

[12648.]—**Moisture on Tin Surface.**—The cause of the water forming on the bottom of "Tintub's" tin cistern is due to the condensation of water vapour formed by the combustion of the hydrogen of the gas flame in contact with the oxygen of the atmosphere, which condenses on the cold surface, water always being formed when hydrogen or coal-gas is burned in air. I found that in 1869 the quantity of water produced by the burning of coal-gas, in Ramsgate, amounted to 16 tons 19cwt.—A. J. Jarman.

[12648.]—**Moisture on Tin Surface.**—The gas, in burning, generates water, its escaping gases are therefore a mixture of nitrogen, carbonic acid, and steam, and the latter is condensed on the cold surface. There is no contradiction to "acknowledged theory," but perfect accordance therewith.—Sigma.

[12649.]—**Kites.**—In kite making the shape of the kite, although the usual one always flies best, is not material, so long as it is light, evenly balanced, and lies at the right angle to the wind. In obtaining and preserving this angle lies the whole art of the kite-flier, and to this end he depends principally on the tail, the best form of which is a string of three or four small conical bags (more or less, according to their size, and also according to strength of wind, which experience will show). The bottom of one tied to the mouth of the other some 6ft. or 8ft. apart. The mouths of the bags are kept open by a piece of split cane made into a hoop, and sewn into the calico or other material of which the bags may be made. For general use and weather I make the tail in about these proportions:—For a 6ft. kite of the common form I should have the first bag of the tail—*i.e.*, the one nearest the kite (and that should be some 8ft. away) about 7in. in diameter at the mouth and 10in. deep to the point, and three others at intervals of 8ft. of string, of diameters gradually reduced, so that the last should be only about 2in. in diameter. With this tail no running is required to raise the kite, it will go up, as it were, of itself in a straight breeze, that is to say, away from the influence of trees or houses, by merely pulling the string with a slight jerk, about thirty or forty yards out and away from the kite, which has been laid with its face on the ground and with the tail clear.—Q. Yorke.

[12653.]—**Poultry Keeping.**—Bring electricity to bear upon this, which may be done very simply and very effectually.—Jack of All Trades.

[12655.]—**Core Box.**—The interior of your box must be made the same shape as you require your steam ways, allowing extra length to fit the prints upon your pattern, that the core can be properly supported.—Jack of All Trades.

[12656.]—**Photographic.**—Transparencies for the magic lantern may be toned to a rich black colour by flowing over the surface of the film a solution of chloride of gold of the strength of 1gr. of gold to 1oz. of water, or by immersion in a 5gr. bath of bichloride of mercury, followed by a solution of ammonia 3 minims to the ounce of water. The former method will be found the better of the two, giving greater delicacy than the latter, which is apt to cause harshness. Transparencies should, if developed with a suitable developer, require neither toning or intensifying. If "Kent" will make a solution of protosulphate of iron 15gr., citric acid 8gr., water 1oz., and use the mixture to develop his transparencies, he will obtain a rich black colour, without any after toning.—Photo Bristoliensis.

[12656.]—**Photographic.** —Print from a thin negative. Do not expose too long under the negative;

develop with pyrogallic acid only, not with sulphate of iron. By these means you will generally get your outlines black enough. Should this not be sufficient, tone with gold.—S. BOTTONE.

[12657.] — Cutting Cylindrical Glass as Bottles and Chimneys.—Take a fine file and nick it all round; afterwards take a long tobacco-pipe, make it red hot, and follow it round carefully, and the glass will drop off.—JACK OF ALL TRADES.

[12657.]—Cutting Cylindrical Glass as Bottles and Chimneys.—W. Pike may cut the above easily without a diamond; let him take a worsted thread and wind two or three; ply a little (say ½in.) beyond the part he wants it cut at, let the thread be thoroughly soaked in water, then let the edge of the flame of a clear gas-burner strike it as close as he can to the thread, turning it all the while, and it will soon fall in two. Should the thread get dry or very hot, wet afresh. I have cut a quart bottle by such a process very neatly.—W. D. T.

[12657.] — Cutting Cylindrical Glass as Bottles and Chimneys.—W. Pike may cut his bottle in the following way: Get a piece of round rod-iron pointed at one end, just long enough to handle conveniently; heat the pointed end to redness (not whiteness), lay it on his bottle where he wants to cut it, and in a second or two he will hear a sound which indicates that his cut, or rather crack, has commenced. Now draw the iron on slowly, and he will find the crack follow after in whatever direction he wishes; repeat the heating process when necessary. He will find it best to make a small "nick" with a file wetted with saliva before applying the heated iron.—OPTICAL BRICKLAYER.

[12659.]—Water Pressure.—If your supply-pipe from the meter is to be of a certain diameter only, of course put that size pipe in, say it is a 4in. Common sense will tell you more than the full of it cannot come through it, but you can increase the rapidity of the flow greatly by enlarging the bore after leaving the meter, and, therefore, get a greater discharge in a given time. After a few yards of the 4in. pipe, continue through a 6in., and your best result will be obtained.—M. A. B.

[12659.]—Water Pressure.—Make your entrance or feed trumpet-mouthed, never mind the rest, as long as your pipe is the full size of meter.—JACK OF ALL TRADES.

[12659.]—Water Pressure.—I should think you would find it best to commence with the smallest pipes, as water would evidently pass through a large pipe with more facility than a small one; you would, therefore, have the resistance lessened every mile, so that if it was able to pass through the first mile satisfactorily, I should think it would be certain to do so in the others.—R. D. D. M.

[12660.]—Aerated Bread Making Machine.—You could not use the machine otherwise than for generating the liquor for wetting. You would want a trough and mixer.—JACK OF ALL TRADES.

[12664.]—To Stereotype Brass Blocks.—Are they some blocks you want to get some copies of, or do you want to cast them in brass, the same as stereotypes are done ?—JACK OF ALL TRADES.

[12665.]—Sea Sickness.—A cure is said to have been discovered by Dr. Landerer, a medical man at Athens. His remedy is to give from ten to twelve drops of chloroform in water. The chloroform in most cases removes nausea, and persons who have taken the remedy soon become able to stand up, and get accustomed to the movement of the vessel. Should the sickness return a fresh dose is to be taken. It was tried on twenty passengers on a very rough voyage from Zoa to Athens, and all, with the exception of two, were cured by one dose. The minority, two ladies, were able to resist the feeling of illness on taking a second dose.—SAMARANG.

[12665.]—Sea Sickness.—Twenty drops of chloric ether in a little water taken when commencing the voyage has been found efficacious.—S.

[12665.]—Sea Sickness.—Keep on deck. Should you feel any nausea, lay flat down, as near the centre of the deck as possible, and fix your eyes and attention on a book, that shuts out from your sight the view of the moving spars, &c. Before going on board, neither starve nor gorge yourself. Avoid fat food, and do not drink brandy.—S. BOTTONE.

[12666.]—Works on Artillery. — Emerson's "Story of the Guns" is worth reading, although not a very technical book.—PHILANTHROPIST.

[12668.]—Auburn Hair.—I do not think it impossible to turn dark hair into an auburn shade, but I have produced fine auburn shades in hair of a middle tint, by means of strong nitric acid. Care must be taken not to dip the hair for too great a length of time. I believe that this is the active ingredient in the "golden" dyes.—ANALYST.

[12669.]—Lottery Laws.—Read the following Acts of Parliament:—17 Geo. II., chap. 5; 42 Geo. III., chap. 119; 5 Geo. IV., chap. 83.—WILLIAM H. HEY.

[12670.]—Engine-Turned Seals.—Take equal parts of nitric acid and water, and turning the face upwards pour some upon it. When it has been on for a few seconds well rinse it in clean water. This process takes the burrs off; to prevent it getting black have it gilded.—JACK OF ALL TRADES.

[12671.]—Dressing Jack Line.—Take a small portion of turps, in which dissolve a small portion of camphor, mix this with six or seven times its bulk of raw linseed oil, and straining your line, dress it. A line dressed any way is not so strong afterwards.—JACK OF ALL TRADES.

[12671.]—Dressing Jack Line.—Make a coil of your line, tie in three or four places with thread. Dissolve half a pound of best glue in water, half a pint in a pipkin. When dissolved, boil your coil of line in it for half an hour, remove it, and dry it on grass, uncoiling it. When dry (4 to 6 hours), recoil it and boil for an hour in a solution of half a pound of terra japonica (catechu) in a pint of water. Hang it up to cool for half an hour, well wash it in clean cold water, dry, and stretch.—M. A. B.

[12672.]—Grove's Cell.—The best way to construct a Grove's cell is to have two platinum plates in a porcelain flat cell, and a single zinc plate in a porous cell, also flat, clamped in the same manner as a Smee. Sulphuric acid 1 part to 8 of water, to be used in the porous cell; and concentrated nitric acid 6 parts to 1 of concentrated sulphuric acid for the outer cell, the platinum plates being immersed in this. Although the arrangement is very costly in the first place, it is the cheapest in working, as the whole of the zinc is consumed without waste. The zinc should be well amalgamated.—A. J. JARMAN, Ramsgate.

[12674.]—Plant Boxes.—The colours are probably glazed tiles. May be got at any pottery and set in wood.—C. B.

[12674.]—Plant Boxes.—I have some pretty ones in my windows, which were made by nailing pieces of oil-cloth of suitable designs on to the wood work for centres, and putting a wooden moulding round the margins, the latter painted any colour to suit the patterns they inclosed.—T. H.

[12675.]—Hay.—This plan, I think, would prove a failure, inasmuch as I do not believe that it is possible to get one drop of juice from a ton of hay, however great the pressure applied.—JACK OF ALL TRADES.

[12675.]—Hay.—The best process is a very simple one for hay, grain, &c., and would often pay well. It only requires a chamber with perforated floor and a fan to draw warm air through the mass.—SIGMA.

[12676.] — Book-Keeping.—The value of the machinery should be put to the credit side of the capital account. It should also appear in the stock account, this account shews what you possess.—PHILANTHROPIST.

[12678.]—The Bluecoat School. — "Tawse" should get a list of governors who have presentations for the current year. This can be obtained at the counting-house of the hospital, I think for 6d. He should then write to any one or two of the governors whose names he may know, stating his circumstances. If he has any friend who can interest himself with a governor his chance would be easier. Boys are received from 7 to 11 years of age. The examination for entrance at 7—8, the Gospels, read any elementary book, write legibly, say the multiplication table. 9—10, ditto as above, spell fairly from dictation, work the four simple rules of arithmetic. 10—11, ditto as above, and fair knowledge of the compound rules of arithmetic, and the Latin Accidence.—AN OLD BLUE.

[12679.]—Papier Mache.—Is no more than old paper reduced to a pulp, or paper pulp mixed with paste and pressed into a mould, it is then dried and stoved, treated to lacquer or a solution of asphalte and stoved again, then dressed off smooth, lacquered again or japanned as the case may be, according to what the articles are.—JACK OF ALL TRADES.

[12680.]—Darkening Graduations on Scales. —Try Brunswick black. Rub quickly over the divisions, wipe off excess with clean soft rag.—S. BOTTONE.

[12681.] — Is the Interior of the Globe Vacuum ?—This was rather fully discussed in No. 167, Vol. VII., "Seven Fundamental Errors in Geology," which "Balcairn" will find worth answering before he proceeds further.—E. L. G.

[12682.]—Evaporation of Water.—The rate of evaporation increases rapidly with the temperature, it varies as the surface; other circumstances, such as temperature, being the same. Increased pressure diminishes evaporation, and *vice versâ*.—PHILANTHROPIST.

[12682.]—Evaporation of Water.—In proportion to surface, not bulk. Increased pressure would lessen the evaporation.—CERVUS.

[12685.]—Garden Models.—Instead of the man turning the grindstone the grindstone turns him. A small windmill might be attached to the shaft of the grindstone, and be concealed from view in some manner. The figures may be made of light wood painted. A weight might be used instead of the windmill, but the mechanism would not be so simple. A spiral of paper placed on an axis some distance over a lamp rotates, and might be connected with a figure. I saw this in Canada.—PHILANTHROPIST.

[12686.] — Gravel for Aquarium. — I have always found simple washing in cold water amply sufficient to remove all impurities deleterious to fish from gravel. I do not think the salt would be in sufficient quantity to injure the fish unless a very large quantity of gravel in proportion to the size of the aquarium was used. I make it a rule to have as little gravel, rock-work, &c.—and, therefore, as much water—as possible in my aquariums.—LOACH.

[12686.]—Gravel for Aquarium.— Boil the gravel well two or three times.—V., Cambridge.

[12687.]—Marking Ink.—If the ink marks turn brown your remedy is to damp the part, and smooth it over with a hot iron, they will then be black.—BALCAIRN.

[12688.]—Training for Bicycle Races.—Let "R. M. D." run a mile daily on a good road, noticing each time how long it takes, in this way he will soon be able to perform the distance in a very short space of time, and will, therefore, stand a fair chance in any bicycle race that takes place.—E. B. SHAW.

[12689.]—Horses' Hoofs.—Oil the hoofs occasionally with neatsfoot oil (to be obtained at the saddlers). Some people stop the hoofs at night with salt mud from the sea shore, or simply wash them in brine. Having tried both plans I think the oil is much to be preferred.—SHYLOCK.

[12689.]—Horses' Hoofs.—Try painting them over the outside with treacle, and packing the bottoms with cow-dung and treacle when put up at night.—JACK OF ALL TRADES.

[12689.]—Horses' Hoofs.—The easiest and best remedy "W. H. K." can apply to his carriage-horse is to get his saddler to make large horse-boots, and fill them each evening with fresh cow-dung (some use large sponges inside boots, wet with water or tar-water), but cow-dung is best; in a short time the hoofs will get in proper order; there are other sorts of coverings for hoofs which have sand-cracks.—SADDLER, Kendal.

[12689.]—Horses' Hoofs.—If "W. H. K." will take of Stockholm tar two parts, and white tallow one part, put it in an old saucepan or ladle, boil it gently together, let it go cold, then apply it to the hoofs two or three times per day with a brush, I think he will find the hoofs in a short time all that he requires. Have the horse shod with a stiff shoe.—ONE WHO HAS BEEN TROUBLED WITH THE SAME THING.

[12690.] — Fire Marks on Silver Goods. — "J. J. N." may easily remove the marks he complains of by well rubbing and brushing the article with strong liquid ammonia, if this will not remove them dip the article into a boiling hot solution of cyanide of potassium, 1oz. cyanide to 1qrt. water, to be made hot in a porcelain basin (never use a metal saucepan) rub the article also with the solution with a brush (never dip the hands into it); this done, well wash the article, dry, burnish, and polish in the usual way.—A. J. JARMAN.

[12690.]—Fire Marks on Silver Goods.—Use nitric acid in water instead of sulphuric to make the pickle. Have your stained silver hot, throw it in, and it will be perfectly clean and free from stain, no matter how much discoloured it may have been.—BALCAIRN.

[12690.]—Fire Marks on Silver Goods.—Try nitric acid, and wash with cyanide of potassium. I am afraid you have given them too much fire—if so, there is no cure.—JACK OF ALL TRADES.

[12692.]—Deliquescents.—There are many salts which on being rubbed up in a mortar together, deliquesce. This is owing to a double decomposition taking place. Generally speaking, two salts, containing water of crystallisation, and acids which have a stronger affinity for each other's bases than for their own, run to a liquid when powdered together. The most deliquescent bodies are calcium chloride and chromic acid.—S. BOTTONE.

[12693.]—Yeast or Barm.—A half gallon of malt and ½lb. of hops will make three gallons of what is called patent yeast. Boil them together for an hour and when luke-warm set them with a cup or half pint of fresh ale yeast. Next day bottle for use; the proportion used is about one quart to a bushel.—JACK OF ALL TRADES.

[12697.]—The Harp.—I would not advise "Un Bouts" to make his sound-box of metal, for it would not be likely to produce the soft mellow tone of wood, nor would it be as easy to work up, and as far as sound giving capabilities go, wood is less affected than iron by variation of temperature. If he lives in London he would do well to visit the Exhibition and there take the measurement required, for he does not say what kind of harp he wishes to make. For the practical details of the manufacture, he could not do better than follow out the suggestions of "The Harmonious Blacksmith," or, if he wants to make the Irish one-keyed affair, of "Ixion."—VERTUMNUS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "West Cornwall" has answered 12284; "W. H. H. C.," 12272; "Jack of All Trades," 12314, 12324, 12327, 12342; "Outgenious Whitesmith," 12324; "Photo. Bristoliensis," 12326; "Philanthropist," 12345; "J.K.P.," 12354 (see letter 4812).

12433 Pie-Heater, p. 471
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12435 The Dragon-fly, 471
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12454 Southern States of America, 471
12460 Four-valved Cornet, 471
12468 Exhibited Inventions, p. 472
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QUERIES.

[12756.]—**Etching on Stone.**—Would "A Working B." be good enough to give as lucid a description of the art of etching on lithographic stone as he has given of chromo-lithography, and explain why lines cannot be drawn so fine on the stone as to match those etched?—W. R., Royal Engineers.

[12757.]—**Hand-railing.**—Can any of your practical readers tell me the method for taking waste wood off top and bottom of wreath of handrail when cut out to fit well; and also best means of moulding same, whether by routers made to suit moulding (it being winding surface), or separate planes to work each member separately?—English Mechanic.

[12758.]—**Socket Handles.**—I should be obliged to some one giving me information as to the best means of making socket handles, such as are fixed on all cast-iron saucepans. I have a very large quantity to make, and I am now turning them on a mandril in a crease, which is a very tedious process. I hope some one can tell me of a more expeditious method, or if I could get some simple machine to assist in the work?—Chester.

[12759.] — **Leaking Indiarubber Bottle.**— Can any one tell me how to repair an indiarubber hot-water bottle that leaks?—W. Davenport.

[12760.]—**Bringing Slate to Surface of Quarry.**—I have a slate quarry which is 400ft. square and 60ft. deep, from which up to the present all the stone has been brought up by horses and carts. I have an 8-horse engine at the surface for the purpose of working the pumps which keep the water down. Now, as the engine is only required to work half time I wish to utilise it for bringing the stone to the surface, by tramway or otherwise. I want to know what is the best and cheapest way of doing this? Would a steam winch fed by the present boiler bring up (say) a ton at a time up an incline of 1 in 6? Any hints brother subscribers may give would greatly oblige—A Poor Irishman.

[12761.]—**Electrotype Moulds.**—Have any of your readers ever used stearine wax for this purpose. I have found that when mixed with a small proportion of rotten-stone (to prevent brittleness) it takes a sharp impression and is easily detached from the mould.—Zeta.

[12762.]—**Curve of Mirror.**—What is the shape of the curve of a mirror for reflecting telescopes? Is it a parabola? Is there any machine for grinding them, or are they done by hand?—Zeta.

[12763.]—**Preparation of Carbon.**—How is carbon prepared from loaf sugar? I have tried in various ways, but with no satisfactory result.—Zeta.

[12764.]—**Fringe Making.**—Can any of the readers of the English Mechanic tell me if a machine is made, and where to get it, for making fringe or ruchings, for ladies' dresses of silks, cottons, or wool cloths? Also a machine to take out of these the warp or woof as the case may require.—Hugh.

[12765.]—**Sun-dial.**—I want to construct a sun-dial as correct as possible, but do not know how to go about it scientifically, will some one help me? It is for lat. 40° N., is it necessary to know the minutes and seconds? I want the outer circle to be 12in. diameter. What height should the gnomon be and what angle? Should it point true N. and S., or would the magnetic variation of the place interfere? If any kind friend in a leisure hour would describe a 12in. circle, and mark off the hour, half and quarter hours on circumference, and cut out size and shape of gnomon and let me have it with directions for fixing, I would advertise my address and thank him many a day when it would be set up in a far-off land. I would engrave it on slate. I think a practical paper on the construction of a reliable sun-dial would be of great interest to many an—Emigrant.

[12766.]—**Fiddles and Fiddling.**—Many useful wrinkles have lately appeared about fiddles and fiddling. I have been watching to see if anything should meet my case. I am in a difficulty that many brother readers will, I think, gladly help me out of. I am troubled with the bow slipping on the strings (as it seems to me); my notes, many of them, are squeaky and offensive, although I try my best to avoid it. Is the fiddle in fault, the strings (I have been told it is bad strings, I always ask for the best, however), the resin (too much or too little), the bow, or him that boweth? My instrument, I "fancy," is a pretty good one—labelled Antonius Strad., &c., Cremona, 1719. Powerful toned.—H. H.

[12767.]—**Puddling Fishponds, &c.**—I have a fishpond to puddle—about 20 yards by 30 yards, by 3ft. 6in.—with blue clay. Would any brother subscriber inform me how to proceed as regards mixing the clay and putting it in, and what thickness will be sufficient, as it has been puddled before with 5in. of yellow clay, but has always leaked, as it is a sandy bottom. Also what thickness of lime will be sufficient to keep the worms out.—A Constant Reader.

[12768.] — **Specific Gravity.—Sykes's Hydrometer.**—I have a Sykes's hydrometer, but am at a loss to take specific gravities with it. I should take it as a great favour if some one would give a comparative table of degrees, as marked on Sykes's, Baumé, and Twaddle's hydrometers.—Spirit.

[12769.]—**Oval Turning.**—I shall be obliged if W. Winkle will kindly give his promised information as to adapting the lathe for oval turning, the bed of lathe being birch 2in. in thickness.—Photo. Bristoliensis.

[12770.]—**Boring for Water Jet.**—I have somewhere read that the Chinese have practised boring—I don't mean each other—but for water, for many centuries, probably long before the adoption of that practice in Artois, whence we derive the name (artesian) of wells so formed. Can any fellow reader oblige me with information concerning the antiquity of this process—when first used in Western Europe and Northern Africa; also in what books I can "read up" its history? I trust my fellow readers are not treated like artesian wells—*i.e.*, bored—by my many inquiries, and that I shall not be considered to be "boring" for information.—The Harmonious Blacksmith.

[12771.]—**Colorado, U.S.**—I am about to emigrate to Colorado, United States. Can any of "ours" give me any reliable information on any of the following points: 1. Best way of getting there—Quebec, New York, or Baltimore? 2. Expense for intermediate and 2nd class. I do not mean the steamer or rail fares, I can find them out, but incidental cost, such as average cost per day in moderate hotels, cost of diet on railways (I believe there are dining carriages in the trains), transit of luggage by cart or cab, &c. 3. I am going to Denver City first, and have a little capital to buy land and either grow fruit, raise stock, or farm; what part of Colorado would be best for each? 4. I am told the climate is the best in the world; is half this true? 5. Are there any books on Colorado or on American farming and life, &c., procurable in this country? 6. Should I take tools and implements or anything particular out of a regular traveller's kit? 7. What are the prospects of success for hard work, some intelligence, and thorough determination? Is it mere competence and comfort or wealth?—Emigrant.

[12772.]—**Bee Keeping.**—Many thanks to Mr. C. N. Abbott for his good advice so frequently given; will he be so good as to inform me how he proposes to deal with bar-frame hives that have movable partitions; if he would advise taking some of the frames that have sealed honey in the comb from each end, and leaving the ends vacant, to be filled another year; and the best way to transfer bees out of one movable frame-hive into another; also the best plan of ventilating or letting off the breath of the bees from bar-frame hives during the winter months?—John Walton.

[12773.]—**Boot and Shoemaking.**—I shall feel obliged to our indefatigable friend "Jack of All Trades" if he will inform me what tools are required for repairing? Also, how are the pieces of leather put on heels' or toes' ends so as to make them appear straight or one piece? Also, is there a tool to take out the old nails?—Harry Macpherson.

[12774.]—**Harmonium Keys.**—Not being in a position to buy ivory for the keys of a harmonium, would any reader kindly oblige by stating the best kind of wood as a substitute, and whether it is advisable to varnish them?—E. W. P.

[12775.]—**Artificial Marbles and Stones.**—Can any reader give directions for making these, and for producing them in various colours? I put this question some time ago, and there was but one answer, and the directions given were too general to be of any use.—Thos. Hackett.

[12776.]—**Gas.**—Like "Philo," I am a gas consumer, also a gas producer (shareholder). I feel with him we ought to have some means of knowing the quality of the gas we burn. Could he or any of your scientific readers tell me the most reliable instrument for testing the quality of gas? It is a notorious fact that with more care and less light we are called upon to pay more; or, in other words, our gas bills increase every corresponding quarter without receiving any extra advantage. I have received valuable suggestions from the columns of the Mechanic respecting gas, but I feel we are too much in the hands of gas companies, and they, as a rule, produce bad gas and good dividends; in short, we require justice.—H. J. W.

[12777.]—**Object-Glass.**—"F.R.A.S." is so kind in answering queries that I am tempted to submit to him the following. I am about constructing a telescope, and in the purchase of the object-glass I cannot exceed a certain sum, and for this amount I can purchase a 2in. glass or a 2¼in. glass of best quality from an optician of great repute, whilst with the amount I intend expending I can buy a 3in. or 3¼in. glass of ordinary quality, such as those supplied in the £5 telescopes. I want my telescope both for astronomic and terrestrial observations, and will thank our kind savant to direct me in the purchase of the object-glass. Which will be the most satisfactory, the 2in. or the 3in.?—Zealous.

[12778.]—**Printing Metal Leaf on Silk and Cotton.**—Will any of our American subscribers oblige by telling me what is used in America for printing metal leaf on silk and cotton for felt hats? A man who has just come from America can print metal leaf on almost anything, whereas I have to make three or four impressions sometimes to get a good one, and he has always good work first impression. I know that he uses a transparent varnish, and that it does not affect the silk or cotton, but leaves it just the same as if it had none on. It drys in one minute, so that they are ready for printing at once. It is made of three things, and they are rather expensive; but what they are, and how the varnish is made, I cannot find out. The French printers and some of the London printers use the same. For some years I have used powdered rosin and shellac. I got a good recipe from this paper, but it is nothing compared with this American recipe. A drawing of the American press would also oblige.—J. B. Sharpley.

[12779.]—**Lightning and Thunder.**—1. What is the cause of the different phenomena of lightning, yclept, forked and sheet? Is it that the flash appears forked when seen directly, and sheet otherwise? and does not the fact of so much sheet lightning being seen at night, unaccompanied by thunder (and, therefore, we may presume, at an extraordinary distance away), prove this? 2. Is the sound produced by an electric explosion, single and distinct, afterwards echoed and re-echoed, causing the continuous sound known as thunder? 3. When an animal, tree, or other object is struck by lightning, what is the material that strikes? Is it simply the concussion caused by the explosion, or is the "electric fluid" a material which may be analysed as well as felt? No doubt an answer to these queries would interest many at this peculiarly lively season.—G. L.

[12780.]—**Turning Spokes of Carriage Wheels.**—Could any reader inform me how or what machinery is needed to turn a spoke for carriage wheel in a common lathe?—Amateur.

[12781.]—**Applied Mechanics.**—If P be the breaking weight of a column fixed at both ends, f and a two constants $= 36{,}000$ and $\frac{1}{3{,}000}$ respectively; s = area of cross section in inches, l = length of column, and h = dia. of column; then

$$P = \frac{f\,s}{1 + a\,.\,\frac{l^2}{h^2}}$$

Now I wish to know to what units P, l, and h are referred—that is, does P represent pounds or tons, l and h feet or inches?—T. Tebeck.

[12782.]—**Full Moon.**—I wonder whether some of your kind readers can give the dates of the full moon for three or four years to come. If so I fancy it would be a great help to many secretaries of societies.—J. G.

[12783.]—**Sash Planes.**—Can any of your correspondents tell me why sash planes are sold in pairs? They are numbered 1 and 2, and cannot be had separately, but so far as I can judge they are exactly alike.—Science and Art.

[12784.]—**Libraries.**—Will some kind reader please to give a few suggestions on the management and conducting of public libraries? How are the books backed and numbered? Is there no better and more lasting way of numbering than by gummed tickets, which are often torn off and lost? Could some kind of a stamp be used for that purpose—if so, where is one to be had?—A Librarian.

[12785.]—**Trompe or Water Blowing Machine.**—Could any correspondent tell me if there is such a machine going in England, as I am not aware of any in Scotland; and if the blast is so moist as to render it unfit for cupola purposes? Any information regarding its advantages or disadvantages will much oblige—W. D. T.

[12786.]—**Photography.**—I shall esteem it a great favour if some of our able photo. correspondents will kindly reply to the following queries. 1. What can be done to silvered paper to make it keep a week or fortnight before using it? 2. Can anything besides kaolin be used for restoring the colour of discoloured nitrate bath? I always find the solution wants filtering several times after using kaolin. 3. How can mounted carte de visites be pressed flat? Mine always curl after rolling. 4. I wish to produce some very opaque transparencies for magic lantern from negatives. How am I to go to work? 5. I shall also be glad of information respecting copying from the carte de visite print, same size and enlargement, without artificial light, if possible. Perhaps our friend "Photo. Bristoliensis" will oblige by replying to some of the above queries.—Camera.

[12787.]—**Dear Coal.**—Will "Philo" kindly tell us the price of the half open stove alluded to in his letter (4723), and also the probable cost of the double fire apparatus?—C. W. A.

[12788.]—**Design for Marble Inlaid Table.**—Will any correspondent give a good design for an inlaid marble table, about 20in. on top, and pieces (say) from 1½in. to 3in.? I understand the practical part very well, but I wish for a good design.—M. & S. Mason.

[12789.]—**Staining Fanlight.**—I wish to stain or colour a fanlight over door to show some view or picture, such as the Last Supper, &c. I have seen the lamps over publicans' doors stained a very bright crimson or green, with picture in uncoloured or plain glass; for instance, the Bridge Inn, with view of a bridge and scenery. If some one would kindly give the information it will probably oblige many as well as—Kendal Saddler.

[12790.]—**Watch Repairing.**—Being in town the other day for the purpose of procuring some watch materials, I found that the same had increased in price. Now, I consider that I would be justified in making a small advance upon my present scale of charges. Being a country jobber, I should feel obliged if any of our brother pivots would inform me what is the usual charge for putting in a mainspring, a balance staff, and a verge; also, if they would kindly say which is the best method of hooking in a mainspring with a steel hook, or with a brass one, same as in a Geneva watch. I also wish to know (perhaps "Practical Seconds" will tell us in his paper) how to take the height of a cylinder from the broken one. P.S.—Thanks to J. McKay for his wrinkle in bumping a Geneva escape-wheel. I only wish I had known it sooner. I see that another jobber adopts the same method.—J. H.

[12791.]—**Table Fountain.**—Will some one explain the action of the self-acting table fountains shown in No. 22 room of the International Exhibition?—Glatton.

[12792.]—**Tempering Needle.**—Ought I to temper the steel for a magnetic needle to a blue or to a straw colour? I wish to weight one end with solder. Will the heat necessary to do this destroy the temper?—Glatton.

[12793.]—**Oil of Peppermint.**—Will any of your readers kindly inform me how to extract from the plant peppermint the oil or essence of that name?—J. W.

[12794.]—**Ammoniacal Liquor.**—I would thank any chemical friend to explain how to compute the number of gallons in a ton of ammoniacal liquor of 5°, 6°, or 7° Twaddle.—J. W.

[12795.]—**Test for Whiting in Paint.**—Will any of our chemical friends kindly inform me the test for whiting in house paint.—R. R.

[12796.]—**The Spanish Language.**—Having decided to acquire a knowledge of the Spanish language, I would thank "E. L. G." or some other correspondent of "ours" to give his opinion with regard to the best grammar for self-tuition. I should use an Ollendorff if there is one published. I find that by such means I can learn a language in much less time than with a grammar and dictionary only.—J. Roberts.

[12797.]—**Rats and their Habits.**—Dr. Livingstone, in his recently arrived despaches, speaking of the elephant tusks left by the Manyema in the forests where the animals were slain, says of them: "Many were half rotten or gnawed by a certain rodent to sharpen his teeth as London rats do on leaden pipes." A common opinion among sailors is that rats gnaw leaden pipes and wooden planks to get at the water they hear rushing past. Can any one acquainted with the habits of those animals say which gives the right reason for the rat's operations, Jack or the Doctor?—Common Sense.

[12798.]—**Air Vessel on Suction Pipe.**—I have a 10in. bucket pump with a 6in. suction pipe, 30ft. long, and on this pipe is fixed a large air vessel 4ft. from pump. Would any kind reader inform what advantage is gained by having one on it.—Doubtful.

[12799.]—**Speculum.**—Will Mr. A. W. Blacklock (in No. 4222), kindly say what thickness his glass was that he got his speculum out of, and also how he managed to get the edge to shape?—Anti-Flatite.

[12800.]—**Pantelegraph.**—I should feel obliged if "Rat-Tat" or some other correspondent would describe the above.—Philanthropist.

CHESS.

ALL communications intended for this department to be addressed to J. W. ABBOTT, 7, Claremont-place, Loughborough-road, Brixton, S.W.

The correspondence match between the City and Vienna Chess clubs, to which we alluded a few weeks back, has been commenced. Two games will be played concurrently, Vienna having the move in one and London in the other. In game No. 1 the Austrians opened the ball with the orthodox P to K4, and London answered by moving P to K4 also. In game No. 2 London commenced with P to QB4, to which Vienna replied with P to K4. The great caution displayed by London in adopting an irregular opening may possibly be a tribute of respect to the known or suspected powers of their adversaries, but whatever influence it may have upon the ultimate destination of the stakes (£100) it is certain to deprive the game of all interest to those amateurs who have been looking forward to this match for some new development of the theory of chess. One of the Vienna papers prints a list of gentlemen appointed by the club to conduct the games on their behalf—viz., Dr. Meitner, Jos. Berger (the well-known problem composer), A. Czank, O. Gelbfuhs, and Dr. Fleissig, favourably known as a blindfold player. London will be represented, we believe, by J. Lowenthal, Horwitz, Potter, Steinitz, and Blackburne.

The score in the match between Steinitz and Zukertort stands:—Steinitz, 4; Zukertort, 1; drawn, 8.

ENIGMA II.—BY J. W. ABBOTT.

White.

K on K Kt 8; Kts on K Kt 7 and K Kt 8; B on Q 8; Ps on K Kt 5 and K R 4.

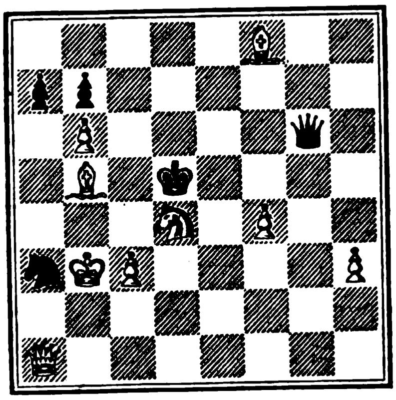
Black.

K on K Kt 3; Rs on K B 4 and K 6; B on Q sq; Ps on K 2 and K 8.

White to play, and mate in *two* moves.

PROBLEM XIII.—BY J. G. SLATER.

Black.



White.

White to play and mate in four moves.

SOLUTION TO PROBLEM XI.

White.	*Black.*
1. Q to Q 7 (ch).	1. K takes Q.
2. P to Kt 8, becoming a Kt (ch).	2. K to Q B 2.
3. Kt. to K 6 mate.	

O. A. BROWNSON (Dubuque, Iowa).—We shall take an early opportunity of noticing the contents of the August number of the *Chess Journal* which you have obligingly forwarded to us.

W. N. P.—Thanks; shall always be glad to hear from you, even if the communication is a little delayed.

S. H. THOMAS (Plymouth).—The problem shall be examined, and reported on next week. In Problem XI. the B P on Q 6 shuts out the ch. of B Q at Q 6, and allows more play at White's command, which adds to the construction of the problem.

ARGO (Yarmouth).—The problems last sent are not equal to your previous effort. No. 1 is very easy, and in No. 2 the capture on the first move is inartistic.

SOLUTIONS to Problem X. (continued).—S. H. Thomas (Plymouth); R. H. Macleod; C. J. L. (Portsmouth); A. R. Moleson (Swansea); J. Hall (Chester).

THE following have sent correct solutions to Problem XI. —W. N. P. (London); J. Hall (Chester); C. J. L. (Portsmouth); S. H. Thomas (Plymouth); A. W. Cooper; S. M. Banker; H. Cherry; W. Nash (S. Neot's); R. L. Conderford; A. R. Moleson (Swansea); W. Airey (Worsley); A. L. (Lincoln). All others are wrong.

Soldering Flux.—It may be important to many to know, on the authority of M. Gaudin, that a mixture of equal parts of cryolite and chloride of barium forms a flux superior to borax for soldering iron, or brazing copper, brass, or bronze. Cryolite is found in great abundance in Greenland; it is a double fluoride of aluminium and sodium, and has been largely employed in the production of the metal aluminium.

THE *ENGLISH MECHANIC* LIFEBOAT FUND.

Subscriptions to be forwarded to the Editor, at the Office, 31, Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged	£342	7	9
S. Morris	1	1	0
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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Tuesday morning, August 27, and unacknowledged elsewhere:—

Geo. Hy. Cox.—W. M. Simpson.—Robert Hirons.—Rev. E. R. Mountford.—Wm. Fryer.—W. Davenport.—John Jones.—G. R. Nichols and Co.—W. D. Skelton.—T. Bond and Co.—Frances Radcliffe.—H. Young.—J. M. Wilson.—W. R. K.—R. D.—W. E. and B.—Pat.—J. O'Brien.—G. Wilson.—Geo. Dawson.—E. L. J.—Filmouse.—Pro Bata.—J. B. W.—J. B. B.—N. and Co.—J. Dresser.—J. Billock.—B. Richards.—G. C. Price.—H. Hird.—J. T. Sprague.—G. R. Nixon.—Solomons & Co.—Charles J. Harcourt.—J. C. Lambert.—J. Frances.—Cunliffe & Croom.—J. A. McKean.—D. Harcourt & Co.—Thomas Atkinson.—M. E. Horley.—John G. Phillips.—F. R. Leyden.—Charles Mace.—Wm. Oldfield.—R. L. G.—J. A. T.—Changki.—Screw Cutter.—Atmospheric Burner.—J. S.—Alfred T. Jenkins.—J. K.—W. M. Parker.—Norwich.—S. Broughton.—Toivo.—W. S. C.—Malt.—W. S. B.—Beta.—Limbo.—D. Duplex.—Manus.—Dutchman.—Mutual Tom.—Sam Weller.—A. D.—Another Paddler.—W. V. Clarke.—Convertion.—C. N. Abbott.—South Line.—Wm. MacNaught.—Rasselas.—Horatio.—Alfred H. Allen.—C. H. W. B.—R. H.—E. M.—W. Brown.—Mechanical Equivalent.—J. Pugh.—N. S. Heinsken.—J. Tregaskis.—Arotes.—T. A.—R. T. Grays.—Alastor.—Ajax.—H. O'B.—Successful.—Prudentia.—A Carlow Mem.—Tintub.—Good Intent.—M. F. P.—J. B. Clay.—A. S.—Zeta.—E. R. Wigan.—Linea.—Enquirer.—E. S.—E. E. G.—One who has Passed.—W. Baker.—J. W. Fennell.—Smalker.—G. H. Goodman.—A. K. C.—Definition.—H. G. W.—A. Z. Y.—C. E.—J. B. Harris.—Samuel Smither.—John Hopkins.—J. Gunn.—Salmo.—E. T. E.—M. F.—M. A.—From one Afflicted.—A Carpenter.—Young Glasgow.—E. T. E.—J. G. H.—E. H.—J. B. H.—Outgenious Whitesmith.—R. A. Proctor.—Sigma.—Beacon Lough.—G. F. H.—F. R. A. S.—J. C. J.—Harmonious Blacksmith.—Edward Gardner.—Samuel Hill.—Saul Rymes.—J. M. Hayward.—One in a Fix.—Albert Lyon.—C. B.

SPINE.—Consult a medical man.

S. K. So. T.—There is no doubt there is much in what you say, but the case you mention must be an exception to the general rule.

STOCK AND DIES.—If you want any definite information that may be useful to yourself and others ask for it, but we cannot afford space to ask for opinions on speculative points.

R. D. S.—Consult back numbers about brewing.

A GRATEFUL READER is a very indifferent one, or he would not ask us to insert a query which is an advertisement.

NIL DESPERANDUM.—You say you "have had several communications from the spirits, and in some cases with startling accuracy with regard to the past, but those of the future are not nearly so much so, for in some cases they have been radically wrong," and you "want some correspondent to explain how this is accounted for." Why not ask the spirits who are so "startlingly correct with regard to the past"? Certainly they, with their vast experience and wealth of wisdom, ought to know more about your affairs than strangers!

PALE.—You say you want to remove a mole spot, and you have been trying to remove it and made the matter worse, for where you had a mole now you have a sore. Leave it alone, or you may make the matter still worse.

C. E. L.—Your only way would be to rent a private wire of the Post-office. Write the secretary.

AN IRON MANIPULATOR, John, W. H. Murch, J. Lucas, A Canny Scot, C. M. M. B. (second question), Etna, A Glasgow Artisan, Herbert, are referred to indices to back volumes.

Communications which can only appear as advertisements to hand from E. J. W., E. Ward Jackson, C. M. M. B. (first question), South Devon.

J. L. M.—Your illiterate vulgarity is only to be pitied, but your spiteful attacks on a correspondent who has always been willing to afford readers all information in his power render you unworthy of further notice.

LOVATT.—See excursion advertisements in the daily papers. Boulogne preferable.

ONE IN THE DARK.—Your query on bronze for brass work has been answered before, and your query on drills for mending china is an advertisement.

T. D. W., L. W. D., J. R. Watson, Optical, Jas. McL., Partner, J. Murdock, see "Hints to Correspondents," No. 4.

W. T. K., J. Laurie, Tam o' Shanter, E. W. S., J. L. L.—Your queries have been answered in back numbers.

H. O. BRIEN.—Your "copy" if written in the same hand and bearing the same signature can be sent to the editor in a halfpenny wrapper.

A. Z. Y., Tom O'B., No. 790, Young Carpenter.—Your queries are inadmissable.

JAMES POLGLAZE.—Most of the information in your letter is good enough, but unfortunately you use twice as many words as are necessary. Make your next letter little and good, and we will insert it.

T. RUSSELL.—You send a long letter on "Lightning Conductors," but the letter is an advertisement after all, and therefore not inserted. Besides, the same letter has been sent to other publications.

J. H. B.—You send a letter written partly in pencil and partly in ink, and the letter altogether is so badly put together that we have not time to endeavour to make out what you mean to convey. As a postscript you say "I hope you will excuse bad writing," &c. We do do not excuse you, as we believe you can do better, and as a punishment drop your letter into the waste basket. What is worth doing is worth doing well, and no one has a right, to save his own time, to trespass on the time of another.

J. W. WALKER.—Pray try and inform yourself on so delicate a matter before you attempt to instruct others.

B. B.—We know of no such a book, and again refer you to back numbers. We find as a rule that correspondents who give us most trouble are those who are neither subscribers nor readers, but who write us when they want any information without troubling themselves to ascertain what has been said on the subject.

J. HAMPDEN.—You appear to forget that you have been bound over to keep the peace before more than one tribunal, as you write a letter which, if published, would subject you to another criminal prosecution. It is said that a burnt child dreads the fire, but you write as if you liked to rush into it. We have several times stood your best friend by preventing you criminating yourself, and, as a matter of course, you have rewarded us by ribald abuse.

EXCELSIOR.—Too legal for us.

WAKENAAR.—Your description of slide-rest next week.

ENQUIRER.—We devoted as much space as we can spare to shorthand about two years since. The discussion on it was somewhat exhaustive.

TO SEVERAL CORRESPONDENTS.—The space we have devoted to reports of the British Association is one reason why a large number of letters, replies, and queries, are pressed out till next week.

F.R.A.S.—Your second article on "The Equatoreal" has been in type two weeks. It shall appear in our next.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING AUGUST 13, 1872.

2334 J. Ellison, Bury, Lancashire, for improvements in self-acting tilts for casks, barrels, or other receptacles.

2335 G. Bray, Leeds, for improvements in gas-burners.

2336 F. M. H. Motard, Paris, for an improved mode of recovering and regenerating steam in motive-power engines.

2337 T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, for improvements in the manufacture of iron and steel, and of revolving puddling furnaces or convertors, and apparatus to be employed therein.

2338 D. K Clark, Buckingham-street, Strand, for improvements in the lubricating arrangements of axle-boxes for railway rolling stock. A communication.

2339 J. Holmes, jun., Dublin, for a new or improved method or methods of building dwelling-houses and other buildings.

2340 T. Spittle, Newport, Monmouthshire, for improvements in cask stands.

2341 C. Morfit, Southampton-buildings, for improvements in the manufacture of pure phosphates of lime.

2342 W. R. Lake, Southampton-buildings, for an improved ink-erasing compound. A communication.

2343 L. Newton, Birkenhead, and J. T. Swallow, Manchester, for improvements in cups, glasses, tankards, soup-basins, and other vessels used for drinking purposes.

2344 C. Morfit, Southampton-buildings, for improvements in the chemical treatment of mineral and other crude phosphates of lime.

2345 W. H. Berry and F. Berry, Leeds, for improvements in machinery for bending iron, copper, brass, or other metals into complete or part circles.

2346 J. R. Readett, Dover, for improvements in machinery or apparatus for expressing or obtaining oil from seeds or vegetable substances.

2347 J. W. Lewis, Coventry, for an improved machine or machines for making and covering all classes of cords, gimps, and other twisted materials and fabrics.

2348 T. Hudson, W. Walker, and J. Robson, North Shields, for an improved metallic sheathing for preventing the fouling and corrosion of iron ships or vessels.

2349 W. Ansell, Birmingham, for improvements in breech-loading small arms.

2350 T. Silver, Moorgate-street, City, for an improved air-rarefying lamp-burner.

2351 G. M. Moore, Liverpool, for improvements in the process of evaporating or concentrating alkaline liquors in the manufacture of caustic soda, caustic potash, soda ash, and other similar substances; also for heating or boiling and refrigerating solutions in breweries, distilleries, chemical and other manufactories, and in the apparatus employed therefor.

2352 R. Turner, Lancashire, and J. Hibbert and J. Cheetham, Hyde, Cheshire, for improvements in machinery for blocking hats.

2353 W. Grimshaw, Ashton-under-Lyne, for improvements in machinery for "planking" or "felting" hats and other coverings for the head.

2354 A. M. Clark, Chancery-lane, for improvements in magazine and other breech-loading fire-arms and cartridges. A communication.

2355 A. Clark, Rathbone-place, Oxford-street, for improvements in the manufacture of corrugated metal revolving shuttles and in machinery for the same.

2356 J. Sabberton, Great Portland-street, Oxford-street, for improvements in the means of and apparatus for ventilating railway carriages.

2357 C. Morfit, Southampton-buildings, for an artificial substitute for "redonda guano," "alta vela" guano, and other natural phosphates of alumina to be used in the defecation of sewage, in the manufacture of sugar from cane and beet-root juices, and in the preparation of certain chemical products, such as pure alumina and the alkaline and earthy phosphates and aluminates.

2358 T. Warren, Glasgow, for improvements in and connected with furnaces employed in the manufacture of glass.

2359 J. Oldroyd, Leeds, for improvements in the construction and working of hydraulic engines.

2360 A. Maw, Salop, for improvements in apparatus to be employed in preparing the clay used in the manufacture of encaustic tiles and other articles requiring similarly prepared clay.

2361 A. Jaynor, Regent's-park, for improvements in the manufacture of artificial stone or compositions suitable for pavements, architectural and other purposes.

2362 S. Myers, Vale-terrace, Maida-vale, for improvements in gas-lighting apparatus. A communication.

2363 R. W. Morris, Ulverstone, Lancashire, for improvements in revolving shutters.

2364 R. Hornsby, J. E. Phillips, and J. Innocent, Grantham, Lincolnshire, for improvements in reaping and mowing machines.

2365 S. H. Hadley, Hampstead, for improvements in cleaning wheat and other grain, and in apparatus employed therein. A communication.

2366 J. Lane and W. Onions, Liverpool, for improvements in apparatus used in brewing.

2367 R. Mill, Jersey, for improvements in or connected with steam-boilers.

2368 J. Drummond, Edinburgh, for improvements in reaping and mowing machines.

2369 W. R. Lake, Southampton-buildings, for improved nutritious compounds. A communication.

2370 G. H. Nussey and W. B. Leachman, Leeds, for improvements in machinery or apparatus for pressing woollen and other woven or felted fabrics.

2371 B. D. Harrison, Leeds, for improvements in kilns or ovens for burning bricks, tiles, and other plastic forms.

2372 F. G. M. Stoney, Glasgow, for improvements in stop valves or sluices.

2373 B. Bagster, Bushy, Herts, for improvements in locks or fastenings for railway and other carriage doors, and for other uses.

2374 R. Willis, Jermyn-street, Piccadilly, for an improved apparatus for clipping horses and other animals.

2375 E. Shaw, Manchester, for improvement in perambulators.

2376 F. W. Scott, Lancashire, for improvements in belts or bands used for colliery winding, suspension bridges, and other purposes.

2377 A. G. Speight, Spencer-street, Goswell-road, for a new or improved manufacture of fronts for personal wear.

2378 T. H. Rushton and W. Dobson, Bolton, for improvements in machinery for ginning cotton.

2379 W. M. Adams, B.A., Salisbury-street, Strand, for an instrument for the solution of triangles.

2380 T. Broughton, Dalston, for improvements in the construction of iron girders, joists, or beams used in constructing buildings.

2381 J. Pickering, Manchester, for improvements in the construction of spring mattresses and other articles for sitting or reclining upon.

2382 T. H. Rushton and R. Tonge, Bolton, for improvements in machinery for spinning and doubling.

2383 J. J. Bodmer, Sheffield, for a new or improved instrument or appliance for sharpening knives and other cutting tools.

2384 D. Macfarlane and R. Macfarlane, Paisley, Renfrewshire, for improvements in dyeing and in the apparatus employed therein.

2385 T. J. Denne and A. Hentschel, Cambridge-road, Mile end, for improvements in waterproofing.

2386 R. Sutcliffe, Idle, Leeds, for improvements in apparatus for utilising exhaust steam for heating feed water for boilers and other purposes.

2387 R. F. Fairlie, Victoria-street, Westminster, for improvements applicable to locomotive-engines.

2388 H. Gledhill, Halifax, Yorkshire, for improvements in machinery or apparatus applicable for either scouring or washing worsted or other textile fabrics in the piece.

2389 H. A. Bonneville, Piccadilly, for a new or improved process of manufacturing cast steel. A communication.

2390 J. Macneill, Brompton, for an improved means or apparatus for communicating signals from passengers to guards and drivers of railway trains.

2391 W. Youngman, Lowestoft, Suffolk, for improvements in apparatus for raising and lowering casks or other vessels without disturbing the contents.

2392 R. M. Letchford, Three Colts-lane, Bethnal-green, for improvements in the manufacture of matches.

2393 S. Barton, Cannon-street, City, for improvements in apparatus for protecting the face and head and permitting respiration in places where the atmosphere is charged with noxious gases or vapours, smoke, or other impurities.

2394 G. Dixon, Cockspur-street, Middlesex, for improvements in the manufacture of fringes and upholsterers' trimmings, applicable also in the manufacture of textile fabrics.

2395 J. G. Williams, Blaenavon, Monmouthshire, for improvements in apparatus for heating, cooling, and fermenting liquids, and for infusing, attemperating, and mashing, especially applicable in brewing and distilling.

2396 R. Hadfield, Sheffield, for an improved process for combining crucible steel with pig iron or other similar metal.

2397 G. Haseltine, Southampton buildings, for improvements in apparatus for adjusting the screw propellers and rudders of canal boats and other vessels. A communication.

2398 E. Probert, Hatfield, Herts, for improvements in asphalte roads and pavements in combination with wood.

2399 J. Richardson, Brighouse, Yorkshire, for improvements in the process of dyeing textile fabrics.

2400 G. Heyes and T. Entwistle, Accrington, Lancashire, for improvements in warping or beaming machines. A communication.

2401 T. Joseph, Glamorganshire, for a new or improved method of cooling mines, and of cooling and ventilating houses, ships, churches, factories, and other structures or places, applicable also for abating heat, smoke, and steam in tunnels and other confined places.

2402 J. Newton, New Wortley, and W. Price, Hunslet, Leeds, for improvements in the means of and apparatus for consuming smoke and economising fuel.

2403 A. M. Clark, Chancery-lane, for a new or improved medicinal compound. A communication.

PATENTS SEALED.

1096 J. Betteley, for improvements in the construction of ships or vessels and in appliances connected therewith.

1391 F. G. Fleury and A. Tylor, for improvements in apparatus for measuring and recording the flow of liquids or fluids.

1479 H. A. Bonneville, for improvements in the construction of two-wheeled vehicles for the conveyance of passengers or goods on common roads.

1570 R. Thomas, for an improvement in tinting or colouring spectacle and other lenses.

818 G. Allibon and A. Manbre, for improvements in steam boilers or steam generators.

429 W. Ireland and J. Ireland, for improvements in the manufacture of cast or Bessemer steel ingots.

440 R. Burn, jun., for an improved apparatus for signalling on railways.

451 A. W. Pocock, for improvements in the construction of fasteners for window sashes.

454 F. H. Warlich, for improvements in the manufacture of artificial fuel, and in apparatus to be used for this purpose.

455 J. D. Nichol and J. Eckersley, for improvements in apparatus for drying and pressing or calendering printed paper.

456 W. Richardson, for improvements in machinery for burring and cleaning or opening wool, cotton, and other fibrous materials.

467 J. Colborne, for an improved apparatus for facilitating the teaching of military drill.

469 T. J. Smith, for improvements in apparatus for retarding and stopping railway trains.

471 O. Walch, for an improved apparatus to be used in the manufacture of matches.

477 T. J. Smith, for an improved means of and apparatus for communicating between railway carriages and for ventilating the same.

510 A. Browne, for an improved method of and apparatus for treating and preparing the stalks of a certain vegetable fibrous substance, known and distinguished in France as "la Filasse d'Alfa (Sparte)," to adapt it for manufacturing purposes.

587 W. E. Gedge, for improvements in rolling mills or machines for manufacturing bar iron.

606 S. T. Vanel, for a new composition and process for waterproofing all sorts of tissues, linen, paper, and other materials.

677 S. H. Stephens, for improved machinery for reducing tin stuff and other partially pulverised ores, to extract the metal therefrom, and also for grinding paint, cement, and other hard substances, together with feed apparatus therefor, which is also applicable to other pulverisers.

876 J. Lewis, for improvements in joining or connecting the parts of the head, foot, and side rails of metallic bedsteads and cots, and metallic railing for various purposes, which improvements are also applicable to the connecting of metallic ornaments to articles of metallic furniture.

922 B. Richards, for improvements in walking-sticks.

1478 H. A. Bonneville, for improvements in the production of motive power, and in the apparatus connected therewith.

1611 I. Brown, for improvements in watering streets and roads, and in the apparatus or means for effecting the same.

1754 J. Ducomet, for improvements in steam gauges.

1917 S. J. Wallis, for new or improved mechanism for discharging both locks or barrels of a double-barrelled gun by one trigger.

472 T. Johnson, for improvements in valve for sewers or drains for preventing or arresting the passage of noxious or offensive gases.

476 T. Rowan, for improvements in preparing carbonates or oxides of lead and zinc for use as pigments and otherwise.

489 A. V. Newton, for improvements in sewing machines.

490 R. Graham and M. D. Wood, for improvements in apparatus used in the production of artificial teeth, known as "dental articulators."

491 H. Gardner, for improvements in treating certain fibres, and more especially the fibre derived from the Baobab tree or Adansonia digitata, to render them fit for spinning and other useful purposes, and in machinery therefor.

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4in. Compound Slide-rest, and 4in. Ornamental ditto, useful offers.—As above.

Grover & Baker Sewing Machine; for Lever Watch.—As above.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 6, 1872.

ARTICLES.

THE EQUATOREAL—ITS USE AND ADJUSTMENTS.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

(*Concluded from page 552.*)

WE said above that we should give directions for finding a meridian line, and since we require to obtain one in the outset before we can even place the iron framework, shown at S in Fig. 4, correctly upon the top of the pillar, or pier, which is to carry it (and to which it is ultimately to be immovably fastened); we will deal at once with the most simple mode of making the determination. It is that of—what is called—equal altitudes. The principle upon which this method depends may be gathered from a study of Fig. 2, where it will be seen that a telescope moving round a vertical axis cuts the diurnal path of a star in two points, and two only, so that an instant's reflection will show the student that as, in the description of such path, the altitude of any star is continually varying, and that if we conceive it to be (for example) 42° 8' above the horizon, when it is 3 hours and 14 minutes east of the meridian it will continue to get higher and higher until it actually transits it; after which it will begin to descend again, and precisely 3 hours and 14 minutes after it culminates will be once more at an altitude of 42° 8'. By the aid of an instrument known as an Altazimuth, the observation of equal altitudes can be made, and the horizontal angular interval between the two positions of the telescope bisected, with all conceivable accuracy; but as these papers are not written for those who can be assumed to be familiar with instruments of this character, we will proceed to describe the very much better known way of getting a north and south line by the use of the shadow of a vertical stick placed on a truly horizontal surface, in sunshine. There is one drawback to this method, however, and that is that it is only rigidly applicable about the end of June or December, when the sun's declination changes very slowly. During March and September the rapid motion of the sun in declination introduces a source of error into the determination of the meridian, which renders it decidedly undesirable that those seasons should be selected for finding it; but even at those epochs a very close approximation to it may be made. The mode of proceeding is illustrated in Fig. 5, in which A B D E represents the top of the pillar (supposed to be square) upon which our equatoreal is to be fixed. The first thing is to level this very carefully with a spirit level. This accomplished, we take the centre C of the slab, and round it describe a series of circles, of which three are shown in our sketch. Then (by the aid of a plumb-line, or otherwise) we erect a rod C R on C accurately vertical. As we commenced by levelling the surface A B D E truly, the rod referred to will evidently be at right angles—or square—to it. This rod should be as thin as is consistent with its rigidity; a perfectly straight knitting-needle answering capitally.

Now, *in limine*, it is apparent that the lower the sun is down the longer will be the shadow of this rod; that it will continue to shorten as the sun ascends; be at its shortest when he is on the meridian; and then, at once, begin to lengthen again, and so on. Let us, then, observe when the shadow of the *top* of our rod falls on one of the circles, four hours or so before noon; this will be at, say, *a* in our figure. Then let *c* be the place just touched by the shadow half an hour later, and *e* that where it falls later still. Now, let us notice where the shadow falls at corresponding instants after noon. We will mark its points of contact *f*, *d*, and *b*. All that remains for us to do is to join each of these pairs of points and bisect the intercepted arcs (*a*, *b*, *c*, *d*, *e*, and *f* in our figure). Should this be properly performed, the line of bisection will be a diameter common to all the circles, and will be the meridian of the place of observation. We have represented it above by the line N S, which may, when once determined, be conveniently marked on the top of the pier permanently. This done, the equatoreal framework is to be so placed on the pier that two plumb-lines dropped, one from the centre of the top of the polar axis, and the other from the corresponding point at the bottom of it shall touch N S. Having effected this, the iron framework S, Fig. 4, may be bolted or cemented down on to A B D E, the more refined adjustments being provided for in the construction of the instrument itself. So far, then, as we have gone, we have got our equatoreal, presumably constructed especially for the latitude of our place of observation, and very approximately in the meridian. How must we now proceed to get it accurately into adjustment.

Before passing to instrumental adjustments proper, we must find the line of collimation, or optical axis of the telescope. To do this let us insert the transit eyepiece (the field of which we have shown in Fig. 6) into the eye end of the telescope.

FIG. 5

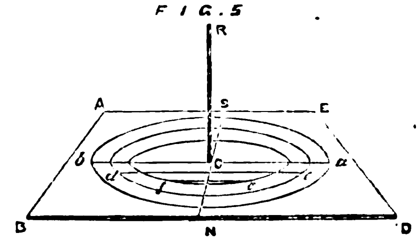


FIG. 6

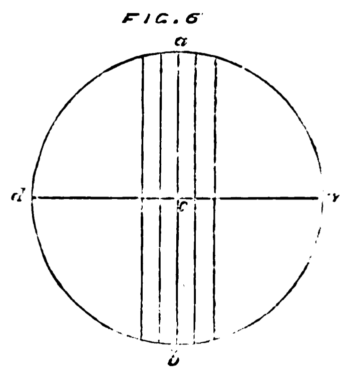
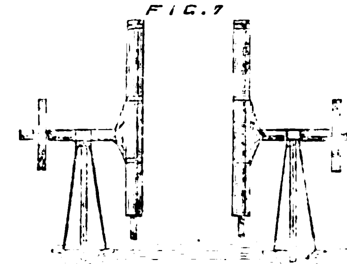


FIG. 7



Turn it round until stars run accurately parallel with the declination wire *d w*, clamp the declination circle D C', and by the slow motion *b b'* thread some star upon it. Now, without moving the telescope, turn the whole eyepiece through an angle of 180°, so that the bottom of the field becomes the top, *a* being at *b* and *w* at *d*, and observe if the star is still threaded on the wire. If it be not, move the frame and wires (by the aid of the proper screws) until the declination wires *w d* is *half way* towards the new position of the star. Once more bring it on the wire, again reverse, and so on until the star continues threaded on *d w* after it is turned through 180°. It must then evidently bisect the field of view horizontally. It is pretty evident that by making *a b* horizontal in the same way, and repeating the same adjustment with that (being careful to make it only by the screws at *a* and *b*), we shall with equal ease and certainty get that to bisect the field too; and hence the point of intersection of these two wires *c c* must, *ex-necessitate*, be in the optical axis or line of collimation of the telescope.

This effected, we proceed to the adjustment of the different parts of the equatoreal, *inter se*. As we shall have frequent occasion to speak of the reversal of the telescope, we subjoin a sketch in which the instrument is delineated in two aspects, the first with the telescope to the west of the polar axis, while in the second it is seen to the east of it. We have marked these A and B for convenience of future reference. We may here mention, once for all, that the instrument is employed in position A for the observation of objects to the east of the meridian, and in the position B for observing those to the west of it.

The first thing, then, is to place the declination axis D (Fig. 4), at right angles to the polar axis P. In many cases this is done by the maker; is effected by the most delicate filing of one of the Y's, and once completed is practically permanent. It may be tested by placing the equatoreal in position A, Fig. 7, and carefully levelling the declination axis by the aid of a striding level, which stands upon its cylindrical extremities. The hour circle is then read. Then, the whole instrument is turned over into position B, the declination axis again carefully levelled, and the hour circle once more read. This last reading ought to differ precisely 12 hours from the first one, and will do so if the two axes be accurately square to each other. Should the readings differ from 12 hours, the hour circle must be placed half way between its present wrong position and its proper one, and the declination axis made horizontal, either by the screws at *l* Y in Fig. 4, or, in their absence, by *the maker* of the instrument delicately scraping one of the Y's.

Adjustment 2 consists in setting the optical axis, or line of sight of the telescope, at right angles to the declination axis. To effect this we must insert the transit eyepiece (Fig. 6) and, as before, make a star run along the declination wire *d w*. Now, with the telescope in position A, (Fig. 7), clamp it a little in advance of a star; read the hour circle by means of the vernier *h v*, and note by a sidereal clock the exact instant of the star's passage over *a b*, the middle wire.* Turn the instrument half round on the polar axis, into the position B, again clamp it a little in advance of the same star, again read the hour circle, and, once more, note the instant of the star's transit over the middle wire. Then, if this adjustment be correct, the interval of time between the two transits and the difference of the two readings on the hour circle will be identical. If there be any difference, the wires (Fig. 6) must be moved through half of it, by the screws at *d* and *w*. This must all be repeated until the interval indicated by the two hour circle readings and that elapsing between the two transits of the star are precisely alike. Let us illustrate this by an example. We will suppose that the equatoreal is clamped in position A at 0h. 22m. We will further imagine that, under these circumstances, the field of view is as represented in Fig. 6—*i.e.*, with the end *a* of the wire at the top, or true south, of the field, and the end *b* at the bottom of it. We will suppose, then, that we note, by the aid of a sidereal clock, the transit of *a* Serpentis, and find that it crosses *a b* at 15h. 59m. 59s., as indicated by it. This observation made, we reverse the instrument, and place it in the position B, thus evidently turning the field of the eyepiece over, and having the end *b* of the middle wire at the south, or top of the field of view. We will now clamp the hour circle at 12h. 26m., and wait until *a* Serpentis again crosses the middle wire. Let us assume that it does so at 16h. 4m. 11s. This is obviously *too late*, as it ought to have been on the wire at 16h. 3m. 59s., whereas its transit has been observed 12 seconds after that time. The half of this, then, or 6 seconds, we must correct for. If we suppose that the interval occupied by the passage of our given star from wire to wire is 18 seconds, we must move the frame carrying the wires through one-third of this interval to make this adjustment. It will be seen that, inasmuch as the star (as we face the south), enters on the right hand of the field, and travels across to the left, and inasmuch as we are supposing the transit of our typical one to have taken place *too late*, the wire frame must be too far *to the left* in the second position B of the instrument. We must, then, lower it to the horizon, bisect some object by the wire *b a*, and move the screw at *d* (bear in mind that Fig. 6 is now *inverted*) until the given object is one third of the distance between the centre wire and the next one to it.

Our 3rd adjustment will be to cause the verniers *dv*, *d'v'* of the declination circle D C' (Fig. 4) to read 0° when the optical axis of the telescope is directed to the equinoctial, or, in other words, is parallel to the equator. In making this adjustment, we would counsel the

* For all needful information as to the nature of sidereal time, &c., and the method of taking the transit of a star, the reader is referred to the tenth vol. of the ENGLISH MECHANIC, pp. 595, 620, and 647; and to Vol. XI., p. 1.

beginner to confine himself to *one* vernier, and to attach a piece of paper, or other mark, to it for the purpose of recognition, and to prevent mistakes. When all is complete, the second vernier may be caused to read identically with it, by one operation. Suppose, then, that we select the vernier *d v* in our Fig. 4 (or that which is next to us when the telescope is to the west of the polar axis, as at A, Fig. 7), and let us make any star, the nearer to the meridian the better, run along the declination wire *d w*, Fig. 6, and read the declination circle by the aid of our selected vernier. Now, turn the telescope half round the polar axis into position B; again bring the same star upon the wire; and, again, read the declination circle by the same vernier (this will now be on the farther side from us). If now this latter reading be identical with the former, the vernier is accurately in adjustment; if it be not, half the difference of the readings is an index error which may either be applied as a correction should it be small, or eliminated by shifting the vernier bodily if it is large. Here, as in the previous adjustment, an example may help us. With the equatoreal in the position A, and the star α Ophiuchi threaded on the declination wire, the declination circle reads 12° 41′; but on reversing the telescope, and again running the star along the wire we find the reading to be only 12° 38′. The difference between these two readings being 3′, the index error is evident 1′ 30″, by which quantity the circle reads too low when the telescope is to the east of the polar axis, and too high when it is to the west of it. This observation (and that in connection with the 2nd adjustment) should be repeated several times, and a mean of the results taken. If we suppose that this mean gives exactly 1′ 30″ as the index error, and that the vernier reads too high by that amount in position A, the simplest way for the tyro to proceed is to clamp the declination circle securely (with the telescope to the west of the polar axis), so that the vernier reads 1′ 30″ north of zero, and then releasing the screws which hold the vernier bring it down and make it read 0° 0′ 0″, after which it may be permanently fixed. Two cautions are needful to the beginner. The first is, in readjusting the vernier to take care not only that the *middle division* or zero of it coincides with the mark 0° on the limb of the circle, but that the *ends* also coincide precisely with divisions on the same limb. The next is, *not to screw any one screw tight up at once*, but to turn them up very gently one after another, half a turn or so at a time. Neglect of this latter precaution may throw the adjustment all out again. When it is completed, we have only to loosen the opposite vernier *d′ v′* and cause it to read identically with the one which we have finished, and this part of our work will be complete.

In the 4th place, we must level the declination axis, with all possible accuracy, by the aid of the striding level, as in adjustment 1. Then, releasing the screws which confine the vernier of the hour circle *h v*, we must, by the aid of the tail piece *i j* in our figure, make this vernier read either 0 hours or 12 hours (according as the telescope is in the position A or B), and, this effected, screw it up and make it a fixture there.

Having thus (practically for our present purpose), eliminated what may be called instrumental errors, it only remains for us to place the equatoreal in such a position that its principal axis shall correspond accurately with that of the heavens; and, it must be obvious to any one who has studied our 1st and 3rd figures, that the first thing to do is to make the elevation of the polar axis exactly equal to the latitude of the place.

We have, from the beginning, assumed that the mounting of the instrument is so constructed that this adjustment is very nearly made; and, therefore, a slight motion of the bottom of the polar axis (effected by a contrivance hidden in Fig. 4 by the hour circle), is all that we shall need to render it perfect. For this purpose we must select a star from the *Nautical Almanac*, which is as near as possible to the meridian at the instant of observation; and the higher up this star is, the less will refraction complicate the matter, and the more accurate the result will be. The following are very good stars for the purpose on these latitudes:—α Persei, Capella, Castor, ι Ursæ Majoris, θ Ursæ Majoris, α Canum Venaticorum, η Ursæ Majoris, ζ Herculis, β Draconis, γ Draconis, Vega, α Cygni, 61^1 Cygni, or ζ Cygni. The meridian altitude of our chosen star we may calculate by adding its north declination to the colatitude; and we must now find from a table of refractions (such as appears in every book of astronomical tables, what is the refraction for that altitude, and must thereupon set the declination circle to the declination of the star, with this refraction added (if it be *south* of the zenith). Then, waiting until it enters the field of view, we must raise or depress the end of the polar axis, until the star runs along the declination wire. This adjustment will then be complete.

We may here, in parenthesis, say, that a table of refraction for all altitudes greater than 10° above the horizon may be calculated by any one, with abundant accuracy, from the formula, refraction = 58·49″ × tan. of zenith distance.

We have now only to get the polar axis into the meridian. For this purpose the ordinarily-prescribed way is to set the telescope upon a standard star about 6 hours from the meridian, either east or west, and read the verniers of the declination circle. This reading corrected for refraction ought to be same as the star's declination given in the *Nautical Almanac*. Supposing, for illustration, that the star is east of the meridian, and its declination, as shown by the declination circle, exceeds that given in the *Nautical Almanac*, the lower end of the polar axis is to be west of its true place (and *vice versa*) and must be moved accordingly. There is, however, a simpler mode of performing this adjustment, which will probably suit the beginner better, should he be the possessor of a sidereal clock. It is this: Once more carefully level the declination axis and clamp the hour circle; calculate the instant of transit of a known star near the equator, bring that star on to the centre wire of the transit eyepiece (*a b*, Fig. 6), a few seconds before its transit, follow it by the screws at the bottom of the polar axis, count the beats of the clock by ear, and stop at the precise second computed. Should the observer have no other means of obtaining time he may do so by levelling the declination axis of the equatoreal and taking the transit of a star close to the zenith. For all details as to time-taking, however, we must refer to paper spoken of in our footnote on p. 629.

This concluding adjustment made, the declination circle must be now levelled for the last time, and the vernier *h v* made to read accurately either 0 or 12 hours.

The very great, and unexpected, length to which our directions for the adjustment of the equatoreal have extended, compels us to be much more brief than we had anticipated in our directions for its use. We will deal, in the first place, with finding an object from a catalogue, and will give an illustration without the enunciation of any merely formal rules. Suppose, then, that at 18h. 4m. 32s. sidereal time, on August 30, in latitude 51° 30′ N., we wish to direct our telescope to 61^1 Cygni, how are we to proceed? The right ascension of 61 Cygni we find from the *Nautical Almanac* to be 21h. 1m. 12s.; so that it is, at our presumed instant, 2h. 56m. 40s. to the east of the meridian. Placing the instrument now in position A, we set the hour circle to read 2h. 56m. 40s. Its declination we see by the almanac is 38° 7′ 10″, and the refraction corresponding to this, at the then altitude of the star, may be roughly taken at 50″, adding this, then, to the declination we get 38° 8′, to which we set the declination circle to read, and the star ought to be very near indeed to the middle of the field. We should, perhaps, add that, to preserve the sequence of our remarks, we have reversed the order of the settings of the two circles. In practice we should set for declination first and for right ascension afterwards.

We will now imagine, though, that we have pitched upon an unknown object, say a comet, the place of which we wish to fix with all possible accuracy. In what way are we to determine its place? We should proceed thus: Clamping the telescope firmly in right ascension, a little in advance of our unknown body, we must note the instant of its transit; and then, leaving the hour circle clamped, raise or depress the telescope, until a known star following the object, whose place we are seeking to obtain, enters the field; when it does so we must carefully observe its transit too. As the hour circle has been fixed, the difference of these two times will give the difference of right ascension of the two bodies. To obtain that of their declination all that is necessary is to thread our comet, say, upon the declination wire, and read the declination circle; then, if we turn the telescope upon our standard star, bring *it* on to the same wire, and once again read the declination circle, and we shall have the difference of their declination. After the first observations it does not matter whether the star of comparison precedes or follows the strange object. It is, however, a sine quâ non that it be close to it, and the closer the better. An example may tend to render this explanation clearer. The transit of a comet over the middle wire of the eyepiece is observed to take place at 19h. 37m. 54s. sidereal time, and that of the star β Aquarii (to which it is near) at 19h. 41m. 41·5s.: therefore their difference in right ascension is 3m. 47·5s. The reading of the declination circle when β Aquarii is on the wire *d w* being 6° 6′ 20″ south, and its reading when our imaginary comet is bisected by it 6° 5′ 50″ south, the comet must be just 30″ north of the star. Turning now to the *Nautical Almanac* we find the right ascension of β Aquarii is 21h. 24m. 51·5s., and taking from this 3m. 47·5s. we get 21h. 21m. 4s. as the R. A. of the comet at the time of its observation. The declination of β Aquarii is stated in the same work to be 6° 7′ 48·4″ south, and if from this we take 30″ we obtain 6° 7′ 18·4″ as the comet's declination.

It was our intention, in commencing this series of articles, to have given a description of the position micrometer, and its use in measuring double stars, the diameters of the planets, &c., as also of the ring micrometer, and its employment in mapping the heavens. We have, however, already exceeded the space which we proposed to ourselves to occupy; and a detailed account of these two forms of instrument must certainly itself expand into another essay. We are compelled, then, reluctantly to pause here. If we have not fulfilled all that we proposed to ourselves to do, we trust that, at all events, we have succeeded in giving the student such plain and intelligible directions, as shall enable him not only to place a telescope mounted in the way we have described in accurate adjustment, but also to understand thoroughly the *reasons* for every successive step that he is called upon to take. Should our studiously simple instructions have enabled him to do this, and to employ this admirable instrument more effectively, and with a better appreciation of its powers and capabilities than he previously possessed, our essay on the equatoreal will not have been written in vain.

THE MUSEUMS OF LONDON.—III.

South Kensington Museum (2).

HAVING in the previous article described the educational department of the Museum, we propose now to speak of the collections of objects of art, which are so numerous and so varied as to preclude any methodical and detailed arrangement throughout. Perhaps in no other single building has such a miscellaneous collection ever been brought together, and in consequence of the frequent changes of the loan objects, and the addition of purchases and gifts, the details of the arrangement are constantly in a state of transition. After premising so much we will take the corridor to the right on entering, which leads to the large courts, and which is hung in part with a large series of photographs published by the Arundel Society, comprising historical characters, art objects in the Museum, and figures and groups of figures from the Raphael cartoons. Copies of these can be had at a cheap rate at an adjoining office, as also negatives for home printing. We are glad to see this branch of education obtaining more favourable recognition than has hitherto been accorded it—*e.g.*, the publication of the photographs from the British Museum; for by what better means can the sphere of usefulness of museums, themselves necessarily local, be extended than by enabling every one to possess accurate representations of their most valued treasures? In a small side room are placed the engravings, miniatures, and books (many of them with interesting autographs), of the Dyce bequest. As an example of the way in which the Museum has grown, we might mention that this gentleman—Rev. Alex. Dyce—in 1869 bequeathed to it 80 pictures, 63 miniatures, 802 drawings; 1,511 prints, 74 rings, 27 art objects, and 13,596 books.

The two large courts—North and South—form the larger part of the new buildings; they are both spacious and lofty, open to the roof above. The South Court is decorated from the designs of the late Godfrey Sykes, and contains in the upper parts of its side walls a series of thirty-six alcoves, each containing a portrait in mosaic (by different makers and of different materials) of some celebrated character in the history of art—William of Wykeham, Raphael, Dürer, M. Angelo, Wren, Reynolds, &c. The "Prince Consort Gallery" (connecting with the picture galleries) runs down the whole length of the court, dividing it into an east and west portion; the latter, which the visitor first enters, is devoted mainly to loan objects, the special loan exhibitions, however, being usually held in the North Court. The visitor will at once remark the exceedingly great variety of objects which are here gathered together, and as a consequence of this the confused manner of their arrangement. The collections admit of no entire classification, and all we can do is to point out the general features of the various divisions, and notice specifically a few of the most prominent articles.

A large altar-piece on panel of the fifteenth century, from Spain, in this court is worthy of careful attention, as it is illustrated with scenes of of the different modes of martyrdom then practised in that country. At the back of the altar-piece is placed an electro-reproduction of one of Ghiberti's famous gates, made for the Baptistery of S. Giovanni at Florence, about the beginning of the fifteenth century. In this neighbourhood are numerous examples of the modern cabinet work of various nations, English, French, Dutch, Japan, &c., and further examples will be found in other parts of the building. In the cases are mineralogical specimens, some ancient jewellery and watches of quaint construction, and small isolated series of pottery, &c. The radiating frames which stand about in many parts of the Museum are very convenient and economical as regards space. They consist of a series of square frames disposed at a medium height by means of lateral hinges round a centre pillar, and for some classes of objects are far superior to the horizontal cases—*e.g.*, medals can be held so as to show both sides. In the cloister between the Dyce gallery and the courts are shown the Abyssinian trophies, very interesting and instructive as regards that country, and an extensive collection of ecclesiastical vestments, amongst which is the "Syon Cope."

The eastern portion of the South Court has, till the present special exhibition of musical instruments, been chiefly devoted to that class of objects. In the large cases is a very showy collection of electrotype reproductions of numerous pieces of plate, comprising the regalia in the Tower, specimens from Windsor Castle, and from private individuals. There is also a reproduction by similar means of the famous violin said to have been given by Queen Elizabeth to the Earl of Warwick, the original of which—lent by the present earl—is now in the Museum. In the centre of the court is an entire pulpit of carved and inlaid wood, and surmounted by a minaret, brought from a mosque at Cairo. Among the furniture at the end of the court is a cabinet of various woods inlaid and carved, secured for the Museum for the sum of £2,750 as being the most elaborate piece of furniture in the 1867 Paris Exhibition. In the gallery above is a picture (best seen from this court) of a meeting of the Commissioners of the Exhibition of 1851, presided over by Prince Albert.

The narrow cloisters on the eastern side of this court are devoted to Oriental objects; they were decorated by Mr. Owen Jones. At the end was a very interesting example of a Parisian boudoir of the latter part of the eighteenth century, decorated by artists of the period, and bought for £2,100. It is a small room about 12 or 13ft. square, the walls and ceiling elaborately ornamented, but all in good taste. This boudoir is said to have been originally fitted up by the wife of the Marquis de Serilly, with the assistance of Marie Antoinette, and among the furniture of the room is a harp supposed to have belonged to that queen. Here are several radiating cases of splendid photographic views taken in India, including landscapes, architecture, &c., in looking carefully over which an hour may profitably be spent. We can only stay to direct attention to a small series of miniatures on ivory by an Indian artist, and to a painting on silk of a crouching tiger, excellently done by a native of Japan—Gauko, a celebrated animal painter, date about 1700.

The North Court is frequently used for the special loan exhibitions. It is a fine room 107ft. by 106ft. and 33ft. high, with an elevated glass roof for lighting. Only the larger objects in this court are permanent; among them are casts of two large pulpits from Pisa. Specimens of screens and gates of wrought iron will also be found here, and some have recently been removed. Among them were portions of the iron railings round Hampton Court Palace (English, date about 1700), taken from that place on account of the signs of their rapidly perishing from exposure. Two colossal statues here are casts of the works of Michael Angelo, one being a figure of Moses, the other of David as a youth. In connection with this artist will be found in a case in this court a number of Italian figures modelled in wax and terra-cotta, and evidently intended as art studies; of these twelve are attributed to M. Angelo. An electric clock, from the Exhibition of 1862, made at Clerkenwell, serves for use as well as show. In the northern cloisters, besides a large number of architectural casts, is contained a very complete collection of Della Robbia ware, which may be almost described as earthenware sculpture, and the character of durability attributed to this ware is attested by a large shield, exposed externally in a villa near Florence from 1442 A.D. to its removal a few years ago. The adjoining small fernery is for the purposes of instruction in the schools of art. Following on to the left we come to the circulating portion of the Museum, consisting of representative art objects which are lent to various local museums, exhibitions, and schools of art, and this is not one of the least important branches of the Museum's organisation. The cloisters contain numerous specimens of ironwork (among which is a *couvre feu*) and of the coffers and chests of the last two or three centuries. In one of the end alcoves is a sumptuous French bedstead of the period of Louis XV., with gilt frame and blue silk drapery, and with a fine circular mirror intended to be fixed in its upper portion. By a careful arrangement of the mirror among the drapery in the bottom of the case reflection from the under surface of the glass case top presents the appearance of the upper portion of the bed.

The western portion of the Museum contains examples of ancient state carriages and sedan chairs, locks, carving (among which are some remarkable carved bellows from Italy of the sixteenth century), and also typical specimens of French bronzes, timepieces, vases, &c., intended to illustrate their cheapness as compared with similar objects of home manufacture. These and similar objects, as well as all purchases, are marked with the price on the label. The food collection—now removed to Bethnal Green Museum—was formerly placed here; the rooms are at present occupied by drawings and designs from art schools.

The neighbouring staircase, the decorations of which are not yet complete—leads to the ceramic gallery, which, in construction and arrangement, we consider to be the finest in the whole Museum; it is quite a model gallery. Owing to good ventilation, it is always cool and pleasant (more especially so by contrast in the evenings), and the lighting is good, and not too glaring. The ceiling and side walls are completely but tastefully covered with decorations and gilding, and the names of the various schools of pottery-manufacture, with date, are painted in chronological order round the cornice. The pillars and the side walls of the staircase are of enamelled earthenware tiles, which have the advantage of cleanliness. We have not space to particularise the collection, but we might state that it is typical rather than comprehensive. Two specimens of household stoves from Germany; French cabinets, stands, &c.; Spanish, majolica, Palissy, Sèvres and Wedgwood wares; and some very fine examples of modern pottery, find a place in the collection.

We next come to the pictures, of which we will only speak collectively. The foundation of this "National Gallery of British Art" was laid by J. Sheepshanks, Esq., who gave a large number of very valuable pictures for that purpose. Before these galleries were opened in the evening, a scientific commission (including Tyndall and Faraday) reported on the effects of coal gas that no injury might be apprehended, but advised that the sulphurous acid gas produced by combustion be properly carried off. Among the artists represented are Reynolds, Landseer (many of his finest animal paintings), Wilkie, Turner, Maclise, (his fine picture of the play scene from "Hamlet"), Gainsborough, Mulready, &c. The "Worship of Bacchus," by Cruikshank, attracts more visitors than any other single picture. A room is specially devoted to the celebrated seven original cartoons by Raphael and some other works of that artist. A gallery of water-colour paintings has recently been opened. Those who delight to examine the ground-work and details of art will find much pleasure in examining a large series of sketches and experiments in colouring by Turner—his "Liber Studiorum," and in another room several hundred pen-and-ink sketches and designs by Mulready. Jewellery and other art-objects are contained in some of the rooms. The manner of lighting the gas-jets in this part of the Museum is worth seeing.

We have not yet spoken of the Art Library, a large and rapidly-increasing collection of books and engravings connected with art—very valuable in connection with the schools. When removed from Marlborough House in 1856 it contained only 5,000 volumes; now it comprises 25,000 volumes and pamphlets, 8,000 original drawings and designs, 600 illuminations, 21,000 engravings, and 35,000 photographs. W. H. W. T.

REVIEWS.

Patterns for Turning, comprising Elliptical and other Figures Cut on the Lathe without the Use of any Ornamental Chuck. By H. W. ELPHINSTONE. 216 pages and 70 illustrations. London: John Murray.

THE title of Mr. Elphinstone's work is a somewhat negative explanation of its contents, but in the preface we learn that all the patterns given in the book can be cut on a lathe furnished with a division plate, a slide-rest suitable for ornamental turning, an excentric cutting-frame, and an overhead motion. The figures or patterns forming the illustrations consist of excentric circles disposed upon circular, elliptical, epicycloidal, and other curves, and the object of the book is to explain how these and other patterns can be produced by the simple apparatus mentioned, and without the aid of chucks and complicated mechanism.

With the geometric chuck highly ornamental curves are generated by continuous rotation, and very similar figures are produced, step by step, with the excentric chuck and excentric instrument, by the method known as "double counting." It occurred to Mr. Elphinstone, however, that as by the horizontal motion of the slide-rest, combined with the circular motion of the lathe, the axis of the excentric cutting instrument might be brought into line with any and every point upon a surface attached to the lathe spindle, the excentric cutting instrument could be made to cut circles upon any line or curve whatever, and by these means patterns produced similar in nature to those obtained by ordinary "double counting." By Mr. Elphinstone's invention the figures are still obtained by double, or, as he terms it, "dual counting;" but whereas in "double counting" the two motions are those of the lathe division plate and the excentric chuck wheel, in "dual counting" the two movements are those of the division plate and the horizontal slide of the rest. By this latter method it is possible to very closely imitate many of the most complicated and intricate patterns produced by a geometric chuck of any number of slides, but the preliminary calculations necessary to enable the amateur to locate the separate circles are such as will limit its adoption for comparatively simple patterns only.

Chapter I. is devoted to general explanations of the terms and adjustments. Chapter II. gives rules for determining the size, number, and portion of circles in contact. Chapter III. is on miscellaneous simple patterns; and it is not until we reach Chapter IV. that the reader finds any explanation of the principles of "dual counting." Mr. Elphinstone then proceeds to give instructions for the production of looped figures, circular figures, straight lines, ellipses and waved ellipses, stars, polygons, and other figures, whilst the remaining part of the book is devoted to "settings" of the apparatus for the reproduction of the various patterns and tables to facilitate the calculations. Most of the patterns are good, but many are extremely neat and well cut. We may pick out as amongst the best, Nos. 20, 34, 42, 43, and 62; but we do not see why they could not be placed consecutively, instead of No. 62 being at the beginning, 68 at the end, and 69 and 70 in the middle of the book. We think, also, the reader should be made acquainted with the principle of the system in the first page instead of at the sixty-seventh. But in other respects the book is very complete, and Mr. Elphinstone deserves the thanks of amateur turners for his very thorough explanation of a system which enables them to produce such pleasing patterns with so few apparatus.

The book is extremely well got up, the letter-press having an ample margin, and each figure a leaf to itself. Some of the patterns, more especially 21, 41, and 63, look rather small to occupy alone such a large page, and much of the print is also needlessly large. Without in the slightest degree injuring the work either in utility or appearance, the cost might, we think, be easily reduced. And cost is considered, even by amateur turners.

CHEMICAL NOMENCLATURE.

DR. A. CRUM BROWN read a paper on this much discussed subject at the meeting of the British Association. He said that setting aside in the mean time "trivial" or "proper names" (names which are simply arbitrary words or marks, each indicating, in virtue of a convention applicable to each individual case, a particular substance), there are two systems, or kinds of systems, of chemical nomenclature. These may be distinguished as 1st, the composition system, and 2nd, the functional or relational system, or class of systems. In the first the name of a compound indicates the elements or radicals contained in it, and sometimes their proportions. Thus Chlornatrium, Chloriod, Dreifach chloriod, Silicium Wasserstoff, &c. In English we have few names so distinctly compositional in form (we have, indeed, zinc methyl and all other allied names), but many of our names, although apparently functional in form, are really compositional. Thus, chloride of A means with us nothing more than, or different from, a compound containing the elements chlorine and A; and chloride of sodium, chloride of iodine, terchloride of iodine, siliciuretted hydrogen, not only represent the same substances as the German names just quoted, but tell us neither more nor less about the substances than these German names do. On the other hand, functional names present the chemical relations between substances.

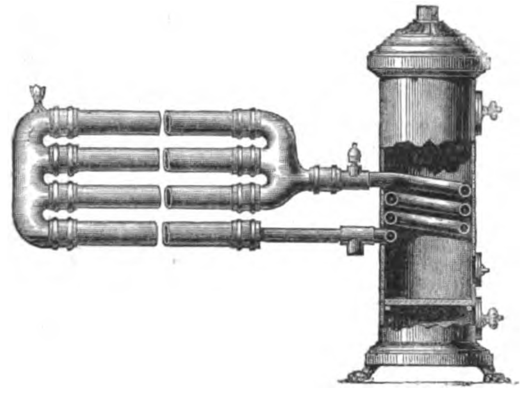
We may take as examples such names as the anhydride, the amide, the aldehyde, the nitrite of acetic acid. These derivatives of acetic acid contain no acetic acid, but they stand in certain definite relation to that substance, and the anhydrides, amides, aldehydes, and nitrides of other acids stand in the same relation to them. What is still, notwithstanding the efforts of modern chemists, the common popular nomenclature of salts, although originally intended as a compositional nomenclature, might, with perfect consistency, be retained as a functional nomenclature. The objection to the term "muriate of soda" was that the substance so named contains no soda. But the amide of benzoic acid contains no benzoic acid. Soda contains oxygen; muriate of soda contains none (unless chlorine be an oxide), but the nitrite of benzoic acid contains no oxygen, although the acid itself does. The name muriate of soda originally meant the *compound* of anhydrous muriatic acid, $2HCl-H_2O$, and anhydrous soda $Na_2O-(2HCl-H_2O)+Na_2O$. We may now, if we please, use the name to mean the result of the action $2HCl+Na_2O-H_2O$. If we do so, the name becomes a fractional one, and the phrase "muriate of," or, what is neither better nor worse, "hydrochlorate of," expresses the complex operation. Addition of hydrochloric acid and simultaneous separation of water. Similarly, in the case of such names as sulphate of potash, nitrate of oxide of silver, &c., the phrases "sulphate of," "nitrate of," express the complete operations, addition of sulphuric, or nitric acid, and simultaneous separation of water.

While the old view that salts are compounds of anhydrous acids and anhydrous bases is now abandoned by most theoretical chemists, a relic of this view still remains in the most advanced systems of nomenclature, producing an inconsistency really inconvenient to the teacher and student. The objection taken to the name hydrochlorate of soda was not only that the substance contains no soda, but also that it contains no hydrochloric acid, this objection is perfectly valid against the name as a compositional one, but does it not equally hold against the words sulphate, nitrate, acetate, &c.?

If we are to have hydric sulphate and hydric acetate for sulphuric and acetic acids, why not hydric muriate for muriatic acid? That this question is not altogether an absurd one will be obvious if we consider that all chlorides are not muriates. Those substances which are by general consent called salts stand in a definite genetic relation to the corresponding acids (or the hydric salts of the series), and it is inconvenient to have the same general name—chloride—applied to substances which do stand in this relation to hydrochloric acid, and also to those which do not. We may divide the chlorides into two groups, very different in character in their extreme members, and gradually shading into one another. We may take chloride of sodium as a representative of the one, and the chloride of phosphorus as a representative of the other. Chloride of sodium is a muriate; the chloride of phosphorus might be better described. We may call the acids and acid anhydrides negative, the hydratic bases, anhydrous bases positive—arranged in a series, we find the series a continuous one from the most positive or basic oxides or hydrates to the most negative; it is however convenient to have a zero point, and it is no disadvantage if this zero point be an arbitrary one. When we come to express numerically the amount of positiveness or negativeness of these oxides and hydrates, it will be necessary to have a zero point, and a very convenient one is that which corresponds pretty nearly to the generally understood limit between bases and acids, and depends upon the direction in which the action takes place.

HOT-WATER HEATING APPARATUS.

THOSE of our readers who are in want of a heating apparatus for their greenhouses, which, while economical in fuel, requires but the minimum of attention, will probably find the desideratum in the arrangement shown in the annexed illustrations, representing the patented centrifugal heating apparatus of Mr. S. Deards, of Harlow, Essex, for which he received a medal at the recent Royal Horticultural Show at Birmingham, as the best "Amateur's Heating Apparatus." The illustrations are sufficiently explanatory of the arrangement, which appears to be constructed on sound principles, and from its simplicity is not liable to derangement. The "boiler," it will be seen, consists of a coil of pipe surrounding the fire; and the advantages claimed by the inventor are economy in fuel, true circulation, and self-cleansing action. It is stated that with one of these "boilers" 60ft. of 4in. pipe can be heated at a cost of less than 6d. for 24 hours, and, what is of equal importance, so little attention is required that the fire may be made up at ten at night and at seven in the morning will be found still alight, with the water but slightly, if at all, lowered in temperature. By means of dampers and the door of the ash-pit the combustion can be easily regulated, so that the boiler may be used either for getting up a high temperature with rapid circulation or for obtaining the more moderate heat required in a greenhouse. The larger sizes can, of course, be so set in brickwork that the fire acts upon both sides of the coil, when the greatest economy of heating power is obtained. One of these large-sized boilers, at the recent trial at Birmingham, went 15 hours without attention, and although in the open air and exposed to several showers of rain, the temperature only fell



off 20° during the whole night. It will be observed that danger of fracture from unequal contraction or expansion is reduced to a minimum in this apparatus, while the perfect circulation prevents injurious incrustations in the pipes.

LUNAR METEOROLOGY.

THE Committee appointed by the British Association for the Advancement of Science to discuss observations of lunar objects suspected of change presented its report at the late meeting at Brighton. The report, which is very short, and merely introductory to Mr. Birt's elaborate report on the streaks and markings on Plato, fully indorses the view of the effect of solar influence in darkening the floor of Plato (see ENGLISH MECHANIC, No. 367, April 5, 1872, p. 53) in the following words:—"One interesting and important change has been fairly shown; the floor of Plato becomes darker with the increase of the sun's altitude. Mr. Birt has suggested an explanation of the phenomenon. Whatever be the true cause of this change it is very difficult to account for it by the ordinary laws of reflection. When we consider the varying aspect of the streaks at the same time of the luni-solar day we cannot but think that with careful observations made with powerful instruments, such as the Newall refractor and many others, we may be able to confirm or otherwise a physical explanation of these curious changes involving the existence of certain gases and vapours on the surface of the moon."

With so successful a termination of the labours of the Committee it is a matter of some little surprise that the report should have been closed without recommending a continuance of observations that appear to be opening up effective means of investigating the moon's surface and throwing light on phenomena observed, more or less, from the epoch of the invention of the telescope. The Committee regard the study of lunar physics as in its infancy, and trust that in *future* years the Association will not overlook so important a branch of astronomical inquiry, yet, to use a homely simile, they do not strike the iron while it is hot, but allow the interest of the public to cool until on some future occasion the Association may for the *fifth* time turn its attention to lunar physics. We have some reason to believe that the observations will not be allowed to drop through. The development and dissemination of truth is the highest prestige the working philosopher can have.

THE SPHEROIDAL STATE OF WATER AND BOILER EXPLOSIONS.

AT the meeting of the British Association, Mr. W. F. Barrett, F.C.S., read a paper on the spheroidal state of water, and its possible relationship to certain boiler explosions. The following is an extract, "On one occasion, some six years ago, I wanted to cool a red-hot copper ball. For this purpose I plunged it into some water in which I had just washed my hands. The hot ball went in without any hissing or visible evolution of steam, and on removing it from the water it appeared as hot as before, in fact it remained brightly incandescent, somewhat below the surface of the water. I was astonished to see this, as I did not know that the spheroidal state of water could be so readily produced and maintained by a body at this temperature. So I tried other red-hot bodies in the same water, and with the same result. I then threw away the soapy water and used plain water; the result was now quite different, the hissing was loud, and the evolution of steam copious. Hence the soapiness of the water was concerned in the phenomenon. Adding a little soap to the water immediately reproduced the result first noticed. Other bodies that dissolved in water were also tried, and the results are briefly these:—Albumen, glycerine, and organic liquids generally facilitate the acquisition of the spheroidal state, probably by increasing the cohesion of the water, whilst of course bodies, such as ammonia, which readily yield vapour have the same effect, but not so marked. Oil shaken up or even placed on the surface of the water has the same effect as the soap. The best method of exhibiting the experiment is to pour a little of Plateau's soap solution into a large beaker of water, and then, by means of a hooked wire, lower into the liquid a white-hot metal ball, some 2lb. weight, and of copper is best. The ball smoothly enters the water, and glows white-hot at a depth of a foot or more below the surface. Notwithstanding the considerable hydrostatic pressure it is seen to be surrounded by a shell of vapour, perhaps half an inch thick. This vapour shell is bounded by an envelope that resembles burnished silver, and has a most striking appearance. In fact, the hot ball blows a soap bubble of steam, from the limiting surface of which the light is totally reflected. As the ball cools (mainly by radiation) the shell of vapour is seen to grow thinner, and finally collapse altogether, when immediately there follows a loud report, volumes of steam are produced, and often the glass is broken. I have heard that traces of oil often get into the boilers of steam-engines, and there can be no doubt that dissolved organic matter often finds its way in. If in any way we increase the density of the water we render it possible for a corroded boiler to give way under the pressure of the steam suddenly generated in the way I have indicated."

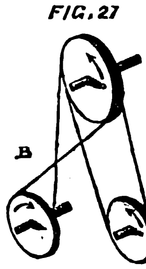
An inventor of Genoa, M. Lamonica, has, remarks *Galignani*, invented a machine for reproducing speech with the rapidity of thought, and destined to suppress stenography.

MECHANISM.*

(Continued from p. 609.)

IF straps have to be shifted on pulleys it should be done when in motion. They are then easily moved, but not so when they are at rest, for there is all the force of their cohesion on the pulley, which causes them to drive it, but if they are moving the strap needs only to be guided, and the pressure of the hand at one side throws the strap to another part of the pulley immediately. That is the only mode of moving the straps with ease. For thus, in fact, the machinery moves the strap, and the workman guides or directs the machinery by his hand on the strap, as a coachman directs the horses by his hand on the reins. Fig. 27 is a diagram with cords showing how they may be arranged so as to cross each other as at B, or act direct as at A. The advantage of crossing is this, that a strap embraces more of the surfaces of the pulleys. Nor is it with cords only that this crossing may be accomplished. The half turn given to crossed straps in passing from pulley to pulley so accommodates itself to the construction that at B the straps pass without even touching each other.

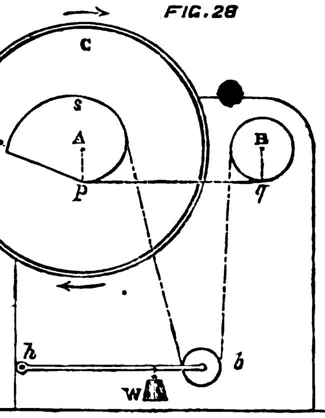
FIG. 27



Cam Pulleys.

These are not generally used, but they have properties which might under many circumstances be utilised. Fig. 28 represents an arrangement by which the peculiar action of cams may be studied in their transference of motion to cords. C is a pulley driven in the direction of the arrows; *s r p* is a cam, around which is passed the cord. From *p* the cord passes to *q*, then round the pulley B and under the stretching pulley *b* to *s*, *r*, and *p*. W is a weight which by means of the arm *h b*—hinged at *h*—maintains the tension of the cord.

FIG. 28



Assume that the cord is round the circumference of the circular pulley C, then the point *q*, in the line B *q*, will be moved uniformly round the centre B, and the directional relations and velocity ratios will be constant. Transfer the cord to the position shown in Fig. 28; then the motion imparted to B *q* will be a variable one. The travel of *q* evidently depends upon the length of cord passing off the cam, *s r p*. Now, the cam may be fixed on any part of the face of the pulley C.

If it be so fixed that the centre of the pulley A is within the cam, then the directional relations of the motions of A and B will be constant, but the velocity ratios will be variable.

Let the centre A, and the cusp *r*, coincide, then in *q* there will be a period of rest. Hence whilst the directional relations are constant the velocity ratios are such that one has vanished and motion has become rest. This, therefore, is a transition stage.

Let now the centre A be without the cam, the point *q* will advance, pause, and then retrograde. Thus, with a cam pulley and a cord, we may, without any alteration in the mechanism, pass from directional relation and velocity ratio constant to directional relation and velocity ratio both varying.

One example of an application of a cam to produce a variable circular velocity in the slide-rest of a screw-cutting lathe may be given. Some years ago the connecting and other long rods in engines were "barrelled," that is, they were in longitudinal section curved, being of a larger diameter in the middle than at the ends. Upon the proportions of the varying diameters much of the beauty of the curve depended. Uniformity was secured thus:—The handle of the slide-rest was removed, and a cam (as *s r p*, Fig. 28), or some other form, was fixed in the stead of the handle. A cord was passed round this cam, and one end tied to the end of the lathe-bed. As the slide-rest was advanced uniformly by the action of the change-wheels, the cord caused the cam to be moved at a varying rate. Having given the required data, it was then easy to form a cam which should give any predetermined curvature to the "barrelling."

Here is an apparatus containing two pulleys of different diameters. It is an old-fashioned Chinese windlass, one of the oldest of wrapping contrivances. The object is to get a motion dependent on the diameters of the two pulleys. You will find that a very large amount of cord passes, and a very small motion of the weight takes place. This arrangement has been chiefly regarded as an illustrative experiment until Weston's pulley blocks were adopted; then, by a peculiar contrivance, that which was nearly useless, owing to the large amount of cord needed and the small motion resulting, became useful, and is now frequently met with in the workshop. Here is a pair of large pulleys by which the action can be seen. The peculiarity is that there are grooves cast in the rims of each of these two pulleys, and the links of a chain drop into them, so that "slip," is destroyed. If the chain does not slip it is held in, and must force the pulley round. One man can lift heavy weights with great ease, leaving them suspended in any position without a counterprise. The weights are lowered by drawing the chain in the reverse direction.

There are various other arrangements of strap gearing, both for the reversing of motion and for producing variable motion, which have been kindly lent. Here is a machine for reversing motion, and producing different velocities. There are two spur or toothed wheels of different diameters, so as to give two speeds. One wheel is brought into use, causing the tool to do its work, and the other wheel causes the tool to run back at a much quicker speed, the reverse motion being obtained by changing the strap from the outside pulley at one side over a loose pulley in the centre on to a pulley at the other side, so that there is a period of rest between the two, preventing any jerk in the machinery. Here is another of the same principle, but without variable velocity. Here is one with two straps, one being crossed. Observe, there are four pulleys—the two centre ones being loose on the shaft. The direction of the machine is determined by moving either the crossed or the other strap on to its correspondent outer pulley.

This subject of strap gearing is far from exhausted. We must, however, turn to a piece of mechanism which is as extraordinary as any ever invented. It is a machine for making cards. The cards which it makes consist of very fine pieces of wire bent and pushed through pieces of leather. They are used for the combing of cotton. Cotton fibre, before it is manufactured into thread, must all be laid in the same direction, and these cards do with the fibre what we with combs do with our hair. Messrs. J. Thompson and Co., of Kendal, have kindly sent one of their machines, and a piece of the leather card it was making before being taken down.

This piece of leather, through which the bent wire is to be put, passes between two grooved rollers, and is led over a pulley, being stretched by a weight of twelve pounds. On the right hand of the machine is a light lantern-wheel, which carries a coil of wire. There are no toothed wheels; it is exclusively a cam machine. Upon one short shaft are thirteen cams, each of which takes its part in a proper sequence in one rotation of the shaft. On the black board is a statement of the sequence of actions, and a few notes as to the character of the cams:—

Action of Cams in Cardmaking Machine.

Cams.	Duties.
1	grips the wire to be advanced.
2	advances the gripped wire.
3	holds firmly the advanced wire.
4	cuts the advanced wire to the required length.
7	actuates prickers of the leather.
8	withdraws prickers.
5	advances fingers to hold and bend the wire.
6	withdraws bending fingers.
9, 10 }	cause the bent wire to enter the pricked holes.
13	raises front nippers and bends the wire.
11	releases the wire-holding pieces.
12	advances a skeleton stepped cam-wheel.

Notes on Cams in Card-making Machine.

1, 2, is a double cam; 1 grips the wire by a cylindrical contrivance; 2 advances it by a swash-plate.

4 not only operates on the cutting-blade, but causes the machinery to stop if the wire should be broken.

5, 6, 7, 8. These rotating cams act in combination with inclined planes which are rectilineal cams—and with springs.

The very fine wire, about the size of a "full stop," passes through a small hole, above which is a pin that can be pressed down so as to hold the wire, and lifted up to release it. When the wire is gripped it is advanced as far as is needful, being adjusted for any required length by a set screw.

As soon as it is advanced, this piece lifts up, leaving the wire so advanced. Another piece now comes down and grips the wire. The piece which originally advanced it goes back and repeats the same operation. The piece that held it down after being advanced retains its hold until a couple of pieces like fingers, operated upon in the centre of the machine, come forward, and a third piece corresponding to them comes from above, so that the wire lies across the two underneath, and the third holds it above. It lies there freely. Whilst so lying another operation is performed. The wire is now lying in what may be called a loose grip, and a motion then takes place which pushing two fingers a little in advance, the wire is gripped firmly. Whilst thus held, as in a vice, two other fingers come forward and bend it. They bend it forward and then close in, causing the points of that wire nearly to touch each other. That, however, is not what is wanted, but the wire has a certain amount of elasticity, and the pressure of these fingers beyond what is required is just sufficient to overcome this excessive elasticity. These bending fingers then withdraw, the elasticity of the wire causes it to open so as to remain with its bent ends exactly opposite the two small holes which have been made in the leather at a previous stage by two prickers. The wire being passed through these two holes as a thread through the eye of a needle, two hooks rise up on the outside, close in, clip the wire, and bend it down, and you will find, on examining this card, that all the wires are bent exactly alike. When so bent, all the operating pieces withdraw, and the wire is left in the leather. Then it is that an action takes place which advances the leather ready for another operation. The processes are these. First, the wire is gripped in the way described by a piece falling upon it; the gripped wire is then advanced. Having been advanced, a piece drops and holds the advanced wire as in a second vice. Whilst so held a knife comes forward and cuts off the required length. These two fingers, previously described, hold the cut-off piece, which has been laid, as it were, upon them; they hold it balanced, projecting an equal length on each side. Whilst so held, a piece descends in front, and, in combination with the two fingers, grips the wire firmly; then two other fingers come forward. Whilst that is going on with the cut-off wire, two little prickers make holes in the leather, through which the wire is to be pushed. A cam withdraws these prickers, then the bending fingers begin to act; when they have bent the wire to the proper position, those bent fingers withdraw themselves and the holders insert the wire through the leather, the hooks in front coming up and bending the inserted wire. Now a wheel, such as few if any in this room have ever seen, called a skeleton wheel, moves. It is a kind of compound side cam stepped wheel, an outline of which has been traced on the board. It is gripped by two clams, and every time the wire is advanced this wheel causes the leather to be pushed sideways. The cams which work the machine are some of them single cams, some swash plates, and some compound cams. There is also one cam which has a very peculiar province. It has no part in the mechanism of the work, but it does this. There is a cam which cuts off the wire at the proper length with a little knife. Upon the wire rides a piece of light metal. This light metal rests as it were upon the wire, so that if the wire should break the light metal would fall down a quarter of an inch, and that falling of a quarter of an inch causes a small piece to rise up which stops the whole machine by throwing the strap wheel out of gear. If the piece of wire were to break, unless the machine were stopped work would go on, the leather being perforated and no wire inserted. It is essential, therefore, that the whole of the machinery should stop when the wire breaks. A similar contrivance causes the stoppage of large silk and cotton looms in case the shuttle thread be broken.

* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

PRESERVED MEAT, CONDENSED MILK, AND EXTRACTS OF MEAT.

DR. EDWARD SMITH commenced his paper read before the British Association, on the principal preserved foods, by stating that the enormous consumption which these foods had obtained rendered it very desirable that the public should understand their value. There was much ignorance and misconception on the subject. First, as to preserved milk. This was sold as a thick fluid in tins, and was manufactured in England, Switzerland, and America. One pint of the product represents four pints of milk, which would cost in this country from 4d. to 8d., according to the locality. The tins held 16oz., and represented a little more than two-thirds of a pint of extract, which would be worth, therefore, about 6½d., whereas the price of the tins was 10d. to 1s. Therefore, instead of being economical, it was very dear to the consumer, though it was a most profitable invention to the manufacturer. The sugar generally used amounted to 20 per cent. of the weight of the tin. Competition would doubtless show its results in two directions, an increased proportion of water or sugar, and a less proportion of cream or butter.

The "preserved meat" brought under consideration was that now so widely known as the "Australian." Dr. Smith described the process of preservation, and stated that 6lb. of raw meat, with a proportion of fat, were placed in a tin, which was put into a bath of chloride of calcium, and exposed to a temperature higher than that of boiling water, namely, from 230° to 250° Fahr. The tin was soldered and closed except at one point, where there was a hole through which the steam escaped. The object to be obtained was primarily the expulsion of the air from the tin, consequently a high temperature was required; and secondly, the cooking of the meat, which, however, might be effected at a much lower temperature. The tin, to prevent too great loss of weight, was "primed" from time to time, so as to keep up the weight of the contents. The circumstances to be remarked in the process were—first, that the meat was neither roasted nor boiled, but stewed in its own vapour; second, that it was overcooked, so that a larger proportion of the soluble materials was extracted than occurred in the ordinary process of boiling, and the solid part was more or less broken up into bundles of fibres; third, the extracted juices were more valuable than from ordinary boiling of meat; and by so much the solid mass was less valuable than ordinary boiled meat; fourth, the peculiar flavour was given partially by the mode of cooking, but chiefly by the addition of the flavour of roasted meat, which was agreeable. The solid matter, although soft, was not easily masticated, since it eluded the grasp of the teeth, and without free mastication it was less perfectly digested. The conclusions to be deduced were classed under different heads. The nutritive value of the whole of the contents of the tin could not be greater than that of the raw meat put into the tin, and hence, although the meat was cooked, the comparison of the value must be with raw meat and not with cooked meat. If, therefore, a dietary was four ounces of cooked meat, the Australian meat would have to be supplied in the same quantity as the raw meat in weight before being cooked—namely 5½ ounces to 6 ounces. He also held that the Australian beast was not equal to the English beast. The pecuniary aspect of the question showed that there was manifestly an advantage to the Australian producer, since he could by this process make larger returns than by boiling down the carcasses of animals for the production of tallow and fat, and, so far, the wealth of the Colonies was increased. Moreover, the process added to the amount of food for man, and therefore must be of universal advantage. As to the English consumer, taking beef supplied to institutions as at 7d. and 7½d. a lb., he thought there was little gain in the use of the Australian tin-meat in those cases, but there was a gain to the individual consumer who had to pay more to the butcher for his meat in this country. He advised that the recommendations laid down by the original importers of the meats should be adhered to in respect of not cooking the meat further than by preparing it in a stew or soup, without more than warming it, and to use it only as a change of food.

Respecting Liebig's extract of meat, he pointed out that it was claimed for this that 1lb. jar represented 32lb. of fresh meat. Its composition was water, and, in large quantity, the salt of meat and the phosphates. It contained only the soluble parts of meat, and only such as could be preserved from putrefaction. The fibrine or solid substance of the meat was excluded, for that was insoluble in water. The fat was excluded most carefully, as it would become rancid. Gelatine and albumen were excluded because they would decompose. When, therefore, fibrine, gelatine, and albumen were excluded, it was certainly not "meat," which was left as the word was understood, for nearly every part of the meat which could be transformed in the body and act as food was excluded; therefore, Liebig's extract of meat was not meat, and to give the meat-power the 32lb. of meat from which it is said to be taken must be added to it, for as it was, it was the play of "Hamlet," with Hamlet left out. The product was of less value to the consumer than to the producer, and the preparation was of a delusive rather than a real advantage; but, although he said this, he held that it had a value as a stimulant in the same way as theine or caffeine; but its economic value was very small as representing 32lb. of meat in a 1lb. jar. There had been much misconception respecting the product, for Liebig never affirmed that it was meat, or the equivalent of meat.

In the discussion which followed the reading of the paper, it was urged that there was one item which ought to be taken into account, viz., that the meat was ready cooked, and so the cost of fuel for cooking was saved. The introduction of the meat into public institutions had, it was stated, reduced the expenditure considerably; and there were the usual stock arguments to prove what is incontestable, namely, that Australian preserved meat must be cheaper, because it is cooked and without bone—the latter being a large item in ordinary "butcher's meat." The assertion that the contents of the tins were underweight was contradicted, with a counter-statement that they are, as a rule, overweight. The condensed milk was considered a great boon where the fresh article could not be obtained; and Liebig's extract was said to be exceedingly valuable as a stimulant. Dr. Smith, in reply, said that the general average of bone throughout the animal was 10 per cent., but it must not be imagined that the bones were of no value. The butchers would allow twopence a pound for them. It must also be recollected that, in boiling a leg of mutton, there was in reality no loss, because whatever nutriment left the meat went into the broth, and the broth should be eaten in some way or other so that the whole produce of the joint was consumed. As to the saving in firing, that had been rather exaggerated, because a fire must be kept up for personal comfort in winter, and in the summer it would be required for boiling a kettle in order to make tea, or for cooking vegetables. He quite admitted that it was very convenient to have cooked food at hand at any time, but that was not a point which he had dealt with in his paper.

THE AIMS AND INSTRUMENTS OF SCIENTIFIC THOUGHT.

THE following is the lecture delivered by Professor W. K. Clifford, before the members of the British Association: Mr. President, Ladies, and Gentlemen—It is my duty to speak to you for a short time about the aims and instruments of scientific thought. It may have occurred (and very naturally too) to such as have had the curiosity to read the title of this lecture, that it must necessarily be a very dry and difficult subject, interesting to very few, intelligible to still fewer, and above all, utterly incapable of adequate treatment within the limits of a discourse like this. It is quite true that a complete setting forth of my subject would require a comprehensive treatise on logic, with incidental discussion of the main question of metaphysics; that it would deal with ideas demanding close study for their apprehension, and investigations requiring a peculiar taste to relish them. It is not my intention to present you with such a treatise this evening. The British Association, like the world in general, contains three classes of persons. In the first place, it contains scientific thinkers, that is to say, persons whose thoughts have very frequently the characters which I shall presently describe. Secondly, it contains persons who are engaged in work upon what are called scientific subjects, but who, in general, do not, and are not expected to think about the subjects in a scientific manner. Lastly, it contains persons who suppose that their work and their thoughts are unscientific, but who would like to know something about the business of the other two classes aforesaid. Now, to any one who, belonging to one of these classes, considers either of the other two, it will be apparent that there is a certain gulf between him and them; that he does not quite understand them, nor they him; and that an opportunity for sympathy and comradeship is lost through this want of understanding. It is this gulf that I desire to bridge over, to the best of my power. That the scientific thinker may consider his business in relation to the great life of mankind; that the noble army of practical workers may recognise their fellowship with the outer world, and the spirit which must guide both; that this so called outer world may see in the work of science only the putting in evidence of all that is excellent in its own work—may feel that the kingdom of science is within it. These are the objects of the present discourse, and you will see that they compel me to choose such portions of my vast subject as shall be intelligible to all, while they ought at least to command an interest universal, personal, and profound.

Scientific and Technical Thought.

In the first place, then, I want to explain what is meant by scientific thought. You may have heard some of it expressed in the various sections this morning. You have probably also heard expressed in some places a great deal of unscientific thought, notwithstanding that it was about mechanical energy, or about hydrocarbons, or about eocene deposits, or about malacopterygii; for scientific thought does not mean thought about scientific subjects with long names. There are no scientific subjects. The subject of science is the human universe—that is to say, everything that is, or has been, or may be related to man. Let us, then, taking several topics in succession, endeavour to make out in what cases thought about them is scientific, and in what cases not. Ancient astronomers observed that the relative motions of the sun and moon recurred all over again in the same order about every nineteen years. They were thus enabled to predict the time at which eclipses would take place. A calculator at one of our observatories can do a great deal more than this. Like them, he makes use of past experience to predict the future; but he knows of a great number of other cycles besides that one of nineteen years, and takes account of all of them; and can tell about the solar eclipse of six years hence exactly where it will be visible, and how much of the sun's surface will be covered at each place, and, to a second, at what time of day it will begin and finish there. This prediction involves technical skill of the highest order; but it does not involve scientific thought, as any astronomer will tell you. By such calculations the places of the planet Uranus at different times of the year had been predicted and set down. The predictions were not fulfilled. Then arose Adams, and from these errors in the prediction he calculated the place of an entirely new planet, that had never yet been suspected; and you all know how the new planet was actually found in that place. Now this prediction does involve scientific thought, as any one who has studied it will tell you. Here there are two cases of thought about the same subject, both predicting events by the application of previous experience; yet we say that one is technical and the other scientific. Now, let us take an example from the building of bridges and roofs. When an opening is spanned over by a material construction, which must bear a certain weight without bending enough to injure itself, there are two forms in which this construction can be made, the arch and the chain. Every part of an arch is compressed or pushed by the other parts; every part of a chain is in a state of tension, or is pulled by the other parts. In many cases these forms are united. A girder consists of two main pieces or booms, of which the upper one acts as an arch and is compressed, while the lower one acts as a chain and is pulled; and this is true even when both the pieces are quite straight. They are enabled to act in this way by being tied together, or braced, as it is called, by cross-pieces, which you must often have seen. Now, suppose that any good practical engineer makes a bridge or roof upon some approved pattern which has been made before, he designs the size and shape of it to suit the opening which has to be spanned, selects his material according to the locality, assigns the strength which must be given to the several parts of the structure according to the load which it will have to bear. There is a great deal of thought in the making of this design, whose success is predicted by the application of previous experience; it requires technical skill of a very high order, but it is not scientific thought. On the other hand, Mr. Fleeming Jenkin designs a roof, consisting of two arches braced together, instead of an arch and a chain braced together, and although this form is quite different from any known structure, yet before it is built he assigns with accuracy the amount of material that must be put into every part of the structure in order to make it bear the required load, and this prediction may be trusted with perfect security. What is the natural comment upon this? Why, that Mr. Fleeming Jenkin is a scientific engineer. Now it seems to me that the difference between scientific and merely technical thought, not only in these but in all other instances which I have considered, is just this. Both of them make use of experience to direct human action; but while technical thought or skill enables a man to deal with the same circumstances that he has met with before, scientific thought enables him to deal with different circumstances that he has never met with before. But how, you will say, can experience of one thing enable us to deal with another quite different thing? To answer this question we shall have to consider more closely the nature of scientific thought. Let us take another example. You know that if you make a dot on a piece of paper, and then hold a piece of Iceland spar over it, you will see not one dot, but two. A mineralogist, by measuring the angle of a crystal, can tell you whether or not it possesses this property without looking through it. He requires no scientific thought to do that. But Sir William Rowan Hamilton, the late Astronomer Royal of Ireland, knowing these facts, and also an explanation of them which Fresnel had given, thought about the subject, and he predicted that by looking through certain crystals, in a particular direction, we should see not two dots but a continuous circle. Mr. Lloyd made the experiment and saw the circle, a result which had never been even suspected. This has always been considered one of the most signal instances of scientific thought in the domain of physics. It is not distinctly an application of experience gained under certain circumstances to entirely different circumstances. Now, suppose that the night before coming down to Brighton you had dreamed of a railway accident caused by the engine getting frightened at a flock of sheep, and jumping suddenly back over all the carriages, the result of which was that your head was unfortunately cut off so that you had to put it in your hat-box, and take it back home to be mended. There are, I fear, many persons even at this day who would tell you that after such a dream it was unwise to travel by railway to Brighton. This is a proposal that you shall take experience gained while you are asleep—when, as the President says, you have no common sense—experience about a phantom railway, and apply it to guide you when you are awake, and have common sense, in your dealings with a real railway. And yet this proposal is not dictated by scientific thought. Now, let us take the great example of Biology. I pass over the process of classification, which itself requires a great deal of scientific thought; in particular when a naturalist, who has studied and monographed a fauna or a flora, rather than a family, is able at once to pick out the distinguishing character required for the subdivision of an order quite new to him. Suppose that we possess all this minute and comprehensive knowledge of plants and animals and intermediate organisms, their affinities and differences, their structure and functions; a vast body of experience, collected by incalculable labour and devotion. Then comes Mr. Herbert Spencer; he takes that experience of life which is not human, which is apparently stationary, going on in exactly the same way from year to year, and he applies that to tell us how to deal with the changing characters of human nature and human society. How is it that experience of this sort, vast as it is, can guide us in a matter so different from itself? How does scientific thought, applied to the development of a kangaroo fœtus or the movement of the sapinexogen, make prediction possible for the first time in that most important of all sciences, the relations of man with man? In the dark or unscientific ages men had another way of applying experience to altered circumstances. They believed, for example, that the plant called Jew's-ear, which does bear a certain resemblance to the human ear, was a useful cure for diseases of that organ. This doctrine of signatures, as it was called, exercised an enormous influence on the medicine of the time. I need hardly tell you that it is hopelessly unscientific; yet it agrees with those other examples that we have been considering in this particular—that it applies experience about the shape of a plant, which is one circumstance connected with it, to dealings with its medicinal properties, which are other and different circumstances. Again, suppose that you had been frightened by a thunderstorm on land, or your heart had failed you in a storm at sea; if any one then told you that in consequence of this you should always cultivate an unpleasant sensation in the pit of your stomach, till you took a delight in it, that you should regulate your sane and sober life by the sensations of a moment of unreasoning terror; this advice would not be an example of scientific thought. Yet it would be an application of past experience to new and different circumstances. But you will already have observed what is the additional clause that we must add to our definition in order to describe scientific thought and that only. The step between experience about animals and dealings with changing humanity is the law of evolution. The step from calculated places of Uranus to the existence of Neptune is the law of gravitation. The step from observed behaviour of crystals to conical refraction is made up of laws of light and geometry. The step from old bridges to new ones is the laws of elasticity and the strength of materials. The step, then, from past experience to new circumstances must be made in accordance with an observed uniformity in the order of events. This uniformity has held good in the past in certain places; if it should also hold good in the future and in other places, then, being combined with our experience of the past, it enables us to predict the future, and to know what is going on elsewhere; so that we are able to regulate our conduct in accordance with this knowledge. I want to make a little clearer the fact that what you call the evidence for a thing depends upon the assumption that this uniformity is valid at places and times at which it has not been observed. The aim of scientific thought, then, is to apply past experience to new circumstances; the instrument is an observed uniformity in the course of events. By the use of this instrument it gives us information transcending our experience, it enables us to infer things that we have not seen from things that we have seen; and the evidence for the truth of that information depends, as we have seen, on our supposing that the uniformity holds good beyond our experience. I now want to consider this uniformity a little more closely; to show how the character of scientific thought and the force of its inferences depend upon the character of the uniformity of Nature. I cannot, of course, tell you all that is known of this character without writing an encyclopædia; but I shall confine myself to two points of it about which it seems to me that just now there is something to be said. I want to find out what we mean when we say that the uniformity of nature is exact; and what we mean when we say that it is reasonable.

Exactness of Natural Laws.

When a student is first introduced to those sciences which have come under the dominion of mathematics, a new and wonderful aspect of nature bursts upon his view. He has been accustomed to regard things as essentially more or less vague. All the facts that he has hitherto known have been expressed qualitatively, with a little allowance for error on either side. Things which are let go fall to the ground. A very observant man may know also that they fall faster as they go along. But our student is shown that, after falling for one second in a vacuum, a body is going at the rate of 32ft. per second, that after falling for two seconds, it is going twice as fast, after going two and a half seconds, two and a half times as fast. If he makes the experiment, and finds a single inch per second too much or too little in the rate, one of two things must have happened; either the law of falling bodies has been wrongly stated, or the experiment is not accurate—there is some mistake. He finds reason to think that the latter is always the case; the more carefully he goes to work, the more the error turns out to belong to the experiment. Again, he may know that water consists of two gases, oxygen and hydrogen combined together; but he now learns that two pints of steam at a temperature of 150° Centigrade will always make two pints of hydrogen and one pint of oxygen at the same temperature; all of them being pressed as much as the atmosphere is pressed. If he makes the experiment, and gets rather more or less than a pint of oxygen, is the law disproved? No, the steam was impure, or there was some mistake. Myriads of analyses attest the law of combining volumes; the more carefully they are made, the more nearly they coincide with it. The aspects of the faces of a crystal are connected together by a geometrical law, by which, four of them being given, the rest can be found. The place of a planet at a given time is calculated by the law of gravitation; if it is half a second wrong, the fault is in the instrument, the observer, the clock, or the law; now, the more observations are made the more of this fault is brought home to the instrument, the observer, and the clock. It is no wonder, then, that our student, contemplating these and many like instances, should be led to say, "I have been shortsighted; but I have now put on the spectacles of science, which nature had prepared for my eyes; I now see that things have definite outlines, that the world is ruled by exact and rigid mathematical laws: 'Kai su, theos, geometreis.'" It is our business to consider whether he is right in so concluding. Is the uniformity of nature absolutely exact, or only more exact than our experiments? At this point we have to make a very important distinction. There are two ways in which a law may be inaccurate. The first way is exemplified by that law of Galileo which I mentioned just now; that a body falling in vacuo acquires equal increase of velocity in equal times. No matter how many feet per second it is going, after an interval of a second it will be going thirty-two more feet per second. We now know that this rate of increase is not exactly the same at different heights, that it depends upon the distance of the body from the centre of the earth; so that the law is only approximate; instead of the increase of velocity being exactly equal in equal times, it itself increases very slowly as the body falls. We know also that this variation of the law from the truth is too small to be perceived by direct observation on the change of velocity. But suppose we have invented means for observing this, and have verified that the increase of velocity is inversely as the squared distance from the earth's centre. Still the law is not accurate; for the earth does not attract accurately towards her centre, and the direction of attraction is continually varying with the motion of the sea; the body will not even fall in a straight line. The sun and the planets, too, especially the moon, will produce deviations; yet the sum of all these errors will escape our new process of observation, by being a great deal smaller than the necessary errors of that observation. But when these again have been allowed for, there is still the influence of the stars. In this case, however, we only give up one exact law for another. It may still be held that if the effect of every particle of matter in the universe on the falling body were calculated according to the law of gravitation, the body would move exactly as this calculation required. And if it were objected that the body must be slightly magnetic or diamagnetic, while there are magnets not an infinite way off; that a very minute repulsion, even at sensible distances, accompanies the attraction; it might be replied that these phenomena are themselves subject to exact laws, and that when all the laws have been taken into account, the actual motion will exactly correspond with the calculated motion.

I suppose there is hardly a physical student (unless he has specially considered the matter) who would not at once assent to the statement I have just made; that if we knew all about it, Nature would be found universally subject to exact numerical laws. But let us just consider for another moment what this means.

Practical and Theoretical Exactness.

The word exact has a practical and a theoretical meaning. When a grocer weighs you out a certain quantity of sugar very carefully, and says it is exactly a pound, he means that the difference between the mass of the sugar and that of the pound weight he employs is too small to be detected by his scales. If a chemist had made a special investigation, wishing to be as accurate as he could, and told you this was exactly a pound of sugar, he would mean that the mass of the sugar differed from that of a certain standard piece of platinum by a quantity too small to be detected by *his* means of weighing, which are a thousand-fold more accurate than the grocer's. But what would a mathematician mean, if he made the same statement? He would mean this:—Suppose the mass of the standard pound to be represented by a length, say a foot, measured on a certain line; so that half a pound would be represented by 6in. and so on. And let the difference between the mass of the sugar and that of the standard pound be drawn upon the same line to the same scale. Then if that difference were magnified an infinite number of times it would still be invisible. This is the theoretical meaning of exactness; the practical meaning is only very close approximation; how close, depends upon the circumstances. The knowledge, then, of an exact law in the theoretical sense would be equivalent to an infinite observation. I do not say that such knowledge is impossible to man, but I do say that it would be absolutely different in kind from any knowledge that we possess at present.

I shall be told, no doubt, that I do possess a great deal of knowledge of this kind, in the form of geometry and mechanics, and that it is just the example of these sciences that has led men to look for exactness in other quarters. If this had been said to me in the last century, I should not have known what to reply. But it happens that about the beginning of the present century the foundations of geometry were criticised independently by two mathematicians, Lobatscheffsky and the immortal Gauss, whose results have been extended and generalised more recently by Riemann and Helmholtz. And the conclusion to which these investigations lead is that although the assumptions which were very properly made by the ancient geometers are practically exact—that is to say, more exact than experiment can be—for such finite things as we have to deal with, and such portions of space as we can reach, yet the truth of them for very much larger things, or very much smaller things, or parts of space which are at present beyond our reach, is a matter to be decided by experiment, when its powers are considerably increased. I want to make as clear as possible the real state of this question at present, because it is often supposed to be a question of words or metaphysic, whereas it is a very distinct and simple question of fact. I am supposed to know, then, that the three angles of a rectilinear triangle are exactly equal to two right angles. Now, suppose that three points are taken in space, distant from one another as far as the sun is from Sirius, and that the shortest distances between these points are drawn so as to form a triangle. And suppose the angles of these points to be very accurately measured and added together; this can at present be done so accurately that the error shall certainly be less than one minute, less therefore than the five-thousandth part of a right angle. Then I do not know that this sum would differ at all from two right angles; but also I do not know that the difference would be less than ten degrees, or the ninth part of a right angle. And I have reasons for not knowing.

This example is exceedingly important as showing the connection between exactness and universality. It is found that the deviation, if it exists, must be nearly proportional to the area of the triangle. So that the error in the case of a triangle whose sides are a mile long would be obtained by dividing that in the case I have just been considering by four hundred quadrillions; the result must be a quantity inconceivably small, which no experiment could detect. But between this inconceivably small error and no error at all, there is fixed an enormous gulf, the gulf between practical and theoretical exactness, and, what is even more important, the gulf between what is practically universal and what is theoretically universal. I say that a law is practically universal which is more exact than experiment for all cases that might be got at by such experiment as we have. We assume this kind of universality, and we find that it pays us to assume it. But a law would be theoretically universal if it were true of all cases whatever, and this is what we do not know of any law at all.

I said there were two ways in which a law might be inexact. There is a law of gases which asserts that when you compress a perfect gas the pressure of the gas increases exactly in the proportion in which the volume diminishes. Exactly; that is to say, the law is more accurate than the experiment, and experiments are corrected by means of the law. But it so happens that this law has been explained; we know precisely what it is that happens when a gas is compressed. We know that a gas consists of a vast number of separate molecules, rushing about in all directions with all manner of velocities, but so that the mean velocity of the molecules of air in this room, for example, is about 20 miles a minute. The pressure of the gas on any surface with which it is in contact is nothing more than the impact of these small particles upon it. On any surface large enough to be seen, there are millions of these impacts in a second. If the space in which the gas is confined be diminished, the average rate at which the impacts take place will be increased in the same proportion; and because of the enormous number of them, the actual rate is always exceedingly close to the average. But the law is one of statistics; its accuracy depends on the enormous numbers involved; and so, from the nature of the case, its exactness cannot be theoretical or absolute.

Nearly all the laws of gases have received these statistical explanations; electric and magnetic attraction and repulsion have been treated in a similar manner; and a hypothesis of this sort has been suggested even for the law of gravity. On the other hand, the manner in which the molecules of a gas interfere with each other proves that they repel one another inversely as the fifth power of the distance; so that we have found at the basis of a statistical explanation a law which has the form of theoretical exactness. Which of these forms is to win? It seems to me, again, that we do not know, and that the recognition of our ignorance is the surest way to get rid of it. The world has made the remark that I have attributed to a fresh student of the applied sciences. As the discoveries of Galileo, Kepler, Newton, Dalton, Cavendish, Gauss, displayed ever new phenomena following mathematical law, the theoretical exactness of the physical universe was taken for granted. Now, when people are hopelessly ignorant of a thing, they quarrel about the source of their knowledge. Accordingly many maintained that we know these exact laws by intuition. These said always one true thing: that we did not know them from experience. Others said that they were really given in the facts, and adopted ingenious ways of hiding the gulf between the two. Others, again, deduced from transcendental considerations sometimes the laws themselves, and sometimes what through imperfect information they supposed to be the laws. But more serious consequences arose when these conceptions derived from physics were carried over into the field of biology. Sharp lines of division were made between kingdoms and classes and orders; an animal was described as a miracle to the vegetable world; specific differences which are practically permanent within the range of history, were regarded as permanent through all time; a sharp line was drawn between organic and inorganic matter. Further investigation, however, has shown that accuracy had been prematurely attributed to the science, and has filled up all the gulfs and gaps that hasty observers had invented. The animal and vegetable kingdoms have a debateable ground between them, occupied by beings that have the character of both and yet belong distinctly to neither. Classes and orders shade into one another all along their common boundary. Specific differences turn out to be the work of time. The line dividing organic matter from inorganic, if drawn to-day, must be moved to-morrow to another place; and the chemist will tell you that the distinction has now no place in his science except in a technical sense for the convenience of studying carbon compounds by themselves. In geology the same tendency gave birth to the doctrine of distinct periods, marked out by the character of the strata deposited in them all over the sea; a doctrine than which, perhaps, no ancient cosmogony has been further from the truth, or done more harm to the progress of science. Refuted many years ago by Mr. Herbert Spencer, it has now fairly yielded to an attack from all sides at once, and may be left in peace. When, then, we say that the uniformity which we observe in the course of events is exact and universal, we mean no more than this, that we are able to state general rules which are far more exact than direct experiment, and which apply to all cases that we are at present likely to come across. It is important to notice, however, the effect of such exactness as we observe upon the nature of inference. When a telegram arrived stating that Dr. Livingstone had been found by Mr. Stanley, what was the process by which you inferred the finding of Dr. Livingstone from the appearance of the telegram? You assumed over and over again the existence of uniformity in nature. That the newspapers had behaved as they generally do in regard to telegraphic messages; that the clerks had followed the known laws of the action of clerks; that electricity had behaved in the cable exactly as it behaves in the laboratory; that the actions of Mr. Stanley were related to his motives by the same uniformities that affect the actions of other men; that Dr. Livingstone's handwriting conformed to the curious rule by which an ordinary man's handwriting may be recognised as having persistent characteristics even at different periods of his life. But you had a right to be much more sure about some of these inferences than about others. The law of electricity was known with practical exactness, and the conclusions derived from it were the surest things of all. The law about the handwriting, belonging to a portion of physiology which is unconnected with consciousness, was known with less, but still with considerable accuracy. But the laws of human action in which consciousness is concerned are still so far from being completely analysed and reduced to an exact form that the inferences which you made by their help were felt to have only a provisional force. It is possible that by-and-by when psychology has made enormous advances and become an exact science, we may be able to give to testimony the sort of weight which we give to the inferences of physical science. It will then be possible to conceive a case which will show how completely the whole process of inference depends on our assumption of uniformity. Suppose that testimony, having reached the ideal force I have imagined, were to assert that a certain river runs up hill. You could infer nothing at all. The arm of inference would be paralysed, and the sword of truth broken in its grasp; and reason could only sit down and wait until recovery restored her limbs and further experience gave her new weapons. I want in the next place to consider what we mean when we say that the uniformity which we have observed in the course of events is reasonable as well as exact.

"Reasonableness" of Nature.

No doubt the first form of this idea was suggested by the marvellous adaptation of certain natural structures to special functions. The first impression of those who studied comparative anatomy was that every part of the animal frame was fitted with extraordinary completeness for the work that it had to do. I say extraordinary, because at the time the most familiar examples of this adaptation were manufactures produced by human ingenuity; and the completeness and minuteness of natural adaptations were seen to be far in advance of these. The mechanism of limbs and joints was seen to be adapted far better than any existing ironwork to those motions and combinations of motion which were most useful to the particular organism. The beautiful and complicated apparatus of sensation caught up indications from the surrounding medium, sorted them, analysed them, and transmitted the results to the brain in a manner with which at the time I am speaking of no artificial contrivance could compete. Hence the belief grew amongst physiologists that every structure which they found must have its function, and subserve some useful purpose; a belief which was not without its foundation in fact, and which certainly (as Dr. Whewell remarks) has done admirable service in promoting the growth of physiology. Like all beliefs found successful in one subject, it was carried over into another; of which a notable example is given in the speculations of Count Rumford about the physical properties of water, to which the President has already called your attention. Pure water attains its greatest density at a temperature of about $39\frac{1}{2}°$ Fahr.; it expands and becomes lighter whether it is cooled or heated so as to alter that temperature. Hence it was concluded that water in this state must be at the bottom of the sea, and that by such means the sea was kept from freezing all through; as, it was supposed, must happen if the greatest density had been that of ice. Here, then, was a substance whose properties were eminently adapted to secure an end essential to the maintenance of life upon the earth. In short, men came to the conclusion that the order of Nature was reasonable in the sense that everything was adapted to some good end. Further consideration, however, has led men out of that conclusion in two different ways. First, it was seen that the facts of the case had been wrongly stated. Cases were found of wonderfully complicated structures that served no purpose at all; like the teeth of that whalebone whale of which you heard in Section D the other day, or of the dugong, which has a horny palate covering them all up and used instead of them; like the eyes of the unborn mole, that are never used, though perfect as those of a mouse until the skull-opening closes up cutting them off from the brain, when they dry up and become incapable of use, like the outsides of your own ears, which are absolutely of no use to you. And when human contrivances were more advanced it became clear that the natural adaptations were subject to criticism. The eye, regarded as an optical instrument of human manufacture, was thus described by Helmholtz, the physiologist who learned physics for the sake of his physiology, and mathematics for the sake of his physics, and is now in the first rank of all three. He said, "If an optician sent me that as an instrument, I should send it back to him with grave reproaches for the carelessness of his work, and demand the return of my money."

The extensions of the doctrine into physics were found to be still more at fault. That remarkable property of pure water, which was to have kept the sea from foraging, does not belong to salt water, of which the sea itself is composed. It was found, in fact, that the idea of a reasonable adaptation of means to ends, useful as it had been in its proper sphere, could yet not be called universal, or applied to the order of nature as a whole.

True Meaning of "Explanation."

Secondly, this idea has given way because it has been superseded by a higher and more general idea of what is reasonable, which has the advantage of being applicable to a large portion of physical phenomena besides. Both the adaptation and the non-adaptation which occur in organic structures have been explained. The scientific thought of Dr. Darwin, of Mr. Herbert Spencer, and of Mr. Wallace, has described that hitherto unknown process of adaptation as consisting of perfectly well-known and familiar processes. There are two kinds of these: the direct process, in which the physical changes required to produce a structure are worked out by the very actions for which that structure becomes adapted—as the backbone or notochord has been modified from generation to generation by the bendings which it has undergone; and the indirect processes, included under the head of Natural Selection—the reproduction of children slightly different from their parents, and the survival of those which are best fitted to hold their own in the struggle for existence. If the naturalists here were able to talk to you for weeks, they might give you some idea of the rate at which we are getting explanations of the evolution of all parts of animals and plants, the growth of the skeletons, the nervous system and its mind, of leaf and flower. But what, then, do we mean by explanation? We were considering just now an explanation of a law of gases; the law according to which pressure increases in the same proportion in which volume diminishes. The explanation consisted in supposing that a gas is made up of a vast number of minute particles always flying about and striking against one another, and then showing that the rate of impact of such a crowd of particles on the sides of the vessel containing them would vary exactly as the pressure is found to vary. Suppose the vessel to have parallel sides, and that there is only one particle rushing backwards and forwards between them, then it is clear that, if we bring the sides together to half the distance, the particle will hit each of them twice as often, or the pressure will be doubled. Now, it turns out that this would be just as true for millions of particles as for one, and when they are flying in all directions instead of only in one direction and its opposite, provided only that they interfere with each other's motion. Observe now; it is a perfectly well known and familiar thing that a body should strike against an opposing surface and bound off again; and it is a mere every-day occurrence that, what has only half so far to go should be back in half the time; but that pressure should be strictly proportional to density is a comparatively strange, unfamiliar phenomenon. The explanation describes the unknown and unfamiliar as being made up of the known and the familiar, and this, it seems to me, is the true meaning of explanation. Here is another instance. If small pieces of camphor are dropped into water, they will begin to spin round and swim about in a most marvellous way. Mr. Tomlinson gave, I believe, the explanation of this. We must observe, to begin with, that every liquid has a skin which holds it; you can see that to be true in the case of a drop, which looks as if it were held in a bag. But the tension of this skin is greater in some liquids than in others; and it is greater in camphor and water than in pure water. When the camphor is dropped into water it begins to dissolve and gets surrounded with camphor and water instead of water. If the fragment of camphor were exactly symmetrical, nothing more would happen; the tension would be greater in its immediate neighbourhood, but no motion would follow. The camphor, however, is irregular in shape; it dissolves more on one side than the other; and consequently gets pulled about, because the tension of the skin is greater where the camphor is most dissolved. Now, it is probable that this is not nearly so satisfactory an explanation to you as it was to me when I was first told of it, and for this reason. By that time I was already perfectly familiar with the notion of a skin upon the surface of liquids, and I had been taught by means of it to work out problems in capillarity. The explanation was, therefore, a description of the unknown phenomenon which I did not know how to deal with as made up of known phenomena which I did know how to deal with. But to many of you, possibly the liquid skin may seem quite as strange and unaccountable as the motion of camphor on water. And that brings me to consider the source of the pleasure we derive from an explanation. By known and familiar, I mean that which we know how to deal with, either by action in the ordinary sense, or by active thought. When, therefore, that which we do not know how to deal with is described as made up of things that we do know how to deal with, we have that sense of increased power which is the basis of all higher pleasures. Of course, we may afterwards by association come to take pleasure in explanation for its own sake. Are we, then, to say that the observed order of events is reasonable, in the sense that all of it admits of explanation? That a process may be capable of explanation, it must break up into simpler constituents which are already familiar to us. Now, first, the process may itself be simple, and not break up; secondly, it may break up into elements which are as unfamiliar and impracticable as the original process.

It is an explanation of the moon's motion to say that she is a falling body, only she is going so fast and is so far off that she falls quite round to the other side of the earth, instead of hitting it; and so goes on for ever. But it is no explanation to say that a body falls because of gravitation. It seems that the motion of the body may be resolved into a motion of every one of its particles towards every one of the particles of the earth, with an acceleration inversely as the square of the distance between them. But this attraction of two particles must always, I think, be less familiar than the original falling body, however early the children of the future begin to read their Newton. Can the attraction itself be explained? Le Sage said that there is an everlasting hail of innumerable small ether particles from all sides, and that the two material particles shield each other from this and so get pushed together. This is an explanation: it may or may not be a true one. The attraction may be an ultimate simple fact, or it may be made up of simple facts utterly unlike anything that we know at present; and in either of these cases there is no explanation. We have no right to conclude, then, that the order of events is always capable of being explained.

Cause and Effect.

There is yet another way in which it is said that Nature is reasonable; namely, inasmuch as every effect has a cause. What do we mean by this? In asking this question we have entered upon an appalling task. The word represented by cause has sixty-four meanings in Plato and forty-eight in Aristotle. These were men who liked to know as near as might be what they meant; but how many meanings it has had in the writings of the myriads of people who have not tried to know what they meant by it will! I hope, never be counted. It would not only be the height of presumption in me to attempt to fix the meaning of a word which has been used by so grave authority in so many and various senses; but it would seem a thankless task to do that once more which has been done so often at sundry times and in divers manners before. And yet without this we cannot determine what we mean by saying that the order of Nature is reasonable. I shall evade the difficulty by telling you Mr. Grote's opinion. You come to a scarecrow and ask, what is the cause of this? You find that a man made it to frighten the birds. You go away and say to yourself "Everything resembles this scarecrow. Everything has a purpose." And from that day the word cause means for you what Aristotle meant by final cause. Or you go into a hairdresser's shop, and wonder what turns the wheel to which the rotary brush is attached. On investigating other parts of the premises you find a man working away at a handle. Then you go away and say "Everything is like that wheel. If I investigated enough, I should always find a man at the handle." And the man at the handle, or whatever corresponds to him, is from henceforth known to you as cause, and so generally. When you have made out any sequence of events to your entire satisfaction, so that you know all about it, the laws involved being so familiar that you seem to see how the beginning must have been followed by the end; then you apply that as a simile to other events whatever, and your idea of cause is determined by it. Only when a case arises, as it always must, to which the simile will not apply, you do not confess to yourself that it was only a simile and need not apply to everything, but you say "The cause of that event is a mystery which must remain for ever unknown to me." On equally just grounds, the nervous system of my umbrella is a mystery which must remain for ever unknown to me. My umbrella has no nervous system; and the event to which your simile did not apply has no cause in your sense of the word. When we say, then, that every effect has a cause, we mean that every event is connected with something in a way that might make somebody call that the cause of it. But I, at least, have never yet seen any single meaning of the word that could be fairly applied to the whole order of Nature. From this remark I cannot even accept an attempt recently made by Mr. Bain to give the word a universal meaning, though I desire to speak of that attempt with the greatest respect. Mr. Bain wishes to make the word cause hang on in some way to what we call the law of energy; but though I speak with great diffidence, I do think a careful consideration will show that the introduction of this word cause can only bring confusion into a matter which is distinct and clear enough to those who have taken the trouble to understand what energy means. It would be impossible to explain that this evening; but I may mention that energy is a technical term out of mathematical physics, which requires of most men a good deal of careful study to understand it accurately.

Doctrine of Contradictions.

Let us pass on to consider, with all the reverence which it demands, another opinion, held by great numbers of the philosophers who have lived in the brightening ages of Europe: the opinion that at the basis of the natural order there is something which we can know to be unreasonable, to evade the processes of human thought. The opinion is set forth first by Kant, so far I know, in the form of his famous doctrine of the antinomies or contradictions, the nature of which I will endeavour to explain to you. Kant said, then, that space must either be infinite or have boundary. Now, you cannot conceive infinite space; and you cannot conceive that there should be any end to it. Here, then, are two things, one of which must be true, while each of them is inconceivable; so that our thoughts about space are hedged in, as it were, by a contradiction. Again, he said that matter must either be infinitely divisable, or must consist of small particles incapable of further division. Now you cannot conceive a piece of matter divided into an infinite number of parts; while on the other hand you cannot conceive a piece of matter, however small, which absolutely cannot be divided into two pieces; for however great the forces are which join the parts of it together, you can imagine stronger forces able to tear it in pieces. Here again, then, are two statements, one of which must be true, while each of them is separately inconceivable; so that our thoughts about matter also are hedged in by a contradiction. There are several other cases of the same thing, but I have selected these two as instructive examples. And the conclusion to which Kant was led by the contemplation of them was that on every side when we approach the limits of existence a contradiction must stare us in the face. The doctrine has been developed and extended by the great followers of Kant; and this unreasonable, or unknowable, which is also called the absolute and the unconditioned, has been set forth in various ways as that which we know to be the true basis of all things. As I said before, I approach this doctrine with all the reverence which should be felt for that which has guided the thoughts of so many of the wisest of mankind. Nevertheless, I shall endeavour to show that in these cases of supposed contradiction there is always something which we do not know now, but of which we cannot be sure that we shall be ignorant next year. The doctrine is an attempt to found a positive statement upon this ignorance, which can hardly be regarded as justifiable. Spinoza said "a free man thinks of nothing so little as of death;" it seems to me we may parallel this maxim in the case of thought, and say "a wise man only remembers his ignorance in order to destroy it." A boundary is that which divides two adjacent portions of space. The question, then, "Has space (in general) a boundary?" involves a contradiction in terms, and is, therefore, unmeaning. But the question "does space contain a finite number of cubic miles or an infinite number?" is a perfectly intelligible and reasonable question, which remains to be answered by experiment. The surface of the sea would contain a finite number of square miles, if there were no land to bound it. Whether or no the space in which we live is of this nature remains to be seen. If its extent is finite, we may quite possibly be able to assign that extent next year; if, on the other hand, it has no end, it is true that the knowledge of that fact would be quite different from any knowledge we at present possess, but we have no right to say that such knowledge is impossible. Either the question will be settled once for all, or the extent of space will be shown to be greater than a quantity which will increase from year to year with the improvement of our sources of knowledge. Either alternative is perfectly conceivable, and there is no contradiction. Observe especially that the supposed contradiction arises from the assumption of theoretical exactness in the laws of geometry. Now, the other case that I mentioned has a very similar origin. The idea of a piece of matter, the parts of which are held together by force, and are capable of being torn asunder by greater forces, is entirely derived from the large pieces of matter which we have to deal with. We do not know whether this idea applies in any sense to the molecules of gases even; still less can we apply it to the atoms of which they are composed. The word force is used of two phenomena; the pressure, which when two bodies are in contact connects the motion of each with the position of the other, and attraction or repulsion; that is to say, a change of velocity in one body depending on the position of some other body which is not in contact with it. We do not know that there is anything corresponding to these phenomena in the case of a molecule. A meaning can, however, be given to the question of the divisibility of matter in this way. We may ask if there is any piece of matter so small that its properties as matter depends upon its remaining in one piece. This question is reasonable, but we cannot answer it at present, though we are not all sure that we shall be equally ignorant next year. If there is no such piece of matter, no such limit to the division which shall leave it matter, the knowledge of that fact would be different from any of our present knowledge, but we have no right to say that it is impossible. If, on the other hand, there is a limit, it is quite possible that we may have measured it by the time the Association meets at Bradford. Again, when we are told that the infinite extent of space, for example, is something that we cannot conceive at present, we may reply that this is only natural, since our experience has never yet supplied us with the means of conceiving such things. But then we cannot be sure that the facts will not make us learn to conceive them, in which case they will cease to be inconceivable. In fact, the putting of limits to human conception must always involve the assumption that our previous experience is universally valid in a theoretical sense, an assumption which we have already seen reason to reject. Now you will see that our consideration of this opinion has led us to the true sense of the assertion that the order of nature is reasonable. If you will allow me to define a reasonable question as one which is asked in terms of ideas justified by previous experience, without itself contradicting that experience, then we may say as the result of our investigation, that to every reasonable question there is an intelligible answer, which either we, or posterity, may know.

Conclusions.

We have, then, come, somehow, to the following conclusions:—By scientific thought we mean the application of past experience to new circumstances, by means of an observed order of events. By saying that this order of events is exact, we mean that it is exact enough to correct experiments by, but we do not mean that it is theoretically or absolutely exact, because we do not know. The process of inference we found to be in itself an assumption of uniformity, and that as the known exactness of the uniformity became greater, the stringency of the inference increased. By saying that the order of events is reasonable, we do not mean that everything has a purpose, or that everything can be explained, or that everything has a cause, for neither of these is true. But we mean that to every reasonable question there is an intelligible answer, which either we or posterity may know by the exercise of scientific thought. For I specially wish you not to go away with the idea that the exercise of scientific thought is properly confined to the subjects from which my illustrations have been chiefly drawn to-night. When the Roman jurists applied their experience of Roman citizens to dealings between citizens and aliens, showing by the difference of their actions that they regarded the circumstances as essentially different, they laid the foundation of that great structure which has guided the social progress of Europe. That procedure was an instance of strictly scientific thought. When a poet finds that he has to move a strange new world which his predecessors have not moved, where, nevertheless, he catches fire from their flashes, arms from their armoury, sustentation from their footprints, the procedure by which he applies old experience to new circumstances is nothing greater or less than scientific thought. When the moralist, studying the conditions of society, and the ideas of right and wrong which have come down to us from a time when war was the normal condition of man, and success in war the only chance of survival, evolves from them the conditions and ideas which must accompany a time of peace, when the comradeship of equals is the condition of national success; the process by which he does this is scientific thought and nothing else. Remember, then, that it is the guide of action; that the truth which it arrives at is not that which we can ideally contemplate without error, but that which we may act upon without fear, and you cannot fail to see that scientific thought is not an accompaniment or condition of human progress, but human progress itself. And for this reason the question what its characters are, of which I have so inadequately endeavoured to give you some glimpse, is the question of all questions for the human race.

BRITISH ASSOCIATION GLEANINGS.

Astronomical Refraction.—Mr. G. Forbes read a paper on "Astronomical Refraction." He pointed out sources of error in the observation of stars, due to the moisture of the atmosphere, variations of barometric pressure in two separate places of observation, as well as other sources of inaccuracy. He stated that, although Greenwich and Chiselhurst were only five miles apart, he had found that there was a range of barometric difference between them of nineteen-thousandths of an inch during a period of one month selected at haphazard. These things might cause differences of atmospheric refraction, which would explain discrepancies in observations of the polar distances of the stars.

Rainfall and Trees.—M. Lemoine read a paper on this subject, in which he said:—The action of forests on the climate of a country must be considered as extremely doubtful. In the basin of the Seine it has been established in respect to forests, as compared with soil covered with grass, or even with other permanent cultivation, that they have no influence on the watercourses. The only absolutely certain action of forests is their influence on the protection of the soil. They prevent the earth being carried away; it follows that, in mountainous countries, they retard the flow of torrent waters. In fact, in the Hautes Alpes, the presence of forests prevents the formation of torrents; the replanting of woods extinguishes torrents already existing; but in most cases turfing alone is sufficient to produce the same effect. These conclusions must be carefully limited to the countries in which they have been obtained. Mr. Brown said there were indications that a great portion of South Africa had been under water, but at what period had not been ascertained. The trees varied in magnitude in different quarters, and yet were of the same magnitude in each locality. The desiccation of the country has been going on since the draining off of the waters, owing to evaporation. The destruction of herbage and grass by fire, the use of the axe by native and colonist, and the formation of sheepwalks, facilitated the process of evaporation. Mr. Blore sunk two cylindrical jars, of the same size, in the ground to the depth of 4in., leaving them projecting 1in. above the surface. One was placed where it was practically protected; the other was sunk in a newly cleared plot. Into each jar was put 20oz. of water on January 31. On February 5th the water remaining in each was carefully measured, and it was found that the evaporation from the jar in the open ground had been more than double that from the other jar, which was partially protected, though not covered by bush.

Vesuvian Dust.—Mr. G. Gladstone, F.C.S., said that, during the eruption of Vesuvius which took place last spring, Naples and the surrounding country was visited by a shower of fine black dust. In some places the fall was very heavy, and even in Ischia, at twenty-five miles distance from the mountain, where the dust examined was collected, the quantity was sufficient to cause great annoyance to the inhabitants. It consisted of aggregations of crystallised quartz, dotted over with the magnetic oxide of iron. The ferrosoferric oxide was also crystalline, and possessed a high metallic lustre. The grains were very uniform in size, and would pass through a wire gauze, the apertures of which measured the 16,000th part of a square inch. By boiling the sand in hydrochloric acid the whole of the iron is removed, and nothing but crystals of pure white quartz remained. Its composition is the same as that of the iron-sand which is formed in the soil in some parts of the country round Vesuvius, and which is the product of former eruptions. The latter, however, contains a larger relative proportion of iron, and the grains show a waterworn appearance under the microscope. Neither of the Vesuvian specimens contain titanium, which is found in the magnetic iron-sand of New Zealand, which has most likely been ejected from the great volcano of Mount Egmont.

Vital Movement.—Dr. Radcliffe read a paper entitled, "Whether the Causes of Vital Movement are yet Clearly Appreciated." The author commenced with a résumé of the opinions of ancient and modern writers on the subject of vital movement. He ridiculed the current doctrine which, he said, assumes that vital movements are distinct from those manifested in inert matter, and which can at best be only regarded as a hasty deduction from superficial observations. The highest aspirations of philosophy, he contended, are in direct contradiction to this assumption; and the doctrine of the correlation of physical and vital forces implies a grand centralisation, by which what have been regarded as separate forces are made to appear as various aspects of some central force. Dr. Radcliffe then referred to some investigations which he had recently made with Sir William Thomson's electrometer, and which had tended to confirm the views of Galvani. He mentioned, by way of illustration, a singular experiment that he had made with a strip of indiarubber, coated on the two surfaces with metal, which was elongated by the attraction of two opposite charges; the discharge causing the rubber to contract to its original length.

The "Fossil" Man.—Mr. Moggridge, F.G.S., read an account of the discovery, by Dr. Rivière, of the "fossil" man at Mentone (see p. 478); after which Mr. Pengelly gave a description of the remains. He said the apparently finished tools lying around the skeleton were not artificial tools at all, but appeared to be what were known as whetstones. They were not instruments in the proper sense of the word. Any person looking at the skeleton would see the attitude was such as was assumed in quiet, tranquil sleep. This might be accounted for by the supposition that the man died tranquilly where Rivière found him, possibly from charcoal fumes, for there was plenty of charcoal discovered about him, and that he was here buried by his friends, who simply covered him over. The remains of a *Kjokkenmodding* were found at the mouth of the cavern. Mr. Boyd Dawkins thought there were no facts to lead to the belief that this skeleton was of any enormous antiquity, or that it dated back to the age when extinct animals were living in that part of Europe.

Evolution, and the Human Arm.—Professor Struthers exhibited a number of bones and dissections, showing the presence in the human arm of a supracondyloid process, to which special interest attaches from its mention in Mr. Darwin's recent work. This little projecting spur, just above the elbow, occurs, Professor Struther says, much more extensively than has been generally supposed. He finds it in about one case in fifty, and it may be observed in a very rudimentary state in almost every subject. It was impossible, he said, to explain this variation on the old ideas of final cause and type, and it was a strong piece of evidence in support of the doctrine of evolution. In some animals the process had a specific function to fulfil, but in man it served no purpose whatever.

The Origin of Alphabets.—Mr. John Evans, F.R.S., &c., read a paper on this subject, in which he spoke of the immense importance attached to writing, and the reverence with which it is regarded by tribes who do not possess the power, and stated that such tribes still had an idea of preserving a record of events by a sort of pictorial writing. So early as the time of the caves of the reindeer period in the south of France, bones and horns were found bearing pictorial representations which seemed to give a history of some character. Similar representations were found on the bone instruments of the Esquimaux. The north American Indians had considerable powers of representation by picture signs, and copies of some tombstones erected over the graves of their chiefs were exhibited bearing such a record. The earliest form of Chinese writing was pictorial, and Mr. Evans showed numerous examples of the manner in which the ancient pictorial forms had been shortened into the characters in use at a later period. There could be no doubt, he said, that the Phœnicians were the first inventors of the alphabet in use among the Greeks and Romans of classical times. The period at which it was introduced was uncertain, but in all probability was not more than 1,000 years B.C. The exact form of the Phœnician letters was shown by the Moabite stone which commemorated the acts of Mesia, King of Moab in the days of Omri, King of Israel, about 2,700 years ago. Diagrams were exhibited showing how the Roman alphabet was derived from this Phœnician alphabet. The word "alphabet" was composed of two Phœnician words, "aleph" and "beth," in an Hellenised form combined together. Lastly, from whence was this alphabet in use among the Phœnicians derived? Was it pictorial or arbitrary? Here, although following in the steps of Gesenius, he could not feel that he was treading on such safe ground as in the former part of the subject. Every letter in the Phœnician alphabet had its name, and they were in nearly all cases able to recognise the meaning of the name of the letter. Aleph was stated by Plutarch to have been placed first, because the ox was the first necessary of life. Aleph meant the head of an ox, and the Phœnician A might be taken to be a representation of the head of an ox. Beth, the second letter, meant a house, and the B might represent the roof. The third letter, "Gimneah," meant a camel," and the Phœnician C represented the head and neck of a camel. Mr. Evans went through the remaining letters of the alphabet, and exhibited diagrams suggesting their original pictorial forms.

Raised Beach in Ireland.—Professor E. Hull read a paper on this subject. All along the eastern coast of Ireland, from Dublin Bay northwards, there is to be found at intervals distinct evidence that the coast has been raised in recent times. This evidence is divisible into two kinds; first, the occurrence of a narrow fringe of varying elevation, forming a terrace extending for some distance inland from the coast, and composed of stratified sands and gravel, containing marine shells belonging to species now inhabiting the Irish Sea; and secondly, the existence of old sea-worn cliffs, forming the inland margin of these terraces, which are now beyond the reach of the highest tides. In the North of Ireland these cliffs are penetrated by caves, which have yielded bones of animals, some of which are extinct in that part of the country, while the gravels of the old beach contain amongst the sea shells worked flints in considerable quantity in County Antrim, which prove the elevation of the coast to have taken place since the human period. The height attained by the beach above the present sea-level is about 8ft. in the south, but it rises gradually northwards, and there attains a height of 20ft. The author considered this to be of the same age as the 25ft. beach of the west coast of Scotland, which falls somewhat in level towards the Solway; southwards this decrease in level continues, till the evidences of a raised beach almost disappear towards the estuary of the Mersey. The identity, therefore, of the phenomena on both shores is evident, and is a matter of some interest in the physical geology of these islands.

Decomposition of Water.—A paper on the "Mutual Helpfulness of Chemical Affinity, Heat, and Electricity, in Producing the Decomposition of Water," by Dr. Gladstone and A. Tribe was read. Some metals are able of themselves to displace the hydrogen of pure water, while other metals are unable. Zinc, if perfectly pure, is incapable of doing so, but if it be brought into contact with another metal still further removed from the power of effecting the decomposition of water, the electric force started by contact of the metals enhances the chemical affinity sufficiently to make it effective—or, otherwise expressed, the electrical tension, *plus* the chemical tension, upsets the state of equilibrium between the oxygen and the hydrogen. The amount of action may be measured by a Thomson's galvanometer. The effect of varying the distance of two plates of zinc and copper was tried, and it was found that the chemical action increases slowly till the plates are within an inch or so of each other, but on continuing to bring them together the action increases at a rapidly accelerating ratio. Heat assists the action considerably. Magnesium is capable by itself of decomposing water, but its action is greatly increased by touching it with a piece of copper, and some of the hydrogen gas makes its appearance on the copper. If, instead of magnesium, a metal less capable than zinc of decomposing water be used, there is still found a deflection of the galvanometer, if it be united with a metal still more negative. The order for pure water seems to be—platinum, silver, copper, iron, tin, lead, zinc, magnesium.

The Geological Distribution of Goitre.—Mr. Lebour has collected a great amount of information upon the distribution of this disease in England, and his facts are of the more importance as no information can be obtained upon the subject from Government statistical returns. He traced in detail the range of goitre over the various formations, and showed that the accepted beliefs on this subject were frequently erroneous. Thus, as regards magnesian limestone, which is commonly believed to be a very goitriferous rock, he showed that goitre was by no means so common there as in some other formations. Again, whilst on some regions occupied by carboniferous limestone the disease abounds, in others, where the general character of the rock is apparently the same, it is entirely absent. In searching for a general cause regulating the distribution of goitre, the author rejected as insufficient that generally given—the hardness of water. He showed it to be more probable that metallic impurities in the water were the cause. The carboniferous limestone was characterised by goitre almost in exact proportion to the metalliferous nature of the rock. Districts where ferruginous water occurs very commonly have goitre, particularly where the iron is derived from the decomposition of iron pyrites.

Glass Plummer-Blocks and Axle-Bearings.—From what is stated it would appear that MM. De Camus and Haret have successfully substituted glass for bronze in the above-named parts of machinery. The use of glass for the purpose alluded to seems to be attended with many advantages, and amongst them that of requiring less labour in making the articles, and greatly decreased consumption of lubricating materials.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the English Mechanic, 81, *Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. Passmore Edwards.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

*** *In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

MOONRISE—TELESCOPE STOPS—THE EARTH'S INTERIOR—ELONGATIONS OF THE INFERIOR, AND OPPOSITIONS OF THE SUPERIOR PLANETS—MIRA CETI, AND ALGOL—HEIGHT OF MOUNTAIN—CLOCK RATE—ROUNDABOUT THEORY—LUNAR MOTIONS—57 M. LYRÆ—SPECULA—PURCHASE OF AN OBJECT-GLASS—AND A FEW FULL MOONS IN ADVANCE.

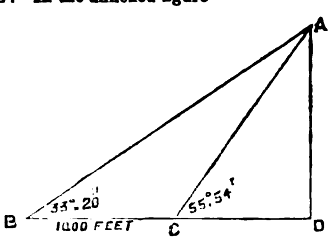
[4823.]—Writing from the locality whence this is penned, I can *not*, off-hand, tell "Delta" (query 12583, p. 574) the title of any book which contains the calculation of the rising and setting of the moon, but have very little doubt that he would find it in such a book as Chauvenet's "Spherical Astronomy," or in any of the larger works on Navigation, such as Raper's, Norie's, Merrifield & Evers's, &c. As for the rising and setting of the superior planets, they may be obtained with abundant accuracy by the aid of a table of semi-diurnal arcs (with an allowance for refraction), such as I have previously advised him (p. 556) to make for himself.

"Tyro" puts a question (12677, p. 574) which it is simply impossible to answer, inasmuch as he gives not the slightest hint either as to the focal length of his telescope or with regard to the internal diameter of his stops. In the absence of these absolutely essential details, I may tell him that he may arrive at the proper places for the stops by the following simple formula: As the diameter of the object-glass : its focal length : : the internal diameter of the stop : *its distance* from the focal point—*e.g.*, suppose that "Tyro" has a telescope of 3in. clear aperture and 45in. focal length, and has a stop belonging to it of 2in. internal diameter, where ought such stop to be placed? We say 3 : 45 : : 2 : x, and this, as a common rule-of-three sum, comes out 30. The stop, then, must be placed 30in. from the focal point, or 15in. from the object-glass. Or, again, imagine the stop to have an opening of ⅓in., we shall have 3 : 45 : : ⅓ : x—*i.e.*, 5, so that such a stop must be fixed 5in. from the focus of the instrument, or 40in. behind the object-glass.

If "Balcairn" (query 12691, p. 575) were to pick up a ball of an inch in diameter, whose external surface was formed of cork, and, putting it into a balance, discover that it weighed two ounces, he would at once be convinced that its interior must consist of some material considerably heavier than that of which its surface was composed. Assuredly he would see, instantly, that our hypothetical sphere was not merely a simple cork shell, with an internal vacuum. Let us apply this reasoning to the case of the earth. The rocky material of which its exterior is composed has a mean density of less than three times that of water. The mean density of the whole earth, however, is *at least* 5·5 times that of water, and is very probably even greater, so that, so far from the interior of the earth being a *vacuum*, it must actually contain matter (in some form) of considerably greater density than that composing those parts which are accessible to us.

I may answer Mr. Somerville (query 12701, p. 575) by telling him that Mercury is at his brightest when his elongation from the sun is about 22°, and that when he is an *evening* star such brightness is at its maximum a few days *before* his greatest elongation. On the other hand, when he rises before the sun, or is a morning star, he is at his brightest a few days *after* his greatest elongation. Thus, for example, he will attain his greatest elongation east (21° 25′) at 1h. 29m. a.m. on November 28, so that he will be at his greatest brilliancy during the week between November 20 and that date. Mercury was, or ought to have been, very visible with proper optical aid on the 3rd August, but a "terrestrial telescope" is scarcely competent to pick the planet up in the daytime. Mercury does not "always recede the same distance" from the sun, its orbit being much more eccentric than that of any of the other large planets; in fact, its distance from the sun at aphelion differs from that at perihelion by something approaching to one-fifth of the major axis of that orbit. I have said that Mercury will attain his greatest eastern elongation on November 28 of the present year. I may further inform my querist that he will arrive at his greatest western elongation (23° 8') about 2 o'clock in the morning on January 6, 1873, so that (according to the intimation conveyed in the beginning of the answer to this particular query) he will be at his brightest about a week after that time. Venus attains her greatest brilliancy some 36 days before, and again 36 days after her inferior conjunction, her elongation being then (as Guillemin, according to your correspondent, correctly says) about 40°. Thus, at 8h. 40m. on the night of February 22nd, 1873, she will be at her greatest elongation E (46° 30'), and will be actually at her greatest brilliancy on the 30th of the succeeding month, March. At this date she will be perfectly visible to the naked eye in bright sunshine if her position, be accurately known. Then, passing her inferior conjunction at 5h. 51m. in the afternoon of May 5, she will again be at her brightest on the 10th of June, attaining her greatest elongation west (45° 38') 17 minutes after midnight on July 14th. Referring to the next part of Mr. S.'s question I may say that Mars will next be in opposition at 2h. 40m. in the afternoon of April 27th, 1873; Jupiter at 52 minutes past 1 a.m. on February 15th, 1873; Saturn at 4h. 57m. a.m. on July 22nd, 1873; Uranus at 5h. 56m. in the evening of January 23rd, 1873; and Neptune at 11h. 14m. on the night of October 17th, 1872. With regard to Mira Ceti, it must have been at its maximum of brightness on or about the 27th of last May. We have only to add 334 days to this to obtain the time at which its next maximum may be expected. I may conclude my reply to Mr. Somerville by saying that his suggestion that I should give the time at which Algol will be at its greatest brilliancy every month has been made before, and I will only here repeat what I have said in these columns on a former occasion with reference to this very subject. It is briefly this, that I could only arrive at "the time at which Algol will be most brilliant" by a method equally open to your correspondent himself—*i.e.*, by actually watching it. If he will do this, and add 2 days 20 hours 48m. 55s. to the instant of the particular phase which he is observing, he will get the time of its recurrence. With regard, however, to the particular star under discussion, he must remember that it remains at its maximum (appearing as a second magnitude) for, as nearly as may be, 61 hours. It then begins to diminish, and in about 4 hours is reduced to a star of the fourth magnitude. It remains at its minimum for about 20 minutes, and in another four hours returns to its maximum again. This is not a very easy sequence of phenomena to tabulate in Greenwich mean time, as even Mr. Somerville must admit.

"Quercus" (query 12711, p. 600) may obtain the height of his inaccessible mountain by the aid of a sextant and a common table of natural sines, &c., without even employing logarithms. He can proceed as follows: In the annexed figure



Let AD represent the mountain whose altitude we wish to ascertain. Then we will imagine the observer standing at C, a spot at an unknown distance from it, and on measuring the angle ACD, finding it to be, say, 55° 54'. Now, let him travel backwards in a perfectly straight line, exactly 1,000ft., to B, and then, measuring the angle ABD we will suppose him to find it to be 33° 20': what is the height of AD? BD is evidently = AD cot. 33° 20', and CD is = AD cot. 55° 54' ∴ BC (= 1,000ft.) = AD (cot. 33° 20' − cot. 55° 54') ∴ AD = $\frac{1{,}000\text{ft.}}{\text{cot. } 33^\circ 20' - \text{cot. } 55^\circ 54'}$. In other words, we have only to take the natural co-tangent of 55° 54' from the natural co-tangent of 33° 20', and to divide 1,000ft. by the result, to get the length of AD, or height of our supposed mountain.

Let us do this. Referring to our tables of natural sines, &c., we find—

Cot. 33° 20' = 1·5204261
Cot. 55° 54' = 0·6770509

0·8433752) 1000·0000000 &c. (1185·7

And performing the division we get as a final result, 1185·7 feet as the height of the mountain.

Unable, myself, to answer the question (12735) of "Rho," on p. 600, I shall be equally glad with him to be furnished with a formula for computing the influence of varying atmospheric pressure on the rate of a clock; inasmuch as I find the effect of change of temperature to be comparatively subordinate as a disturbing influence, to that of any considerable barometric fluctuation.

"Balcairn" in his query—if it be a query—(12737, p. 600) is really a trifle too much for me. *Imprimis*, he confuses revolution and rotation. In the next place, he seems to fancy that the earth's axial rotation causes the seasons, which it does not. And thirdly, there is a pervading absence of pronouns, which obscures even his obscurity. The sentence "It follows that the globe travels 8,760,000 miles a year" contains some great mystery. Why, the globe travels something like 574,810,000 of miles in her annual orbit alone (neglecting the motion which she possesses in common with the sun and the whole of the solar system in space). As for "Balcairn's" concluding sentence, it seems to me to be only paralleled by that famous one commencing, "What, no soap! So he died, and she, very imprudently, married the barber," &c. Œdipus left four children, Polynices, Eteocles, Ismene, and Antigone; but I cannot trace my own descent from any of them; nor am I acquainted with any one who is able to do so.

Mr. W. L. Brown (query 12753, p. 601) puts a question, or string of questions, with reference to one of the most abstruse and recondite subjects which can occupy the attention of astronomers—the motions of the moon. These may be—in your correspondent's own words—"very easy to understand to those who know all about it;" but it may be as well to say in the outset that the astronomers who "know *all* about it" might be counted upon his fingers without the smallest difficulty. It will easily be imagined, then, that it is almost a hopeless task to attempt to do more than popularise the leading features of the lunar movements; and all I can hope to do is to indicate some of the reasons for the phenomena with regard to which Mr. Brown feels a difficulty. To begin, then, with the changes in the moon's declination. It must be remembered that the plane of her orbit is inclined to that of the ecliptic about 5° 9', by which quantity she will be sometimes to the north and sometimes to the south of it. Here, then, is a fertile cause of varying declination. And it must further be borne in mind that the moon's path varies from month to month both in form and position, changing even its eccentricity within small definite limits. The major axis of the ellipse which she describes moves forward on the ecliptic some 41° every year; in fact, goes right round it in something short of nine years; so that in less than 4½ years the perigee arrives at the former position of the apogee. Even this motion is irregular, being direct, or in the order of the signs, when the moon is in conjunction or opposition, and retrograde when she is in quadrature. The former movement must, however, obviously exceed the latter. Again, the line where the moon's orbit cuts the ecliptic, or, as it is called, the line of nodes retrogrades at the rate of about 19° per annum; so that the nodes make a mean tropical revolution in about 18 years and 224 days. This, as in the preceding case, is an irregular movement. Without, then, going any farther it will be seen that the moon's path *does not return into itself*, but is a curve of the most intricate kind, and one in a condition of perpetual change. To answer the concluding part of query 12753 rigorously would involve a tremendous amount of calculation. *Pro hac vice*, then, it must suffice to say that at the end of 223 lunations (or a few days over 18 years) the moon will return very nearly, *but not quite*, to the position which she occupied at the beginning of the cycle—*i.e.*, will be in the same position in the sky, in the same position in her own orbit, and in the same position with regard to the ecliptic. This period is the so-called "Saros" by the aid of which the Chaldæans calculated eclipses. It is, however, quite apparent that as this number of lunations by no means corresponds *exactly* with 18 years, the lunar phenomena will not occur on the same *days* at its expiration. To obtain a cycle which shall fulfil this latter condition, we must go to that of Meton, which is one of 235 synodical revolutions of the moon. These differ only from 19 years of 365¼ days by something more than an hour, so that at the expiration of this period New Moon, Full Moon, &c., will recur on the same days of the year. Yet another cycle, known, from its inventor, as the Calippic, is obtained by multiplying the Metonic one by four, inasmuch as 76 solar years (minus 1 day) contain 940 lunar months almost exactly. It is, perhaps, worth while to mention, too, with reference to the "Saros" of which we have spoken above, that we may obtain a cycle of increased accuracy by multiplying it by 3, since 669 lunations correspond very closely indeed with 54 common years, excluding leap years. By this time I think it will have dawned upon Mr. Brown that the computation of the exact interval which must elapse before the moon will return to precisely the same position in her orbit, as respects her nodes and syzygies, and have exactly the same right ascension and declination at the same instant of the same day of the week and month, is one which is *not* "very easy," even to those who do "know all about it," and that it involves an amount of mere numerical work which very few people would care to undertake, save with some very specific object indeed.

The quotation made by "Linea" (let. 4796, p. 614) from Mr. Proctor's article in the *Mechanics' Magazine* only shows how largely idiosyncrasy, or "personal equation," enters into every observation of a celestial object by different eyes. *I* invariably see the interior of the ring in 57 M. Lyræ, with a 4¼ Dallmeyer object-glass, perceptibly lighter than the surrounding sky; whereas we find him, with an instrument whose light-grasping power exceeds mine in the proportion of 22 : 17 describing this same nebula as "an oval ring with the interior as dark as the sky outside the ring." I remember Mr. Proctor, some considerable time ago, in these columns, trying to deprecate an attempt on my part to lay down a hard and fast line with reference to the visibility or non-visibility of stars of a certain magnitude in a telescope of given aperture, and I certainly think that the instance now under discussion affords a fair illustration of the general soundness of the views which he then advanced. Albeit, I must adhere to my opinion that the 5th star in θ¹ Orionis is *not* visible in one of the much be-puffed "light 5-pounders."

I may answer "Zeta" (query 12762, p. 626) by telling him that the mirror of a reflecting telescope is a segment of a paraboloid of revolution; and that though in years gone by they were figured (by a tentative process) by hand, they are now invariably ground and polished by machinery, several forms of which he will find described and illustrated in back volumes of the ENGLISH MECHANIC.

I would by all means advise "Zealous" (query 12777, p. 626) to purchase "a 2½in. object-glass of the best quality" for the purpose he requires. A man like Wray would construct him one of the smaller aperture, which would be as, practically, effective as the larger glass, and I fancy be quite within his means.

It is somewhat difficult to conceive in what way "the secretaries of societies" are to be benefited by the knowledge of the dates at which the moon will be full for some years to come, as implied by "J. G.," in query 12782, p. 626; but, assuming that some occult advantage is derivable, or to be derived, from such knowledge, I append a list of dates of her opposition up to December, 1875. She will, then, be full in 1872 at 3h. 35m. p.m. on October 16; at 5h. 8m. a.m. on November 15; and at 9h. 44m. p.m. on December 14. During 1873 she will be full at 4h. 23m. p.m. on January 13; at 11h. 33m. a.m. on February 12; at 5h. 44m. a.m. on March 14; at 9h. 51m. p.m on April 12; at 11h. 18m. a.m. on May 12; at 10h. 1m. p.m. on June 10; at 6h. 33m. a.m. on July 10; at 1h. 52m. p.m. on August 8; at 9h. 9m. p.m. on September 6; at 5h. 31m. a.m. on October 6; at 3h. 48m. p.m. on November 4; and at 4h. 20m. a.m. on December 4. In 1874 full moon will occur at 7h. 3m. p.m. on January 2; at 11h. 36m. a.m. on February 1; at 5h. 21m. a.m. on March 3rd; at 11h. 19m. p.m. on April 1; at 4h. 9m. p.m. on May 1; again at 6h. 46m. a.m. on May 31; at 6h. 48m. p.m on June 29; at 4h. 43m. a.m. on July 29; at 1h. 28m. p.m. on August 27; at 10h. 6m. p.m. on September 25; at 7h. 21m. a.m. on October 25; at 5h. 34m. p.m. on November 23; and at 4h. 56m. a.m. on December 23. During 1875 there will be full moon at 5h. 41m. p.m. on January 21; at 8h. 1m. a.m. on February 20; at 11h. 52m. p.m. on March 21; at 4h. 30m. p.m. on April 20; at 8h. 50m. a.m. on May 20; at 11h. 56m. p.m. on June 18; at 1h. 27m. p.m. on July 18; at 1h. 34m. a.m. on August 17; at 0h. 42m. p.m. on September 15; at 11h. 14m. p.m. on October 14; at 9h. 30m. a.m. on November 13; and, finally, at 7h. 45m. p.m. on December 12.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

THE SOLAR CORONA.

[4824.]—MY opinion that the phenomena of the solar corona are in great part due to the existence of meteoric and cometic systems near the sun, was maintained *after* the discovery that the light of the corona is in part due to glowing gas. This discovery was not made by Mr. Lockyer, or in December 1871, as supposed by Mr. Gore (let. 4798, p. 614), but by Professors Young and Harkness during the American eclipse of August, 1869. It was somewhat pertinaciously opposed by Mr. Lockyer, even after Professor Young had renewed his observations in an unmistakable way, in December, 1870; but this circumstance scarcely brings the credit of the discovery home to Mr. Lockyer. Soon after the last-named eclipse, Professor Young devised a very ingenious method for yet further testing the matter, and that method was applied by Mr. Lockyer in December, 1871, unsuccessfully so far as the corona was concerned. The method consisted in viewing the eclipsed sun through a train of prisms, without any slit; and no doubt is capable of showing monochromatic images of the corona. Indeed, a method depending on the same general principles was applied successfully by Professor Respighi, who saw three monochromatic images of the corona about 8' high. Mr. Lockyer saw images only about 2' high, and therefore not ranging above the height of medium-sized prominences, an observation which could prove nothing. But the great spectroscopic success in December, 1871 (a success only surpassed in value by that which the photographers achieved), was obtained by Janssen, who recognised *several bright lines* in the spectrum of the corona, and moreover *several dark lines* in the continuous spectrum (belonging also to the corona). These results are of extreme interest and importance.

There can be no question, I think, that Mr. Lockyer would have obtained interesting results if he had given his whole attention to spectroscopic work. His skill as an observer would have stood him in good stead, as well as his familiarity with the practical details of spectroscopy. (This is not a case where a knowledge of the theory of the subject was in any sense important.) But unfortunately Mr. Lockyer attempted to do too many things. Stationed at the very worst part of the track of central totality (so far as duration was concerned), we find that (1) he looked for the reversal of the Fraunhofer lines at the beginning of totality (failing, says Dr. De la Rue, in his address to Section A of the British Association, through the temporary derangement of his instrument); (2) he tried to record the naked-eye aspect of the corona (with the result that it was "rigid," and "like a decoration"); (3 and 4) he made polariscopic observations in two different ways (getting directly contradictory results); (5) he examined the corona through the telescope (with the result that it was "like Orion"); (6 and 7) he looked for the spectrum in the usual way, and he applied Young's method (results negative); (8) he adjusted the twin telescope for Maclear to see the spectrum (no result); and (9) he looked, I suppose, for the reversal of the Fraunhofer lines at the end of totality. It is no disparagement to his unmistakable skill as an observer to say that no good could possibly result from observations so crowded upon each other. (The eclipse at Bekul only lasted two minutes.) There was something singularly generous in the attempt to do everything in this way; but success was an impossibility. Moreover, all the best instruments being with Mr. Locker at Bekul, the other members of the Expedition were rather ill-provided.

I need hardly say that I do not regard the discoveries made by Young and Harkness in 1869 and 1870, or those made by Respighi and Janssen (severally) in 1871, as in any sense opposed to the meteoric theory of the corona. This theory was never meant to account for every feature of the corona, but only (1) for a portion of its light and (2) for some of the most remarkable of its peculiarities. Janssen's recognition of the dark lines in the coronal continuous-spectrum confirms (what, however, needed no confirmation) the theory that a portion of the coronal light is due to reflection from meteors travelling (at the moment) close to the sun. The existence of these meteors in millions of millions is as nearly a scientific certainty as the existence of a zone of asteroids.

But other features of the corona seem only explicable by recognising the extension of gaseous matter to a great distance from the sun. And again, there are several features which appear due to the action of an energetic repulsive force exerted by the sun on certain forms of matter in his immediate neighbourhood. We have also evidence of eruptional action intense enough to affect the condition of the corona to its very outermost extension.

On all these points—as well with respect to what we know as to the matters which yet remain undetermined—my views now are those which are expressed in the chapters on the prominences and corona in the second edition of my book on the Sun (pp. 242—424).

RICHARD A. PROCTOR.

THE AUGUST METEORS.

[4825.]—IN the neighbourhood of Salisbury, on the night of the 28th, the August shower was partially renewed, and though the meteors were not of such brilliancy as on the 8th, still their numbers made them worthy of notice. They were observed from 8 to 10 p.m., the clouding up of the sky at the latter hour preventing further observation. I was unable, on account of the darkness, to register the exact time of each appearance, and the following list contains all the data I am able to furnish:—

No.	Time.	Direction.	Magnitude as compared with stars.	Apparent starting point.
	h. m.			
1	8 5	W.	4 white.	B'tw'n 23,22 Ur. Mj.
2	8 20		2 "	
3		N.W.	3 "	δ, ε Cassiopœiæ.
4		W.N.W.	3 "	
5	8 45	towards α Ursæ M.	1 green.	α Pegasi.
6	9 10		3	δ Cassiopœiæ.
7*			4 gr.	
8	9 30	towards β Cameli.	3 red.	β Andromedæ.
9	9 50	towards θ Ur. Maj.	3 wh.	ε Ursæ Majoris.
10			2 wh.	
11	10 0	N.W.	2 wh. gr.	δ Cassiopœiæ.

The one marked with an asterisk appeared and disappeared suddenly, leaving a small train. There were several seen to start from the neighbourhood of Pegasus, Lacerta, and Andromedæ, which could not be noted as regards position. In most cases the course was short, and in that of 5, 8 it was extremely curved. No. 5 was of a brilliant green, with a short train of sparks.

P. W. WYATT.

COMPARING ELECTRO-MOTIVE FORCES.

[4826.]—I REGRET that I must still insist on the incorrectness of the equations stated by "O." The law enunciated by him in letter 4697 (p. 543) is true, not generally for all closed circuits, but only for those in which all the electro-motive forces act homogeneously, which is not the case in "O.'s" experiment. For, assuming the law to be universally true, we shall have, as "O." states—

$$i_1 (x + R) + i_3 g = E_1,$$
$$i_2 (y + r) + i_3 g = E_2.$$

From which we get—

$$i_1 (x + R) - i_2 (y + r) = E_1 - E_2. \quad (1)$$

But the circuit $x R r y$ is a closed circuit;

$$\therefore i_1 (x + R) + i_2 (y + r) = E_1 + E_2. \quad (2)$$

Hence from equations (1) and (2)—

$$i_1 (x + R) = E_1,$$
$$\therefore i_3 g = o$$

—*i.e.*, either $g = o$, which reduces the case to two independent circuits having no portion in common, or $i_3 = o$; so that these two are the only cases in which the law, as applied to this experiment, holds good, or "O.'s" equations are true, as stated in my former letter. (Because "O." can obtain, as he has done, a correct expression for i_3 from his equations is no more proof of their accuracy than that the combination of the equations $x = a$, $x = b$, giving $x^2 = a\,b$, shows that a and b are the roots of that equation.) The true mathematical demonstration is that indicated by "O." in his last letter. In answer to "S. T. P." (let. 4739, p. 566), I beg to say that "Sigma," in his letters on electricity, described Fitzgerald's method of measuring internal resistance, a year or more ago, and I gave Mance's method a few months back. If he looks back he can easily find them.

PI.

WALL TRANSIT INSTRUMENT.

[4827.]—IN the hope that it may be of service to some of the readers of the ENGLISH MECHANIC, I herewith forward a photograph and description of a simple transit instrument, which was contrived by me in 1838. A more complete instrument I described in that year in the London *Mechanics' Magazine*, Vol. XXX. The transit is fixed to the face of a wall or side of a window as near as may be in the meridian by three screws passing through the lower plate. This plate has a stem terminating in a ball screwed into its centre. The upper plate has a corresponding hollow turned in it to receive the ball. It has also on its under surface a projecting flange or rim which has a screw cut upon it. Upon this a stout brass ring is screwed, the inside of which fits the lower part of the ball, forming, in fact, the well-known ball and socket. The stem proceeding from the upper part of Plate 2 has its interior turned out slightly conical to receive an axis to which the telescope clip is fixed. At the top of this axis are a screw and washer by which it can be tightened. The lower part of the clip passes through a loose ring, which can be clamped to the clip by the small thumb-screw shown in the photograph. The axis and ring will then revolve together. This ring has a piece of wire pro-

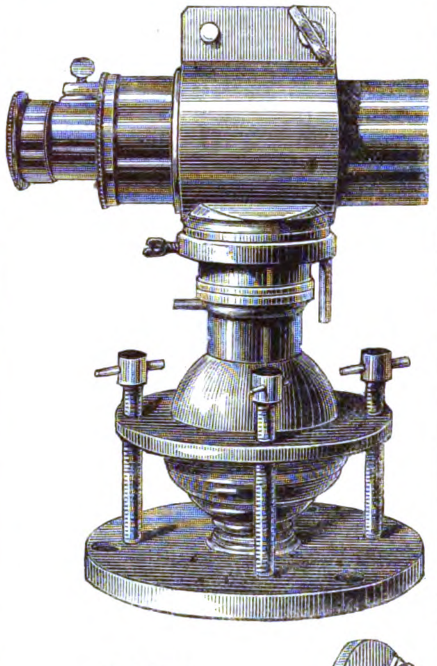


FIG. 1

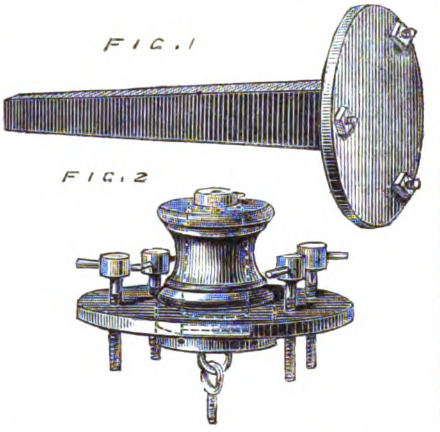


FIG. 2

jecting from it at a right angle. From the top of the stem of the upper plate another piece of wire projects. The end to be answered by the above arrangement is the ready finding a star when the instrument is used for ascertaining the rate of a clock by the acceleration of the fixed stars. Thus, a star having been chosen, the two projecting pieces of wire are brought into contact when the star is on the cross-hair of the telescope and the ring is then clamped. On a succeeding night the telescope will, therefore, be stopped by the pins at the same elevation without further trouble. The four long screws which pass through the upper plate serve—two of them—to level the axis and the other two to adjust the telescope to the meridian. When the instrument is fixed to the wall the two levelling screws are placed vertically (as near as may be) by the coincidence of a dot in their centres with a fine plumb-line suspended at a short distance. The eye-tube of the telescope is turned about for the adjustment of the cross-hairs, and is then clamped by the screw shown in the photograph. The accuracy of the levelling, &c., can be tested by viewing a star by direct and reflected vision, or more roughly by a plumb-line suspended at some distance. The telescope with the cross-hairs is adjusted to the meridian by the methods adopted for the adjustment of the real transit instrument. Fig. 1 represents a circular plate of iron having a wedge-shaped projection at the back, and three screws with nuts in the front. This projection can be driven into the joints of a wall, and the telescope, &c., attached by the three screws to the plate. In Fig. 2 a simple substitute for the ball and socket is shown. The piece of brass to which the rings are fixed screws into the bottom of the stem of the levelling plate and presses against the lower end or the conical telescope axis, shown by dotted lines, which can then be tightened without interfering with the telescope itself. The clip is attached to the axis by a flat headed screw and stud. In conclusion, I would remark that the above, as is evident, is merely the ordinary level modified so as to answer the purpose of a rough transit, which any clockmaker can construct.

N. S. HEINEKEN.

LUNAR METEOROLOGY.

[4828.]—THE success attendant upon the discussion of the observations of the floor of the lunar crater Plato, in the determination of a *darkening* of the floor as the sun increases in altitude (see ENGLISH MECHANIC, No. 367, p. 53), has induced a series of observations during the August lunation, which, if continued, may lead to some very important results. The objects observed form a group of dark spots S.S.E. of the Mare Serenitatis, the principal being Julius Cæsar (No. 7 in table), and the spot named Boscovich by Lohrmann (Nos. 4 and 5). This spot is divided by a mountain range into two portions, east and west. The western portion appears to be differently affected by the sun's rays as compared with the eastern, exhibiting a *steady* tint, with altitudes varying from 80° to 12°, while the eastern appears to become *lighter* under the higher sun. The spot originally named Boscovich by Schröter is the *largest* between Manilius and Menelaus. The observations are given in parts of unity—a light tint = 0·33, medium = 0·50, and dark = 0·66, as in the Plato observations. All the objects were very carefully compared *inter se* on each occasion, the intermediate tints being expressed by intermediate quantities, as in the table. For finding the objects, "Schröter's Fragments" (Table LXII.) and "Lohrmann's Sections" are the best authorities. By giving publicity to these observations you will oblige.

No.	Objects.	August, 1872.					
		16	17	18	19	20	21
1	Mare Serenitatis, near Bessel		0·50	0·50	0·50	0·40	[illegible]
2	Mare Serenitatis, border near Pliny		0.60	0·60	0·60	0·60	[illegible]
3	Boscovich (Schröter)		0·55	0·55	0·60	0·60	[illegible]
4	Boscovich (Lohrmann) W. part	0·66	0·66	0·66	0·66	0·66	[illegible]
5	Boscovich (Lohrmann) E. part	0·33	0·33	0·33	0·16	0·33	[illegible]
6	Spot between Boscovich (S) and Julius Cæsar ...			0·60	0·63	0·63	[illegible]
7	Julius Cæsar, N. part	0·66	0·66	0·66	0·66	0·66	[illegible]
8	Plato			0·63	0·70	0·70	[illegible]

W. R. BIRT.

A GIANT PLANET, &c.

[4829.]—THE ENGLISH MECHANIC for May 31 reached me when I was on a journey, and "Linea's" letter escaped my notice. I have not the number by me. I fear I cannot find leisure for the search "Linea" proposes. During my time in the Royal Astronomical Society, the records of the appearances presented by Jupiter's satellites in transit have been few and far between. I shall endeavour, however, to secure an answer to "Linea's" query from another source.

There is a misprint in the passage quoted from *Mechanics' Magazine*, so that I appear to make the absurd remark, "The ring-nebula in Lyra may now be studied to advantage with the 4⁷/₁₀in. telescope belonging to the Astronomical Society," &c.; the semicolon should have followed the word "advantage." I have not seen the nebula with the instrument in question on a good night yet, but only when there was a residuum of twilight. Doubtless the instrument will show the faint interior light when the conditions are more favourable. So soon as I am settled in town again, I am going to employ some eyepieces by Browning, which, from their work on double stars, promise to do much better than the eyepieces belonging to the instrument.

I am glad to hear "Linea" has found my plan for an alt-azimuth convenient. I remember I used to find it work very handily for keeping a star in the field. Instead of a toothed-quadrant working with a pinion, a cord taken with a twist round a small cylinder can be used as readily and much more cheaply. I thank "Linea" for the pleasant terms in which he speaks of my attempts to be of use.

RICHARD A. PROCTOR.

SUN SPOTS.

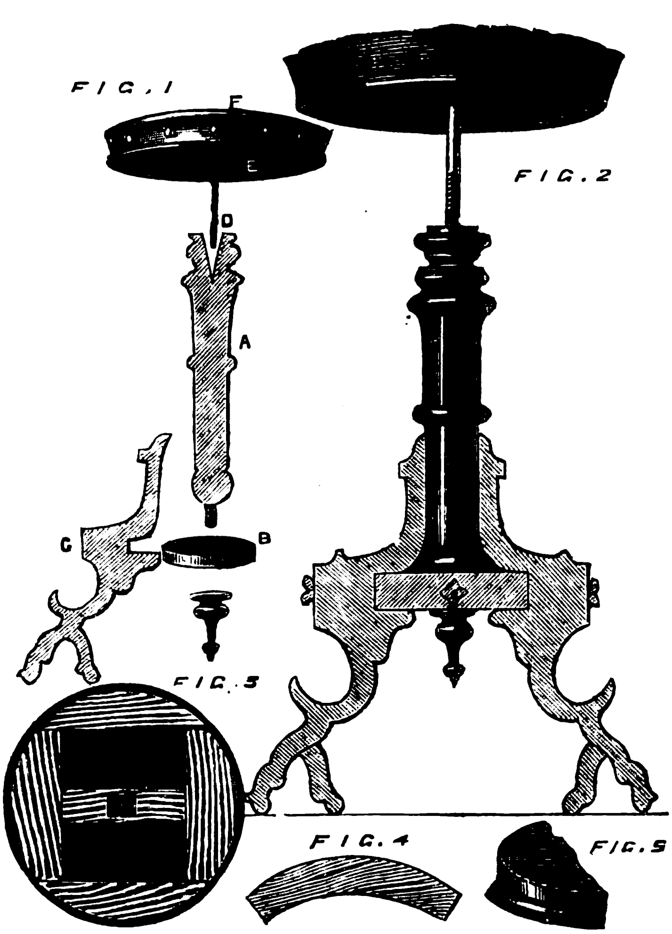
[4830.]—MR. PROCTOR'S letter on sun spots (4712), in which he describes certain dark spots as "broken umbræ," leads me to venture to bring forward my theory (4453) again. When a sudden jet of flaming hydrogen gas springs up, it must produce cyclones that denude part of the sun's surface. If the surface of the sun is in a molten state, it may cool in those places sufficiently to harden, like the lava in Hawaii (see let. 4898), and to remain hardened for a time; and the larger the surface so acted on, the longer it would continue as a "crust" (*i.e.*, as a rule), since the centre would be the farthest removed from the influence of the sun's fiery "envelope." Then it might break up and sink, or float away in pieces for some distance before sinking. The penumbræ might be caused by cracks being formed in the outer—the last-formed, and therefore thinner—parts of the crust, and letting the light from the molten matter below shine through (see again let. 4898). Such "spots" would prevent inflammable vapour from arising from where they were, and thus would preserve themselves for a time. A. (not of Liverpool).

[4881.]—Mr. Proctor (let. 4712, p. 562) speaks of seeing the granules. Does he mean on the body of the sun, or on or near the spots? Also, if these were well seen, were not the nuclei in the umbræ perceptible? Having myself generally noticed them in moderate-sized spots with a much smaller telescope, their absence in those Mr. Proctor drew is rather noticeable.

T. H. B.

ORNAMENTAL TURNING.—XIV.

[4882.]—In my last letter I described a boring collar. As this article is very useful, and can scarcely be dispensed with by the general turner, I propose to show in several ways its use. This week I describe a music-stool and its complete manufacture. Procure a piece of wood, say walnut wood, 12in. in length, 3½in. square; fix in the lathe and turn it the pattern A; at the bottom end turn a pin, and tap it with the screw-box (described a few numbers back); next turn a collar 6in. in diameter, 1in. thick; screw the collar on the bottom of the pillar; next cut out four claws in shape of Fig. C, carve them and fix them by means of screws to the collar B previous to fixing, and after the pillars are turned fix it in the boring collar, and bore a taper hole; the size of the hole can be judged if the iron screw for the top is purchased beforehand; a socket will be found with the screw when purchased, this socket must fit into the pillar at D, after which fix on the brass cap on the rabbet of the pillar which went into the boring-collar. The cap prevents the pillar from splitting. Next the seat or top of the pillar has to be made, the sketch 3 is the under part of the top when made. It consists of five pieces of beech mortised and glued together, with piece of walnut the shape of Fig. 4 glued upon it, then fixed in the lathe and turned; first the rough or top side, then the under part, which consists of a thumb moulding; but as the top is rather difficult for an amateur to make, a solid top will answer, merely a circle 14in. in diameter, 1½in. thick, turned with a rabbet, as shown in Fig. 5, for the purpose of stuffing.



To Stuff and Polish.—After well papering, brush the music-stool over with brown hard varnish, let the stool stand by a day, or even more, then paper, and rub down with flour glass-paper, using a little linseed oil. The whole of the varnish must not be papered off, only the rough part. Next polish with French polish, using a rubber of wadding covered with old linen rag, moisten the rubber with polish, cover with rag, one drop of linseed oil or olive oil, and gently rub all the parts accessible. Give it two or three coats, but it must dry between each application; when quite dry, finish off with methylated spirits on the same rubber, only clean rag, use a little oil at first, finish off with a light and quick stroke. If any difficulty is found from the spirit not bringing up a gloss, a makeshift can be used, namely, spirit glaze, it will look as well, but not last half as long. To stuff the top (the trade use a seaweed called alva; it is very pliable and springy), nail a piece of stout cloth on the top, put a layer of hay, flock, or alva to the required thickness, cover with a piece of sacking, pressing at the same time as much stuffing as can be got in; but the shape must be retained, nail the edges with stout short tacks. Trim the edges, and cover with American cloth the desired colour, trim off the same, cover the edges where tacked with braid a deeper colour than the cloth; if the top is a solid one nine holes should be bored underneath for the following purpose (in the regular top, holes will not be required):—Procure a stuffing-needle with a point at each end, also some buttons and some stout twine. Take the needle when threaded with double twine, pass it through the shank of the button, pass the needle through the exact centre of the American cloth at the top to a hole underneath, pass it back again to the same place. Having caught up a piece of the cloth in the descent, draw the twine tight, and fasten off underneath with another button; the buttons underneath must be a trifle larger than the hole, but the holes need not be larger than ⅜in. If these directions are carried out a handsome music-stool can be made at a small cost.

15, Diss-street, London. Samuel Smither.

THE CHEAP OBSERVATORY CLOCK.

[4883.]—The home-made mean and sidereal time clock (figured and described at p. 630, Vol. XIV. of the English Mechanic) has now been in action for more than six months, and the steadiness of its rate and arc has been very remarkable, notwithstanding the wide range of temperature to which it has been subjected.

I wish now to describe an addition lately made to this clock, which greatly adds to its convenience for observatory use; although the obvious simplicity of the contrivance, when seen, or explained, makes me doubt whether it can be so original as I supposed when it occurred to me.

All practical astronomers know the value of some audible signal, marking the expiration of each minute of time, and an observatory clock or chronometer is sometimes made to strike a bell for the purpose; but this is objectionable, as it involves the friction and inertia of raising the bell hammer by means of a cam or similar contrivance, and a "journeyman clock" is very generally used as a substitute.

I have attained the same object, at the cost of a few shillings, by means of a very simple apparatus, which was added to the A1 clock without even stopping it, and whose action involves no appreciable amount of friction. The following description will be intelligible without a diagram if the reader will refer to the drawing of the A1 clock above referred to: Resting upon the crossbar which supports the front pivot of the pallet arbor there is a small slip of ebonite, in which two insulated wires connected with a small galvanic battery are separately conveyed to a point just above the seconds dial. One of these wires terminates in a short horizontal wire of platinum, on which a little slip of platinum foil (bent at a right angle like the letter F) hangs at the bend or angle. The other wire terminates in a small strip of thin and elastic platinum foil, which is placed just above, but without actually touching, the extreme end of the letter F. The seconds' hand of the clock, when taking its leap forwards at the sixtieth second of every minute, just grazes the bottom of the letter F, causing the upper arm to rise and press against the elastic slip of platinum foil, and thus completes the circuit, sending the current through the coil of a miniature electro-magnet, whose armature is attached to the hammer of a small electric bell, which is thus made to strike one with the utmost precision.

By touching a wire beneath the clock, the slip of ebonite carrying the wire can be raised so as to disconnect the apparatus and suspend its action until again lowered by pulling down the wire. But the friction involved in making contact is so exceedingly small that I have allowed mine to remain constantly in action, and the bell has never ceased to announce the completion of each minute of time during the two months that it has been connected with the clock. The force required is indeed so very small that when the cover is removed from the clock my breathing near the pendant slip of platinum foil is alone sufficient to make contact with the battery, and to ring the bell.

As regards the cost, I at first used for a battery a single plate of zinc and carbon in a small preserve jar filled with an acidulated solution of bichromate of potash, and this was amply sufficient for the purpose; but it required frequent renewal, and I have since obtained a small manganese battery, requiring only about a pound weight of salt to evolve a sufficient current for a period of six months or more without further trouble or attention. The electric bell I first used was one of the smallest of those sold for house use, but I have since made one myself of much greater power and sensibility, costing for the materials less than a tenth of the price charged for the one previously purchased. The apparatus above described might be added to any clock, but the peculiar form of the A1 clock frame made it easy to accomplish it without even stopping the pendulum. John F. Stanistreet.

Abercromby-square, Liverpool, Aug. 29.

THE PARALLELOGRAM OF FORCES.

[4884.]—As the subject of the parallelogram of forces seems to have been dropped, I may be permitted to try to convince "Marine Engineer" that it is in perfect "harmony" with the law of quadruple force in the theory of projectiles. Call the length of the side of the parallelogram s, let its length in feet represent the force in pounds, write this F, put M for the weight of the body considered as its resistance or inertia, t for the time, v the velocity, and g the rate of acceleration produced by gravity—viz., 32ft. per second, then—

$$\frac{2\,M\,s}{F\,g} = t^2 \quad (1) \quad \text{and} \quad \frac{2\,F\,g\,s}{M} = v^2 \quad (2).$$

Now, by mere inspection of the first equation we perceive that as the angle diminishes (let. 4649), and the resultant A D approaches to 2 s—the force also approaching to 2 F—both numerator and denominator increase in the same ratio, and therefore t^2 is unaltered, because double the force produces double velocity in the same time. But if we double both F and s in the second equation, the numerator becomes quadrupled, and v^2 becomes quadrupled—that is, v becomes doubled in consequence of a double force having acted through a double space upon the same mass. But in projectiles the space s is the length of the gun, minus the charge, and does not alter materially, therefore to produce 4 v^2 or 2 v, the force F must be quadrupled. For example, let the side of the parallelogram be 6ft., representing 6lb., then the diagonal ultimately becomes 12ft., representing 12lb. That is, $s = 6$, and $s^1 = 12$, also $F = 6$, and $F_1 = 12$. Let $M = 24$lb., then, if "Marine Engineer" will insert these values in equation (2), he will find $v = \sqrt{96} = 9{\cdot}75$ft., and $v^1 = \sqrt{384} = 19{\cdot}5$ft. per second, and by using equation (1), t in both cases is $= \sqrt{1{\cdot}5} = 1{\cdot}092''$. By inserting $s = 6$, and $F_1 = 24$, he will obtain $v^1 = 19\tfrac{1}{2}$ as before, but t^1 will be $= \sqrt{\cdot 375} = \cdot 546''$, or half the former. This is the same as if the body was a projectile.

Crawford House, Rochdale. Wm. McNaught.

ENGLISH MECHANIC TURNERS' SOCIETY.

[4885.]—Has "Faber" any practical suggestions to offer on the formation of the above society? if so, I for one shall be glad to co-operate with him. Several weeks ago I proposed what I deemed best, but met with no response. One thing I will state, if six gentlemen will start the affair, I will give the said six gentlemen gratuitous insight into my own business—viz., general band and circular sawing; at present I have no lathes at work, or I would include that, but have a portion of room I could spare in my mill for that purpose; after which, if the society was advertised in the English Mechanic weekly, I would fix up a general workshop on certain terms, and include instruction in the following branches:—Ornamental turning, fret-cutting, sawing, cabinet-making, and carving. Being well known in the trade, I would advocate the society to my best ability. I hope to hear from some of our old subscribers soon.

15, Diss-street, London, E. Samuel Smither.

ADJUSTING MAINSPRINGS.

[4886.]—I am afraid many will be misled on one point in "Seconds' Practical Watchmaker's," article upon adjusting mainspring, p. 529, first column: "If the rod passes over equally except the last turn, hesitate whether any further alteration should be made," and so on, and he states it can be safely left so, as no watch is supposed to be let down. Now, many watches are allowed to go down, customers forgetting to wind them up at night. Mainsprings frequently lose their power, and the spring not being set up to take the last turn over the same as at first many evils occur. The watch loses time, the chain gets out of position on barrel, and I have had watches brought in with the chain quite loose on the barrel for the want of the adjusting rod passing over the last turn the same as at first. Conversion.

SPINNING TOPS AND GYROSCOPES.

[4837.]—I THINK it should be obvious to any one whose attention has been attracted to this subject for the first time by reading some of the most recent letters upon it in the ENGLISH MECHANIC, that these letters are but the continuation of a discussion, and I think that such a one should read and study the whole of the discussion before ventnring to take part in it himself. If "J. K. P." (let. 4718, p. 563) had done this I believe he would not have commenced his letter in the manner he has done. Even if he had carefully considered the very letter of mine to which he refers, I fancy he would have hesitated before referring to the fact of a spinning-top commonly rising from an inclined to a vertical position under ordinary circumstances as contradicting my statement, for that statement did not refer to ordinary circumstances, but to the case supposed by "Gy," in which friction and resistance of the air were assumed to be absent. The problem of explaining why a top not only does not fall but rises (under certain ordinary circumstances) is a very interesting one, but cannot be grappled with until the explanation of the top's not falling is thoroughly understood. It may seem paradoxical, but it is nevertheless the fact, that the rising is due to the frictional action of the top's peg on the horizontal supporting surface. And this action is a compound one, as is shown by an interesting experiment to which I have already referred (January 7, 1870). Take a common gyroscope with its one ring, and fix a short peg to the ring almost in the continuation of the axis of the wheel; the gyroscope can then be supported on this peg in the position of a common spinning-top. If the peg were exactly in the continuation of the axis the ring would very soon acquire the velocity of the wheel and make the conditions the same as those of a common top, but when the peg is the least thing to one side it prevents the ring from acquiring the spinning motion from the friction of the journals or pivots. The spinning-motion is thus, as it were, separated from the gyratory motion, the ring and peg having only the lattter. Well, when this apparatus is set (with the wheel spinning, of course) on a hard surface like glass with the axis in an inclined position, the inclination of the axis from the vertical increases; but if the peg is set on a surface like that of rubber or leather, the inclination decreases. As the ring does not spin it can be taken hold of whilst the wheel is spinning, and during one ordinary spin of the wheel, the apparatus may be repeatedly transferred from the hard to the soft support and back again, and so be made to rise and fall several times alternately, thus showing that the change is not caused by the gradually-diminishing velocity of the spinning motion. I have already said that those attempting to explain the action of a gyroscope or top have to deal with several phenomena besides the ordinary one; this rising or falling, according to the nature of the support, will, I imagine, be found rather a puzzler to some of them.

Now, for another phase of the subject, in reply to "Gy" (letter 4720, p. 564). Imagine friction and resistance of the air absent—imagine the point of the top's peg supported on a fixed point, with perfect freedom for the top to spin, and with perfect freedom for it to assume any inclination, even an inverted position, but not able to leave the fixed point of support. First, suppose the top is not spinning, but is placed in an inclined position and let go; it wil swing for ever like a pendulum continually rising to the height from which it falls alternately on diametrically opposite sides of the point of support. Next, suppose the top to have a very slight spinning motion when it is let go, it will swing, but not exactly as before—it will always rise again to the same height, but the position into which it rises will not be diametrically opposite to that from which it falls. If the change of position is measured by a horizontal angle of 180° in the first case, it will be measured by a smaller angle in the second case. Then, as the spinning velocity imparted to the top is assumed to be greater the horizontal angle will be less; and as this angle is less so will the angle of descent be less. If the top has any spinning motion at all it does not pass through the lowest point, but swings past it on one side, as it were. Supposing the first swing of the top measures 40° horizontally the next swing does not take place backwards through the same angle to the starting point but onwards, so that at the end of the second swing it will be 80° from the starting point. Whether the top will swing to the right or the left of the starting point depends simply on the direction of the top's spinning motion. If the spinning velocity of the top is very great the horizontal and vertical angles of each successive swing will become very small, so that the centre of gravity of the top will move round almost horizontally. But for the centre of the top to move round quite horizontally a certain horizontal force or impulse must be added to the other conditions, as was first pointed out by Poinsot, and the slower the top's spinning velocity is the greater must this horizontal element be to produce the common gyratory phenomenon. In a top, or gyroscope, under common conditions this horizontal element of force becomes supplied through friction, resistance of the air, and otherwise in a very curious manner. As the spinning motion of a top decreases its gyratory motion increases, and for a time the horizontal element increases also, but eventually this element is not sufficiently increased, and the swinging motions begin to appear in what is known as the wobbling of the top just prior to its coming to rest.

If, then, "Gy" wishes a top to gyrate with a very small spinning motion in the manner in which it does when spinning rapidly he must contrive means to supply the necessary horizontal impulse and to maintain the spinning motion.

It must not be supposed that in the foregoing I have proposed to explain any gyroscope phenomena: I have merely stated what would be the phenomena exhibited under certain conditions, with a view of leading others to consider some of the less known parts of the subject, and thereby, perhaps, arrive at a better comprehension of the interesting phenomena of rotary motions.

Glasgow. E. H.

PROPERTIES OF THE GYROSCOPE.

[4838.]—THIS false-explanation mania seems hydraheaded! The gyroscope does not act "according to Hoyle," at any rate, not according to the William Hoyle at p. 582, August 23. His explanation is not unlike Mr. Proctor's at p. 446, 21st January, 1870, and it is equally faulty. He does not correctly apply the proposition he refers to as Frisi's, paragraph 15. According to that proposition, and under the conditions stated, the body will "revolve on another" axis; therefore, not on the axis constituting the centre line of the wheel's spindle. Again, the new axis will be "in the same plane," which, in the case considered, is the horizontal plane. Therefore the end of the spindle must be outside of the new axis, and it (the end of the spindle) must, in taking part in the rotation of the body about the new axis, begin to move either upwards or downwards. The complete application of the proposition would show that the spindle should begin to move downwards. The proper application of the proposition is a step towards the explanation of the ordinary gyroscope phenomenon, but it is obviously not the whole explanation, for we know the spindle does move horizontally and not downwards. I submit that Mr. Hoyle's sixth paragraph is not an explanation, but a mere guess at what is supposed to take place, and that unless the assumption in that paragraph is granted his whole attempted reasoning fails. Clause 1 under paragraph 16, is incorrect and inconsistent with 2. The orbital motion or gyration would not be accelerated if the spinning motion were maintained uniformly. The acceleration observed arises from the gradual diminution of the spinning motion.

Really, Mr. Editor, I think it would save valuable space, when correspondents send you new attempts at explaining the gyroscope, if before printing their papers you would first ascertain whether they have read and studied the many letters you have already published on the subject, and particularly whether they are prepared to explain not only the common phenomenon but also the other phenomena referred to in those letters.

In reply to J. M. Taylor (let. 4719, p. 564) the whole weight of a tree (or let us say of a non-spinning top), when in the act of falling, is not exerted at the base or point of support, and it is a part of the explanation of gyroscope properties to show how the whole weight is exerted at the point of support when the top is spinning. But when a top spins in an inclined position the peg point is affected by something besides the downward pressure of the weight; for supposing the peg point were upon a perfectly frictionless horizontal surface it would not remain stationary, but would describe a circle in such a way as to keep the centre of gravity of the top vertically over the centre of that circle. If a common gyroscope, instead of being set on the usual pointed supporting pillar, be set on a pointed support capable of horizontal motion this tendency of the gyroscope to keep the centre of gravity of the floating mass in one spot will be exhibited, and may be made to produce a variety of very curious movements. I have tried it with the horizontal motion of the supporting point limited to a circle by fixing that point on the outer end of a long balanced lever set on a stationary pointed pillar. In this case the inertia of the lever and the limitation of the motion combine to affect the results, whilst these may be varied by starting the gyroscope from different positions. One half gyration of the gyroscope tends to move the lever in one direction and the next half gyration in the opposite; and in one experiment one half gyration may be got to simply neutralise the momentum derived from the preceding one without actually producing reverse movement, so that the lever moves round always in the same direction, but intermittently.

Glasgow. E. H.

DEATH OF THE CRANK.

[4839.]—"G. J. H." (let. 4708, p. 561) calls attention to a supposed American invention, "Mr. Morton's Substitute for the Crank." The very same plan, and several others, for changing an alternate rectilineal into a continuous circular motion I proposed to several engineers in 1862, but could not prevail upon them to take it in hand. Mr. Morton, however, is wrong, if he asserts that the dead points are the cause of the loss of nearly one-half the power in the crank, for, theoretically speaking, as is well known by all engineers, there is no loss of power; it is true that the connecting rod only exerts the greatest force at half centre, which then gradually diminishes to zero as the dead point is reached, but what is lost in power is gained in distance, for it is evident that the circle is greater than twice its diameter, and in this manner the direction of the force is changed without loss.

In my endeavours to get the invention introduced, I could only urge, as generally made, that cranks and their connections were subjected to great strains, which must cause a loss of power, and this view seems to be correct, seeing that there is an occasional smash.

CHANGEL.

BEE MANAGEMENT.—FEEDING.

[4840.]—IN a former letter I advised all those who had weak stocks to commence feeding their bees forthwith, and, lest it might have seemed whimsical, I repeat the advice, notwithstanding all that may have been written about October feeding, and deliberately say that now, when the honey-crop is failing, and the queens are relaxing in their ovipositing, is the time to supplement the one, and stimulate the other, if the said weak stocks are worth any attention at all. Langstroth's "Old Fogey" will say, "Who ever heard of such a thing? Feeding bees in the middle of August; in such beautiful weather, too! Absurd," and so on.

Well, sir, "Old Fogey" has had "his day," and a pretty long one it has been; he has stuck to his text for several thousand years, and has crammed all his disciples with his antiquated ideas, until it is almost wicked and against nature to suggest any alteration or improvement, and, as a consequence, the question of bee-feeding and bee-feeders is as little understood as ever. Before feeding at all, the cause of weakness should be correctly ascertained, for there are some causes which feeding will not remove; for instance, the disease called foul brood, which is always progressive, and apparently incurable. A hive overcharged with pollen cannot be strengthened in bees by feeding, but may be increased in weight, but after giving several empty combs for those filled with pollen, the breeding of young bees may be promoted by gentle feeding, and this should be done now, for as no young bees will be hatched out for at least three weeks, and the stock will be dwindling all that time, the importance of immediate action cannot be over estimated.

Queenlessness after swarming is a very common cause of weakness, but this, of course, cannot be cured by any amount of feeding alone. It is necessary to provide the stock with a queen, or give them the means of raising one for themselves, but as the latter leaves a chance that the young queen may fail in her search for a drone, and as at least sixteen or seventeen days would elapse before oviposition commenced, and three weeks more before the numbers of bees would increase, the former process is much to be preferred, but when the cost of a queen is an insuperable difficulty, it will be necessary to extract one from a full hive (by driving, as described last week), and give it to the weak one, leaving the strong stock to raise a new one for themselves, and then by feeding to stimulate the queen to increased exertion in her new home, and this it is almost unnecessary to say should be done now, if hitherto delayed. Another great cause of weakness is the hiving of late swarms without giving them help at first, and in their case what can possibly be gained by delay? Simply nothing, but on the contrary much valuable time and opportunity lost, for by feeding gently and continuously now, the queen will be stimulated into enlarged oviposition, the bees would probably enlarge the combs, and fill the hive, and even if more drone comb should be built than might be required for the ensuing year, it will be easier to excise that for use in supers, than it would have been to keep the stock through the winter by any other means.

A fifth cause is the presence of an antiquated queen, against which bee-keepers cannot be too strongly cautioned, for as physically she becomes unable to deposit sufficient eggs to keep up the numerical strength of a hive, so does the hive gradually become overcharged with pollen, and although after her natural autumn repose she may in spring be enabled to lead off a swarm it will be necessarily a small one, and later on many of her progeny will be attenuated and physically unable to labour, and hundreds of them will be killed by their stronger brethren, and cast out as useless. These attenuated bees are little fellows with small pointed tails, which are, if Italians, invariably jet black, but on the abdomen near the thorax there is usually one bright broad yellow band. In this case a new queen should be substituted, and the same principle of feeding adopted as in the former case, and the best time to do that is now. A sixth cause of weakness may be the presence of too much drone comb in the hive, and the consequent preponderance of non-workers, which are large consumers; this may arise from the stupid practice of cutting out honey-comb from stock hives, and leaving the bees to fill the space again, in which, as I have before remarked, they almost invariably build drone comb.

The remedy in this case is to feed so as to stimulate the breeding propensity to the utmost now the drones have departed, and in early spring to remove all the drone comb so as to prevent the early breeding of drones, and later on, as the strength of the stock increases, and the more breeding space is required, the bees will build a large proportion of new worker comb. The indiscriminate cutting out of honey-comb from the stock hive is about the stupidest folly a bee-keeper can be guilty of, and is almost sure to result in the ruin of the stock. In large hives with movable combs it is sometimes good policy to cut out the drone comb from the stock hive, and fill up the spaces thus made with worker comb if it can be obtained. In practice I very seldom exchange combs from one hive to another, having such a wholesome dread of transmitting disease, beside which it is seldom that the combs of different hives will exactly fit each other, notwithstanding their "interchangeability," as it is called.

Let me again advise that all feeding be done forthwith, so that the bees may evaporate the moisture from the hives before the cold weather prevents their sealing it over.

Dysentery is a disease which is seldom discovered until it is too late to repair the mischief. Foulness at the entrance of the hive is no positive index, as it is generally left by the bees as they return to the hive after their cleansing flight, which is perfectly natural and healthy. But when the bees are physically unable to take that flight, and perforce, exude the filth inside the hive, and so poison the whole atmosphere, and further vitiate the already vitiated honey, and bees die and rot in between the combs, then it is that the effect of late feeding and ill ventilation become apparent, and dysentery is rampant.

It is a physiological fact that bees in a healthy condition always evacuate their fæces on the wing, and never in the hive unless diseased; indeed, bees that are the subjects of dysentery in cold weather, often actually burst, through the fermentation of their food within them, and smear their combs and their fellows with the filth, causing increased disease and death, and until the cold spell is broken, the bee-keeper gets no sign, and when the discovery is made it is often too late.

Hanwell, August 20. C. N. ABBOTT.

BEES AND BEEHIVES.

[4841.]—THE perusal of Mr. Abbott's prescription to "W. T. L." (see reply 12392, No. 383) of a course of "Langstroth," suggested the idea that by the same means I, too, might be purged of some misconceptions, and might find it a useful tonic, not only for next spring, but for this autumn and winter. Accordingly, the "Hive and Honey Bee," published by Lippincott, Philadelphia, was procured and has been read with some care. Notwithstanding its cost—and it is as dear in proportion as a Woodbury hive — I thank Mr. Abbott for the advice, and would urge many of your other correspondents to do as I have done, in the hope that, as Langstroth says, we may become bee-masters as well as bee-keepers. Space permitting, I should like to transcribe some of Mr. Lippincott's paragraphs, such as some of his "Requisites of a Complete Hive," and "The Beekeeper's Axioms," but I will only ask room to print Oettl's golden rule—"Keep none but strong colonies." Doing so, in twenty years "there has not occurred a season in which the bees did not procure adequate supplies for themselves and a surplus besides;" neglecting this rule, "the more money you invest in bees the heavier will be your losses."

Best thanks also to Mr. Abbott for his letter (4764 in No. 387), on transferring our "industrious subjects" from straw skips to hives with movable frames. He must, however, forgive me for adding that this letter only increases our regret that his specification of the hive he now uses is still deferred. If he cannot give it us at once, I hope he will answer the following queries:—(1) Should we do wrong—I mean, run the risk of having to begin again, because our frames are of wrong dimensions, or for some other reason—in following the mode of construction explained in letter 3162, No. 350, provided we make the interior dimensions 20½in. × 17in. × 11in., and introduce the other improvements described in subsequent letters? (2) Should bottom boards be fixed? Mr. Langstroth seems to prefer them, but for cleaning, for artificial warming, &c., the movable boards give greater facility. (3) If the hives are to be in a windy locality, would Mr. Abbott add a porch? For economy, it need not extend laterally much beyond the entrance, say 10in. wide inside; we might then use the triangular entrance-regulators, as well as a large alighting cloth. (4) Would it be profitable to procure a Ligurian queen at this time of year, or would it be safer to wait for the spring?

E. T. GRAYS.

TUNING KEYED INSTRUMENTS.

[4842.]—I FEEL personally obliged to "Vertumnus" for the attention he has given to my idea. Fiddles and fiddlers are not thought much of at any time, and now that the best of fiddles, or rather violins, are on show at the South Kensington Museum, not more than a dozen persons assisted during the three hours I had the pleasure of viewing them—I mean the viols d'amour, &c. I noticed that one of these instruments had the wires (for tone reflection, hardly repetition, eh!) without tuning-pegs, for they were merely stretched through holes in the bridge, and attached at either end of the breast by pins. This I call trusting to chance, for how could one tell if the wires would sound in unison with the gut strings unless tuned to correspond? Another I found with the full complement of pegs for strings and wires; so far so good, but I fully expected to see an improvement on this, by allowing the stopping to take place on string and wire together, thus insuring the peculiar whirr of sound in all the tones. I have no doubt many will regret not seeing this collection when it is too late.

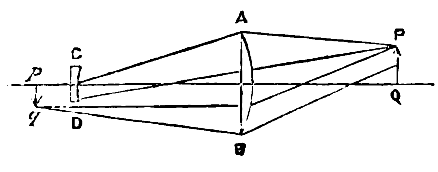
With respect to my idea, I don't back it up as being first-class, but I think there is more in it than "Vertumnus" sees as yet. First, I have a great objection to the finger-board being altered in the slightest degree. No, let there be a key for every finger, in the same way as you have a finger for every note while playing on the violin. Excuse my putting this so curiously, but in violin playing the fingers form themselves the action of the keys, and it is this I want to introduce in part in piano, organ, or harmonium playing. By using two keys to the same string, or pipe, we bring the tone and its expression more under our command. Mark the difference between a flute solo and the same tootled by an organ, yet give the organist a direct command over the pipes and there would be greater effect, besides better tuning. "Vertumnus" says, "A more serious objection is that the difference of tone is produced by so indefinite and uncertain a thing as the varying strength with which the note is struck." Now, this I consider to be the cream of the whole affair. All solo instruments are constructed so as to be under the control of the player. The most perfect in this respect is the violin. The certainty is in the will of the performer, if he can play at all. Of course we must have an instrument constructed to produce certain sounds, and where there is a keyboard various appliances are used (under the control of the player). All I want to see is more variety allowed, and not for a lever to come down on a string always in the same style and place; and as our object is to insure perfect harmony by better tuning, I cannot conceive anything better than that each string, pipe, &c., should be under the performer's will. I beg to state that the hammer, or the wind, would have nothing to do with changing the tone, any more than the bow of a fiddle does now. The same wind and the same hammer would do, but another action must be given to the other key to produce another tone when it is pressed down, using the same hammer as the first key. So half the hammers and half the strings are dismissed, also half the pipes and half the size of the organ, &c.

With respect to the third objection, I am to blame for making an obvious mistake, for if the lever presses on the string as the finger does, a higher tone is the consequence. I supposed the key note to be C, and reckoned down to B, whereas I should have gone up to C sharp; and this makes all the difference, as I have no doubt "Vertumnus" will see, for here we are out of the way of the major seventh, and continuing the process with every key, yet having the complete keyboard, we can play with facility all the chords and discords that happen, nine hundred and ninety-nine times out of a thousand, in any species of composition. I have played on a keyboard constructed on this plan, and it answered better than the present one, for it gave more power to the performer over the tone. I acknowledge that the major seventh will crop up in the more difficult keys, but so very seldom that I think that part of the question may be waived, or perhaps remedied by a movable keyboard that has been adjusted to Debain's harmoniums—an idea that I do not like "at all, at all." Perhaps some other artist will help with an idea.

FIDDLER.

ON THE DISREGARD OF THEORY FREQUENTLY SHOWN IN THE CONSTRUCTION OF THE OPERA OR FIELD-GLASS.

[4843.]—THIS kind of telescope has the rays of light passing through the object-glass in such a manner that except in the centre of the field of view only a portion of them falls on the eye-glass, that portion becoming smaller towards the edge of the field. Thus, let P Q be the object, *p q* its virtual image—that is, the image which *would* be found only for the eye-glass



C D. It will be seen from the diagram that only the rays falling on the upper part of the object-glass from P reach the eye-glass; hence, if the object-glass were not larger than the pupil of the eye in a greater ratio than the magnifying power of the glass bears to unity, we should have deficient illumination, and I think a small field of view, owing to the excentrical refraction through the object-glass. Low powers only are suitable for these glasses. PHILANTHROPIST.

RADIUS OF SURFACE OF OBJECT-GLASS.

[4844.]—IN reply to Mr. Cash (let. 4696, p. 543), as he will spare no trouble in correcting his object-glass, I send him the following assistance, which I promised some time ago, and which his last letter enables me to give. The results of Mr. Cash's last experiments have verified my belief, because the refractive index corresponds very nearly to my own (for Chance's dense flint, specific gravity 3·645; and crown, specific gravity, 2·553), and I have found by experience that when their sheets of flint and crown glass have one specific gravity up to the fourth place, the refractive index is the same. As Mr. Cash has tried or tested the flint and crown for veins, which his object-glass is composed of, he may grind them to the following radii—viz., with flint lens, specific gravity, 3·6452; with refractive index, 1·6375. Flint lens, first surface, convex, 156·0 – 26·0, radii = 63·40, RR = 1·95, 26·8 × 40·0, R = 32·0. Crown lens, white, specific gravity, 2·5529; refractive index, 1·529. Focus for parallel rays, 72in. As regards Mr. Cash's doubts about the strength of the flint and crown lenses composing his object-glass, he can rest contented about that. There is no particular fault in a flint or crown lens having plenty of strength; the greatest fault is when the lenses are thin, which in many cases causes them to spring in the working, and when that is the case they are of no use. It is in microscope achromatic object-glasses that the strength has to be taken into account so minutely. Before commencing to grind his flint and crown lenses to the curves above, Mr. Cash must curve a piece of common plate glass, of the same size as the flint and crown lens, to the same curve as the other or opposite side to which he is about to grind, and must lay on it a piece of thin cloth dipped in melted pitch. On this the lens must be fastened, and every surface he grinds he must fix a glass holder on the opposite side, to prevent the lens from springing in the working of it. A cork or bung, about 2½in. or 3½in. in diameter, dressed into shape so as to be pleasant to the hand, is fastened with pitch on to the glass holder, and used as a holder in the working. Great care must be taken in making the grinding tools to the exact radii, and also in working them true before the lens is worked on them. The tools must be worked in pairs, to true each other; and in working the lenses care must be taken that the lens is turned round in the hand regularly about every ten strokes taken with the lens. In grinding and polishing six sizes of emery are generally used in fining the lens after it has been ground up on the true tool. A cement for polishing object-glasses is made by mixing lampblack with soft pitch until it becomes hard, when it is softened to the proper state, according to the work for which it is required, by the addition of beeswax. If Mr. Cash is anywhere near to Sheffield, and will advertise his address, I will send him a piece of cement which will be suitable for a room of 70° temperature Fahr., which will save him a deal of trouble. I would have given the recipe for it, but it would be hardly fair, because it has cost my late father and myself a nice fortune; when I have done with it I may divulge the secret. The cement, the ingredients of which are given above, is a good one, and has polished good object-glasses up to 10in. diameter, though I have not seen it for several years. As regards eyepieces, I send the proportions for three or four powers of the Huyghenian form:—

A eyepiece: First lens, ·70in. focus, diameter five-tenths of an inch, plano convex; second lens, 1·50in. focus, diameter nine-tenths of an inch, plano convex, diameter of stop six-tenths of an inch, distance from lens to lens (inside measure) 1·10in., exact power 70 times.

B eyepiece: First lens, 0·50in. focus, diameter three-tenths of an inch, plano convex; second or field lens, 1·25in. focus, diameter six-tenths of an inch, plano convex, diameter of stop four-tenths of an inch, distance from lens to lens 0·85in.; power about 110 times.

C eyepiece: First lens, 0·30in. focus, diameter two-tenths of an inch, diameter of stop two-tenths of an inch; second or field lens, 0·70in. focus, diameter five-tenths of an inch, distance from lens to lens (exact inside measure) five-tenths of an inch; power 160 times.

D eyepiece: First lens, 0·20in. focus, diameter 0·15in., diameter of stop, 0·15in.; second or field lens, 0·50in. focus; diameter 0·4in., distance from lens to lens 35-100ths of an inch, power 250 times.

If Mr. Cash will follow these instructions exactly, he will have a different and a better instrument than he would have had if Mr. Vivian or I had sent him the curves to alter his object-glass to. On its present principle it would never have made a good one at the best. I have no doubt but Mr. Vivian—if he has had much practice in the construction of large astronomical telescopes—knows that object-glasses ground with the inside surfaces to fit, or as he recommended (the crown slightly deeper in radius on the inside surface), never make a first-class telescope; I do not consider one worth its mountings. The greatest fault with Mr. Cash's object-glass at the present time is the botheration of the inside surfaces fitting; or in the working very probably the crown has worked slightly deeper, and when it is screwed up in the cell causes the crown lens to tip, and produces the effects Mr. Cash speaks of. Before I close this letter I wish to remind him to be very very careful in the re-centreing of his object-glass after he has worked it to the curves I have sent, which will, I have no doubt, make him a good telescope.

Sheffield. WILLIAM OLDFIELD.

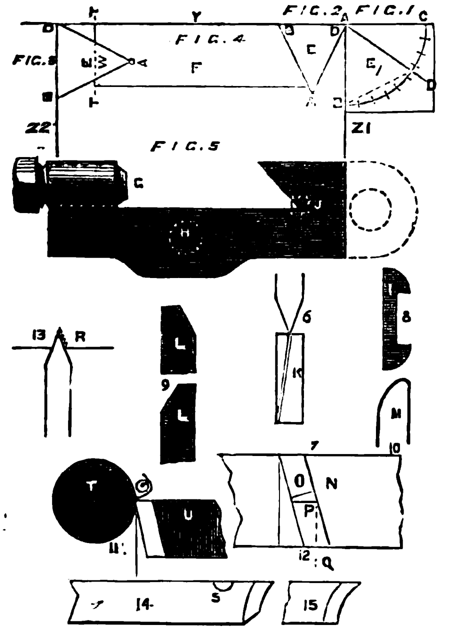
ECONOMY IN USING COAL.—STOVES.

[4845.]—"PHILO," in his interesting letter (4723), refers to the escape up the chimney of a large proportion of heat derived from the fuel; it is a fact, and one which was observed and commented upon, both in England and abroad, more than thirty years ago, one writer fixing the waste at seven-eighths, another at fifteen-sixteenths of the whole, but a better plan, though diligently sought after, has not yet been found (except in theory). Practical experience shows it to be one of the least of the evils attendant upon the production of artificial heat, while its use as a means of ventilation to an apartment in which persons live is a set-off against its extravagance. Perhaps the point which deserves more attention in stoves is the exact angular form which is calculated to radiate the heat to the greatest extent—the one familiarly known as the "Register" is the nearest approach to the perfect form. To avoid this waste of heat with open stoves, Dr. Arnott invented a close one, more than thirty years ago, which it was thought would supersede all others; it has not done so, nor, on the other hand, has it been superseded by any other of the like principle. One of Dr. Arnott's stoves was fitted up in the Customs House, where a number of clerks were employed, and in as far as it thoroughly heated the large apartment, at a very trifling cost, it was a success, and effected a great saving of fuel, but in a short time it had to be removed, being very injurious to health, for like all close stoves, which necessarily warm the air by conduction, instead of radiation, it destroyed the humidity of the atmosphere, so I think we shall have to waive the objection to open chimneys for the present. Again, British prejudice is in favour of the present plan. Our people are very sentimental regarding a cheerful looking fire, which can scarcely be enjoyed without an open chimney. Of course, these remarks do not apply to cooking stoves of any kind.

TINTUR.

SCREW CUTTING.

[4846.]—PERHAPS a few tips from "Jack" would not be amiss, and enlighten some of our junior hands. First, we will start with the tools requisite for the job. These, though not absolutely necessary, will facilitate the operation. These few sketches will illustrate what is wanting. First get a piece of saw plate about an inch (see Fig. 1), with a small prick punch put a centre in one angle A, take a pair of dividers and strike a quadrant B C, true the edge up A B to the centre, and the other edge, A C, truly square or at right angles. Divide the quadrant C B into nine equal parts, take 5½ parts, as shown at D, and draw a line through the centres, D A. File up truly to the lines, and thus you are furnished with the angle 55, the angle of Whitworth's threads in general use, in the shape of a cone, and of which B D is the base. Keep this as a standard gauge. Now take a piece of the same stuff—saw-plate or sheet steel, I mean—and, filing it true upon the edges, and parallel, about ⅝in. or ¾in. wide, and from 1½in. to 2in. long (see Fig. 4 F), take your



square, and place the stock against the planed edge of your lathe-bed, the blade resting upon the bed. Apply one edge to the stock and the angle piece, with the base B D at 2, keeping them both together. Mark the angle off upon Fig. 4, A B, which is 27, and half file this off true, then reverse the order of things, and, applying the square blade upon the other side, apply your angle to the square blade, Z 2, the base B D being to the blade, and mark off the angle W 3 in F 4, and, drilling a fine hole, file it carefully out. This, squared off at T, constitutes the screw cutting gauge.

Figure 5 is an adjusting stop to regulate the feed of cut and dispense with the chalking operation. It is made to fix upon the slides, either a tool stock slide or transverse slide, and can be made of a piece of ⅜in. or ⅝in. square iron. G is the fixing or clamp screw. In H a screw is put—a screw for the regulating of the cut, with a milled head, and acts against the end of slide. If made in the first instance with the dotted addition, it will suit most lathes. I (Fig. 8) is a gibb which, if fitted in J, gives it a longer bearing. Fig. 6 shows front and top of a screw tool, which, with some there is so much bother about to have twisted the same angle as thread, which is not needed, the rake of thread will give you clearance upon one side, therefore you can leave it wall-sided, as shown in the dotted line 7 P N, supposed to be the piece upon which a screw is to be cut, L L 9 is the shape of tools for a bracket thread, 10 a tool for a thread for a metal screw for wood, 11 position of V tool at work, 12 for square thread, the diagram of which I shall have to refer to again, 13 how the work is to be performed by steps, and G 14 the practical and best rake of comb or chaser, thereby keeping the proper angle and depth of thread, not like 15. Straight tip No. 1. JACK OF ALL TRADES.

[4847.]—"APPRENTICE TURNER" (let. 4760, p. 589) is quite right in saying that shopmates are afraid of another knowing the "tips." I will give him one of my "tips," as he terms them. Suppose he wants to cut ten threads per inch with a leading screw of two per inch: Multiply the wheel upon the lathe spindle by half the number of threads required to be cut, again multiply by small wheel on the intermediate spindle, divide by the large wheel on the same spindle, and the result will be the wheel required on the leading screw. For example, $\frac{20 \times 5 \times 20}{40} = \frac{2000}{40} = 50$, the wheel required for the lathe-screw; this is compound or double gear. Now, suppose I am going to cut (say) eleven threads per inch, which is gas thread, and also odd pitch, I just find the wheels by the above-mentioned rules, then mark the face or chuck-plate with chalk, also a mark on the lathe spindle opposite, a small piece of wood or chock against the loose headstock; this is to allow the saddle to come against it when the tool is beyond the work required to be cut. This piece of wood is instead of the mark on the lathe-bed, which I think would take too much time to bring the saddle exactly up to the mark. If he got it past the mark, or not quite up to it (say a sixteenth part of an inch either way), he would still be able to get the nut into gear, and also have a cross thread for his trouble, whereas if he uses the wood it would be an impossibility for him to get the saddle too far back. SCREW CUTTER.

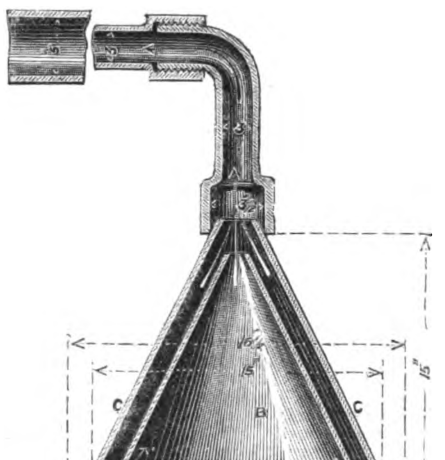
AURORÆ BOREALES AND GALES.

[4848.]—IN the *Weston Mercury*, a short time ago, I read a letter signed O. S. Round, having reference to the supposed connection between auroræ boreales and the occurrence of gales. The writer made the remark that subsequently to the display of aurora on the evening of August 3rd last, "within 48 hours we should have a gale," and so it turned out, as August 5th testified, for it blew a tremendous gale throughout that day. On reading this I determined to test, if possible, the accuracy of the statement. An occasion soon occurred, for on the evening of August 8th I witnessed from this town (Weston-super-Mare), a somewhat bright exhibition of the aurora borealis. I observed the streamers for some time, and noticed with what rapidity they changed both in their positions and in their intensity. On August 10th (*i.e.*, within 48 hours after the occurrence of the aurora), a tremendous gale blew, and it was scarcely possible to make any headway against the extreme force of the wind. This fact supports Mr. Round's statement, and it would be interesting to refer to former meteorological registers and endeavour to find if there is any corroborative evidence forthcoming. No doubt many of your scientific readers have sufficient data in their possession to enable them to accomplish this without much difficulty, and I think it would afford matter of interest if they would send you the result.

August 31. WILLIAM F. DENNING.

GREENHOUSE HEATING.

[4849.]—WITH your permission I will give an outline of an apparatus used in connection with atmospheric burner described on p. 592. The sketch will fully explain it. Over the burner A is placed a cone of sheet iron B, or, more correctly, the head of burner is inserted some distance into cone, which concentrates the intensely-heated current, and directs it into 3in. bend and short 3in. pipe in connection therewith. As the cone would quickly become white hot, a second cone C C is placed over and surrounding the first, leaving an air space of ⅜in. all round. As a consequence of this arrangement (which is common in sunlights, a rapid current of air rushes up between the cones, keeps B from overheating and destruction, and, what is more to the purpose, sends almost all the heat into the greenhouse. The outside cone is flatted in against the inner one at three points at the bottom, and riveted to it. Pipes 5in. inside diameter are laid through the house as required, and suitably connected with the first



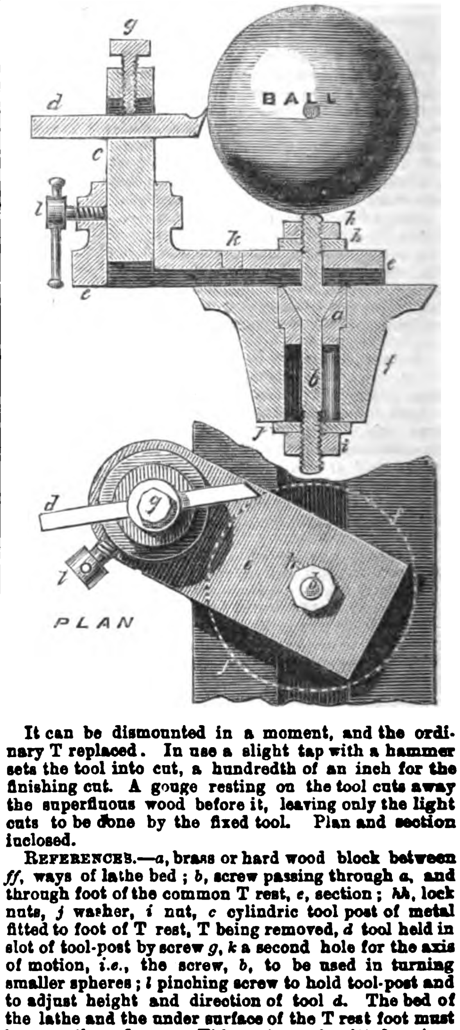
3in. pipe. A chimney at the furthest end completes the apparatus. The joints are made with fireclay, made into stiff paste and rammed in tight. About 30 feet of 5in. downspout piping will absorb the heat generated by gas from two No. 3 burners. The pipes require a rise of about half an inch per lineal foot. In the greenhouse I speak of, 3in. pipes were first used, but the first few feet absorbed most of the heat and burned the air; 5in. pipes obviate this, as the draught is more perfect. If the first portion should overheat it should be surrounded with sand. If of interest I can give a sketch of a very effective fire-grate and arrangements for coke burning which I built for a friend.

ATMOSPHERIC BURNER.

[Please send.—ED].

THE WASHINGTON SPHERICAL REST.

[4850.]—YESTERDAY and to-day, before breakfast, I fitted the T rest of my 4in. centre lathe with a brass slotted tool post, and bored it with two holes for an axis secured in a shifting block between the ways of the lathe bed, so as to fit it for spherical turning. The spherical rests described in the books, so far as I have seen them, are complex and costly. This arrangement is cheap, and a few hours' work makes all the additions to the lathe needed. It will turn, having two holes for the axis, balls from 6in. to ½in. diameter. Possibly it may be interesting to some of your mechanical amateurs, who, with a good spherical rest, could quickly turn their own croquet and billiard balls. This plan dispenses with everything not necessary, but contains everything really needed. The tool-post can be revolved right and left, so as to present the tool at a most convenient angle. It shifts, also, to regulate height of tool.



It can be dismounted in a moment, and the ordinary T replaced. In use a slight tap with a hammer sets the tool into cut, a hundredth of an inch for the finishing cut. A gouge resting on the tool cuts away the superfluous wood before it, leaving only the light cuts to be done by the fixed tool. Plan and section inclosed.

REFERENCES.—*a*, brass or hard wood block between *ff*, ways of lathe bed; *b*, screw passing through *a*, and through foot of the common T rest, *e*, section; *hh*, lock nuts, *j* washer, *i* nut, *c* cylindric tool post of metal fitted to foot of T rest, T being removed, *d* tool held in slot of tool-post by screw *g*, *k* a second hole for the axis of motion, *i.e.*, the screw, *b*, to be used in turning smaller spheres; *l* pinching screw to hold tool-post and to adjust height and direction of tool *d*. The bed of the lathe and the under surface of the T rest foot must be smooth and even. This rest can be fitted up in a few hours, is cheap, effective, and as perfect in its action as those ten times as costly.

Washington, U.S. GIMEL.

CALCULATING WAGES.

[4851.]—THIS little table (let. 4788) would also be suitable for cases where odd half-hours were worked, if the pay ended with 6d. Thus, suppose 41½ hours were wrought, and the wages for a full week's work to be 25s. 6d., how much is to be paid? Adding, considering the 6d. as a half, we get 67. Opposite this in the table is .... 20s. 9¼d.
Subtracting, we get 16. Opposite this is...... 1 2

19 7¼

The difference of these two sums gives the wages to be paid. The table would be useful for calculating or verifying ready reckoners. PHILANTHROPIST.

MARINE AQUARIUM.

[4852.]—WHILE acknowledging "Cuprum's" kindness (let. 4761) in communicating the result of his experience to the readers of the ENGLISH MECHANIC, I would point out that his plan is somewhat complicated, and to dwellers at a distance from the sea rather impracticable, and in regard to the expense is very little cheaper, unless made by the owner. A glass aquarium, flat sides, to hold ten gallons, can be purchased for 10s. 6d. A less troublesome plan is to employ artificial sea water, which from the accurate knowledge which chemical analysis supplies us can be made to answer every purpose from the following formula:—
To every 100 parts of the solid ingredients, common salt 81 parts, Epsom salts 7 parts, chloride of mag-

nesium 10 parts, chloride of potassium 2 parts; add water 2,900 parts. Of course any quantity in these proportions can be mixed up. The mixture should be allowed to stand a few days for the impurities to settle, it may then be poured off; no living creatures should be put into it except weeds and plants for a few weeks, the water will thus become oxygenated; carefully stocked and its contents well looked after, it will retain its pristine purity for a length of time. The above formula costs in preparation about 10½d. per lb., and where sea water direct from the sea is unattainable (where probably the majority of our fellow-readers live) is just the thing. TINTUB.

BOILER INCRUSTATION.

[4853.]—HAVING noticed in the MECHANIC for some time back articles on the subject of the formation and deposit, and the induration of the material, on the surface of the steam boiler plates, and the great difficulty of removing the same, whether the said material was lime, magnesia, or iron, or, which frequently happens, a combination of all the three bodies. We for years had great difficulty in removing the scale, in fact, we could only remove it by absolute chipping, and that very slowly and indifferently; we tried greasing the plates, gas tar, both acids and alkalies in abundance, and all without the least effect. I thought I would try an experiment with pigeon dung, and knowing it contained when fresh a considerable quantity of ammonia as well as other bodies we threw a quantity, about half a bushel of fresh pigeon dung, into the boiler—the first time about a year ago, and have done the same each time it has been empty ever since, and have not had since then one particle of scale adhering to the plates since. The matter is thrown down, and when the boiler is let off is mere slutch at the bottom, which during the night dries into a powder, such as you find inclosed in this note. A CONSTANT READER.

OUR MATHEMATICAL COLUMN.

[4854.]—I AM glad to see in our "answers to correspondents" that one of our contributors has invited our attention to the question of a mathematical column. It would, no doubt, be "a boon to many." Only yesterday a young friend of mine, who has read my MECHANIC for a twelvemonth or more, confessed to me his difficulty in understanding the figures used in the scientific papers. "To illustrate my meaning," said he, "I cannot tell what is expressed here (p. 578) by specific heat 0·250; atomic weight 16·; atomic heat 4·" Now, my impression is that there are scores of readers of the ENGLISH MECHANIC in a like predicament. Half the information it is capable of affording is lost, because every one does not learn decimals at school, nor is every one capable of teaching himself. If, then, you should conclude to act upon Mr. Biggs's suggestion, I have no doubt you will see the advisability of beginning at the beginning, so as to lead the minds of tyros up to the mathematical problems, and not to take it for granted that all readers of the ENGLISH MECHANIC are perfect, or even amateur, mathematicians.

H. G. W.

COAL IN IRELAND.

[4855.]—PERMIT me to correct "Philanthropist's" (let. 4274) statement in one particular—viz., as to the Leinster coal formation: the coal of counties Carlow, Queen's, and Kilkenny, being all the anthracite or stone coal, nor do I recollect that any of the bituminous sort is found in that province. When I was a lad, 40 years ago, very little other coal was used in my native town, and that (called sea coal) was confined to sitting-room fires. Of later times I cannot speak positively, many of the old pits having been worked out or abandoned, and I do not know if new ones have been discovered or opened. At the time to which I refer, on a certain day in the week, housekeepers used to go to the coal market and purchase a load of coals just as they would hay or any country produce, but alas! like many other Irish industries, that is now a thing of the past. It would be a blessing to that land if the present excessive price of coals roused the people to utilise the bounties of nature lying just at their feet.

A CARLOW MAN.

The Pathology of the Chignon.—M. Lindeman continues (says the *British Medical Journal*) his investigation of the parasitic bodies (Gregarinidæ) found on the false tresses and chignons commonly worn by ladies. They are to be found at the extremity of the hairs, and form there little nodosities, visible, on careful examination, to the naked eye. Each of these nodosities represents a colony of about fifty psorosperms. Each psorosperm is spherical; but, by the reciprocal pressure of its neighbours, it is flattened, and becomes discoid. Under the influence of heat and moisture, it swells; its granular contents are transformed into little spheres, and then into pseudo-navicellæ—little fusiform corpuscles, with a persistent external membrane, and inclosing one or two nuclei. These pseudo-navicellæ become free, float in the air, penetrate into the interior of the human organism, reach the circulatory apparatus, and produce, according to this author, various maladies—"cardiac affections, especially valvular affections, Bright's disease, pulmonary affections." M. Lindeman calculates that, in a ball-room containing fifty ladies, forty-five millions of navicellæ are set free; and he concludes that it is necessary to abolish false hair, which often proceeds from unclean persons.

REPLIES TO QUERIES.

. *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[12311.]—**Hydraulic.**—I have a rainwater tank collecting the water from the roof of my house. It is 5ft. deep; the water enters the suction pipe of the pump by a tube 6in. long at right angles to the pipe, and 6in. from the floor of the tank. A plentiful collection of soot is found on cleaning the tank once a year, sometimes forming a layer of dirty water 4in. deep, but not a drop of this sooty water is pumped up.—WILSE BROWN.

[12348.]—**Spanish Pronunciation.**—I wish Mr. Wray would not insist on dubbing me "our learned friend." I know nothing of the Oriental alphabets, and cannot in the least say whether the *heth* (also spelt *cheth* formerly, and now commonly transliterated by *hh*,) is considered equivalent to the German and Scotch *ch* and Spanish *j*. I have seen a statement, in some grammar, that only one English word, *alcohol*, has the *h* made usually equivalent to the latter. The Sanscrit letters represented by *kh*, and *gh*, are said (as well as all those expressed by a consonant and *h*, as *bh*, *dh*, &c.) to be really double sounds, that, in a "perfect language," would only have needed a single character for *h* inserted between the mute and the following vowel. It is an interesting question what was the sound of the old English letter (always used till printing began) that has become *y* in a few of our words, as *you* and *yet*, while in the great majority it has become a silent *gh* (*might*, *though*, &c.) After throwing away the letter to make foreign type available, we have plainly lost the sound utterly.—E. L. G.

[12359.]—**Sulphurous Smell after Thunderstorms (U.Q.).**—Does not this arise from the conversion of the oxygen of the air into ozone? as in a room in which electricity is being developed and the spark passes through the air, this smell is very sensible.—S. BROUGHTON.

[12394.]—**Fret Saw (U.Q.).**—In what way is your fret saw mounted? if in a bow, your bow must be very weak, or you must have some back lash somewhere that wants taking up.—JACK OF ALL TRADES.

[12402.]—**Grease on Leather Bands (U.Q.).**—I know of no process that will make them look new, but a great quantity of grease may be got out by soaking in hot water and scraping, and the stains may be removed to a great extent by sponging with oxalic acid and water when damp. The above is a deadly poison.—JACK OF ALL TRADES.

[12405.]—**Boiler for Model Steamboat (U.Q.).**—The worst of these things is not being able to get heat enough, because you cannot get them fired well, or a draught up the flue. A boiler of the locomotive type would look and be best, and as large as you could conveniently get it in proportion for these things, if you wish to work them is out of the question. You could not do with less than a 2in. barrel, chimney end 1¼in., fire box 2¼in, and about 3½in. deep, and about six ⅜in. tubes through the barrel.—JACK OF ALL TRADES.

[12408.]—**Brass Moulding (U. Q.).**—I know of no process but mixing the lead and zinc, then adding to the copper.—JACK OF ALL TRADES.

[12410.]—**Chemical (U. Q.).**—This is a thing not come at as yet; copper, zinc, and Muntz metal do not do it, although they clean themselves to a certain extent by the chemical action of the salt water by exfoliation, but do not keep a clean bottom by any means.—JACK OF ALL TRADES.

[12418.]—**Resistance of Steel Plates to Air Pressure (U.Q.).**—This will depend upon the size of chamber. If I recollect right this was tried upon the Epsom line by some foreigners in 1846-7 after the atmospheric tubes were tried and found wanting.—JACK OF ALL TRADES.

[12422.]—**Steam Power (U.Q.).**—Work your steam more expansively; a counter shaft with a pair of pulleys may assist you, making a slight difference of one-third or two to one.—JACK OF ALL TRADES.

[12425.]—**Piano (U.Q.).**—I should advise you to have a fresh board put in.—JACK OF ALL TRADES.

[12426.] — **Unsound Pianoforte.**—If "A Subscriber's" piano has become a "rattletrap," which suffers the "rattles" to escape out of the trap simply in consequence of its soundboard being what many of us are, to-wit "a we bit crackit," this evil may be remedied two ways—First, by boring a small hole a little beyond each end of the crack, and widening the latter by running a common key-hole saw down it, thus preventing its sides from rattling against each other; secondly, by doing what my friend "Fiddler"—in common with many other fiddle fanciers—has, in all probability, often done—viz., introducing rather thin and very hot glue into the crack, and thereby making a sound joint, which, by the way, is not a very easy thing to do. Indeed, the attempt is almost hopeless, unless you thrust the edges asunder by a wedge while you introduce the glue, and warm it afterwards, for which purpose a hot smoothing iron serves very well, if not held too near the wood. Of course, the edges of the crack must be brought together and retained until the glue is dry. As an open slot in a soundboard is said to diminish the loudness of the sounds, you may—after widening the crack with a saw, and smoothing them with a thin file—glue in a slip of wood. The fiddle's belly—I mean the piano's—then becomes, for all practical purposes, at least as good, if not—like the ancient coat offered for sale by the Israelite, not without guile, who at once "sold" Old Clo' and his customer—"better than new." Should the soundboard have sank under the downward pressure of the strings, the only remedies I know are first to reduce the downbearings by introducing some packing between the strings and the string plate—or the fillet of the bent side—when they rest on it. If, however, the downbearing be not excessive, say not more than from 1 to 2 per cent. of the tensile force in the bass, from 2 to 3 per cent. from tenor C to pitch C, and from 3 to 5 or 6 per cent. in the higher trebles, the one thing needful is to make the soundboard more rigid. The best methods of effecting this are to block up the soundboard until sufficiently arched, and, having "shot" the backs of the belly-bars, to glue on more wood so as to make them deeper. Also, if needful, to "fit" additional bars to the back or under side of the belly, and glue them on securely, inserting a few screws (about No. 6 or 8) from the front. See my article on "Bellying," printed in No. 377.—THE HARMONIOUS BLACKSMITH.

[12444.]—**Day and Night Telescope.**—The only "speciality" I know of in the construction of day and night telescopes is that an eyepiece of low power is—or should be—provided for use when but little light is available for them. Much amplification cannot be allowed with small apertures say 1½in. to 2in. A 4in. astronomical (achromatic) serves exceedingly well for a night-glass with a power of about 12 to 30, according to the amount of light, but not so very much better than a non-achromatic glass, because at night there is but little colour to be corrected. I once made a night-glass—I don't mean a glass of grog employed for a night-cap—out of a 6in. plano-convex lens ground out of a piece of plate glass. The focus was about 100in. This was supported in a cell formed out of a piece of wood 3in. thick, with a recess 7½in. diameter (and a hole 58/10in. diameter), formed in it by turning out the material in the lathe—a wooden ring which fitted the recess being employed to retain the object-glass in its place. The tube was formed of four pieces of ⅜in. seasoned American pine wood, and the tube carrying the eye-pieces fitted into a hole about 1½in. diameter formed on a similar rectangular block. With this instrument—which, I fear, "F.R.A.S." would designate a "rough"—I could see "far into the night," sometimes too far for my peace of mind, for with it I have seen things which strongly impressed me with the notion that all my fellow Christians—notwithstanding. I was then "young" myself—were hardly so modest as—THE HARMONIOUS BLACKSMITH.

[12457.]—**Geometry.**—"Bobo" will not find any triangle in which my procedure does not produce an equal-sided rhombus; but perhaps the problem is to inscribe a rhombus whereof no angle shall be at an angle of the triangle, but one at a given point on its base, as S in the figure (p. 546). The proposer did not say "a given point," but simply a point of the base, which I assumed might be one of its ends. The problem is possible, however, with any point, as S, though not so easy. As for "P. W. H. J.," he merely describes how to make a rhomboid, but the engraver has made a trapezium.—E. L. G.

[12483.]—**Rewiring Old Piano.**—From the, now, very unusually short compass of "H. W.'s" piano—only five octaves—I presume it is even older than myself, for few pianos were, I believe, made with a compass of less than five and a half octaves after the year of grace A.D. 1799. I have had some little experience in "rewiring" old pianos, and experience has quite convinced me that it is my duty to quote, for "H. W.'s" behoof, Punch's good advice to persons about to commit another act of folly, "don't" use thicker strings, unless you are willing to incur the trouble and expense of making your ancient-keyed dulcimer stronger. Most ancient square pianos have but one pin in their belly-bridges for each string to press sideways against, consequently their bridges—and soundboards—are pushed in one direction (*i.e.*, backward) with a force equal to the total side pressures of all the strings resting on them. The common effect of this is to raise the soundboard in front and depress it behind the bridge; but this very great defect may be remedied by double pinning the bridge and moving the strings (at their ends, which are on the hitch-pins) to others which are in a continuous line with these parts of the strings between the bridges. Probably, a few additional hitch-pins will be required in the bass. I hope the wrest-pins of "H. W.'s" piano are not at the right-hand end of its case, but distributed on the back block, *à la* Broadwood. If "H. W." determines to "rewire," I should strongly recommend him to have his wrest-pins drilled. This costs but a trifle, and so greatly facilitates putting on the strings that Messrs. Kirkman had it done to some harpsichords they restored, in which wire as small as from No. 1 to about 16 is used. Unless the frame of "H. W.'s" piano be strengthened, it would be very imprudent to use wire more than one or two sizes larger for all the bichord notes which usually extend throughout the compass of old squares. I have, however, seen a foreign one (made during the last century) which had three strings down to fiddle G. Did "H. W.'s" piano belong to me, and I was afflicted with an irrisistibly insane desire to improve it, I should do the same to it as I once did to a 5½ octave square by Tomkisson formerly in my possession, to-wit, make the instrument unichord for the lower two or two and a half octaves in manner following:—Having double-pinned the belly-bridge, and also the wrest-plank bridge for about two octaves in the treble (where the side-bearing is usually insufficient to keep the strings steady enough for anything approximating to pure tone), using bridge-pins about four sizes larger than the old ones, and about 1/12in. diameter on the wrest-plank, I proceeded to strengthen the frame by introducing an iron bar above the highest treble strings, and another below the lowest F in the bass, notching the name-board to allow space for it. The trebles from C down to G were then strung with No. 12 instead of No. 9, after which Nos. 13, 14, and 15 wire, was used in nearly equal proportions, the F below fiddle G being strung with No. 15 wire, very lightly loaded by thin covering wire wound on it in an open spiral The same size was employed down to tenor C, which was the first string with its covering wire coiled closely on it. The B string was covered on No. 16, which size extended down to the lowest F. I forgot to mention, I blocked up the soundboard at the top, and down to pitch C, and strengthened it by glueing on a belly-bar 1in. × ⅜in. within 2in. of the bridge at the top C, and about 5in. distant from it at pitch C; it being tapered off to about three-sixteenths thick at each end, one of which rested on the fillet of the soundboard, and the other was about 6in. distant from the pitch C strings. This enabled me to give the strings more downbearing in the treble to the great amelioration of its tone, which was afterwards yet further improved by substituting a metal bridge on the wrest-plank for about an octave and a half. What all this cost, I am ashamed to say, but it is some excuse that I was then "young" as well as "green," which, no doubt, I yet am (more or less). The next thing to do was to improve the action; I deepened the touch, originally only ¼in., to full five-sixteenths of an inch, and made all the hammers about double their original weight, yea, even three times as heavy in the lower bass; they were then re-covered, the high treble hammers being made more pointed, and the bass hammers somewhat flatter. The tone was not only far more powerful than it originally was, but also of much finer quality; in short, the experiment was very "satisfactory," (except pecuniarily), especially after I had raised the pitch of this old instrument, so that the A keys produced sounds in unison with C of our philharmonic pitch; but then, alas, transposition by shifting its keys being quite beyond its capabilities, the singing men and women complained it was a trifle too sharp for their vocal organs. By the way, I found not many of them could play music written in C on the keys of the scale of A, so after greatly improving the old family piano, I had to re-write all the songs a minor third lower; rather small consolation for my brain and handwork, but was comforted by the reflection, "it might have been worse," for "ye practical man" prophesied the piano would be spoiled. Let me caution "H. W." against the use of brass wire, which is a delusion and a snare. The tone is, doubtless, very fine, but it won't stand in tune with steel strings. There is no difficulty in using covered steel wire in lieu of brass for old square pianos, and other instruments which have but one belly-bridge, in proof of which I may mention I once had some strings of only No. 10 steel wire covered (open) with No. 00 copper for the lower notes of the octave-stop of a harpsichord. "What man has done, man can do." If "H. W." will inform me the maker's name and date of his venerable piano, I might possibly give him further information, some of which he might possibly obtain by reading my rather long paper on the possible improvement of old pianos, published in "our" journal under the title of "How to Convert Good Old Pianos into New Ones." I have often thought if I had possessed sufficient "gumption" to have spent the time and money which was expended on the old "family" square on such an instrument as the Stodart grand therein mentioned, which sold for only 31s., the musical results might have been something more valuable; however, "H. W." may take "heart of grace," for after all his venerable piano can hardly be so old as those by Steen at Potsdam, nor even Mozart's square piano which, is yet extant; perhaps not so old as the "Zumpe" A.D. 1770, now in the possession of Messrs. Kirkman, which is, I believe, one of the most ancient pianofortes extant made in England.—The Harmonious Blacksmith.

[12502.]—**Nevill's Bread.**—No special formula for the manufacture, I believe. It is merely baked in hot-water ovens.—E. M.

[12504.]—**Sketching from Nature.**—The great requirement for correct sketching is an accurate and well trained eye. All mere mechanical contrivances have a tendency to weaken the self-relying powers of the eye, just as the constant use of a note-book weakens the memory. All that any one who has an eye sufficiently trained to be competent to commence sketching from nature should require, is to get his principal objects properly placed. This may always be done by the following simple means, which only require a little practice to become quite easy. As soon as he has ascertained, by holding his paper at a proper distance, the space his drawing is to take in, let him take the paper in one hand and a pencil in the other, then holding the former so as to cover the view exactly, let him lower it gradually, and as each principal object in turn cuts the top of the paper, let him make a dot on the edge. The same may be done at each side of the paper in turn, and thus, by drawing your pencil down and across (without marking lines on the paper), you get the exact place of each principal object on precisely the same principle as that suggested by Webb and others, while you dispense with the mechanical contrivance and gain training for your eye, which is, after all, the most important of all qualifications. When you have got the principal objects successfully placed, the minor ones are easily filled in. I have adopted the above method for many years, and while I will yield to no one in accuracy of outline, I will undertake to have my drawing all placed by the time the man with the frame and lines has adjusted his apparatus.—G. Nash.

[12510.]—**Camera Obscura.**—The dimensions are immaterial, so long as they are suited to the focal length of the lens. The ground glass is placed "flat," and a piece of tracing-paper on it if you want the drawing on paper. Ascertain the focal length of the lens, as directed on p. 494, Vol. XIII., and make the box accordingly with a little play either way. The only essentials are placing the mirror at an angle of 45°, and in the focus of the lens.—Tages.

[12523.]—**Lacquer.**—You can buy a blue lacquer for the purposes mentioned. The directions for applying it are given with it.—E. M.

[12524.]—**Holtz Electrical Machine.**—It would be quite possible to substitute a varnished tin plate for the small glass disc; but *cui bono?* I think the glass would give the best results.—Tages.

[12528.]—**Hay Asthma.**—This complaint is caused by the pollen of flowers of any sort. I have seen a lady unable to bear a glass full of garden flowers in a room. In 1850, a friend, liable to the disorder, came to shoot grouse on my moor in Teesdale on August 12. The heath was then in bloom, and he felt the effect of the pollen the moment he set foot on the moor.—Wilse Brown.

[12532.]—**Republican Months.**—The correspondent who answered this query on p. 571 omitted to give the complementary days, of which there are five in ordinary years and six in leap year. They commence Sept. 17.—Deeside.

[12537.]—**Compressing Air.**—By all means let "Mechanical Equivalent" publish the rest of his experiments. There are none, I believe, since Dalton's in 1800.—E. L. G.

[12539.]—**House-fly.**—There are two sorts of house flies, which so nearly resemble each other that few people ever think of distinguishing them. They are, however, really quite distinct species. One, the common house-fly, does not bite, having no apparatus for the purpose; the other, which may be distinguished by the wings being wider apart at the tips, and by its having the biting prong protruding from the front of its head, does bite, and when it does, makes itself felt pretty sharply. It does not often bite, however, in this country, but in Australia, where both species are also found, I have often both felt them myself and have seen the blood running down the legs of horses from the pertinacious attacks of these small tormentors. It was there I learnt to distinguish them from the common fly. The real mosquito is also common enough in this country, but it, too, seldom bites, except in particular localities, generally near the sea-coast, where there are drains or marsh, as in Lincolnshire, for instance.—G. Nash.

[12539.]—**House-fly.**—A little black pepper, a little brown sugar, mixed with water in a saucer, is a deadly poison to flies.—Wilse Brown.

[12550.]—**Seaweeds.**—I have repeatedly arranged specimens on a plate with a little water in it. The plate being gently shaken, gives the plant a good spread; begin the trimming and flatting out at one side, using a long pin, or wire, a hairpin does admirably; overlapping sprays must be nipped off with a thumb-nail or finger-nail; by gradually raising the plate, the water drains away, and leaves the seaweed behind, quite ready to be laid aside for a day or two to dry. To remove, loosen it gently with a pin or blunt knife. The very delicate species are better laid in the same manner on pieces of paper, and afterwards pressed between fine cloths, such as clean pockethandkerchiefs, &c.—H. O'B.

[12555.] — **Packfong, or Chinese White Copper.**—Several recipes having been given for this metal, I beg to send a formula I came across recently. It varies from the others which have been given, but they are all different. It consists of copper, 10·4; nickel, 31·6; iron, 2·6. As to the mixing, I know nothing, but I imagine the nickel and iron should be first melted, and the copper added afterwards.—Saul Rymea.

[12566.]—**Bees.**—The rule is for the owner of a hive to follow a swarm which leaves his premises. If he can keep it in sight—sometimes no easy matter—he can hive them, and take them home from his neighbour's land. Bee-keepers ought never to leave an empty hive in their gardens. It serves as a trap to a swarm, for bees are always in search of some habitat at swarming time, whether a hollow tree, or an empty space in the roof of a house, and will certainly fly to an empty hive.—Wilse Brown.

[12598.]—**Age of Trees.**—This is a strangely neglected question, on which something really ought to be ascertainable without refined science, if colonists could only be induced to remember it, when opportunities occur; and if the writer of the first and very ridiculous reply on p. 598 can succeed in spreading his notion that we have here a compendious and easy way of smashing up parsons, "theological myth," or anything of that sort, there will be a chance of eliciting somewhat of "visible fact" in a matter where all seems as yet the vaguest conjecture. His "reply," together with that of "M. A. B." would convey the impression that some Californian tree has been felled in which somebody has counted 3,800 or 3,900 rings (one for each year since "Abraham was a boy") and that other trees, a baobab and a deciduous cypress (it is not said where) have been felled in which somebody counted 5,150 and 6,000. Now, it would be extremely interesting to hear of any piece of wood wherein *one thousand* were ever counted, and still more, if any museum could exhibit a bar of wood, say 3in. or 2in. wide and deep, cut radially from the face of a stump, extending from the bark to an inch beyond the axis, and displaying any number above 1,000 layers. How easily might those who fell any remarkable tree (say the Californian pine whose bark stood up ten years ago, inclosing a winding stair, in the burnt wing of the Sydenham Crystal Palace, how vastly more easily and cheaply than all that cargo of bark), might they have sent us this little "visible fact," in the compass of a moderate breechloader case; and which would have been safe, in all probability, from any such conflagration! Most assuredly we may be grateful for any "facts of extraordinary longevity of trees," but not to correspondents who merely "add *other* facts" according to this disciple of Sir Richard Phillips's notion of "facts." By all means let us have *some* facts first, and then "add *other*." The test distinguishing "one fact" from "a million myths" would seem to be whether the thing happened to get copied into this thrifty bookseller's note-book, who, by the way, besides being knighted for happening to be alderman at some pageant, was the "Hampden" of his day! The Phillippian "system of the universe" was going to smash up Newton and gravitation all to shivers. Is our correspondent aware that all the trees these particular calculations referred to, the baobab of Cape Verde, the deciduous cypress of Oaxaca, the dragon tree of Teneriffe, are still each a "visible fact," standing and flourishing? Who are the clairvoyantes poor Sir Richard got to count him the rings in a living tree? Of course, though all very old trees are hollow, there is little doubt these have *had* some thousands in their day, but whether 3,000 or "5,150" or 6,000, De Candolle (from an early work whom the figures are copied and recopied) in his latest work ("Geographie Botanique," pp. 1063—5) finds no evidence for calculating, even to a millennary. Between 3,000 and 4,000 he assigns to the Oaxaca cypress (*taxodium*) if a *single* tree; but as its diameter is fully thrice that of any other known specimen, he thinks it more likely to be four or five, "soudées" like the trunks of the famous hollow chesnut tree of Etna. We must further observe that in this and most tropical trees, to prove 6,000 years age requires 12,000 rings counted, as they are semi-annual, one formed at each rainy season, in nearly all the few tropical trees that have visible rings at all. In the greater number they are indistinguishable as in mahogany; and scarcely one in 100 of tropical species have probably (like the Jamaica cotton-tree), such an annual interruption of functions as to mark single annual layers like our timber. The baobab above mentioned (*Adansonia*), is a close relative of this *eriodendron*, and like it, certainly fast-growing and short-lived, though both, at a couple of centuries old, are the monarchs of their respective woods. I have assisted at the felling of an eriodendron whose girth was 32ft. at 30ft. from the ground; the rings were about 90, and negroes present remembered it a sapling.—E. L. G.

[12598.] — **Age of Trees.** — Why cannot "A Believer that One Fact is Worth a Million Myths" (answer to query 12598) speak of the ascertained age of certain trees without indulging in a gratuitous sneer at what he calls a "theological myth"? What it has to do with the trees I cannot well see; they may have been growing for millions of years instead of thousands for all that theology says to the contrary, provided it is not at the same time asserted that they are younger than Adam. The reason why naturalists' statements have not always received implicit credence is due to no such absurd prejudice, but to the difficulty of obtaining an exact estimate of the number of zones in the wood by an outside measurement of the tree. So many causes may operate on a tree, particularly when young, to make it grow faster or slower, or more or less irregularly, that we cannot speak with anything like certainty as to the age until it is felled and the rings carefully counted. Measurement and calculation can only give an approximation. As theological discussions are excluded from the pages of this journal, correspondents should be careful to avoid giving provocation by making statements and allusions which others are not allowed to answer, and above all they should not, as in this case, sneer at the views of their opponents, without being quite sure that they know what those views are.—Vertumnus.

[12608.]—**Bookbinder's Press.**—"Dublin Subscriber's" question refers to a bookbinder's press, not a bookbinder's plough, as illustrated and answered by "Jack of All Trades" this last number.—Zeta No. 1.

[12613.] — **Excessive Perspiration.** — In the Brompton Hospital for Consumption they give tincture of zinc three times a day. Any chemist on reference to a Pharmacopœia, will tell you the dose. Buy threepenny worth, and find how many drops in water to take, if expense is an object. Wear flannel, but not in bed.—Zeta No. 1.

[12631.] — **Fixing the Bloom of Scarlet Runners.**—The falling off of the bloom of scarlet runners is very general this year. Some assign the cause to excessive heat. Fuchsias in the open garden also drop their petals. Give water freely; liquid manure if possible, and the later blooms of scarlet runners will pay for the trouble.—Zeta No. 1.

[12638.]—**Fleas in Dogs.**—"Countryman" will find common sweet oil, poured down the middle of the back of dog, a safer remedy than sulphurous acid. A solution of stavesacre flowers answers equally as well, and of all the dog soaps advertised, the best is the Japan soap, prepared by Rackham, of Norwich. An owner of upwards of eighty dogs, of various breeds, has tried them all, and ought to know something.—Zeta No. 1.

[12639.]—**Worms in Pony.**—Get an areca nut or two from a chemist, grate it on a nutmeg grater, and give it twice a day, in any kind of food, or made up as a pill. For a pony about as much as will cover a shilling, for a dog one-third that quantity. The cost of nuts are 2d. each, large size, and have proved very sure on all cases I have tried and elsewhere.—ZETA No. 1.

[12642.]—**Ice Cream.**—Put into a bucket 1lb. of ice broken rather small, throw two handfuls of common salt upon it, and leave it in a cool place. Put the cream into a pewter ice-pot, or an ordinary pint or quart milk can, with a tight-fitting lid, will do. Immerse it in the ice, and draw the ice round the pots so as to touch every part, then commence spinning the can round in the buckets by means of the handle on the lid. Every few minutes take a spoon and stir the cream so that it may freeze equally—stirring quickly increases the cold. As the ice in the bucket thaws, fresh should be added, and the water thrown away. The cream for iceing is thus made:—New milk one quart, yolks of six eggs, fine sugar 4oz., mix, strain, heat gently, and then cool. To this may be added any essence or flavouring you think proper.—E. R. WIGAN.

[12648.]—**Dictionary of Scientific Terms.**—There is a small one by Dr. Nuttall, published by Strahan and Co., 56, Ludgate-hill, about 5s. in price. There is also a more comprehensive one by Dr. Stormonth, published by Blackwood.—N. S. HEINEKEN.

[12649.]—**Kites.**—I send the description of a bird-kite which can be very easily made. The only materials are some stout glazed calico, a lath, a couple of good sound canes, some wire and string. Cut the calico to the shape of a hawk with outspread wings; omitting all minor details, and aiming only at the general outline. 2ft. 6in. from head to tail, and 4ft. 5in. across the wings, is a very good size. The canes, which should taper at the ends, should be 2ft. 10½in. each, and are inserted in the hem of the upper edge of the wings. At 9in. from the end of each cane a hole must be drilled, through which a stout wire pin, bent into a ring at the top, is placed, which itself fits into a hole made at 9in. from the top of the lath. It would be safer to tie a piece of tape to the pin, with which to wrap round the place of joining. A flat piece of wood 11in. long, and nearly 1in. wide, run through a broad hem at the bottom of the kite, will serve to keep the tail stretched out. The tail proper is composed of wire hoops, to which are attached conical cups, in the manner described by "Q Yorke," five of which are quite sufficient. If these directions are not intelligible enough, I shall be glad to answer any questions.—C. N. W.

[12653.]—**Poultry Keeping.**—A young woman, daughter of an innkeeper near Liverpool, was left alone one evening. She heard a noise in the poultry-yard, took a pistol loaded with small shot, went to the fence round the yard, and saw two men catching the birds in the dark. A scream from one of the men followed the report of the pistol, and both dropped their game and bolted.—WILSE BROWN.

[12657.]—**Cutting Cylindrical Glass.**—Heat a stout iron wire or thin rod to redness. Heat the neck of the bottle in a gas flame, and touch the hot part with a drop of water, which will produce one or more cracks. Then guide the crack in the desired direction by applying the red hot iron. The crack will follow the course of the wire, and the glass can thus be cut in any manner.—ALFRED H. ALLEN.

[12663.]—**Sunrise.**—The "Ephemeris," published by the Astronomer Royal at Greenwich, will give all the information "Delta" requires.—WILSE BROWN.

[12664.]—**To Stereotype Brass Blocks.**—When I get a new block cut, some customers want their printing done in black and some in metal leaf, so that if I could take an impression of the brass block I could have three or four working at once. They would cost but little, whereas if I must get three or four more brass blocks it would come very expensive. If I could cast them in brass it would be much better.—J. B. SHARPLEY.

[12665.]—**Sea Sickness** can be prevented by the voyager getting all strings, straps, and buttons loosened, and berth-gear put on whilst the vessel is still; keep the head on a low pillow, "screwed down," as a friend of mine once said, and determinately maintain the one position, not raising even a finger, not moving a limb, the whole time the steamer is in motion. "What man has done man may do," and I have tried and been successful.—H. O'B.

[12665.]—**Sea Sickness.**—Repeated small doses (10 grains) of chloral hydrate are said to have a marked effect in preventing sea sickness. I have myself avoided it when nearly every other passenger was ill, by sitting between the paddle-wheels (or as near the centre of the vessel as possible, not only from end to end but side to side), and carefully avoiding a view of the waves by reading an interesting book. A game of chess has answered the same purpose very effectually.—ALFRED H. ALLEN.

[12665.]—**Sea Sickness.**—Do not eat for two or three hours before going on board. Swathe the abdomen tightly with a broad bandage from ribs to hips; take 10 drops of chloroform on sugar or peppermint water as you go on board; lie down at full length as near centre of vessel as possible, and with head to vessel's stern, but not close to engines, as the oily smell and heat often sickens, and go to sleep.—M. A. B.

[12665.] — **Sea Sickness.**—Moderate doses of "hydrate of chloral" taken immediately on going aboard with an assumption of the recumbent position effectually preserved a party from sickness when crossing the Great Belt, from Denmark to Norway, and *vice versa*, although the passage was rather rough and vessel small. Recently, I prescribed doses of 15 grains in orange flower-water to a friend going to Quebec, and he writes that he was the only passenger free from sickness in the ocean steamer. The chemist prepared the doses in a graduated bottle, and my correspondent felt no discomfort whatever.—P. F.

[12665.]—**Sea Sickness.**—Eat a hearty meal of good plain food before starting, that the stomach may not be empty. When on board, avoid a hot rich dinner in the saloon, but have bread and cheese and ale on deck. Take brandy with you, but only use it as a last resource, and then drink a little, as nearly neat as you can bear it. Have some dry biscuits with you, to be eaten slowly if the feeling of sickness comes on. During the voyage, if the vessel pitches or rolls, do your best to stand; face the breeze and watch the motions of the ship so as to understand them and overcome all fear with respect to them. Above all, resolutely determine not to be afraid. Do not start, as I believe some people do, thinking about sea-sickness, expecting to be sick, wondering whether it is rough enough, and when you ought reasonably to be expected to begin. Go with the full confidence that you will not be sick and don't mean to be, but to enjoy the voyage instead; and then I think that with the precautions I have named you ought to get through your day comfortably, unless you are an exceptionally bad sailor, or the weather is unusually rough.—CERVUS.

[12665.]—**Sea Sickness.**—A light bandage pressing gently across the stomach I have proved to be a great comfort in heavy weather. If sickness should come on, avoid "brandy and soda," the stomach is irritated enough already. A little ice or iced water is good. And to bring the stomach round, nothing can do it more effectively than to eat very slowly; and well masticate a small plain hard water biscuit, taking also a small cup of strong tea without sugar or cream (sip this gently). If you can lay this foundation, supplement it with some beef tea. Twenty-eight years of sea journeying have convinced me that attention to diet will tend more to prevent sickness than the 101 nostrums vended.—JOE.

[12671.]—**Dressing Jack Line.**—"J. D." had better not use any waterproof composition for his lines. After years of experience as a salmon and trout angler I have come to this conclusion:—I have tried numbers of recipes—varnishes, plain boiled oil, &c., and the result invariably was the speedy decay of the line on the one hand, and increased weight on the other, so that the light cast, when the tail-fly should first touch the water, is not easily attainable. For a different reason I object to the staining of salmon or trout gut. The angler forgets, that although the plain gut appears very white to him when he looks down on it in the water, if he could look upwards through the water he would fail to see the gut-line, except by its disturbance of the water, the gut when wet being nearly transparent; but if he wishes to stain it, his best plan is simply to steep the gut-line a few minutes in lukewarm tea-water that remains in the pot. The reel-line I used was a thin one of plaited green silk. I had it in constant use for five years, and a bit that still remains I could not break by a fair pull. Of course, it was only used in fresh water; many a salmon I held with it, and the only precaution I adopted was to reel off the entire line immediately on my return from fishing and hang it on pegs to dry. "J. D." would require a powerful rod for pike, and I recommend him to adopt the one-splice rod; the best made either of pitch-pine or well-seasoned ash, from a tree that has grown in poor soil; and the top of lance wood. My rods were made thus, of 18ft. and 16ft. Those pretty toys of screw rods would soon come to grief with a 15lb. salmon. The best colours for salmon flies in August are a rich deep blue, and a claret nearly black; for September, the latter colour and plain gray bodies, each with fiery brown hackle at shoulder, and later in the month a blue jay's hackle.—E. J. D.

[12671.]—**Dressing Jack Line.**—"J. D." had best use indiarubber dissolved in bisulphide of carbon. If he had not rubbed it with wax I would have recommended steeping in a solution of catechu; solutions of shellac are good, but make the line too stiff, increasing the liability to "kink."—SOUTH LINC.

[12674.]—**Plant Boxes.**—I have seen Dutch tiles make a very pretty bordering for windows; the tiles are about 5in. square and ¼in. thick. It is merely a front and two ends, there being no bottom or back; the front is made like a picture frame, the depth of the tiles and length of the window it is intended to go in. It is placed on the window ledge before the flower-pots, and a screw in each end to keep it firm. If a back and bottom were put to it it would answer instead of pots.—F. S. M. W.

[12676.]—**Book-Keeping.**—The money invested in furniture, machinery, &c., must be considered as capital, and entered to credit of capital account, not to debit of profit and loss; only current expenses should be posted to the latter, such as rent, wages, packing materials, &c. All expenditure on work increasing the value of the plant, &c., is, or should be, capable of being realised again as cash or capital, and, therefore, should be considered as such; subject to a yearly deduction for depreciation in value, which latter item only should be carried to profit and loss.—LOACH.

[12676.]—**Book-Keeping.**—I suppose that "Book-keeping" charges his outlay for machinery to furniture account, and if he has a large expenditure for machinery carried quarterly or half-yearly to capital account, no wonder that his capital will appear to be diminishing. I would suggest that a "machinery account" should be kept and not closed, into which it would be quite legitimate not only to debit outlay for machinery proper but repairs—writing off a certain per centage yearly for "wear and tear." The balance of this account would then be an asset, and very properly so. This is the plan adopted by a Spinning Co. (Limited), whose books I audited at Christmas.—SENECIO.

[12680.]—**Darkening Graduations on Scales.**—First well clean your scales with turpentine or spirits of wine, and a piece of cotton wadding, then take a saucer and hold over a lamp or candle flame, and collect the carbon upon the same, next get a few drops of copal varnish and mix it up with your finger end and well rub it into the scales, and wipe it off clean with the palm of your hand, put by to dry for a day, then you may clean your face thoroughly with a piece of cloth and elbow grease.—JACK OF ALL TRADES.

[12681.] — **Is the Interior of the Globe Vacuum?**—From experiments made on the attraction of the earth, by observing the length of the seconds' pendulum at the top of a mountain or the bottom of a mine, it has been ascertained that the earth's specific gravity is about six, roughly, therefore its interior must be composed of much heavier matter than that which constitutes its surface. A pendulum vibrates more slowly at the top of a mountain than at the surface of the earth, because the attraction is less, the distance to the earth's centre being greater; it also vibrates more slowly at the bottom of a mine, as the attraction of the portion of the earth above the pendulum opposes to some extent the attraction of the rest of the earth. (There is an error in the query; the core, if possible to exist, would be 6,900 miles in diameter, not 5,000.)—PHILANTHROPIST.

[12681.] — **Is the Interior of the Globe Vacuum?**—I extract the following from Ansted's "Physical Geography," for the benefit of "Balcairn:"—It has been calculated by Professor W. Thomson, Glasgow, and Mr. W. Hopkins, Cambridge, that the crust of the earth must consist on the whole, and to an enormous depth, of some kind or condition of solid material more rigid than steel. If it were not so the height of the tides and the amounts of procession and nutation would be smaller than they are found experimentally to be. . . . . It seems that at least half the distance from the surface to the centre must be solid and rigid, to enable our planet to preserve its figure and allow the tides of the ocean and the movements of the earth to remain unchanged." The numerous volcanos and geysers sufficiently answer "Balcairn's" question about the heated interior. — RASSELAS.

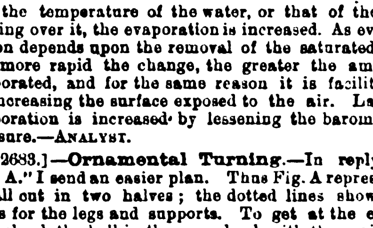
[12681.]—**Is the Interior of the Globe Vacuum?**—Mathematicians, as a rule, I believe, are inclined to favour the theory that the globe is solid. I would advise "Balcairn" to read what Thomson has to say upon this subject. I think his views are published in the Edinburgh "Philosophical Transactions." I have not made this branch of science a study, and would prefer to hear the opinions of "F.R.A.S.," Mr. Proctor, "E. L. G.," or J. H. Smith, upon the subject. At any rate, I fancy, that at the end of a discussion upon the question some of us would hold one opinion, and some the opposite. I doubt, too, whether it can be brought forward in a popular manner—*i.e.*, without the aid of higher mathematics. A large question, there is plenty of room for the mooting of theories, but will the ultimate good be sufficient to compensate for the space occupied?—C. H. W. B.

[12682.]—**Evaporation of Water.**—"Tintub" gives insufficient data. I think the question involves temperature, motion of atmosphere, &c.—C. H. W. B.

[12682.]—**Evaporation of Water.**—The rate of evaporation of water depends upon (1) the temperature of the water; (2) the temperature of the air; (3) the barometric pressure; (4) the more or less rapid removal of the air saturated with moisture. By raising the temperature of the water, or that of the air passing over it, the evaporation is increased. As evaporation depends upon the removal of the saturated air, the more rapid the change, the greater the amount evaporated, and for the same reason it is facilitated by increasing the surface exposed to the air. Lastly, evaporation is increased by lessening the barometric pressure.—ANALYST.

[12683.]—**Ornamental Turning.**—In reply to "T. A." I send an easier plan. Thus Fig. A represents a ball cut in two halves; the dotted lines show the holes for the legs and supports. To get at the exact line chuck the ball in the cup chuck with the grain of the wood across the chuck, with the corner of the chisel

FIG. A



mark a circle at C, then at D, and at E (of course the lathe must be in motion); next with a pair of compasses mark three dots with point of the compasses at equal distance apart; chuck the ball in the cup chuck in such a manner that one of the points marked shall revolve true as a centre—that is to say, the dot shall represent the centre; then bore the hole with the bits as described before, the holes should be quite through the ball, and so with the other two holes. When done, if care be taken, the six holes will be equal distance apart on each line; if the legs are required to stand wide apart, make the circle C and E nearer the centre of the ball; if to stand closer, farther from the centre. Any further information I will send if required. —SAMUEL SMITHER.

[12692.]—**Deliquescents.**—Sulphate of lead and nitrate of ammonia, muriate of lime and nitrate of soda, acetate of lead and sulphate of zinc, citric acid (in crystals) and carbonate of potash, carbonate of ammonia (3 parts) and sulphate of copper (2 parts). Powdered and rubbed together in a mortar.—T. P. H.

[12696.]—**Atmospheric Pressures.**—The Board of Trade's "Barometer Manual," price 1s., contains tables applicable to small heights, up to 500ft. from the sea level, and the formulæ for extending similar calculation to all heights. The rate of decrease upward varies greatly with temperature. The warmer the atmosphere, the higher must you ascend to reach a given diminution of pressure.—E. L. G.

[12696.]—**Atmospheric Pressures.**—The following table is copied from Brooke's "Natural Philosophy":—

Height above Sea Level.	Height of Barometer.
0 feet	30·0 inches.
5000 ,,	24·797 ,,
10000 ,,	19·000 ,,
15000 ,,	16·941 ,,
3 miles	15·00 ,,
6 ,,	7·50 ,,
9 ,,	3·75 ,,
15 ,,	1·00 ,,

—ALFRED H. ALLEN.

[12696.]—**Atmospheric Pressures.**—I know of no book giving such a scale as J. M. Taylor requires. It is not difficult to ascertain the pressure at any given point, and I have no doubt that if Mr. Taylor mentions any particular place some of your correspondents would give him the pressure. Why not make a table himself?—C. H. W. B.

[12698.] — **Vermin.**—Let "Sleepless" get six pennyworth of oil of rue in a small bottle with a cork (not a glass stopper), and wrap the bottle in his night-shirt when he gets up. I think he will not be plagued with fleas after the first night. Proved.—J. R., Jun.

[12699.] — **Onions.**—"Giant rocca" or any other "winter onion" requires no frame. Now is the time to sow in well-manured ground; if in a warm situation, so much the better; dig deep, and tread the top firm. I have just gathered a splendid crop of "giant rocca" sown this time last year.—SOUTH LINC.

[12700.] — **Bees.—Removing Supers.**—I have tried a number of ways for the last twenty years with varied success. My greatest difficulty often arose from having to leave the supers or glasses before I could get the bees out. An apiarian friend, Mr. Richard Aston, has invented a bee trap attached to a board. I simply place the super or glass on the board, and leave them. A bright day from nine in the morning to three in the afternoon is the best time for removal. You may place your bees thus removed to almost any part of your garden, covering glasses to make them as dark as possible, the entrance of the trap facing the light. Your bees will quickly pass through the trap, but cannot return, joining the parent hive as if nothing had happened. By this means I have removed about 20 supers and glasses this season, and only once had trouble with the queen; on which occasion I got the queen into any empty glass, placed a piece of zinc over the glass, inverted the glass, and placed it on the top of the hive, carefully withdrawing the zinc. We have 25 stocks at present in our apiary and garden, and I find it a great relief to be able to leave my glasses as long as I like, and attend to other pursuits.—APIARIAN.

[12700.]—**Bees.—Removing Supers.**—Choose shortly before sunset, and with a thin bladed knife remove the propolis by which the super is fastened to hive. Push a piece of sheet zinc under the super, remove to a short distance, place on its side upon the ground, and if the super is of glass cover with a cloth. After ten minutes remove the zinc, and the bees will in a few minutes go to the hive. Watch for this, and remove the honey, or the bees will return and deposit it to the main stock.—JANNIFRED.

[12703.] — **Fuchsias.**—There are several things that will cause this: sudden removal to a colder atmosphere; letting them suffer from drought; their being in too small pots, and becoming pot bound, so that the rootlets come in contact with the pot, and suffer from the heat of the sun when exposed to its rays; watering with too cold water, more especially if watered when the sun is broiling them, and sometimes from the pot being badly drained.—JACK OF ALL TRADES.

[12704.] — **Maple Veneers.** — Get a perfectly smooth bench or board on ditto, and plane them with fine set smoothing plane or tooth plane, a little each side till you get the ridges off. If you are going to veneer mouldings, you must get it nearly as thin as writing paper. Fix with hand screw to board or bench, and plane *from*, not *to* your fixing.—W.

[12704.] — **Maple Veneers.**—"Old Hatter's" veneers must not be up to much, or they would not show the saw cuts. I cannot see any better mode than well damping them with hot water on one side, then glue, and lay them immediately. If the veneers are very stout, tack them down, and use a plane carefully on them, or a scraper; when dry, finish off with a moulding plane or a steel scraper; be careful not to knock out the bird's eyes; although, I doubt if they will see any worse than before, if you do so.—SAMUEL SMITHER.

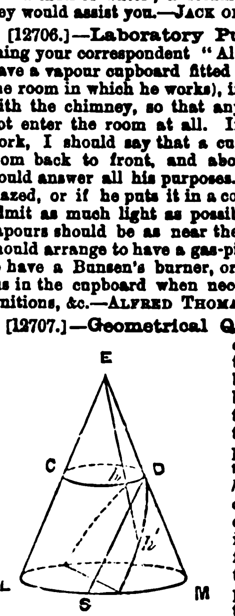
[12706.]—**Laboratory Purification.** — Never open the door of your laboratory. If you want a current of air, open the window at the top, and also at the bottom—the nearer the ceiling and floor the openings are the better. If you choose to assist the exit of noxious fumes and vapours, the following is an excellent plan. You have, doubtless, seen those circular ventilators in the tops of windows which revolve very rapidly when the heated air in the interior passes out. They are made similar to a marine screw-propeller. Fix a cord over a bobbin attached to the centre of the ventilator, pass the cord round a large wheel and fasten up; you can then turn the wheel. The ventilator spins round with great velocity, and sucks the foul air out of the room in a twinkling.—JOHN HOPKINS.

[12706.]—**Laboratory Purification.**—The best ventilator you can have is an Arnott's valve placed (as near the ceiling as possible) in the chimney breast—but noxious gases should as far as possible only be liberated in a gas-closet, which is simply a closet fixed beside the wall with openings top and bottom into the external air, and a glass front with sliding doors to enable you to see and regulate the operations conducted therein.—WILLIAM PARKER.

[12706.]—**Laboratory Purification.**—Let some air-bricks into the wall at foot, and ventilate into some chimney. Much may be done by a box of quicklime and a tank of water; a steam jet up a shaft or chimney would assist you.—JACK OF ALL TRADES.

[12706.]—**Laboratory Purification.**—The best thing your correspondent "Alastor" can do will be to have a vapour cupboard fitted up in his laboratory (or the room in which he works), in direct communication with the chimney, so that any obnoxious gases may not enter the room at all. If he does not do much work, I should say that a cupboard 24in. long, 18in. from back to front, and about 24in. to 30in. high, would answer all his purposes. Three sides should be glazed, or if he puts it in a corner, only two sides to admit as much light as possible. The outlet for the vapours should be as near the top as possible, and he should arrange to have a gas-pipe near so as to be able to have a Bunsen's burner, or other heating apparatus in the cupboard when necessary for evaporations, ignitions, &c.—ALFRED THOMAS JENKINS.

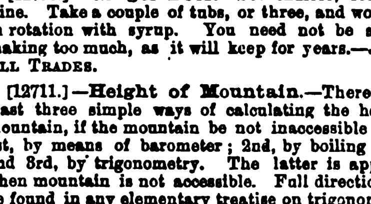
[12707.]—**Geometrical Query.**—Let ELM be a cone, CD a circular section of it, the circle to be projected into a parabola, E the position of the eye, DS a section of the cone made by a plane parallel to EL; this section is a parabola. Let h be any point on the circle, join Eh and produce it to h'; h' is its projection, and so, for any other point, the cone should be produced indefinitely in the direction towards LM.—PHILANTHROPIST.



[12710.]—**Ginger Beer.**—See indices, for ginger wine. Take a couple of tubs, or three, and work them in rotation with syrup. You need not be afraid of making too much, as it will keep for years.—JACK OF ALL TRADES.

[12711.]—**Height of Mountain.**—There are at least three simple ways of calculating the height of mountain, if the mountain be not inaccessible itself—1st, by means of barometer; 2nd, by boiling water; and 3rd, by trigonometry. The latter is applicable when mountain is not accessible. Full directions will be found in any elementary treatise on trigonometry—*e.g.*, Todhunter's "Smaller Trigonometry," or Hamblin Smith's, &c., &c.—C. H. W. B.

[12711.]—**Height of Mountain.**—Observe the elevation at two points, A and B, in line with the summit of the mountain, and measure the distance AB. Let the observed angles be a and β respectively. Angle



ACB $= \beta - a$; whence, by the rule of sines, BC $= \text{AB} \times \dfrac{\sin. a}{(\sin. \beta - a)}$; but FG $= \text{BC} \times \sin. \beta$; $\therefore$ FG $= \text{AB} \times \dfrac{\sin. a \times \sin. \beta}{\sin. (\beta - a)}$; and similarly F B $= \text{AB} \times \dfrac{\sin. a \times \cos. \beta}{\sin. (\beta - a)}$. P C, added to height of observer's eye, gives the height, and FB gives the distance of the mountain.—W. AIREY.

[12711.]—**Height of Mountain.**—Your best plan would be to ascertain first the distance of the mountain by means of a base line and quadrant; the height can then be calculated in the usual manner.—ALASTOR.

[12712.]—**Linseed Oil.**—Take spirits of turpentine.—JACK OF ALL TRADES.

[12714.]—**Echo of Sound on Water.** — The velocity of sound in water is about 4,708ft. per second, or more than four times the velocity in air. Therefore, a listener on the banks of Lake Simcoe, five miles from the discharge of the guns, would first hear the sound conveyed by the water, afterwards the more tardy air would produce a second impression. If "Gillem" was stationed at the end of a long iron pipe, while I struck the other end with a hammer, he would first hear a loud rap transmitted by the iron, and after a time a second faint rap transmitted by the air. —JOHN HOPKINS.

[12714.]—**Echo of Sound on Water.**—In the absence of data as to the elevation of the guns when fired, the state of the atmosphere, proximity of mountains, and the surroundings of the town and lake, it is almost impossible to answer the query satisfactorily. The sound would scarcely be carried by the water, although the latter is an excellent conductor, for sound seldom passes from one medium to another, unless they are of nearly equal densities.—ALASTOR.

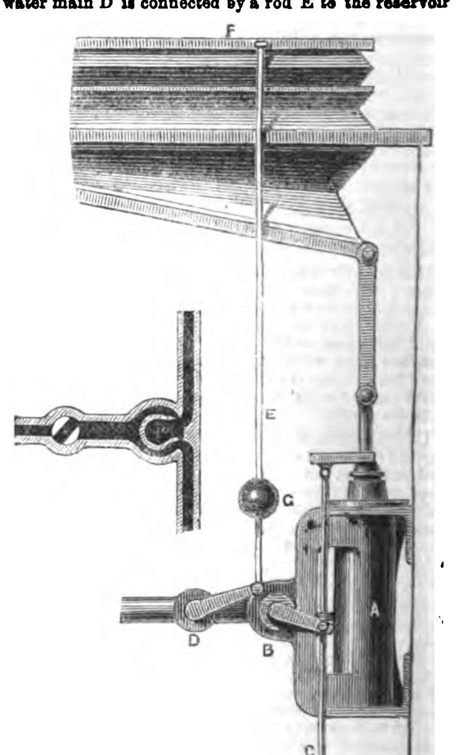
[12716.]—**Watch Drills.**—Get some silver steel wires and file them near the size required. Heat them in a candle and plunge them in the tallow; it is a rare thing to over heat them that way; grind them either on a stone or glazer, and point them on a Turkey or Arkansas stone for use; these I use without tempering.—JACK OF ALL TRADES.

[12719.]—**Medical Coil.**—Yes, Daniell cells do first rate for use with coils, and will do very well to work a clock, but are expensive to keep going.—WM. PARKER.

[12719.]—**Medical Coil.**—It will not be preferable to abandon the Daniell cells for a quart bichromate battery. I have used Daniell cells to work a medical coil, and would prefer three-pint Daniell cells to one-quart bichromate any time. You must only consider your cells three-pint Daniell, not four-pint cells. Leclanché's cells are preferable for clocks on account of their constancy.—JOHN HOPKINS.

[12720.]—**Medical Coil.**—"No. 170" is mistaken concerning screwing down the contact breaker to get a continuous current, he would simply get no current at all by these means except a momentary one. He doubtless means a current in one direction only. In most coils, the current is one way and then the other on each break of contact. If his coil is one of these he must be satisfied with one kind of current, and if not, he must purchase another coil which gives currents in one direction, or backwards and forward according to arrangement.—JOHN HOPKINS.

[12721.]—**Hydraulic Machine for Blowing an Organ.**—A is a cylinder similar to a steam-engine, B a valve moved by tappets on an adjusted rod C; the water main D is connected by a rod E to the reservoir



of wind F at such a position that when the reservoir descends by the exhausting of the air, the cock D is opened by the weight G, and the engine is set in motion. Cannot say what would be the cost of one. There is one of these machines at the Temple Church, Fleet-street, London.—J. B. CLAY.

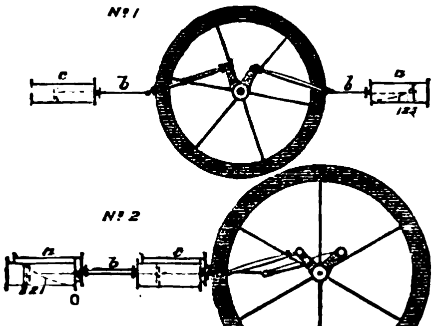
[12722.]—**Coal Getting.**—We have now two styles, one after that of a man hewing, and another after that of an elliptical saw, sawing or scraping the coal out. I have reason for preferring the former.—MECHANICAL EQUIVALENT.

[12722.]—**Coal Getting.**—There are some very good descriptions of coal-cutting machinery, with illustrations, in Vol. I of ENGLISH MECHANIC, Nos. 4 and 10, showing how compressed air is conveyed to the workings, and other valuable information.—W. BAKER.

[12723.]—**Compressed Air.**—I hope some of our friends will enlighten us upon this subject, as I have seen a patent apparatus with the six pumps worked by a twelve-horse engine labouring very hard for some hours to get a pressure of from 4lb. to 6,000lb. per square inch, but failed; the tremendous heat generated prevents the pumps from getting a full feed; but it is my belief that between 70 and 80 per cent. of that is generated by the friction of the pistons against the pump barrel, and not by the compression of the atmosphere. I hope some one will tell us a little about this, as I believe it will be a better way of ventilating the mines, as well as making a difference in price of coal in more than one way—viz., by cheaper working, and enabling us to get at and work coal that cannot be worked by any other means.—JACK OF ALL TRADES.

[12723.]—**Compressed Air.**—The best air-compressing machine is an ordinary steam cylinder and piston, the slide-valve of which works in opposite direction to slide-valve of the steam-engine by which it is driven. The air is then taken into the cylinder by the exhaust-pipe, and discharged after being compressed through what would be the supply steam pipe into the vessel prepared to receive it. Various other methods have been tried with engines without fly-wheels, but they do not appear to do so well, not being so steady.—COLLIER.

[12723.]—**Compressed Air.**—I send diagram of an engine, or rather compound engine, for compressing air, which is at present working as a commercial success (No. 2 engine). *a* are the air compressing cylinders, *c* the steam cylinders, and *b* the piston-rods, the air escape valves are weighted to 45lb. per square inch, consequently the air is being compressed to four atmospheres, the effective working pressure being three atmospheres. The dotted curved line in the air compresser shews the ratio of compression as the piston traverses the cylinder. It will be seen that the terminal pressure is not reached till the piston has accomplished three-quarters of its journey. Consequently, if the cylinders of the engine utilising this compressed air are of equal capacity, and worked non-expansively, the engine compressing the air will have to make four strokes, while the engine utilising it makes but one stroke, or otherwise, we must have reservoirs of compressed air, so that while the engine utilising the air is worked intermittently, the compressor can work continuously. I here take no notice of the loss of power by the generator of heat in the compressing cylinder when this heat is afterwards

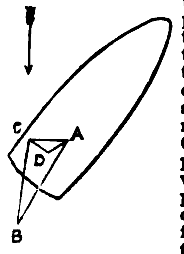


lost. One fact, however, is very important to notice—viz., the comparatively little opposing pressure of the air being compressed during the earlier part of the stroke. The maximum resistive force being the terminal pressure during the last quarter of the stroke, this necessitates the use of double engines when by the alternate action of the engines, and the momentum of the moving parts, accumulated during the earlier part of each stroke, the power thus accumulated is in practice found sufficient to urge forward the piston forward through the latter part of the same stroke, and even to compress the air to a tension greater than that of the steam. With single engines this is impossible, because the maximum power is required at the latter part of each stroke, causing a jerking motion to the engine, of an injurious nature. By a different arrangement this may to some extent be avoided even with a single engine, by having the cranks set at an angle of 60° instead of 90°, the general plan of which is apparent by an inspection of No. 1 engine. Our editor has a plethora of communications, so I had better conclude. If "Inquisitive" desires more information, I will either send it or communicate privately.—MECHANICAL EQUIVALENT.

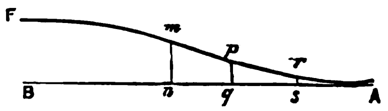
[12725.]—**Fused Chloride of Silver.**—From the description given, I fancy "Argentine" has in some way got the chloride converted into metal. The heat required for the fusion is very moderate—below redness—and the operation must not be performed in a metal vessel. Did "Argentine" use an iron pot or ladle?—ALFRED H. ALLEN.

[12726.]—**Motion of a Sailing Boat.**—When a boat is sailing, no matter whether close to wind or not, she moves from the point on which the wind presses most; but it must likewise be taken into account that a sailing boat is so constructed as to move easily ahead or astern, but with difficulty broadside ways. When a boat sails close to the wind's eye there is more pressure on the aft than the fore part of the sail, therefore she goes ahead. As a proof of what I say, run her up to the wind, and three or four points more, and keep her so, and then she will sail astern, because the most pressure is then on the fore part of the sail. A slate sinks zig-zag in water, because, although the attraction of gravity is equal the resistance is unequal, it being easier to sink edgeways than broadside first. A perfect globe of metal will sink straight.—DAVID CHRISTIE.

[12726.]—**Motion of a Sailing Boat.**—Let the accompanying figure represent the boat, the direction of the wind being indicated by the arrow, the direction of one of the sails is A B (the mainsail, &c.). Let C B indicate the force of the wind in direction and magnitude, it can be resolved by the parallelogram of forces into the two forces C A and A B respectively perpendicular and parallel to the sail; the latter has no effect, the former gives the pressure on the sail. It may be resolved into the two forces C D and D A respectively perpendicular and parallel to the vessel's keel; the force C D produces lee way, but the shape of the vessel adapts her to go forward much more easily than sideways; the force D A propels her. As to a slate, &c., sinking in an oblique manner or zig-zag in water, the centre of gravity does not coincide exactly with the centre of pressure.—PHILANTHROPIST.



[12728.]—**Wave Pattern.**—A body moving under the influence of a uniform accelerating force, such as gravity, describes spaces varying as the squares of the times taken to describe them. Let A *r p m* be a portion of the water line of one side of a vessel, A being the bow, and A *s q n* B a line passing through the middle of the vessel at the water line; A *r p m* and *m* F are two parabolas meeting so as to have a common tangent at *m*. Now, if we take equal distances A*s*, *s q*,



q n, along A B and draw the perpendiculars *s r*, *q p*, *n m*, these vary as the squares of the distances A *s*, A *q*, A *n*, and thus the water is separated as it would be by a uniform force. A *n* is one quarter of the vessel's length at the water line if *m* be the point where the two parabolas have a common tangent. A vessel constructed in this manner raises hardly any wave at any place. Bourne, in his work on the screw propeller, a rather dear book, describes this matter fully. More explanation if desired.—PHILANTHROPIST.

[12729.]—**Breech-Loaders.**—If "Faber" could get the Proceedings of the Mechanical Engineers for 1871, I think he would find therein no less than sixty-nine drawings of breech-loaders, details, &c. Unfortunately, these Proceedings cannot be bought, but may be borrowed, if "Faber" has a friend belonging to the association. I have often spoken of this exclusiveness of societies, and would again strongly urge attention to it. They profess a desire to disseminate information, yet refuse to let the public buy their reports. You must join us or go without, is the cry. Personally, I am greatly interested in this *Journal* of the Mechanical Engineers. I want to see all the numbers I can, yet hitherto have been unable to obtain a sight of more than the one above mentioned. Is any mechanical engineer willing to assist me in this matter? If thought desirable, I will make tracings of these drawings, so that, at any rate, readers of the ENGLISH MECHANIC may snatch this information from the hands of the few.—C.H.W.B.

[12730.]—**Weir's Sewing Machine** cannot get out of order. Probably the mishaps of which "H. E." complains are because he has not the proper tension. "H. E." should alter the tension nuts only a quarter or half a turn at a time.—T. P. H.

[12730.]—**Weir's Sewing Machine.**—Has this been taken to pieces? If so, the wheels have been misplaced, and want readjusting. The needle must descend and return to form a loop before the hook or retainer can enter it. There may be one of the small wheels shifted upon the shaft from the set-screw getting loose, or from dragging the work. The needle may have damaged the needle-plate, and made it rough. The looper underneath may become choked with shoddy, if stuff has been worked, and the consequence is the under part is hampered. This is caused sometimes by the needle acting like a pair of shears by its coming in contact with the needle-plate and shearing the stuff; more especially if the needle has come in contact with the needle-plate, blunted the needle, and roughened the plate, it will every now and then shear the cotton off as well.—JACK OF ALL TRADES.

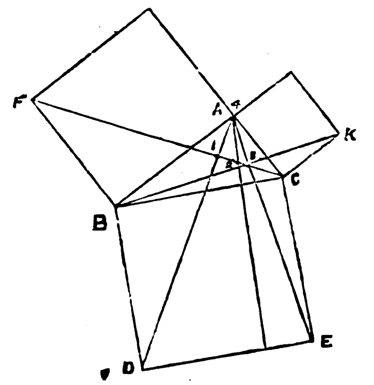
[12731.]—**Hand Pad.**—The handle must be hollow, and a brass head fitted to it, in which are two set screws, pressing not on the tool, but on an intervening piece of metal. The tools must, of course, fit accurately.—BRANCA.

[12736.]—**Cement on Postage Stamps.**—It is dextrine, or British gum, made by ex osing starch to a high temperature in presence of a very dilute acid or diastase for some time, and then baking. It is innoxious.—WM. PARKER.

[12736.]—**Cement on Postage Stamps.**—An article once appeared in "Household Words" on the above, headed "The Great British Gum Secret." The following is the substance of it:—A little westward of Dublin, on the banks of the Liffey, stood the village of Chapelizod. In 1821 it contained a large starch manufactory. The use of potatoes in this manufactory caused great discontent among the people, and one night it was set on fire. Great efforts were made to save the building, but with little success. The starch, mixed with the water used in quenching the fire, covered the streets and ran into the Liffey. A journeyman block-printer had assisted in putting out the fire, but being rather the worse for liquor had several times fallen among the liquid starch; and, next morning, on awaking, found his clothes completely gummed together. This led to a consultation with some of his shopmates, who had been in a similar condition, and the result was a visit to the ruins of the manufactory. They took some of the soft gummy substance that still lay in the streets, tested it in their trade, found it to answer, bought starch, burnt it brown in a frying-pan, added water, and discovered that they had a substance as good as gum arabic and many times cheaper. The block-printers did not keep their secret long. They sold it to a gentleman in Lancashire, from whom it passed to another English gentleman. This gentleman suffered a great amount of persecution, and was the object of a large number of spies. His secret at last oozed out. When the penny postage system came into use British gum was adopted for the labels. Some time after a rumour became prevalent that the cement on postage stamps was a hurtful substance. The secret was then spread far and wide. "The public was extensively informed that the postage-label poison was made simply of—potatoes."—TUB.

[12737.]—**Size of Globe and Speed Rate of Rotation.**—The motion of the earth round the sun is much faster than its motion of rotation on its axis. The earth goes more than 1½ millions of miles in the day in its motion round the sun. The query is not very clear.—PHILANTHROPIST.

[12739.]—**Geometrical Theorem.**—In the accompanying figure the angle BFC equals the angle BAD (as shown in the demonstration to Prop. XLVII., Euclid, Book 1). Also the angle ACF is equal to the angle CFB (Prop. XXIX). Therefore, angle ACF = angle BAD. But BAD and IAC make up a right angle. Therefore, IAC and ICA also equal together a right angle. But all the angles of a triangle together = two right angles, therefore the remaining angle at I is a right angle. The intersection of the lines AEBK may, in the same manner, be also shown to be at right



angles. Now, on reference to Euclid, Book 3, Prop. XXII., I find as a deduction to that proposition that "if two opposite angles of any trapezium be (equal to) two right angles, a circle may be described about it." Join points 2 and 4, and the line of junction being bisected gives the centre of the circumscribing circle.—C. P. E.

[12740.]—**Lever Escapement.**—By all means put new escapement. Look on the back of pillar plate, and you will see the size of the movement either 16, 18, or 20; send to a good tool shop, or to an escapement maker, for the size stamped on the plate. Your escape pinion (if not worn) will do again, and very probably the collet also; if your pallet-staff is true, and polished pivots, they will do again most likely. Pivot in your balance staff, have roller right height and firm, fit pallets and lever on its staff, pitch cross depth, bank and set pallets in angle, drill pallets and lever, finish off, poise balance, spring, and time. If the watch keeps the same time lying as hanging, pass it, but if not, do not put your balance out of poise.—CONVERSION.

[12741.]—**Leather Machine.**—Try a spokeshave, such as saddlers use.—TOIVO.

[12741.]—**Leather Machine.**—This is a very difficult job, as the leather differs so much in texture—some places are so tight, others so loose; cut your leather in strips, and pass it through a spokeshave. I have seen a good job made of it, but it requires a little practice.—JACK OF ALL TRADES.

[12743.] — **Essence of Wood Smoke.**—If "Anxious One" wants to know how to smoke his hams and bacon, he cannot do better than follow the instructions laid down some time back in these columns. But this I know, the men in the east of London smoke haddocks, kippers, bacon, and other goods, in a smoke-hole built on a certain plan, and use oak, mahogany, and other sawdust. Butchers prefer mahogany turnings for that purpose, but the fish smokers prefer oak sawdust. I formerly sold my turnings for that purpose, and at the present time can get a high price for oak sawdust.—Samuel Smither.

[12743.]—**Essence of Wood Smoke.**—Pyroligneous acid, I suppose you want. It can be purchased very cheaply. Unless you have a chemical plant that you can work out all your products, and that upon a large scale, it will not pay.—Jack of All Trades.

[12743.]—**Essence of Wood Smoke.**—A very dilute solution of carbolic or phenic acid in water, and put the ham into a bath of it, will give the ham a smoked flavour, but makes it taste sodden.—W. M. Parker.

[12743.]—**Essence of Wood Smoke.**—This is simply the crude or empyreumatic acetic acid of the wood-acid or pyroligneous acid works. It is obtained as one of the products of the destructive distillation of wood in close chambers or retorts. It has a brown colour, and a very strong smoky smell and flavour, but in other points resembles ordinary acetic acid of the same strength. The article commonly sold in bottles, at high prices, under the names of "Essence of Smoke," "Essence of Wood Smoke," "Cambrian Essence," "Smoking Fluid," &c., is commonly thickened and darkened by dissolving about two or three ounces of spirit-colouring (caramel) in each pint of the crude acid; but this adds nothing to its antiseptic and smoke flavour qualities, although it improves the colour of things prepared with it. The cheapest way of procuring the above is to buy it, of any wholesale or large druggist, under the name of "Crude (Smoky) Pyroligneous Acid." Price, wholesale, about 4d. per pound, or 2s. 8d. per gallon. (I think my last hogshead cost 2s. 4d. per gallon.) It is used either by brushing a little over the meat or fish, or by mixing a little with the brine. Some persons steep two or three drachms of the best wood-tar in each pint of the crude acid, with brisk agitation and slight warmth for one or two hours, and then, after repose, decant the clear portion for use. This is, however, quite unnecessary, as the acid itself is smoky enough; but the treatment slightly modifies the flavour and is in a manner relished by some persons. I cannot agree with "An Anxious One" that the old plan of curing by exposure in appropriate chimneys or smoking-houses is "unsatisfactory." In no way can such an excellent and refreshing flavour and odour of the kind be given to meat, fish, &c., as by direct and lengthened exposure to the attenuated smoke or fumes of a slow wood or turf fire. Some persons attempt to impart a smoky flavour to hams and bacon by the addition to the brine of a little creosote (previously dissolved in strong vinegar); but this is expensive, and the effect is not very satisfactory, as the food then gets a crude whisky flavour, smoky certainly, but devoid of the characteristic brown colour, rich flavour, and fragrance, of a prime smoked ham or flitch.—Arotes.

[12744.]—**Martini Rifle.**—See reply to 12729.—C. H. W. B.

[12744.]—**Martini Rifle.**—The extractor in the Martini-Henry rifle is shaped something like the letter L, moving on a pivot at the bend. The vertical arm of this bell-crank is formed like a fork, one of the prongs being at each side and exactly fitting the rear of the cartridge when "home." When the breech-block is depressed, it catches the horizontal arm of the extractor, forces it down, and consequently brings the vertical arm away from its place against the barrel, thus throwing out the cartridge case. There is no spring about the extractor, only this little bell-crank and the pin it works on. The bottle-neck cartridge has to be used with this rifle, owing to the manner in which it is loaded. The cartridge has to pass along the curved slot on the breech-block, and for this reason the ordinary cylindrical form of cartridge would not do.—Artillery Captain.

[12746.]—**Screws for Woodwork.**—This requires some space to illustrate as well as to engrave plant, for they are cut with dies.—Jack of All Trades.

[12747.]—**Roasting Jacks.**—Take a sheet of steel the thickness required, and cut strips the width required in the length, as that would be the way of the grain. Punch a hole in both ends and lap up on a mandril, harden, and blaze off with tallow. Put the spring inside a drum, and drive off the drum.—Jack of All Trades.

[12749.]—**Punching Holes in Sheet Brass.**—This depends upon the thickness and size, if light and small, a lever press, the same as the endorsing presses, might do.—Jack of All Trades.

[12749.]—**Punching Holes in Sheet Brass.**—Look at a punching machine and apply the same principle—that is, with a punch and die to fit each other and the punch to fall exactly into the die. This is the best method of punching.—Mutual Tom.

[12752.]—**Nervous Excitement.**—Your correspondent "Tremolo" ask for a remedy for the above ailment. I know of nothing better than that advised by Dr. Johnson, namely, the hydropathic treatment. In my last on constipation, I omitted to mention another proof given by Dr. Johnson that excitement arrests the secretions, and that cooling the body restores them. Let us take the case of one addicted to drink. In the evening he has excited the system with strong stimulants. In the morning he wakes with all his secretions arrested, mouth and throat dry, his nose dry, skin dry, his bowels costive—that is, dry also. Now let him get up, take a cold bath and go out into the cold air. The saliva returns to his mouth, moisture to throat and nose and skin, and soon after this, his bowels (if he be not habitually constipated) will be relieved. But if instead he remains in bed, the secretions may be many hours before they return. With those whose daily occupations render it impossible to take the hydropathic treatment, the doctor advises that one of Mead's Anti-Constipation Plaisters be worn, which is seldom known to fail to relieve the bowels daily, and also to use daily cold ablutions.—P.S.—Every nurse knows that one of the first and best signs of the subsidence of the excitement of fever is the return of the natural secretion to the nose and skin.—T. L. V.

[12755.]—**To "Jack of All Trades."**—How you manage to make rosin and shellac adhere to curd soap is something more than I can understand. You may blister it if the heater is too hot. Take the two—viz., soap and finely-powdered French chalk, and prepare some unglazed paper for the purpose, like whitewashing it. Use when dry.—Jack of All Trades.

[12766.]—**Fiddles and Fiddling.**—The bow must be well cleansed with soap and water, then rosined till white as snow, taking care not to use the refined specimens of rosin sold at music shops, but get a good piece of ordinary rosin from your chemist, and always use it before you play. Do not play too near the bridge, unless your position is a high one on the finger board. Do not attempt anything difficult until you can make clear tones. Place your bridge exactly in the centre, between the *f* holes, and try, try again.—Fiddler.

[12771.] — **Colorado, U.S.** — 1. Allan line *viâ* Baltimore. 2. Meals on cars are very expensive. Buy a basket at Baltimore, and fill with four days' supply of bread and corned beef. Coffee is to be had at all stations at any time. 3. As near to Denver City as practicable. 4. As good as the best. 5. Yes; can be had of Messrs. Reid and Keim, 36, Finsbury Circus. 6. Take no tools, but good warm and strong clothing, thick boots, pair of blankets, and indiarubber sheet. 7. With the qualities named, "first rate" and "independence."—R. H. Leese, Lt.-Col., U.S. Consul, per W. H. Coffin.

[12784.]—**Libraries.**—If "A Librarian" will get a set of brass figures with handles (say, one of each up to 10) he will be able to print all the books in gold at a very small cost. One book of gold at 1s. 3d. will print 700 or 800 books, and the numbers will last as long as the book. The figures will cost about 5d. or 6d. each. Make the figures hot in gas (not too hot), rub the face on a piece of cloth with a few drops of oil on, apply a little powdered rosin where you are going to print, then pick up the gold leaf with the figures, and hold it on about two or three seconds. After this rub it with a soft rag with a few drops of oil and turpentine on, and it will give a beautiful bright gloss. If you want any more information I will give it with pleasure.—J. B. Sharpley.

[12779.]—**Lightning and Thunder.**—1. "Sheet lightning" is merely the glare of a flash, reflected from cloud, sky, or other objects. However near a flash be, if our back is turned to it we can only see "sheet lightning." The varieties in the form of the flash itself are forked or unforked. The latter, by far the commonest, sailors very well name "chain lightning." It is more like a chain than the ribands (or strokes of uniform width) drawn by painters. It is commonly far less crooked in the general course, but with innumerable short crooks and dot-like raggedness. 2. The sound starts simultaneously from every point of the chain. If its form were a circular arc, with your ear in the centre of curvature, you could hear but a single gun-like explosion. But if you are a mile farther from one part of the chain than another, the peal must last 5 seconds; if 2 miles, 10 seconds; and so on. I do not believe in echoes from clouds, or any echoes contributing to the thunder, except those from mountains and precipices, which give it quite a distinct character from what it has over flat countries or sea. 3. What blasts a tree is simply its own sap suddenly made steam; and the instantaneous vaporisation of confined moisture, or of soot, will equally explain the demolition of the chimney witnessed by M. Paris, p. 620. Without having seen a large tree the day after its destruction, one can hardly form an idea of the tremendous force exhibited. I had such a view of a beech tree that was probably one of the largest in England, and may be remembered as standing before the elder chalk-pit west of Caversham, Oxon. The trunk, about 6ft. in diameter, and perfectly sound to the heart, had been cleft, and, except the lowest yard or two, had fallen with the limbs in all directions, with most of its wood in minutey separated fibres like over-stewed meat, and seeming fit to go into a paper-mill, and with very little more pounding form pulp. The fibres were also bleached whiter than parts that had been out of the lightning's track.—E. L. G.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last S. Broughton has answered 12359; "Jack of All Trades," 12394, 12402, 12405, 12408, 12410, 12418, 12422, 12425.

12493 Grove's Gas Battery, p. 496
12497 Horizontal Escapement, 496
12498 Green Shade, 496
12508 Eloby, p. 497
12509 Chemical, 497
12521 Value of Locomotives, 497
12522 Length of Pendulum, 497
12536 Speculum Grinding, 497

QUERIES.

[12801.]—**Hygrometer.**—Will some correspondent kindly show me how to find the dew-point and degree of humidity by Glaisher's tables, adapted to Mason's hygrometer, when the dry and wet bulbs indicate a fraction of the same degree—*e. g.*, 39·6° and 39·1°? Other indications, such as 39·6° and 38·1° I can manage.—Clitus.

[12802.]—**Length of Pendulum Springs.**—Would "Seconds' Practical Watchmaker" kindly give me his opinion as regards the length of pendulum springs, for best timekeeping?—D. C.

[12803.] — **Mainsprings Breaking.** — Would "Seconds' Practical Watchmaker" explain the cause of mainsprings breaking when the spring is the right height and strength, and the arbor the right size? One will last a week and the other for years; both best springs and fitted to the same watch by the same workman, and kept in the same temperature.—D. C.

[12804.]—**Fixing Photographic Prints.**—Can any one tell me the cause of my prints (after toning and when in the fixing bath) losing all their tone, and becoming a leathery brown colour?—One in a Fix.

[12805.]—**Photography.**—Can any reader give a process for sensitising paper, so that it may be kept without injury for two or three days? I believe such a process is in use.—C. B.

[12806.]—**Boat Building.**—I wish to build a small pleasure boat, say from 14ft. to 15ft., by 2ft. 6in. to 3ft. beam, yacht shape, principally for sailing, but also of a light build to row. Would any kind reader favour me with some practical information, or name a book from which I could get all practical information and dimensions? I have been trying to obtain a suitable book through booksellers' agency, but without success.—Another Paddler.

[12807.]—**Darkening Pale Mahogany.**—Will any subscriber kindly inform me the easiest way to darken the colour of pale mahogany, so that it will match that of a darker colour?—A. D.

[12808.]—**Enlargements on Zinc Plates.**—Will any of your numerous correspondents kindly furnish me with a method of taking enlargements on zinc plates direct or by transfer?—Sam Weller.

[12809.]—**Economy in Fuel.**—I want to know if there is any liquid that will bind ashes together, so as to burn them over again. I have wetted them with water and made it like clay, but when dry it crumbles. I should like to make it lumpy to burn like coke. I have put a lot of wet ashes in an American kitchener; it burns very well, when it gets dry, on the top of coke. The liquid must not be expensive, otherwise the economy will be lost.—Duplex.

[12810.] — **Electro-Magnet.**—I should be glad to learn how to construct such an electro-magnet as would be advantageously excited by 10 cells of Daniell's (quart size). Also what weight such a magnet would probably sustain. I find it much easier to coil the wire upon two brass tubes than to coil it directly upon the arms of the iron core. Will the currents induced in the tubes by the primary current appreciably diminish the magnetic intensity of the core?—Beta.

[12811.]—**Lamps.**—I have a quantity of good lamps, the brass bottoms of which have become tarnished or "shopworn." I should feel obliged by any one informing me how to get them up again like new.—W. S. C.

[12812.]—**Water for Aquarium.**—Will any of your correspondents kindly inform me which water is best for aquariums—whether rain-water from off tile roofs or that supplied by water companies?—Norwich.

[12813.]—**Circular Saw Bench.**—Can any of "our" subscribers tell me what size circular saw a 4 horse-power engine will drive, and what size pulley to fix on the same? Fly-wheel of engine, 4ft. 10in. Also what kind of teeth are best for cutting ash, oak, &c.?—Constant Subscriber.

[12814.]—**Contracted Muscles.**—Would some one kindly advise what could be done for a lad—twelve years of age—who is afflicted with a contraction of muscle in the neck, directly under left ear, which holds the head on one side. Can the muscle be developed?—Parent.

[12815.]—**Fusing Brass.**—Will one of your readers kindly describe to me the method of fusing brass? I have tried and failed. Would it require blowing with bellows?—Branca.

[12816.]—**Sepia.**—Sepia ought to be made from the inside of the cuttle fish. Can any one tell me how it is really made?—G. S. E.

[12817.]—**To Chemists.**—If sulphate of quinine is dissolved in sulphuric acid, and a few drops are mixed with water, it turns the water a blue colour. Will any of "our" chemical readers state the cause of this and oblige—William H. Bey.

[12818.]—**Postman's Duties.**—Will some brother reader kindly tell me the distance a walking postman may walk out of the highway? I live about 70 yards out of the highway and he says I shall have to pay extra for every letter.—H. W. F.

[12819.]—**Stains in Wood.**—Can any correspondent tell me of a substance which will take stains caused by nitrate of silver out of wood, and its price?—T. V. B.

[12820.]—**Churning.**—Is the separation of butter in churning caused by any chemical in addition to the mechanical action of the process, and if so what is the whole chemical action that takes place? An answer from "Sigma" would oblige—M. F.

[12821.]—**Soluble Glass.**—Referring to letter on Soluble Glass, p. 590, letter 4765, will your correspondent "G. J. H." kindly inform me how to prepare a soluble glass as a coating for brick or stone perfectly transparent and colourless?—Ajax.

[12822.]—**Extracting Opium, &c., from Poppies.**—How is opium obtained from ordinary poppies? How is the red colouring matter extracted? What is its name? Is anything else obtained from poppies? If so, what are their names and how are they obtained?—G. S. E.

[12823.]—**Cochineal Blue.**—I made a decoction of cochineal by pouring boiling water over the dried insects. I poured some of this into a clean tumbler, and added some acetate of lead in water, when, to my astonishment, it produced a light blue precipitate which remained suspended for some time in the water. What was the cause? Could not wool be dyed thus?—G. S. E.

[12824.]—**Magnesium.**—How is magnesium obtained from its salts and made into wire?—G. S. E.

[12825.]—**Insects in Leather Trunk.**—I have a large box covered with leather, with partitions and trays inside, and fitted with straps outside after the manner of a portmanteau, which has been unused for six months or more. On looking at it a few days ago, I found one of the wooden ribs at the bottom to be completely riddled by what looked like small worm holes—doubtless the work of some insect. The wood, on being touched, crumbled into dust in many places. It is an easy matter to replace the damaged rib, but I find that the box is eaten into in about two dozen places on the sides where it is covered with leather and on the bottom beyond the ribs. The holes are of the thickness of a knitting needle or thereabouts. If any reader of the ENGLISH MECHANIC will inform me how I can arrest the progress of the destroyer, he will confer a favour upon your constant reader—T. A. H.

[12826.]—**Panning and Non-Panning Tea.**—Some planters adopt the system of panning (frying) the leaf before it is finally dried, saying it excites the juices, whilst others, myself amongst the rest, dispense with it as being extra labour involved to no purpose. Could any reader inform me what actually takes place, or what chemical action takes place (if any) in the leaf whilst being panned, and which is dispensed with by being non-panned, and what effect it would have on the manufactured tea, whether making stronger, weaker, brisker, more pungent, &c.?—MELVILLE PIKE, Mohumpore, E. I.

[12827.]—**Blight to which the Tea-plant is Subjected.**—I send you a dried shoot of a tea-plant blighted. This disease, if so it may be termed, comes on principally and more severely after excessive and continual rain, and increases when rain falls more like a mist than rain proper. It is to be seen on plants in all positions, open or confined, barren or rich soil, and at all the bearings of the compass, N. S. E. W. Before it makes its appearance perceptible, the plants, I have observed, show a reluctance to shoot, and when they do shoot, the bud at the end of the shoot is affected, thereby causing a stoppage of growth, together with the three or four new leaves which compose the flush; some old leaves are also affected. In some cases, if the stalk or shoot be nipped off, a black spot will be seen in the centre (where the pith is in trees) of the shoot to varying depths according to the severity of the disease. I have seen portions of gardens looking as if a fire-blast had passed over them, and from which no leaf can be expected, unless the shoots are plucked off below the black dot in the centre of the shoot, and then it is doubtful. Could and would any kind readers give me their views on the subject, so as to enlighten me a bit? I wish to know what causes it, and why, and whether it cannot be prevented, and if not, if it can be cured by any means different to what I have already said (plucking off the shoots, &c.)? This complaint is very prevalent in Hylakandy, a sub-division of Cachar, and is scarcely known in Assam, North Cachar, Darjeeling, &c., the other tea districts.—MELVILLE PIKE, Mohumpore, E. I.

[12828.]—**Apothem in Tea.**—What is it composed of, and which would be the simplest and most certain way to extract it; and what is the test for it?—MELVILLE PIKE, Mohumpore, E. I.

[12829.]—**Theine in Tea.**—What is it composed of, and which would be the simplest and most certain way to extract it; and what is the test for it?—MELVILLE PIKE, Mohumpore, E. I.

[12830.]—**Carbonate of Iron in a Tea Soil.**—This is a component part of the Assam tea soil. What important part does it perform in relation to the growth of the tea-plant?—MELVILLE PIKE, Mohumpore, E. I.

[12831.]—**Charcoal for the Desiccation of Tea.**—It is asserted by the home (tea) trade, as also by some tea planters, that the fumes of charcoal alone, from its peculiar properties, are only adapted for the drying of tea; for one or two experimentalists have tried the drying of tea in pans, &c., but have arrived at very unsatisfactory results, such as the leaf not being good in appearance, the liquor relatively very much worse than the leaf, and, although not burnt, it had a peculiar flavour, classed by the trade "flat and odd." Would some kind reader inform me whether the fumes of charcoal have any chemical effect on the tea, if so, what effect, and how does it act? Cannot some substitute be suggested; hot air has been tried, but the tea is not as good as tea dried over charcoal fires.—MELVILLE PIKE, Mohumpore, E. I.

[12832.]—**Manufacture of Charcoal.**—Would any kind reader inform me the simplest way to manufacture charcoal, from all woods light or heavy, close grained or not, so as not to lose a grain, so that all may go to the designed end? I have been making about 65 tons yearly, and wood is becoming difficult to obtain. The method must be one understood by a coolie, a native labourer, whereby about half a ton can be made at once.—MELVILLE PIKE, Mohumpore, E. I.

[12833.]—**White Ants and Wood.**—Some time back there was a controversy in the Indian papers (the *Englishman*) regarding the destructive habits of these insects on green wood, which a Mr. P. Saunders confuted by saying, as I do, that they do not touch green wood to destroy it, but that they may, and do, climb up and go along it in search of dead wood or injured wood. Would any kind correspondents (Indian or otherwise) give their experience relative to these insects eating and destroying green wood? As this subject is of interest to many planters (tea, coffee, &c.) in remote districts and abroad. I would be glad to see it discussed and well ventilated in the ENGLISH MECHANIC.—MELVILLE PIKE, Mohumpore, E. I.

[12834.]—**Queensland.**—What are some of the best recent works on Queensland?—A. B. M.

[12835.]—**Unequal Timekeepers.**—Would a thorough practical workman explain to "our" readers the cause of one watch keeping much better time than the other—both Geneva watches, same size, and same maker; both have the same action, and the same number of turns in the hairspring; both have plain balances and same number of beats per minute?—CONVERSION.

[12836.]—**Light and Glass.**—How is it that shop lights, seen through the glass of an omnibus, produce an appearance of concentric fibrous circles in the glass?—A. B. M.

[12837.]—**Tobacco and Electricity.**—I was shown, the other day, some tobacco in a very mouldy state, and said to have been thus changed in one night through electricity in the atmosphere. Is this a known effect? Should any one wish to examine the tobacco microscopically, I can send him a little.—A. B. M.

[12838.]—**Testing Milk.**—Will some one kindly give me full directions how to use my lactometer in testing milk?—J. G. W. R.

[12839.]—**Prismatic Compass.**—Will some reader kindly give a short description of this?—DEESIDE.

[12840.]—**Watch Jobbing, &c.**—Does any reader know of a work from which a novice could learn to repair jewellery and watches and clocks, and the art of gilding?—W. W. BACARROUGH.

[12841.]—**Canal Steamboats.**—Having been informed that there are steamboats running on the canals between London and Derby, I should be greatly obliged if some intelligent subscriber would inform me, through your columns, whether such is the case. If so, please answer the following questions:—1. Whether the engines are worked on the high-pressure principle, or whether they are condensers? 2. Whether they use the ordinary canal water, or whether they carry filtered water with them? 3. What weight of coal they usually carry, and whether the coals do not sink one end of the boat deeper than the other? 4. What is the usual diameter of the boilers? 5. What is the saving effected compared with horse-power? In addition, I should be very much obliged if I could see a drawing of a boat and engines, or any information relating to any of the above questions.—J. P., Walsall.

[12842.]—**Vineries.**—Would "Saul Rymea" or any other reader give a few hints regarding the construction of vineries, and the most profitable vines to grow?—SODA.

[12843.]—**Blue Pipe-Clay.**—Would "Jack of All Trades" or any maker inform me how to make blue pipe-clay, and say the quantity of blue colour and vitriol used to the cwt. of pipe-clay, also the price per cwt. of blue colour?—CLAY.

[12844.]—**Cleaning Bones.**—Will some correspondent kindly inform me of the best way to clean thoroughly very dirty bones and small skeletons without injuring them in any respect?—VOIX.

[12845.]—**Fossils.**—I wish to know how to extract fossils from hard and soft rocks without injuring them. A few hints as to collecting, cleaning, and preserving fossils would be very acceptable. A list of places within (say) twenty miles of London suitable for geological excursions would, I think, be useful to many besides myself.—VOIX.

[12846.]—**Rowing.**—What lever (1st, 2nd, or 3rd order) does the motion of an oar, in rowing, constitute?—VIELLENT.

[12847.]—**Cleaning Steel, &c.**—What is a good preparation for cleaning and polishing steel and brass?—VOIX.

[12848.]—**Log-House.**—Will any one kindly give a sketch, with some particulars, of a four-roomed log-house, such as is usually erected by settlers on grants of land in the Western States of America on 160 acres of land? 1. Cost where timber is easily got. 2. Whether two or one story. 3. Height, length, breadth, slant of roof, doors, windows, and general out-houses. 4. How is a handy man to go about building his own shanty for self, wife, and child?—EMIGRANT.

[12849.]—**Separating Lenses.**—Will one of the clever contributors to "ours" kindly tell me how to separate the compound lenses forming object-glass of field-glass, as some liquid has partially penetrated between, and of course interferes with its clearness? Also, if after separation I can safely re-cement them together. I am desirous of doing it myself if I can manage it without damaging the glass.—R. HOWSE.

[12850.]—**Joining Manganese Cells.**—I inserted a query some time since, to which an answer was returned that the carbon must be soaked in paraffin, and the wire soldered in the carbon. The cells are now charged, covered with wax on the top, and the pores of the carbon are saturated with sal ammoniac. Must I first pick off the wax I have tried, uncharge the cells, and soak the AmCl out with water, join the copper wire by solder, and then soak with paraffin, or paraffin first and then solder into the hole? What paraffin do I use, paraffin oil or solid paraffin? and if the latter, how is it liquefied, and how long must the carbon be soaked? I suppose it would not do if I saturate with paraffin without freeing from the AmCl?—T. H. SOMERVILLE.

[12851.]—**Policeman's Lamp.**—Will any of "ours" kindly offer a few suggestions towards improving the present form of policeman's lamp? The leading features to be desired are small size, great reflective power, to be easily turned on or off, and to be easily taken to pieces and cleaned. The present forms are large, cumbersome, heavy, and impossible to take to pieces to clean. I think an improved form might be made with a flat wick instead of round, as at present, and when the light is turned off it might be made to turn the wick down at the same time, thus causing a great saving of oil, heat, and smell, which is anything but pleasant for a man to have under his nose the whole night long. Perhaps "Jack of All Trades" will kindly render assistance to the 40,000 men comprising the police and constabulary forces of Great Britain. This question was asked by "Phœnix" in last volume, but no satisfactory answer ever came.—W. H. H.

[12852.]—**Slide-valve Rod.**—Will some one kindly inform me of the best way to connect the slide-valve rod to the eccentric rod, the steam-chest being on top of cylinder? Diagrams will oblige.—J. W.

[12853.]—**Eyepiece.**—"F. R. A. S.," in his "Astronomical Notes" for this month, speaks of an eyepiece invented by the Astronomer Royal, for rendering objects free from prismatic colours when at a low altitude. Will Mr. Oldfield or some other reader kindly describe this eyepiece?—K.

[12854.]—**Dressing Corn.**—Will you or any brother reader of the MECHANIC inform me which is the best way of preparing Egyptian and Californian corn for grinding, as we are greatly in need of such an apparatus at our firm?—A DUSTY MILLER.

[12855.]—**Table Claws.**—Several readers as well as myself, wish Mr. Smither would, in his next letter, send a design for claws to match the table leg, inserted in No. 386.—H. COOK.

[12856.]—**Carbonic Acid Engine.**—Could any of "our" correspondents kindly give me some information about the construction of a carbonic acid engine? Are chalk or whiting and hydrochloric acid the best substances for generating the gas? Would it be possible to lead the gas as it escapes from the cylinder into a tank containing lime hydrate, so as to form carbonate of lime? Would a sufficient quantity be formed to be used to generate gas in the boiler? I should be very glad if I could get some hints as to the construction of an engine of this kind, and what success experimental ones have met with?—JUVENIS.

[12857.]—**Rust.**—Living amidst chemical manufactures the gas from them rusts all steel and iron. A preventative wanted.—MUTUAL TOM.

[12858.]—**Caustic Soda.**—Will some correspondent afford me an explanation of the gradual deepening of colour from a pale straw to a deep brown, consequent upon the evaporation of a solution of caustic soda.—A. K. C.

[12859.]—**Sand Wheel.**—I shall feel obliged if one of your readers can tell me what is the right speed for a sand wheel for planing or polishing wood. Also if the glue should be thinly brushed on, and the best way of getting the sand to stick on.—C. E.

[12860.]—**Dr. Carpenter and Geometry.**—In Dr. Carpenter's address before the British Association at Brighton, reported recently in the ENGLISH MECHANIC, this passage occurs which puzzles me:—"The whole fabric of geometry rests upon axioms, which are incapable of demonstration." Surely it is possible to show that "the whole is greater than its part?" Perhaps one of "our" mathematical correspondents would be kind enough to throw some light on this point.—TYRO.

[12861.]—**Bricks from Sand, &c.**—Is there any satisfactory process (and the rationale of the same and cost) for making bricks for building from fine sand or fine sandy river mud? Will concrete building answer for walls and beds of furnaces as well as brick, and what character of concrete is preferable? Is it an easy method to make a fair cement from fine river mud and other materials, and what are the materials and cost?—IGNORAMUS.

[12862.]—**Envelope Making.**—Can any reader say the size paper envelopes are cut from, and how many of each size (envelopes) will a sheet cut? If the sheets are different sizes, please state size of each. An answer will oblige—D. H. GDMN.

[12863.]—**Schroter's Telescope.**—In let. 4783, p. 574, "R. C." makes mention of the telescope of Schröter, as being 10ft. long, and only 3in. aperture. Will "R. C." oblige by making known the construction of the above, as to the steadying of such a whipstick of a tube on a stand, also as to the glasses made use of?—YOUNG GLASGOW.

[12864.]—**Sour Ginger Wine.**—I have some home-made ginger wine which has become sour or tart. Is there any way of removing this sourness and rendering the wine wholesome and agreeable again?—W. M.

[12865.]—**Sympathetic Clocks.**—Among the applications for letters patent during last month is one for improvements in sympathetic clocks. Can any fellow subscriber enlighten me as to the nature and application of this ingenious piece of mechanism known as a sympathetic clock.—CRUX.

[12866.]—**Quality of Cloth.**—Can any one give some useful suggestions in the choice of cloth, &c.? There must be a mode of distinguishing good from bad material, but though at the time of selection I carefully unravel numerous patterns and study the relative length and strength of the fibre, I have signally failed to discover the secret of stability. The most durable cloths within my experience were described to me at the time of choosing as Venetian cloth and double corded Scotch tweed respectively. Is there any way of recognising these materials and insuring a profitable investment with your tailor?—CRUX.

[12867.]—**Lightning Conductors.**—I am thinking of protecting my house. Will some kind reader inform me if it is necessary to put a conductor on each chimney, of which the house has four, three in gable ends of the house, and one near the centre? The distance between is, greatest 23ft. nearest, 11ft. Has it ever been ascertained what distance a conductor will protect (say if it projects 3ft. above the chimney). I should feel obliged if any one would inform me who publishes a book on the above subject.—J. G. T.

[12868.]—**Gyro Pigeon.**—How is this made and propelled?—PHILANTHROPIST.

[12869.]—**Water Power.**—Will some of your numerous readers, acquainted with water power, say what power a wheel of 4ft. diameter, supplied with water with an easy flow through a circular opening of 5in. will have, applied upon the overshot principle? and if the turbine with 4ft. 6in. of fall will be equal to the wheel?—AQUA.

[12870.]—**Stringed Instrument Maker.**—Can "The Harmonious Blacksmith" or other reader of "ours" oblige me with any information as to the status of one John Pitts, S. Paul's Churchyard, 1694? I have a very old viol de Gamba bearing above upon an almost obliterated ticket.—JOE.

[12871.]—**Burning Wood Pulp.**—Will some of our readers kindly inform me what I can mix with wood pulp that when it burns it will burn its own ash with little smoke.—ONE AT A STANDSTILL.

[12872.]—**Electro-Gilding.**—In electro-gilding some articles, I was called away, and left the solution on a stove, and on my return found it boiling. It was all right before, but after, it would not act. Is the gold precipitated, and, if so, must I use more cyanide, or is something wrong?—W. BAKER.

CHESS.

All communications intended for this department to be addressed to J. W. Abbott, 83, Loughborough-road, Brixton, S.W.

We have received the August number of the Dubuque *Chess Journal*, now recognised to be the leading organ of American chess players. The number is embellished with a protrait of the Rev. A. B. Skipworth, with some selections of his games, a large number of problems by American composers, and the advanced sheets of the late Congress at Cincinnati. We shall take an early opportunity of placing a few extracts from the *Chess Journal* before our readers.

ENIGMA III.—By A. W. Cooper.

White.

W K on Q 3; W R on K R 2; W Kts on K Kt 4 and K R 4; W Ps on Q 4, K B 3, K B 4, K Kt 6.

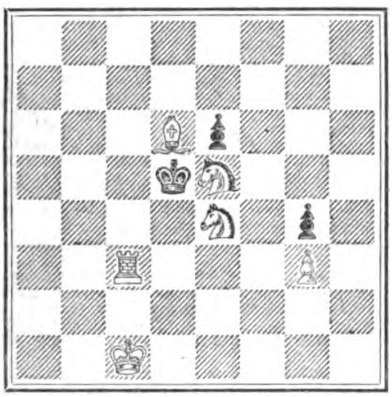
Black.

K on K R 4; B Ps on K R 3, K Kt 2, and Q 3.

White to play, and mate in three moves.

Problem XIV.—By P. T. Duffy.

Black.



White.

White to play and mate in three moves.

Solution to Problem XII.

White.	*Black.*
1. Q to Kt sq.	1. Anything.
2. Mates, acc.	

Solution to Enigma I.

White.	*Black.*
1. Q to Q R 8	1. Anything.
2. Mates, acc.	

D. M. (Norwood).—Problem XI. is quite correct, and admits of no other solution but that given by the author. If, as you suggest,

(1) $\frac{\text{P to Q Kt 8 (a Q) (ch.)}}{\text{K to B 3}}$ (2) $\frac{\text{Q to Q R 8}}{\text{Kt (interposes)}}$,

how can you mate next move? 2. The rule you quote is still in force. 3. There is no difference except in name.

S. H. Thomas (Plymouth).—Your problem is hardly difficult enough for publicity. Send us a few more specimens of your composition. We agree with the remarks contained in your letter on the construction of problems.

Argo (Yarmouth).—The problem is still faulty—*e.g.*,

(1) $\frac{\text{Q to Kt 2}}{\text{anything}}$ (2) Q to Kt 8,

and play as Black may, mate follows in two more moves.

G. C. Heywood.—We shall communicate with you on the subject of your last letter.

F. Owden (Hoxton).—Study the compositions of Healey, Duffy, & Campbell for six months, at the end of that period you may be able to produce something of your own.

D. A. (Maldon).—A forced move is when a player has but one legal move at command.

R. H. (Bristol) and A. B. C.—Look at the problem again, and you will find you are mistaken.

Correct solutions to Problem XII. and Enigma I. have been received from G. C. Heywood (Great Torrington); J. Bray (Langport); R. Lines (Cinderford); H. Cherry; W. Nash (S. Neot's); J. C. U. (Leicester); J. C. S.; A. R. Moleson (Swansea); W. F. (Manchester); Edeography (Leicester); W. N. P.; W. Airey (Worsley); Fritz (Bradford); G. T. F. (Croydon); A. W. Cooper; Argo (Yarmouth); C. J. L. (Portsmouth); S. H. Thomas (Plymouth); and Alchemist. All others are wrong.

Heated Bearings.—Dr. Mayer suggests the employment of a layer of iodide of mercury to test whether journals or other parts of machinery become heated by friction. A thin layer of the red-coloured salt is sufficient, and it becomes black when the temperature reaches 70° C. (154° Fahr.)

ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Tuesday morning, August 27, and unacknowledged elsewhere:—

H. Waters.—C. Bullock.—E. Tutte.—E. S.—G. C. Price.—E. Erasmus Wilson.—J. B. Ward.—F. E. Guinness.—Cox and Co.—Aurora.—Wm. F. Denning.—N. B.—T. W. J.—J. W. D.—J. W. Fennell.—K.—Rob Roy.—Bobo.—Old Ploughman.—L. E. E.—J. L. H.—Arid.—J. G. Rowe.—C. Bethel.—Kelby.—R. W. Barber.—D. G. W.—E. L. G.—Alfred H. Allen.—E. Stanford.—C. J. Harcourt.—E. A. Hodges.—J. Binchin.—J. F. Stanistreet.—Le de Fontainemoreau.—A. Felton.—Barnes Richards.—J. J. Reddell.—James Verity.—J. H. W.—John Manning.—J. Hebb.—Columbia.—An Engineer.—Logan.—P. C. E.—E. T. E.—M. Paris.—A., Liverpool.—J. M. N.—S. E. C.—J. T. R. Gorett.—Peacock.—Afflicted Subscriber.—Leonard N. Gill.—C. N. Abbott.—E. G.—H. Highton.—W. R. Birt.—Nathan Mutch.—Paul Greggor.—G. A. C.—Caledonia.—N. G. N.—Smoked Out.—Horosupus.—F. E.—Ignoramus.—Cervus.—Hypo.—J. Steward.—R. A. Huntley.—Tantalus.—J. S. Sharpe.—R. A. Proctor.—J. Frost.—The Harmonious Blacksmith.—Edward Hunt.—A Benefitted Reader.—F.R.A.S.—Dr. A. W. Blacklock.—P. R. S.—S. W. D.—C. B. A.—Old King Cole.—R. Dixon.—S. W. Burnham.—John White.—Rev. A. B. Kerins.—B. Solomon.—Cambria.—A. Deane.—J. M. Livens.—Pedro.—J. Fowler.—W. B. Newman.—Cooke & Sons.—G. S. Hinton.—Geo. Townsend.—C. Clapham.—Henry Clarke.—F. Bradshaw.—A. B. M.—G. F. M.—Canoeist.—Lambda.—J. C. H.—Sarah.—Tai.—A Lancashire Beekeeper.—Joseph Gadsby.—Equator.—F. S. M. W.—A Turner.—T. Stewart.—J. H. Crillin.—Cumro Bach.—Xenophon.—High.—A Constant Reader.—John Watson.—Brym.—Experimenter.—Leander.—S. Ibbotson.—Inchicore.—Hone Ko Io.—H. T. Ward.—Apprentice.—B. C.—R. W. P.—Percival Norton.—C. M. B.—Aroma.—U. S. A.—J. H. Whistle.—Calico.—John McIntosh.—Tag.—M. F. P.—Q. Q.—L. C.—Zax.—J. T. C.—W. M. Parker.—Young Beginner.—A Young Jobber.—Mutual Tom.—James Tresise.—J. M. B.—Sigma.—Jack of All Trades.—Plymouthian.—James Odgen.—W. R. Butler.—A Plumber.—S. B. H.—An Expert.—R. W. P. Jun.—B. F.—James Gaze.—E. W. T.—R. A.—Rat-Tat.—H. M. M.—R. R. W.—Saxmundham. Dr. Hall.—Eyepiece.—James Ramsden.—O. P. Q.—Optician.—Tyro.—Anxious.—J. H. J.—Cumberland.

M. A. B.—Your "sheshee" is nothing more than crystals of magenta, and as you bought it in India is probably that prepared from indigo.

Bel Demonia.—We cannot help you.

Hy. Clark (Derby).—The "note" you have sent is not a copy of your rejected letter. You write as if we were under an obligation to insert all the letters sent to us, whether they are good, bad, or indifferent. You make a mistake. Your letter on phrenology was certainly, however, not good, and it was consequently rejected.

F. D. asks our readers to suggest something that will destroy those "horrible pests, beetles." He surely cannot be a reader himself, or he would know that "suggestions" were given so recently as last May, pp. 209, 235, &c., of the present volume. If he will also refer to Vol. XIII., he will find several replies on the same question.

C. Swale.—The "useful hints on French polishing" which you require, will be found in both Vol. XIII. and XIV., see indices. Look at p. 468, Vol. XIII. Anything you do not understand, if you will put it in the form of a definite question, will be inserted; but we cannot repeat information recently given.

T. Hatton.—Spitting of phlegm is a case for a medical man. If he says your lungs are sound, there is nothing seriously the matter with you. Take open-air exercise, and throw the paregoric "to the dogs."

Hugh Parr.—Consult a medical man.

J. H. Sutherland (Kingston, Jamaica).—You say you have "discovered the quadrature of the circle," and you want to know whether there is any particular society or department in Great Britain to which you can make your discovery known. We know of no such "society" or "department." Are you sure your discovery is not a "mare's nest"?

F. P.—Advertise for Newton's "Principia."

Bay Window.—We are not sufficiently acquainted with technical law to give you any reliable advice on the matter.

Warming Greenhouses (4774).—"Atmospheric Burner's" plan of a burner appears good. Why does he not make and advertise them in the Mechanic, that amateurs might experimentalise on their power?—Cheltenham.

Albert Lyon, Edinboro', Duplex, Limbo, J. K., J. A. T., S. Hill, E. T. E., J. B. Harris, Definition, E. C. G., Engineer, E. S., Scarboro', A. S., Good Intent, Horatio, C. H., are referred to indices to back volumes.

James Starum.—See let. 4761, p. 589, for information on marine aquarium.

J. Hampden.—Your outrageous letter is forwarded to Mr. A. R. Wallace, to be disposed of as he may deem advisable. Probably you may once more calculate on his mercy.

T. B. C., J. Harland, and Calico Printer.—Consult medical men.

K. L., Jacobin, Pro Bono, and R. W. Bruce.—See Hints to Correspondents.

A. B. C. (Lanark).—Nothing new in your method of warming rooms. See also article on "Healthy and Comfortable Houses," p. 577.

G. T. Kremlett.—For a practical treatise on harmony, see pp. 8, 50, 75, 123, 173, 273, 278, 324, 423, 503, 553, and 606, Vol. XIII. Second question write Secretary of Society of Arts.

H. Cook.—They were reprinted by Trübner and Co., Paternoster-row.

J. Gunn.—We have no room at present for attempts to trisect angles.

S. A. Z.—Private communication with contributors can only be made by means of advertisement.

H. T. B.—Don't trouble yourself about the matter.

Unit.—Can you not ask your question without an engraving? Benzoline lamps would hardly yield sufficient heat for a vinery, 33 by 15, unless they were employed in a very inconvenient if not injurious number. It has already been stated in our columns that these lamps are not injurious to plant life if properly trimmed, so that your pipes would be a needless expense. Better keep to the hot-water pipes you have.

Edward Gardner.—The technological examinations of the Society of Arts to which we recently referred are not actually in work, but there is little doubt the recommendations of the committee will be adopted. The plan of the scheme and the nature of the subjects in which candidates will be examined were sufficiently indicated in our article, which we shall supplement by further and complete information when the details are definitively settled. In the mean time you and others can study the subjects mentioned, for even if the scheme falls through, which is scarcely probable, you will obtain ample reward. The proposed examinations will commence with the technology of the paper and cotton manufactures, for either of which you can "go in."

Jas. Gray.—Yes; price according to length, from a few pence upwards.

C. Carter.—The only "book" on carpentry and joinery which descends to such rudiments as the methods of "holding the tools," is the English Mechanic (see the Amateur Mechanic's Workshop, Vols. VII., VIII. and IX.). For the rest, get "Tredgold's Carpentry," or the "Practical Carpenter and Joiner," by R. Riddle just published.

Chemicus.—A "good, cheap, and simple galvanic battery" depends upon what you want it for. At any rate you will find how to make the various cells detailed in back numbers.

W. W. Bacarrough.—Articles on watch repairing are in course of publication in our columns. Information on repairing jewellery and gilding will be found in previous volumes. We know of no work embracing the whole of these subjects. Query inserted.

J. C.—You will find the whole art of gilding in pp. 51, 66, 145 of Vol. X. Your query is too indefinite, and would involve two or three columns for a reply which might be given in a few lines. You should at least say what kind of frames you wish to gild.

J. Rhodes.—There are many brick making machines, made on different principles.

Sigma.—Your letter and replies next week.

J. E. Austin.—Consult Bradshaw's "Railway Guide."

Philanthropist.—Copy of your reply on "Chess" has been mislaid: the drawing is engraved.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT DURING THE WEEK ENDING AUGUST 2?, 1872.

2404 A. M. Clark, Chancery-lane, for improvements in looms for weaving. A communication.

2405 P. McKinlay, New Broad-street, City, for husking, hulling, or shelling, and for cleaning and preparing rice and other grain.

2406 B. Hunt, Serle-street, Lincoln's Inn, for an improved refrigerating apparatus for ships or vessels, for railway carriages or cars, or for other structures or places. A communication.

2407 C. Randolph and C. R. Harvey, Glasgow, for improvements in and connected with tramway carriages to be propelled by steam or drawn by horses.

2408 J. Horton, Glasgow, for a new or improved mode and means of cooling the tools for turning and planing metals.

2409 J. Pinches, Oxendon-street, Middlesex, for improvements in presses for embossing, stamping, perforating, or punching, and an improved die and counterpart for embossing and perforating.

2410 G. W. West, Edinburgh, for improvements in machinery for ginning cotton. A communication.

2411 T. B. Daft, Failsworth, Lancashire, for improvements in indiarubber manufactures and in tools and machinery employed therein.

2412 U. Green, Cassland-road, South Hackney, for improvements in apparatus for washing and separating ores and other minerals. A communication.

2413 T. Thomson, Southampton-buildings, for improvements in anchors.

2414 G. Haseltine, Southampton-buildings, for an improved holder for scrubbing-brushes and other similar implements. A communication.

2415 W. B. Chapin, Southampton-buildings, for improvements in fastenings for railway fish-joints.

2416 S. Chandler, sen., S. Chandler, jun., and J. Chandler, London-road, Southwark, for improvements in dip pipes for regulating the seal in hydraulic mains used in the manufacture of gas.

2417 F. D. Blyth, Fenchurch-street, City, and A. G. Southby, New Inn, Strand, for improvements in the process and apparatus for treating wood for the manufacture of pulp for paper.

2418 H. Crawford and J. Crawford, Beith, Ayrshire, for improvements in machinery for finishing thread and yarn.

2419 T. B. Rossiter, Bristol, for improvements in sewing machines.

2420 J. Riddale, Tufnell-park, West, for improvements in lamps.

2421 J. J. Blackham, Birmingham, for improvements in stoves.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

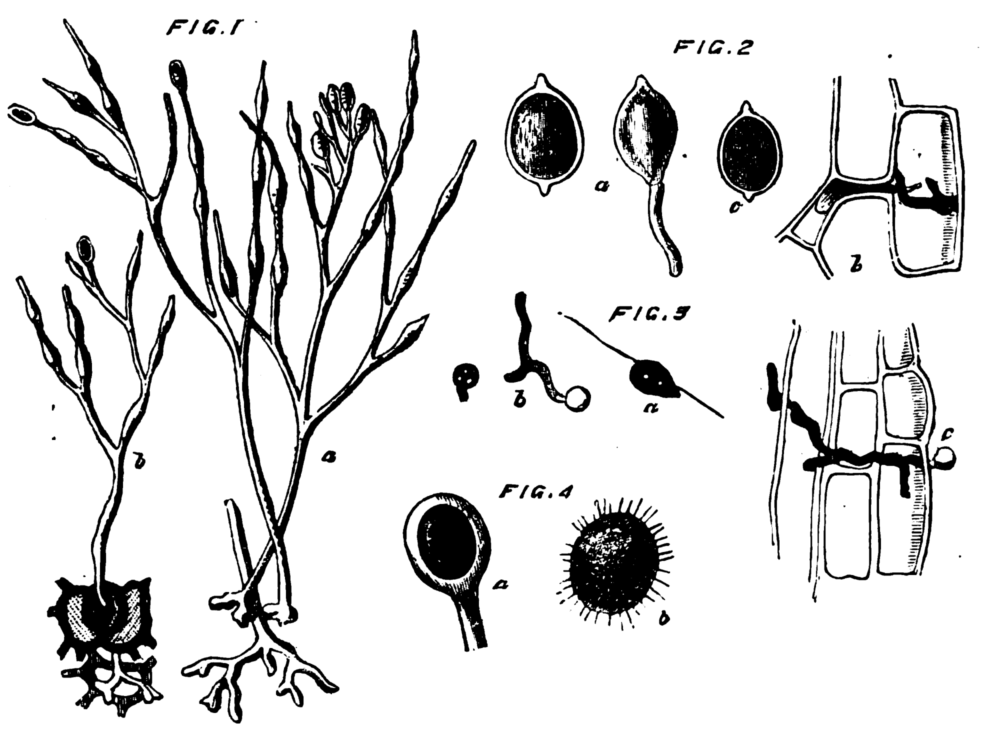
FRIDAY, SEPTEMBER 13, 1872.

ARTICLES.

THE POTATO DISEASE.

REPORTS from all parts of the kingdom represent the potato crop as being only about half the average yield; and there is only too much reason to fear that the reports, allowing for the usual amount of exaggeration, are true. To ascertain the magnitude of this loss, and estimate its effects on our food resources, a few figures may be serviceable. It is stated, then, that about 1,630,000 acres were this year planted with potatoes, and supposing each acre to produce 4½ tons (many produce more than double) we have 7,335,000 tons, representing at usual prices no less a sum than £30,000,000; so that if half the crop is diseased, there is a loss of £15,000,000. It must be acknowledged that under these circumstances it is not to be wondered at that the *Times* has opened its columns to the truly-vexed question of the potato disease and the means of preventing it, for no one talks of curing it, or doubts that the cause is involved in obscurity.

But, as a matter of course, we have had the usual flood of opinions—some from persons who probably never grew a potato or examined the ominous spots on its leaves; others from those who have some pet variety of the *S. tuberosum*, or some special method of planting and cultivating it, to which they attribute the immunity from disease hitherto obtained by themselves in its cultivation. It may interest many of our readers if we make a short digest of the letters which have appeared in the *Times*, steering clear of that peculiar disease which at this season of the year exhibits itself in leading articles—viz., newspaper science. The letter of Dr. Hooker, suggesting the utilisation of the starch, which we reprinted on p. 621, opened the discussion, and, of course, came in for criticism—one writer considering that the act of grating potatoes into a tub of water was of "rather too scientific a nature" for the agricultural mind! As a matter of fact, however, this plan is successfully carried out in places where the diseased tubers are not used for feeding pigs, and Dr. Hooker has done well in making it more widely known. But to return to the disease itself: there seems a general concurrence of opinion that it is connected in some way with the "electrical state of the atmosphere," and the fact that the disease is more prevalent when thunderstorms are most frequent is well established. But the potato blight does make its appearance even in seasons peculiarly free from electrical disturbance, so that the "post hoc, ergo propter hoc" style of argument does not fit in well with any of the theories yet broached. All that can be fairly asserted is that the blight is more wide-spread and more rapid in its action in a direct ratio with the number and severity of thunderstorms. So firm a hold on the agricultural mind has this idea obtained that various remedies have been proposed having for their object the arresting or turning aside of the electric "fluid" by planting some taller-growing specimen of the vegetable kingdom between the rows of potatoes. One gentleman, who claims the theory as his, recommends the planting of broad beans, the stalks of which "act as natural conductors and carry off the superabundant electricity." It is possibly not worth while inquiring who first started the "electrical" theory, but it is well to mention that the veteran Mr. Glenny years ago saw that lightning had something to do with the disease, and promulgated the only palliative that has ever been found worth practising—viz., cutting off the haulm directly the spots are seen, on the economic principle that it is better to have small and sound than full-grown diseased tubers. The bean-stalk notion has been tried and found wanting over and over again. The various nostrums recommended from time to time—the sulphur and iron, the soot and lime, night-soil, blood manure, bone dust, rape dust, and the numerous special compounds—have all failed in their turn; and planting wide or close, deep or shallow, earthing or not earthing, have yielded equally negative results. In short, scientific men, as well as the practical cultivators, have found themselves completely baffled by the insidious nature of this terrible blight; that is, as far as preventing its ravages is concerned, for the life-history of the characteristic fungus which is generally accepted as its cause amongst students of science is tolerably well known.



Potato-growing seems gradually becoming a lottery—a mere game of chance. Sorts that turn out healthy and good croppers in one district are often the most seriously affected in others; and although much has been done, solely by the enterprise of our large seedsmen, in improving the stock, imparting vigour and early maturity, there is ample room for much greater improvement in a direction now generally acknowledged to be the most likely to lead to the stamping-out of the disease.

It is doubly unfortunate, too, that the blight should have appeared in such force this year, for if the reports are to be relied upon, there is no doubt the potato crop of 1872 would have been the most abundant known for many years. But although the damage is in many cases over-stated, there is, as we said before, too much reason to fear that a heavy and irretrievable loss will be the result when the accounts are made up. A Cambridgeshire farmer, writing to the *Times*, says:—"The results of my examination this day of many varieties of potatoes grown on my driest and best soils, which are noted for being, as a rule, freer from disease than any in this district, show an average of disease of from 30 to 80 per cent. It is worthy of remark that the most prolific varieties seem to be most liable to disease. There is, however, one most striking exception to this rule, and that is Sutton's red-skinned flour-ball. This is the most abundant cropper I ever grew, and yet I did not find among them one diseased tuber. This is all the more remarkable since, as I use it as a dividing line between all the other varieties—it being so strong a grower and so distinct in colour of tuber—each root, tested in every part, was growing side by side with the roots of the others showing so much disease." If similar results are obtained with this variety in other parts of the country it will speak volumes in its favour, and at the same time dispose of the idea of contagion, or the spreading of the blight from one tuber to another while in the ground. It is satisfactory to turn from an account which shows an average loss of more than 50 per cent. to one furnished by the rector of a Devonshire parish, who says that Mr. Randle of Ringmore, in the South Hams of Devon, reports that "never in his life have his potatoes turned out so well as this year," the yield, moreover, being so abundant that the money value would purchase the land on which they grew. This letter is especially valuable in connection with the "electrical" theory, for the rector informs us that there have been less than six thunderstorms during a period of more than 12 years, and that during the present year there has been far less electric disturbance than in other parts. Among the more sensible of the preventatives proposed by the writers to the *Times* is one from Mr. Hallett, of Brighton, who describes his own plot as yielding three heaped bushels per rod and "no sign of disease." He thinks that disease is as hereditary in plants as in man, and that so long as unhealthy seed is planted so long will the potato be liable to disease. Acting on this view he has carefully selected his seed potatoes for years, rejecting the whole root when only one tuber was tainted, or even suspected of being tainted, and the result has been an almost complete immunity from disease.

But the experience of Dr. Wallace, of Colchester, who has been a cultivator of the potato for some years, and whose letter is more valuable than any which have yet appeared, is directly opposed to this, for he says that he has had most excellent crops from seed saved from infected plots. Dr. Wallace considers there are only three theories of the potato disease which are worthy of credence—first, that which attributes it to the operations of an insect (*e.g.*, Smee's *Aphis vastator*); second, the fungus origin; third, the atmospheric. In these three causes, taken conjointly, Dr. Wallace is convinced the true origin of the disease is to be found. He considers that the error of former observers lies in their having found but one link of the chain; but there are three links, any one of which being absent the disease does not appear. The following is a brief summary of his theory:—

Towards the end of June or in July, if any one approach growing potatoes and strike the haulm gently with a stick, he will see numerous small green flies, or midges, dart away. These are named *Eupteryx picta*, *E. viridis*, and other varieties, and are common in our gardens. If he proceed to examine the haulm and leaves, he will find numerous white specks, and, looking closely, will find small green insects without wings—the larvæ of the Eupteryx. There are also two or three other species, one a bug, and other aphides, which prey similarly on the potato. These white specks are made by the larvæ, which have consumed the chlorophyl on the under surface of the leaf; the haulm, also, to some extent, is similarly affected. These specks increase in size and coalesce, and as the weather gets warm become discoloured, and form a brown blotch, chiefly at the tip of the leaf; any injury to the cuticle—as a bruise—will create a similar blotch. This is the first link in the chain, the primary or predisposing cause of the disease. The haulm and leaf are punctured in many places, and their juices withdrawn by insects. An effort is required from the plant to heal the wounds; an exudation arises. All this weakens the constitution of the plant. Should fine weather continue, the blotches merely dry up, the haulm in due season dies down, the tubers ripen, and are turned up free from disease. And this is a good season. But should rainy weather (the second link in the chain and exciting cause of the disease) supervene in July and August, just when the wounded stems and leaves are healing up (the critical time), when the potatoes are nearly at their full size or just about to ripen, and more especially should electrical discharges, with heavy rainfall, supervene, saturate the ground, and induce for several days a muggy condition of atmosphere, then a fungus (the third link in the chain), *Botrytis infestans*—the true potato disease—is developed with marvellous rapidity. A white film of mould appears on the under surface of the brown blotch—not, indeed, on the dry portion, but where the exudation has been poured out at the edge of the green portion of the leaf—a rapid development of mycelia and spores ensues, and in another 48 hours, if the atmospheric conditions be favourable, the mycelia will spread with marvellous rapidity, attacking the haulm and leaf at numerous points, descending through the stem to the roots and tubers (those at the top are generally the first affected), and thus the three links of the chain are completed.

The first appearance of disease in the tubers is a brown discoloration, generally commencing at the eye attached to the haulm, and the only remedy with which the doctor is acquainted is that mentioned above—pulling out or cutting off the haulm. It seems that this theory is due to the late Dr. Maclean, of Colchester, who explained it some years ago to Dr. Wallace, and gave him an account of the experiments which confirmed him in his opinion. These experiments were made by planting potatoes in pots, and covering the haulm with gauze supported on sticks. From one series all insects were excluded, but the Eupteryx was purposely introduced to the other; the result being that in the first case every tuber was sound, in the latter every tuber was diseased.

The more generally accepted theory of the disease is that which originated, we believe, with Dr. Julius Kühn, who stated that the "cause" of the blight is a parasitical fungus called *Peronospora infestans* (Fig. 1),* the spawn or mycelia of which penetrates the tubers, and communicates the disease from one to the other. This theory is held by the Rev. M. J. Berkeley, the highest English authority on mycology, who says that the first appearance of the blight is indicated by the presence of brown spots on the upper surface of the leaves. If the reverse of these spots be examined, it will be found that the brown colour has been produced by the action of a parasitic mould, which gradually extends in the circumference of the spots, destroying the tissues as it proceeds, and ultimately gaining extensive possession of other portions of the plant. The genus Peronospora consists of some forty species, all of which are parasitic on living plants, but the species known as *infestans* was not observed previous to 1844. The mould bears abundance of spores on the tips of the branches (Fig. 1, *a*); the mycelium burrows amongst the cellular tissue of the leaf (*b*), and causes rapid decomposition, while the vertical threads, carrying the spores, find their way through the stomates, or leaf-pores. The spores, falling on different parts of the plant, germinate and penetrate the tissues, producing a brown tint in the parts infected. Some of these spores undergo a peculiar process, and are divided into a number of cells that ultimately produce a multitude of zoospores, which are exceedingly active so long as there is sufficient moisture to enable them to change their position by means of the thread-like processes shown in Fig. 3, *a*; these also germinate and penetrate the tissues in the same way as the simple spores *b c*. Scientific inquirers are not quite certain that the potato Peronospora possesses the perfect form of fructification, called resting spores—that is to say, they are not certain it has been observed, for there can be little doubt that the fungus has some means of surviving the winter and propagating its species under suitable conditions. Dr. Montague figured a genus discovered in spent tubers by Dr. Payen, to which he gave the name of Artotrogus, which there is reason to believe is the resting spore of *Peronospora infestans*.

* The illustration is copied from the figures by Mr. Berkeley in the *Gardeners' Chronicle*.

Von Schultzenstein, however, is of a different opinion; he considers the cause of the blight to be a withering or dying of the cellular tissue and the vessels, and states that it is only along with the chemical decomposition of the decayed parts at a later stage that the fungus makes its appearance. It is, too, asserted that fungus growths rarely if ever appear on healthy organisms; but this notion has been often refuted, and can scarcely be held as true. A curious fact has, however, been recently mentioned, which shows that after all there may be something in Von Schultzenstein's theory. A number of potatoes were left on the ground exposed to the sun, as it was thought they were all diseased. On examining them a few days afterwards about half were found to have been acted on by sunlight in the usual manner, being turned a dark green, while the remainder, submitted to exactly the same influence, retained their pale and sickly hue. This would seem to show that some great change had been effected in the constitution of the tubers; and on examination those which had greened were found sound, but the others were all diseased.

The different results obtained in similar experiments in potato culture, the diverse and conflicting opinions of those who have studied the matter, together with the utter inability to point out a a remedy of those who have the best right to our attention, have involved the whole subject in obscurity. Few of us can believe that if the disease and its cause were really understood we should fail so lamentably in grappling with it. There is good work in this direction for the Royal Agricultural or the Royal Horticultural Societies. Cannot they try experiments in raising new sorts, by crossing *S. tuberosum* with another member of the Solanaceæ, and so mayhap impart some property which will make the potato proof against the attacks of the fungus? There is hope that something may be accomplished by this means towards stamping out the disease, for the instance of the red-skin flour-ball mentioned above, and the new American sorts, which have hitherto been but little affected, give an earnest that if as much skill, care, and enterprise are brought to bear on the potato as have been lavished on florists' flowers, we may eventually obtain a tuber as greatly improved in hardiness and healthiness, as the flowers are in beauty.

DESCRIPTION OF ILLUSTRATIONS.

Fig. 1.—*a*, *Peronospora infestans*; *b*, the same, burrowing amongst the tissues of the leaves, and making its way through the stomates.

Fig. 2.—*a*, Spores germinating; *b*, the same, sown artificially, and penetrating the tissues after 18 hours; *c*, spore with contents differentiated.

Fig. 3.—*a*, Zoospores; *b*, zoospores germinating; *c*, zoospores sown artificially in the stem, and, after 24 hours, penetrating the tissues and entering the intercellular spaces.

Fig. 4.—*a*, Young Artotrogus still in mother cell; *b*, young Artotrogus free.

RAILWAYS OR NO RAILWAYS—THE BATTLE OF THE GAUGES CONTINUED.

NARROW gauge railways and the Fairlie locomotive are facts too well established in different parts of the world to have needed the triumphant "apology" for their introduction issued by Mr. Fairlie. Engineers of the 4ft. 8½in. standard seem to be as much chagrined at the successful and economical working of a narrower gauge as Brunel may be supposed to have been when he discovered that his magnificent innovation found few imitators; and the Fairlie type of locomotive has met with opposition of a character and to an amount which could scarcely have been expected by its inventor. Mr. Fairlie has, however, told his tale well in the little book whose title we give below, and has met the arguments of his opponents at every turn. If he has failed to convince them of their mistakes, they have at all events not succeeded in carrying his position. The question of narrow gauge does not, of course, affect this country to any extent, where all the main lines † are of the standard gauge ordered by Act of Parliament and only a few local and special lines are of a different width; though there is ample room in this latter direction for the introduction of cheap narrow gauge lines for suburban traffic around large centres of industry, and for special purposes in different localities. But in many of the more sparsely populated countries of the globe—in those, in fact, where railways are especially necessary to their development—the difference between the so-called broad and narrow gauge is in reality the difference between a "railway and no railway." On this point of the question there can, we should think, be little discussion, whatever there may be on the broader ground on which Mr. Fairlie has taken his stand when he contends that a broad gauge means costliness with extravagance when compared to the economy with efficiency of the narrow gauge. In a country like India, requiring long lines of permanent way, embankments, bridges, cuttings, and engineering achievements of a more or less costly character, the question of expense is of the first importance, and a saving of even £100 per mile a consideration not to be lightly thrown aside. The argument that has been used with regard to the Indian railways—that they should be constructed with a view to Imperial purposes, such as the speedy conveyance of troops in emergencies—should not be allowed to weigh in the balance, unless a complete network of lines is to be at once constructed; for it is obvious that, even taking this argument into consideration, three narrow gauge lines would probably be more advantageous than two broad ones. Mr. Hawksley spoke at his inauguration as President of the Institution of Civil Engineers of the new gauge of absurd dimensions which had been introduced into India at the instance of some unknown crotchetty person, which would inflict all the evils of break of gauge, and all the inconveniences of inefficient accommodation, in a country in which a magnificent system was being constructed. But, as Mr. Fairlie points out, the Indian railways are too magnificent, and the few miles (comparatively speaking) yet built, have cost an enormous sum, and earn but a small income. In Australia, too, the broad-gaugers are straining every nerve to burden with costly constructions a country which wants cheap railways.

But it is in the United States that the problem of the efficiency and economy of narrow gauges, when tried in actual work on a large scale, will first be solved, and it is mainly in reply to the Hon. Silas Seymour's review of the report of Gen. Buell, the engineer of the Texas Pacific Road, that Mr. Fairlie has written this book. The subject seems to have been treated in a much better manner in that country than it has here, for the opponents of the narrow gauge do not appear to have sought out all the minute and apparent defects, but have argued earnestly and ably against it, pointing out what they considered its disadvantages. The advantages claimed by Gen. Buell in recommending a gauge of 3ft. 6in. for a railway of 1,500 miles, were a saving of 30 per cent. of the cost of the narrow gauge road-bed, &c., 45 per cent. of the cost of the super-structure, and 50 per cent. of the cost of rolling stock; while the proportion of dead weight to load would be ·47, as compared to ·75 on the broad gauge, and a speed of thirty-five to forty-five miles an hour might be attained with safety. These estimates were reviewed by Mr. Seymour, who objected that the difference in cost of the road-bed would only be the value of a longitudinal slice 1ft. 2½in. wide, taken out of the centre of the ordinary track (single line); this, of course is absurd, for the wide gauge is necessarily constructed to withstand the heavy weights passing over it, and in estimating the cost of the road-bed for the narrow gauge, it should be remembered that the "true practice permits a closer adaptation of grade to the natural surfaces than is attained on the broad gauge," requiring lower banks and shallower cuttings, less formation width, because the running weights are less; sharper curves are also permissible, thus avoiding tunnelling as a rule, and executing that description of work more cheaply where necessary. As a matter of fact, this question had been already settled in Norway, where the first railways cost £11,000 per mile, an outlay which M. Carl Pihl has brought down to an average of £4,347 for three lines of narrow gauge railway, one of which at least was carried across very difficult country. Mr. Fairlie can also point to the narrow gauge lines of Russia, Canada, New Zealand, and other parts, where the actual cost is well known to be considerably less than for the broader gauge. With Mr. Seymour's other objections, which were of a similar nature, he deals in an equally conclusive manner, and quotes the tables prepared by Mr. Fowler to show the

* Railways or no Railways. By ROBERT F. FAIRLIE. London: Effingham Wilson.

† The Great Western is, we believe, in course of alteration throughout its whole length.

difference in cost of a "light" 5ft. 6in., and a 3ft. 6in. gauge for India—viz., £5,397 as compared with £4,543, or a difference of 16 per cent. Now, allowing the heavy charge of 3½d. per ton for shifting merchandise, this is but a small item when we remember the saving in first cost, and the smaller amount of dead weight to be hauled, with the consequent saving in hauling-power. The advocates of broad guages will here find the case against them fairly stated; we shall be curious to see if they as publicly and conclusively answer it. As might be expected in a work on narrow gauge railways, several pages are devoted to combating the adverse criticisms of the now well-known Fairlie locomotive. Our own pages have contained statements of opinions on the advantages and disadvantages of this type of engine, but it must be acknowledged that its opponents have failed to make out a case. But it is principally in reply to a report against the principle of the Fairlie engine by Mr. Ramsbottom, the well-known able engineer of the London and North-Western, that the author brings what we consider conclusive arguments to bear. Mr. Ramsbottom reported upon three engines sent out to Queensland to work upon the 3ft. 6in. gauge, which were condemned as useless and reshipped to this country. It is unfortunate that the examination of these engines should have been made the foundation for an attack upon the *principle* underlying the peculiarities of the Fairlie design; for it appears that Mr. Fairlie never saw these engines till they reappeared in England, when he found that they "were not constructed in any measure" upon his designs. Independently of this fact, the engines had not a fair trial, for only one was put together and worked in Australia. Mr. Ramsbottom alleges that a serious defect of the Fairlie engine is to be found in the bogie frames, which are not free to move *vertically* as well as horizontally; but Mr. Fairlie disposes of this objection by stating a simple fact that in the Fairlie engine proper the bogie frame is free to move in both directions. With the view of testing this part of the arrangement in the returned Queensland locomotives, Mr. Ramsbottom had a portion of a temporary road raised so as to form an apex with two opposite inclines of 1 in 100, and he asserts that the result of passing the engines over the summit of the gradient was to reduce the weight on the leading wheels so materially as to show that the engine was unsafe for travelling over such a road. This is his chief objection to the Fairlie engine, and Mr. Fairlie demolishes the whole argument by a few diagrams. Assuming, he says, for argument's sake, the two bogies of the engines in question to be held perfectly rigid vertically, like a girder—a thing utterly impossible—yet, under such conditions the alleged effect when the engine was standing on the crown or apex of a reverse gradient of 1 in 100 could not be produced. Mr. Fairlie takes, by way of argument, two reverse inclines of 1 in 50, and shows that even then, when the engine is crossing the apex, there is the weight of the leading wheels, axles, and boxes on the rails, assisted by the down pressure of the springs. But it is impossible to explain this question thoroughly without the diagrams, which are drawn to scale, and with the description clearly show the fallacy of Mr. Ramsbottom's argument. But it was not to be supposed that Mr. Fairlie would submit to this sort of treatment of *his* engine without putting his opponent's to the same test, and he clearly shows the absurdity of the argument by illustrating the position and action of an ordinary six-wheeled goods engine in passing over the "apex" of the inclines of 1 in 50, when the weight would at one time be supported entirely on the centre wheels with the leading and trailng wheels 1in. from the rail—a see-saw, in fact. Besides this, he does not fail to point out the advantage of his own arrangement in securing a stratum of water over the fire-box in ascending and descending inclines of any possible gradient; while in ordinary engines, with the fire-box at one end, in descending inclines the water naturally flows to the lower end, leaving the fire-box uncovered, or partially so. Mr. Fairlie, after meeting and demolishing the arguments of his opponents, appends the following note:—"Such a thing as an apex being permitted to occur on any line is unknown to my experience; what I mean by an apex is that rails are never so laid on a grade up and down as to form a distinct angle, but its introduction in Messrs. Ramsbottom and Marshall's report only shows how far the opponents to the principle of the double bogie engine will permit themselves to be carried in order to find some excuse to damage it." With the other objections urged against the Fairlie engine its designer deals in an equally satisfactory manner. The steam-joints *are* found steam-tight in practice; the repairs are not excessive; and the engine is not too powerful for properly managed traffic. To the absurd argument that it is too powerful for the coupling chains of ordinary wagon stock, and that, consequently full advantage could not be taken of their capacity, Mr. Fairlie replies, that one of the principal causes of coupling chains breaking is want of power in the engine; "because these engines can only start their trains when the wagons are coupled up loose"—*i.e.*, with from 6in. to 12in. between the buffers, so that the locomotive is in motion before the whole weight of the train is brought upon it. These jerks and snatches frequently part the chains, while the tendency of the hinder wagons to overrun the front ones when speed is suddenly slackened or the road is uneven often causes the link to be lifted off the hook. Now, the Fairlie engine being so powerful enables the wagons to be coupled up tight, preventing jerks, broken chains, and consequently accidents. The book contains some heliotypic illustrations of Fairlie engines and stock constructed for different lines, with much interesting matter for the careful consideration of directors and shareholders; and some facts, figures, and arguments, not easily overthrown or disputed by the advocates of the broad gauge and the prejudiced opponents of the double bogie locomotive.

NOTES OF COMMUNICATIONS TO THE ACADEMY OF SCIENCES, PARIS.*

PHYSICS.—ON THE CURRENTS OF INDUCTION DEVELOPED IN THE INSTRUMENT OF M. GRAMME.

1. M. Gramme employed a long bar of soft iron in his instrument described to the Academy in July, 1871. On the bar was coiled an insulated conducting wire, presenting a straight permanent magnet to this, and moving the magnet parallel to itself, maintaining a constant distance from the bar; magnetism is developed in the bar and helix as long as the permanent magnet is in motion, the polarisation in the bar changing with the motion of the magnet. M. Gaugain, when analysing these inductive actions, placed pasteboard between the bar of soft iron and the coil to enable one to slide freely on the other, and with this arrangement met with the results detailed below.

2. Placing the bar and the magnet at right angles, the latter towards the middle of the former, on sliding the helix in the direction of its axis, without moving the bar, an induction current is obtained which cannot be set down to the account of a change in the magnetic state of the bar, but depends exclusively on the displacement of the helix, by rapport with the magnetic pole developed in the soft iron by the magnet.

3. If the helix be stationary, and the bar moved in the direction of its axis, the relative positions being maintained as in No. 2, a similar result is produced by the alternate magnetisation and demagnetisation of the latter.

4. From the two following facts it results that when the bar and helix are moved together the resulting induced current arises from different causes; the one is the movement of the helix in presence of the pole developed in the bar; the other from the successive changes the magnetic state of the bar undergoes. This applies to M. Gramme's experience (No. 1) with the inverse movement of the magnet in presence of the immovable bar and helix.

5. I proceed to point out the results of the experiences yielded by the first of these two causes. Taking a bar of steel regularly magnetised, placing on the middle of it a helix formed of several spiral turns, and putting the helix in communication with a galvanometer, on making the helix slide rapidly towards one or other of the poles of the bar, an induced current is obtained, the direction of it remaining the same whichever pole the helix may be pushed towards. An inverse current is obtained when the helix is brought again from either extremity of the bar towards the centre. This fact, known long since, accords with the theory of Ampère and the law of Lenz, and we will now see if we can here connect the theory with the experience of M. Gramme.

6. Placing together in succession two bars of magnetised steel, as identical as possible, opposing them with like poles, a double bar is obtained. Passing from one extremity to the other there is first a simple pole; suppose it to be N.; then follows a neutral region; then a double S. pole; then a second neutral region; finally, a second N. pole, placing upon this double bar a helix formed of some spiral turns, and connecting it with the galvanometer, on sliding it from one extremity to the other of the bar we obtain at first, in passing from the first N. pole to the first neutral region, a current moving inversely to the molecular current which, on the theory of Ampère, constitutes the magnetism of the first bar; let us consider this current negative. It will change its direction and become positive on passing the helix from the first neutral region to the double pole, and remain so whilst passing to the second neutral region, becoming again negative on the helix being moved to the second N. pole. Thus, when the helix is moved constantly in the same direction, the inductive actions developed in the space between the two neutral regions are opposed to the actions which develop themselves in the spaces situated out of these neutral regions, and, as the sum of the first is equal to the sum of the second, it results that the sum total of the forces developed in the whole extent of the bar is *nil*. The author has verified by direct experiment these consequences of the theory.

7. Now suppose a bar of soft iron be placed in presence of a magnet in the position indicated in No. 2, this bar will assume, under the influence of the magnet, a magnetic state analogous to that of the double bar of No. 6; only that each of the neutral regions in the double bar finds itself at an equal distance from the double pole and the adjoining single pole, whilst in the bar of iron magnetised by influence the neutral regions approach nearer to the double pole than to the single. On placing a small helix on the iron bar, and moving it from one extremity to the other, the current will yield the same changes as in No. 6.

8. If in place of a helix of eight or ten turns one is employed embracing the whole space between the two neutral regions, and encroaching a little beyond, it is very clear that the induced currents resulting from the displacement of the helix will be all of the same kind, so long as the extremities of this helix be not sensibly removed from the neutral regions.

9. If, on the contrary, a helix be employed covering the whole length of the bar, the sum of the inductive actions will be *nil*, after No. 6; for it is clear that if this helix be displaced to the extent of one turn of the spiral there will be the same result as if we operated with a single turn of wire and that this were moved from one end of the bar to the other.

10. This last case is precisely that of M. Gramme in No. 1, and, consequently, the induced currents which manifest themselves in that experiment ought to be attributed to the second of the causes mentioned in No. 4, since the actions arising from the first cause in No. 4 naturally neutralise themselves.

11. This conclusion does not apply to the instrument of M. Gramme, in which a ring of soft iron, surrounded by an endless helix, turns between the two poles of a permanent horseshoe magnet. The disposition of this machine is such that one gathers exclusively the currents developed in the intervals which separate the two neutral regions; the apparatus finds itself in the conditions examined in No. 8; then, as we have seen, all the conducting actions resulting from the displacement of the helix by rapport with the double-developed pole in the soft iron act in the same way, and, in consequence, this displacement of the helix contributes to the production of the current obtained. The author is even of opinion that it contributes to it for the greatest part.—M. J. M. GAUGAIN.

TERRESTRIAL PHYSICS.—OF THE MAGNETIC CURRENTS AND SOLAR EXPLOSIONS THAT ACCOMPANIED THE AURORA OF THE 7TH JULY.—1. *Magnetic Phenomena.*—Very pronounced magnetic perturbations showed themselves upon the telegraphic-wires of Brest suddenly at 5.2 p.m., by energetic positive emissions, and a strong adherence of the armatures in all the apparatus. As in all other analogous cases, the intensity of these currents was greatest on the longest lines, and those directed from W. to E. were most affected. The following are deviations of the galvanometer (of 12 turns) at this first characteristic period:—

h. m.		h. m.		h. m.	
5 2	+ 18°	5 15	+ 40°	5 23	+ 28°
5 5	+ 25°	5 20	+ 30°	5 25	+ 25°
5 10	+ 40°	5 22	+ 25°	5 28	+ 0°

*Translated and abstracted for the ENGLISH MECHANIC.

The following are subsequent deviations out of sixty-five observations :—

Maxima Negative Deviations.		Return to Zero.	Minima Negative Deviations.	
h. m.		h. m.	h. m.	
5 32	− 12°	5 33	5 48	+ 30°
5 40	− 20°	5 41	...	...
5 55	− 20°	...	6 57	+ 27°
7 02	− 16°	7 06	7 20	+ 28°
...	...	7 47	7 50	+ 18°
8 08	− 22°	7 55	...	...
8 55	− 15°	...	...	...
10 00	− 20°	10 45	10 50	+ 10°
10 51	− 10°	10 52	...	...
11 00	− 20°	11 45	...	...

From 5.41 to 6.10 there were several negative waves; from 6.10 to 7.1 several positive. The most remarkable wave of this period was from 6.57 to 7.2, which passed zero at 7.1. From 11.0 to 11.72 the needle remained immovable at − 20°, the most prolonged period of contact. There was a very prominent maximum in the terrestrial currents when the aurora was at its height. From 11.12 to 11.24 the intensity diminished gradually from + 20° to + 10°. At 11.45 the luminous and magnetic phenomena ceased at the same time. On the 8th July there were magnetic perturbations all day, until 8.50 p.m. Sky overcast.

2. *Solar Phenomena.*—M. Le Verrier is of opinion that this magnetism is of the same nature as ordinary magnetism. The theory which I had the honour to offer to the Academy on 15th February last, placing the origin of it in the explosions or great commotions that occur at the surface of the sun, acquires a character of probability from the observations of Father Secchi. On the 7th July, independently of the solar spots observed for several days even with the naked eye (one of them 2' 24" diameter), he witnessed at 3.30 p.m. a violent solar explosion. At 2.40 there had been at the same locality only a small luminous jet. The interior movements of the incandescent vapours, amongst which he recognised hydrogen and the unknown matter which has yet only been seen in the sun, were so intense that the luminous clouds changed form to the eyes, and at 1.15 their height was ten times greater than the terrestrial diameter. This spectacle remained at its height for two hours. At 7 p.m. the appearance had become the same as at the beginning. On the 8th another eruption was seen by the same observer near the locality of that of the evening of the previous day. An aurora was perceived at Madrid the same day. Violent magnetic disturbances were noticed on the 7th and 8th at Rome, and in other observatories.—M. H. TARRY.

PALÆONTOLOGY.—ON THE FOSSIL CROCODILE OF AMBOULINSATRE (MADAGASCAR). — Amongst the animal fossils of Amboulinsatre are found bones of the hippotamus, epiornis, and a reptile of the crocodile family. The two former have ceased to exist in Madagascar, but crocodiles still live there. The following is a comparison of the extinct with the living species. The former is only known by disjointed but well-preserved bones, a certain number of which are from parts of the skeleton important enough to admit of a sufficiently complete knowledge of the animal. This animal was of great length, and stout; the bones are thick, with prominences well-accentuated; the teeth and alveoli are enormous. Without doubt it should be classed with the genus *Crocodilus*. The teeth, to the number of nineteen of the upper jaw and fifteen of the lower, show well the customary form in this genus. The snout would be short. A first very strong caudal vertebra is fifty-six millimetres long. The examination of the whole remains shows sufficiently that this crocodile is absolutely different from the only species still existing in Madagascar, *Crocodilus Madagascariensis*, Grand., which approaches *C. vulgaris*, Cuv., above all to the variety *Suchus*, remarkable for its gracefulness and elongation of its snout. Thus this fossil crocodile has disappeared like the animals it accompanies. As to crocodiles in other parts of the globe, it can only approach *C. bombifrons*, Gray, of India, or *C. Niger*, Latr., of Senegal, but with the former the first inferior teeth penetrate the intermaxillaries, and in the latter, the five last teeth, according to Owen, are in a simple groove without separation by transverse partitions of bone, characters which fail in the crocodile under consideration. The authors propose to name this *C. robustus*, adding that it appears to have affinities with the Senegal species. —MM. A. GRANDIDIER AND L. VAILLANT.

CHEMISTRY.—ON THE INSTANTANEOUS OXIDATION OF ALCOHOL.—We have here a simple example of the direct conversion of alcohol into acetic acid and aldehyde without the medium of any other agent than oxygen modified by electricity. If into a demi-litre flask filled with concentrated and moist ozone be inserted about ten cubic centimetres of absolute or hydrated alcohol it is sufficient to agitate the flask strongly for some seconds, when the neutralised, and, so to speak, inodorous, alcohol manifests to turnsol paper a strong acid reaction due to the vinegar formed,* and develops an odour of aldehyde, the presence of which is shown by the reductive influence the liquor exercises upon an ammoniacal salt of silver. But the most curious fact of the experiment is the simultaneous formation of quantities, relatively considerable, of oxygenated water. Some cubic centimetres of the alcoholic liquor strongly colours blue the mixture of chromic acid and ether. In operating with ordinary oxygen—that is, with oxygen from the same source before the gas has undergone obscure electrisation—nothing like this is observed. Even after twenty-four hours' contact the alcohol is left neutral, inodorous, and without action on the salt of silver, as upon the chromic acid. Ether undergoes from concentrated ozone under the same conditions an analogous and yet more rapid oxidation with production of oxygenised water. On comparing these effects of oxidation with like effects that alcohol exhibits in oxidising bodies, as chromic acid, the mixture of sulphuric acid and bichromate of potash, &c., one cannot misunderstand the deep analogy that seems to exist between free ozone and oxygen in combination. It is, indeed, that analogy which, for a long time, made the author suppose that ozone can only be the primitive state of oxygen.† Whatever it may be, it is shown by these experiments that concentrated ozone, which can now be easily produced by his ozonising tubes, is an oxidising agent, at once simple and energetic, the use of which may be useful in researches in organic chemistry. It is necessary to use ozone with great caution, as even a small quantity will cause rapid inflammation of the mucous membranes that will give rise to a spitting of blood.—M. A. HOUZEAU. JOHN J. LAKE.

* After the action of the ozone the alcohol, being saturated with limewater and evaporated to dryness, leaves a residuum which disengages acetic acid on contact with diluted sulphuric acid.

† There is more in it than this. See the translator's paper on the subject, *Polytech. Rev. and Mag.* Vol. II., 1845, page 260, and article "Ozone" in *Supplemen. Pen. Cyclop.*

THE TEMPERATURE AND PHYSICAL CONDITIONS OF INLAND SEAS.

IN the paper by Dr. Carpenter, on the "Temperature and other Physical Conditions of Inland Seas, considered in Reference to Geology," read at the meeting of the British Association, he stated that the earlier experiments with thermometers in ascertaining the temperature of deep soundings could not be depended upon, on account of the pressure having interfered with them. Recent soundings, recently taken under the equator with protected thermometers, at two thousand fathoms, gave a temperature of about thirty-two and a half degrees. He thought that, if they went deep enough in sounding equatorial seas, they would invariably find the temperature to be glacial, which must exercise great influence in dwarfing animal forms. This cold could not be understood except by supposing the cold water from the poles to creep along the sea-bottom. Dr. Carpenter then pointed out the ridge which arose from the Mediterranean floor, and so shut it off from the Atlantic, making it an inland sea. In consequence of this the cold water flowing at great depths along the bottom of the Atlantic could not get into the Mediterranean, and soundings at the greatest depths of the latter showed a uniform temperature of 51° to 56°. This exception could only be understood on the theory of a general polar circulation in open seas like the Atlantic. The fact that no circulation could take place in the Mediterranean had an important bearing on its animal life. They expected, when sounding, to come on an abundant fauna, instead of which the dredge brought up nothing but mud. The blue colour of the water in the Mediterranean, and also in the Lake of Geneva, was due to the minute diffusion of fine particles of mud. This fine mud had borne on the distribution of marine life in the former waters, as it choked them, so to speak, and thus prevented their multiplication. The organic matter at the bottom of this sea used up most of the oxygen when decomposing. This organic matter was poured into the Mediterranean by the rivers. Turning his attention next to the physical conditions of the Red Sea, Dr. Carpenter showed that its upper waters had a very high temperature. Even at a great depth there was a general temperature, even in winter, of over 70°. There was no large amount of organic matter poured into it, and hence he thought that an abundant fauna would be found along the Red Sea floor, simply because there was no decomposition of oxygen by organic matter. This was proved by the abundance of corals in that sea, as these forms cannot live except in purer water. He thought that the reason why reef-building corals could not live at a greater depth than 25 fathoms was entirely due to the temperature. Wherever the colder sea currents kept up a temperature of less than 68°, coral reefs could not grow, in fact, that these animals could not live where the temperature was less than 68°. Hence the limited vertical distribution of coral-reefs. If this was true, then they ought to find reef-building corals at greater depths in the Red Sea, where the deep temperature was so much higher, and he ventured to prognosticate such would be found to be the case. In the sea, shut out by islands, &c., the temperature was the same as that of the neighbouring ocean, but it had not a lower temperature than 51°. He thought the fissures in the barrier rock allowed water of that temperature to flow in. In conclusion, he showed how different would be the animals entombed in the deposits of these different seas, and the large bearings the question had on geological deductions.

Prof. Phillips then referred to the movements of the atmosphere as illustrating the circulation of water in the ocean. He thought Dr. Carpenter's theory about the vertical distribution of reef-making corals being due to temperature would throw great light on geology, and enable geologists better to ascertain the physical conditions of ancient seas. He thought nothing had been read for many years before the section which would prove so suggestive to geologists.

In reply to Mr. Balls, Dr. Carpenter remarked that all rivers contained a large amount of organic matter—a sort of dilute protoplasm. In the Black Sea the specific gravity varied according to what was poured into it by rivers, and the conditions of life were the reverse of those of the Mediterranean. The doctor stated, in conclusion, that he did not himself lay any claim to being the author of the theory of general oceanic circulation.

FRAGRANT BISULPHIDE OF CARBON.

IT will be a matter of interest to some of our readers, says the *British Journal of Photography*, to know that the usually offensive liquid, bisulphide of carbon, can be obtained free from unpleasant smell, and this as an article of commerce. The value of the liquid as a solvent for resin and other purposes is very well known, but its extremely unpleasant odour had hitherto greatly limited its use, notwithstanding the fact that it is very much cheaper than ether, and can be employed for many of the purposes to which ether is at present solely applied.

We do not know by what process the commercially purified bisulphide is prepared; but, on a small scale, the following plan succeeds very well :—Shake up about one per cent. by weight of corrosive sublimate with the liquid bisulphide, and allow the two bodies to stand for several days with repeated agitation. Some sulphur compounds appear to be removed in great part or decomposed by this treatment, for the mercury salt is rendered nearly black, owing to the formation of sulphide of mercury. This treatment so far reduces the unpleasant smell that, in distillation, a comparatively sweet-smelling liquid is obtained; but a much better product is prepared if the bisulphide, after the treatment with the corrosive sublimate, be mixed with one-third of its volume of almond oil, and then distilled after the mixture has rested for some time. Of course the bisulphide only distils over, since the oil is not volatile, but the former is now found to possess a rather agreeable ethereal odour. It is probable that the oil acts in somewhat the same way that fat or oil does in retaining the perfumes of flowers. In the south of France this power is taken advantage of for the extraction of the delicate odoriferous principles of some flowers; but we employ the oil, in the case of the bisulphide, to remove a very unpleasant smell. The treatment is in both cases effective, whatever its rationale may be, and we can convert bisulphide of carbon into a liquid of agreeable ethereal odour. Now that the purification has been effected on a large scale, we hope to see the bisulphide employed for many photographic purposes for which its use has been hitherto greatly limited.

New Microscopic Slide.—At a late meeting of the Biological Microscopical Section of the American Academy of Natural Sciences, reported in the *Philadelphia Medical Times*, Dr. Hunt called attention to an ingenious slide invented by Mr. D. S. Holman for exhibiting infusoria, especially under the gas microscope. These slides are made by grinding a deep depression in a thick slide, and then making a very shallow circle all round the deeper central cavity. If the shallow depression be filled with the organisation in water which it is desired to study, and covered with a thin glass, in a short time the shallow circle all round the margin will be filled with minute bodies, often zoospores or other objects in the life-history of the object in the deeper cell. The pressure of the atmosphere retains the cover in position.

THE WATCH, AND HOW TO REPAIR IT.

By "SECONDS' PRACTICAL WATCHMAKER."

(*Continued from page* 581.)

THE former remarks in connection with the horizontal escapement are intended as a popular description of that particular arrangement. Proceeding further to consider it, we refer to Fig. 9, which represents the horizontal escape-wheel tooth in action with the cylinder C, both lockings and impulses being shown, the lockings at M N, the impulse at O O H L'; the wedge tooth L is represented as just having fallen from the outside impulse F on to the inside locking M, the point of the tooth there resting during the motion of the cylinder, in common with the balance in the direction P; so far, then, a dead or repose of the train of wheel-work until the return vibration of the balance, which would permit the point of the tooth L to escape from the locking M, and continue to press onward the section of the cylinder M N, till it assumed the relative position as at I H; the wedge having gradually pressed onward the cylinder C until L' had slipped from the curved face of the cylinder C N, and would have advanced so far, and fallen from the cylinder at H, and thus have that portion of the outside of cylinder presented to the succeeding tooth of escape-wheel, in order that when that tooth had fallen it would rest upon that part of the cylinder marked I; therefore the angle of escape is shown by the dotted portion of the diagram marked O O, for during the advance and pressure of the wedge tooth on the edge of the cylinder, it gradually advances and presses forward the cylinder till it escapes from it, and when the point of the tooth falls either on the outside or the inside, the fall of such tooth causes the "tick" which is recognised when heard. The "tick" is caused by the escape-wheel teeth falling alternately upon the outside and inside of the cylinder.

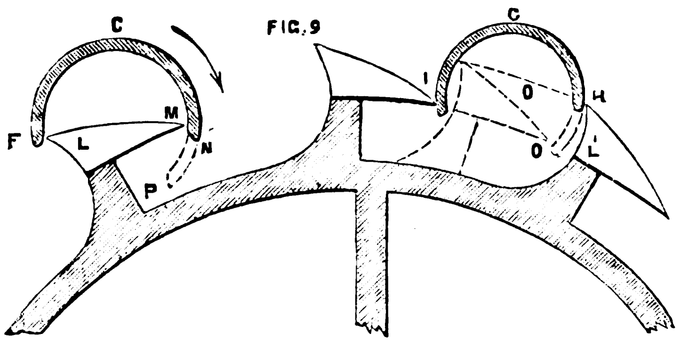


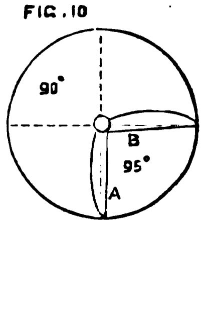
FIG. 9

Therefore it is important that the distance that the teeth fall upon the cylinder should be equal; there is, therefore, a rule by which examiners judge the quantity of "drop" (as it is termed) necessary. When the watch is held firmly, and the balance fixed by a thin wedge of cork, and the escape-wheel tooth inside the cylinder as represented at L M; when the wheel is pressed by a nicely-cut peg the tooth should have appreciable shake as freedom; and also when the cylinder is brought into the relative position as represented at I L H, the escape-wheel should have exactly the same amount of shake or freedom as in the former instance. If all the teeth are tested in this manner, and the point of the escape teeth pass over the centre of the cylinder lower pivot hole, the cylinder and its depth may be considered correct. The angles of the teeth, as shown in Fig. 9, are somewhat in excess of those usually adopted in the early watches by Graham and others of that period, which produced scarcely half a turn of motion of the balance, but since the time of Professor Robison the angle of the teeth has been greatly increased, until our foreign neighbours have produced the present form of escape-wheel teeth, which in practice is found to be all that could be desired to produce the great end in view—namely, steady and good timekeeping of the watches to which such escapements are applied. But we are compelled to remark that there are many Swiss watches, even at the present day, with escape-wheels having teeth of various angles, some even similar to Graham's, but they are rather to be catalogued as ironmongery than as watches.

Having thus far followed the escapement of the horizontal watch, we have to be equally familiar with the "verge" escapement, because, although an old-fashioned piece of mechanism, it is to be found in every part of the world, and it is supposed (and not without cause), that very few minds are attracted toward it in such a way as to obtain for it the best result, for when all its parts are thoroughly worn out, and the escapement is in its worst possible condition, the verge watch will continue to tick, and that state of things occasionally satisfies; but if the best result is required, a deal of thought may be bestowed upon it, and it will be found that the verge escapement requires as much thought and care as any which has followed.

It is very important that the angle of the verge should be attended to, also that the balance-wheel should be hung so that its teeth are equal on each pallet, and that the drop of the teeth on the verge pellets should be as nearly equal as possible. We will first notice the angle of the pallets, which will, perhaps, be better understood by the diagram 10, and must be considered as the most important part of the escapement. By the term "angle" is meant the relative positions of the upper and lower pallets one to the other as regards their angular opening. For instance, holding the balance (with its verge secured thereto) in the left hand, and the lower pivot upward, look down from it toward the upper pallet, and observe whether the face of the lower pallet and that of the upper one form nearly a right-angle triangle, *i.e.*, about a quarter of a circle. By this term "quarter of a circle" I intend to direct the mind's-eye in a popular manner to the subject, and thus follow more in detail. Fig. 10 will assist in further describing the verge escapement. The circle represents 360°, divided into quadrants by dotted lines of 90° each; therefore, by laying down upon the circle the faces of the two pallets, it will be observed that the opening of the pallets in the diagram represents rather more than a quarter of a circle, and thus it should be in practice. Their angular opening is about 95°. If the opening of the pallets were only 90°, and the escapement otherwise good, the backs of the pallets would strike the banking-pins, if banked inside, and whether banked inside or otherwise, when they were made free the verge would hang on its bankings, and no remedy could be devised to alter it; such a defect, it is well known, would cause very irregular going of the watch. See, therefore, when looking down at the verge "angle" that the pallets stand similar to 95°, as marked in the diagram. If so place the escapement together, leaving only just freedom of balance-wheel as regards end shake. If holes are good size, and the verge not worn, proceed to try the "drop" of balance-wheel teeth on the verge pallets. Therefore hold the upper-plate in the left hand, keeping the balance steady by means of the fore-finger, then with the point of a nicely cut peg press the balance-wheel by its pinion so as to impel the wheel forward. If the teeth drop the same quantity upon each pallet, that part of the escapement may be left without further alteration; but then, before deciding whether the "drop" is in excess, the hanging of the wheel upon the verge body should be seen to; that is to say, the teeth of the balance-wheel should be the same distance from the body of the verge at the upper-pallet as they are at the lower one, which may be seen when the verge is turned round, so that the pallets are from the teeth of the wheel, in which case the wheel can be turned round and easily determined. The next procedure will be to see that the balance-wheel teeth are not too close nor too far from the body of the verge. The general rule will be to have the teeth of balance-wheel just free of the verge, in which state it is termed "'scaped" full close; that is, it cannot be 'scaped closer; at the same time the balance-wheel must have no end shake. Then follows the trial as to the quantity of drop of wheel on the pallets, and this leads to ascertaining the breadth of the pallets, for if the pallets be narrower than they should be, the balance-wheel teeth will fall sooner than they would were the pallets broader, and consequently the teeth will have greater drop on to the other pallet. It is, therefore, necessary to keep the verge pallets as broad as possible for the sake of gaining advantages of leverage, and also to reduce to the smallest limit the drop of the balance-wheel teeth on the pallets. To test the breadth of pallets allow the tooth of wheel to drop from the lower pallet to the upper one, keep the balance perfectly steady at that precise instant, then turn the balance the least bit possible back, so that the *edge* of the lower pallet is presented to the back part of the balance-wheel teeth, and then try if the wheel has perceptible shake or freedom; if so, it would be right; if not, narrow a trifle, but be mindful to keep the edge rounded from the back of pallet, because that shape permits free motion between the backs of the balance-wheel teeth and verge pallets. If the wheel has excessive shake or freedom on the pallet's edge that pallet is too narrow, and no remedy is at hand but another verge, if the wheel is the proper depth on the body. In trying the drop of wheel on the pallets the angle of the verge has to be kept in view; for instance, should the pallets be very open, the drop would be greater than when the angle is correct, so that although the wheel may be 'scaped quite close, yet with open angle of verge the wheel will have excessive drop which cannot be avoided unless the pallets are closed. By a little practice the verge angle may be altered, either opened or closed, in the following manner. Some verges are very highly tempered; but if so, in most instances, the pallets may be closed without breakage. Having fixed in the vice a brass stake, and holding the balance firmly in the left hand, place the lower part of the verge on it with the edge of the pallet somewhat raised from the stake, then with a hammer, such as might be used for ordinary work, strike the edge of pallet downward with little force at the first trial; should it not yield, then make another trial with a little more force, and in this way the angle may be formed at pleasure; be sure that the verge lies fairly level on the stake, else there is danger of it breaking. Thus far we have before us a few of the leading principles connected with the verge escapement, but although there are many other points to be considered relative to it, they more specially belong to the jobbing department.

FIG. 10



Having left the escapement as complete, it is necessary to try its correctness; and, therefore, when the watch has been cleaned, put together, and ready for the balance to be pinned in, it will be found of great service to have the watch going without the pendulum spring; therefore mark where end of the spring lies, then remove and clean it. Screw in the verge and balance; having seen that the verge holes are of the proper size, wind the watch a little, and observe the amount of vibration of the balance (half a turn is considered fair motion) when acting on the lower pivot; then, when it is acting on the upper one, and probably the two actions will be similar. Next hold the watch so that the follower is downward, the frame being held vertical; observe the balance motion in that position, for this is a test whether the upper pallet will catch or hang on the balance-wheel teeth, and is a very general fault with verge watches after repairs. Trying thus without the pendulum-spring saves a deal of trouble, because the tension of the pendulum-spring assists the pallet to pass the teeth of wheel, provided a slight catch only existed, and hence this kind of slight defect causes many watches to be complained of as either frequently losing a great deal, or at times stopping. This part of the trial being disposed of, reverse the frame, and hold it so that the follower is upward, and the motion of the balance when in that position will test whether the lower pallet is perfectly free. When such conditions are obtained from a verge watch, and the balance-wheel teeth have very little drop on the pallets, there need be no fear as to the watch going fairly well. Our next article will introduce to us the patent detached lever watch.

Oxyhydric Light.—"The entire town of Buffalo, U.S.A., is now lighted by hydrogen gas, extracted from hydrate of lime, carburetted, and burnt with the oxygen extracted from the atmosphere. The cost of the hydrogen is about a penny per cubic metre; that of the oxygen varies with the price of coal, and is estimated at the value of six kilogrammes (18lb.) of coal, say 2d. to 3d. The oxygen is nearly pure, containing only about 3 per cent. of azote." So says an old established "magazine." Will any of our American correspondents kindly inform us how much (if any) of the above statement is true.

LESSONS ON CHEMISTRY.*

By SELIMO R. BOTTONE.

(Late of the Istituto Bellino, Novara, Italy.)

(Continued from page 579.)

215.—WE have seen that sulphur can be made to unite directly with oxygen in two different proportions—viz., to form sulphur *dioxide* SO_2, and sulphur *trioxide* SO_3 (163). Placed in contact with water, both these sulphur oxides form sulphur acids, and it is of course essential to be able to distinguish them by the name. The mode in which the distinction is made is as follows:—The acid formed by the union of an element with the smallest number of atoms of oxygen takes the termination *ous;* thus, sulphur*ous* acid. The acid containing the larger number of atoms of oxygen is known by the ending *ic;* as sulphur*ic* acid. It sometimes happens that after two acids of a self-same element have been discovered and named, others are discovered; in such cases prefixes are used to denote whether the new acids contain more or less oxygen than the old ones. The acids formed by chlorine will be found to exemplify this matter very clearly. In this series we have:—

Chlorous acid.
Chloric acid.
Hypochlorous acid (from *hypo*, under or less).
Perchloric acid (from *per*, over or more).

216.—With regard to the names of the salts formed by the union of acids with bases, it is only needful to note that those acids, the names of which terminate in *ous*, form salts, with names ending in *ite;* thus potassium united to *chlorous* acid, or to *hypochlorous* acid, will form a potassium chlor*ite*, or hypochlor*ite*. Acids, the names of which terminate in *ic*, give rise to salts, with a name ending in *ate;* as potassium sulph*ate*, potassium chlor*ate*, and potassium perchlor*ate*, for compounds in which potassium is in combination with sulphuric, chloric, and perchloric acids, respectively.

217.—Perhaps the most vexed question of modern chemical nomenclature is the one concerning the correct application of the word *acid*. While some chemists maintain that no real *acids* can exist without the presence of the *elements of water*, others uphold that these hydrated bodies, usually called *acids*, are in fact only the *hydrogen salts* of the true acid; and regard as the real *acid*, the body which is usually known as the *anhydride*.

In order that the reader may be in a position to judge somewhat of the merits of these rival opinions, it is necessary to throw a glance at the progressive steps made in our knowledge of the constitution and properties of acids.

Until the time of the discovery of oxygen, little or nothing was known for certain of the constitution of acids; and no attempt had been made to theorise on the reason of their acidity. Lavoisier, basing his ideas on the limited number of acids then known, came to the conclusion that the acidity† of the bodies in question was derived from the oxygen they contained, and in accordance to this view gave the name oxygen, from *oxys*, "acid," and *gennao*, "generate," to the newly-discovered element. But it was not long before it became known that many acids existed which did not contain oxygen as a constituent. Hence it was evident that oxygen was not *the* acidifying principle. Chemists then divided acids into two groups—viz., (1) such as contained oxygen, and (2) such as contained no oxygen. The latter were known as *hydracids;* the former as *oxyacids*. As it was found that those oxidised bodies which played the part of acids when combined with the elements of water had no action on litmus, and did not combine with bases, unless water were present, it became necessary to include these elements of water in giving the composition of the true acid; while the body which formed the acid on admixture with water was designated by the term "anhydrous acid," or more recently "anhydride." The following table of a few of the oxyacids and hydracids will serve to illustrate the two groups into which these bodies were divided:—

Hydracids.

Hydrochloric acid, HCl.
Hydrobromic acid, HBr.
Hydriodic acid, HI.
Hydrofluoric acid, HF.
Hydrosulphuric acid, HS.

Oxyacids.

Nitric acid, HO,NO_5.
Sulphuric acid, HO,SO_3.
Carbonic acid, HO,CO_2.
Chloric acid, HO,ClO_5.
Perchloric acid, HO,ClO_7.*

A cursory glance at this table at once shows that no point of resemblance exists in the constitution of these two groups when expressed in the above manner. Yet in their physical properties, in their behaviour towards bases, and in their general chemical reactions, the greatest similarity was found to prevail. When the so-called hydracids acted on metallic oxides (bases), water, and a salt of the acid employed, was formed. The same was found to take place when an oxyacid acted on a base; and, notwithstanding the exact correspondence of the reaction in both cases, it was customary to express these changes in two different ways, as the following equations will show:—

For hydracids.—The action of hydrochloric acid, &c., on potassium oxide, &c.:—

$$KO + HCl = HO + KCl.$$

For oxyacids.—The action of nitric acid, &c., on potassium oxide, &c.:—

$$KO + HO,NO_5 = HO + KO,NO_5.$$

The incongruity of this view soon led to a more rational method of viewing the constitution of acids, and it was soon shown that all these bodies might be ranged under one head—viz., that of hydracids.

The following formulæ and equations, illustrative of the composition of the acids and their action on potassium oxide, will prove how much this view simplified the comprehension of the subject:†

(1) Hydrochloric acid, HCl.
Hydrobromic acid, HBr.
Hydriodic acid, HI.
Hydrofluoric acid, HF.
Hydrosulphuric acid, HS.
Nitric acid, HNO_6.
Sulphuric acid, HSO_4.
Carbonic acid, HCO_3.
Chloric acid, $HClO_6$.
Perchloric acid, $HClO_8$.

(2) Action of hydrochloric acid, &c., on potassium oxide, &c.:—

$$KO + HCl = HO + KCl.$$

And in the case of sulphuric acid and potassium oxide, &c.:—

$$KO + HSO_4 = HO + KSO_4.$$

This view, with the addition of the changes in quantity, which the new atomic weights have necessitated, is the one which now meets with the general approbation of chemists. Hence we may define an acid to be "the hydrogen compound of a radical, in which the hydrogen can be replaced by a metal." The radical may be an element, as in hydrochloric acid; or it may be a compound, as in sulphuric acid. The only difference in the formula of the above and other acids will be that necessitated by the view that the relative atomic weights of hydrogen and oxygen, &c., are as 1 to 16. The annexed is a tabular view of the constitution of the above bodies, as expressed in the modern notation:—

Hydrochloric acid, HCl.
Hydrobromic acid, HBr.
Hydriodic acid, HI.
Hydrofluoric acid, HF.
Nitric acid, HNO_3.
Hydrosulphuric acid, H_2S.
Carbonic acid, H_2CO_3.
Chloric acid, $HClO_3$.
Sulphuric acid, H_2SO_4.
Perchloric acid, $HClO_4$, &c.

218.—This is the view which we have ourselves followed in the course of the lessons. It by no means follows that the above formulæ represent the exact position of the various atoms in the molecule. It does not appear probable at present that we shall ever know the mode in which the atoms are arranged. But we do know that in some instances a compound splits up in one way, and in others in a mode quite dissimilar; and it is always well to bear in mind the various groupings to which these various modes of decomposition point. As examples, we may quote the different results of the decomposition of sulphuric acid, according to the method employed. When sulphuric acid is distilled along with phosphoric anhydride, this latter body seizes on the oxygen and hydrogen contained in the acid in the proportions to form water, leaving sulphuric anhydride, thus:

$$H_2SO_4 + P_2O_5 = H_2PO_6 + SO_3.$$

From this reaction it is evident that we may consider sulphuric acid as being constituted of one molecule of sulphuric anhydride united to one molecule of water,

$$H_2O.SO_3. \quad \text{(See 165.)}$$

By the aid of heat alone sulphuric acid splits up into sulphurous anhydride, water, and oxygen,

$$H_2SO_4 = SO_2 + H_2O + O.$$

In this latter case we may suppose the constitution of this acid to be:

$$SO_2 \begin{cases} HO \\ HO \end{cases}.$$

219.—Those who give the name *acids* to the bodies which we have hitherto termed *anhydrides* do so from an idea that these bodies are the radicals of the salts formed on union of the acid with a base; but a moment's consideration will show how fallacious this application is. It is admitted on all hands that in the bodies usually termed acids, the hydrogen contained in them plays the part and holds the place of any metal with which the acid can combine; thus, in sulphuric acid H_2SO_4, the hydrogen holds exactly the place of potassium in potassium sulphate, K_2SO_4. But it must be remembered that the majority of these acids, or *hydrogen salts*, as they are sometimes called, are sour, corrosive, redden litmus paper, &c., and that these *acid* properties disappear in exact proportion to the amount of hydrogen replaced by a metal. Hence it is evident that the name *acid = sour* is more appropriate and more applicable to these bodies, as a class, than to the anhydrides, which do not exhibit any of these distinctive properties, unless placed in contact with the elements of water. But the anhydrides (generally speaking) are *not* the radicals existing in the salts, any more than the metallic oxides are the bases; for instance in the presence of potassium oxide, sulphuric anhydride is changed as follows:—

$$K_2O + SO_3 = K_2SO_4.$$

Now, if it be really desirable to limit the term *acid* to the radicals of the salt, it is evident that the real acid in the bodies H_2SO_4 and K_2SO_4 must be the compound SO_4, and not SO_3, &c. The fact is, the terms *acid* and *base* are in the highest degree unscientific and unsatisfactory; and it is much better to use the terms *chlorous* and *basylous* for the negative and positive radicals of a compound than to continue the employment of the words acid and basic in any other than an adjective sense.

† Acidity, sourness, capacity for combining with metals, &c.

* These formulæ are all according to the old notation, taking the atomic weight of oxygen as 8.

† For the facility of comparison these formulæ are also given with the old notation.

NEW SAFETY LAMP FOR MINERS.

AT the recent meeting of the Iron and Steel Institute at Glasgow, Dr. Irvine introduced to the notice of the members a new safety lamp, based on the now well-known phenomenon of the singing flame. He stated that when a mixture of any inflammable gas or vapour with air in explosive proportions passed through, and was ignited on the surface of, a disc of wire gauze of such mesh as to prevent the passage of flame, and a suitable tube or chimney was placed above, and surrounded at its lower end, the disc preventing the admission of atmospheric air to the chimney except through the wire gauze, a musical sound was produced, varying in pitch, &c., with the size of flame and dimensions of the chimney. In this, as in other flames singing in tubes, the sound was caused by the vibration of the flame determined or intensified by the current up the chimney, and communicated to the column of air or gaseous fluid within the chimney, whose length commanded and timed the rapidity of the vibrations, so as to produce a given note, just as the flutter of the air originating at the embouchure of an organ pipe was commanded by the length of the pipe. The conditions under which this flame was produced differed considerably, however, from those of other singing flames. The hydrogen jet, for instance, was burned in an open tube, to which air was freely admitted at the lower end, and it was necessary that the tube inclosing the jet should be lowered more or less till the singing point was found. In Dr. Irvine's singing flame, the tube was not open at the bottom, and no admission took place except through the wire gauze, and the note was produced when the flame was at the lower extremity of the tube or chimney. These were the conditions which gave to this flame its applicability to the purposes for which he (Dr. Irvine) employed it. The fact of the combustion of an explosive gaseous mixture on the surface of a material impervious to flame (viz., wire gauze, originally employed by Sir Humphry Davy in the construction of safety lamps), suggested the possibility of employing this flame for the purpose of giving warning by sound of the presence of an explosive atmosphere, or elsewhere, by means of a lamp suitably constructed. Accordingly, he had had lamps made for giving light, which, while the atmosphere was not contaminated by fire-damp or other inflammable gas, burned in the usual way, but which, as soon as such a gas mixed with air in explosive proportions entered it, appeal to the ear by a loud musical sound, as well as to the eye by its effects on the appearance of the flame in the lamp—just as in the "Davy." In one form of the lamp, which was more particularly adapted for the use of the viewer or wasteman of the mine, the air entered near the top of the lamp, obviating the necessity of turning the instrument on its side, as it was frequently necessary with the "Davy," when but a thin layer of fire-damp was floating at the ceiling of the mine. In another form the lamp was adapted to the use of the working miner, and a superior light was obtained by the use of paraffin oil. In a third form, specially constructed with the object of being a warning apparatus as well as a stationary light, the sound was given forth when an atmosphere of gas and air under the explosive point entered it. Dr. Irvine had thought of a variety of applications of this singing flame besides safety lamps, but he brought only one more to the notice of the meeting —viz., its use as a fog horn, which on account of its portability, simplicity, and cheapness, might take the place of a costly apparatus, and would be highly suitable for railway junctions, or other situations of danger.

The merits of the new lamp have been freely discussed at the various meetings of those interested in collieries which take place at this season, and a great diversity of opinion has been expressed. At the meeting of the South Midland Institute of Engineers, Mr. Bromley said he thought the invention was one of considerable merit as an alarm lamp, to be hung up at the end of the workings, there to indicate when danger existed. In that shape it would be a tell-tale more likely to prove effective than were the instruments now in use. As a lamp for the every day use of the miner, he did not think the invention was of great value, because when the gas reached a certain point the lamp ceased to afford light to the workmen. The impracticability of such an invention in the North Staffordshire pits would appear when he stated that at that hour there were many miners at work, in that division of Staffordshire, with the gas burning upon their lamps all day long. —Mr. Glennie thought that as the lamp did not begin to sing until the gas and air had arrived at a stage at which the mixture became highly explosive, the fact of its ceasing to give light to the workmen would be an advantage. If he mistook not, the Government Inspectors and other official personages regarded the existence of gas in such a degree as calling for a cessation of labour. No doubt many mines were carried on in a loose way, and perhaps considerable risk; but what would be the position of a mine manager in the event of a fatal explosion occurring at a pit worked under the circumstances mentioned by Mr. Bromley? He thought that although the lamp might not be of so much practical utility as to supplant other lamps at present in use, yet that it was an invention of great value, to which the attention of the Institute might well be given with great deliberation.—The Secretary said that Dr. Irvine had visited Birmingham with a view of making some business arrangements with a lamp-making firm, for the bringing of the lamp into the market as an article of commerce. So soon as two lamps were ready the Dr. had promised to send them to the Institute; and he (the secretary) would take care that they should be in a position to experiment with them. He explained that the lamp, which was fed by paraffin at the bottom, and did not require the removal of the top in order that it might be replenished with oil at the same time that it went on burning, was one from which much practical good might be looked for. After the adoption of such a lamp, miners would have no excuse who exposed the naked flame of their lamps for any purpose. This brought up the question of the practice of miners smoking in the pits; and an expression of a favourable opinion as to the lamps that the Institute had seen in use in North Staffordshire, which could be locked and unlocked only by a powerful magnet.—The Chairman concurred in the testimony borne to this lock lamp by the other members, but observed that Mr. Heath had himself remarked that if miners were determined to smoke in pits, it was next to impossible to prevent them. This, however did not stop either Mr. Heath, or any other colliery proprietor from doing their utmost to impose obstacles in the way of a practice so greatly to be deprecated.

At the meeting of the same Institute held at Stoke, a modification of the lamp was shown, in which the sound was given forth before the proportion of gas was so great as to make an explosive mixture. The use of such a lamp, which is not intended for workmen, would be to indicate the presence of a small quantity of gas, the approach of danger, and the necessity for looking to the ventilation. The working of the principle was also shown in its application to a fog horn. Dr. Irvine further exhibited a paraffin safety lamp which gave forth a brilliant light, and the flame of which, on the entrance of an explosive mixture, "sings" like his ordinary oil lamp. The paraffin lamp is so constructed that the workmen can take out the reservoir and refill it without interfering with the flame, which continues to burn with undiminished brightness, notwithstanding the temporary removal of the reservoir. Mr. W. Ness said, as a practical miner, he considered Dr. Irvine's lamps were perfect, and the paraffin lamp of very great value, because it removed from the miner the temptation to take off the top of his lamp in order to get more light. Mr. Udall and other gentlemen recognised the ingenuity of the invention, but opinions were nevertheless divided as to its practical value.

VIENNA UNIVERSAL EXHIBITION.

HER Majesty's Commissioners for the Vienna Universal Exhibition have obtained answers to a series of questions of importance to exhibitors.

Machinery and apparatus specially adapted to the requirements of the exhibition may be supplied by exhibitors, as, for instance:—Boilers for the production of steam for engines. Steam-engines for driving the main shafting. Gas and water-power engines, for driving single machines and groups of machines. Large and small pumps for waterworks and fountains. Travelling cranes, with normal gauges of 1·5 metre (4ft. 11in.) Overhead travelling cranes, with winch and moving gear, with a gauge of 10·5 metres from rail to rail. Hydraulic lifts for raising persons. Portable engines for service outside the Machinery Hall. Exhibitors supplying such machines and apparatus, intended for special service during the exhibition, will enjoy special privileges. If British makers lend cranes, hoists, boilers, engines, &c., for use of British exhibitors, no fees will be levied by the Imperial Austrian Commission for the use of the same by British exhibitors. But if British exhibitors lend such machinery for the use of foreign exhibitors, arrangements will be made by the Austrian Director-General to indemnify British Exhibitors for the use of their machinery.

The power required to set machinery and main shafting for driving machinery in motion will be supplied by the Austrian Commission, and exhibitors will in no case be charged for motive power supplied by the main driving shafts. The moving force will be transmitted by two horizontal shafts of a diameter of about 4·39in., and at 120 revolutions per minute. Exhibitors supply the pulleys for the main shafts, as well as any other gear and driving bands, at their own cost. The preservation, cleaning, and oiling of the main shafts will be attended to by the Austrian manager, but exhibitors will have to attend to the preservation and oiling of the gear supplied by them, as also to the security of their straps.

Brickwork foundations in the Machinery Hall must be built at the cost of the exhibitors, and be finished and ready for receiving the machinery by the 15th of March, 1873; but the brick foundations and the stonework for engines and steam boilers, &c., employed for setting in motion the machines exhibited, will be constructed by the Austrian Commission, according to the plans of the exhibitors. The main lines of pipe for water, steam, and gas will also be laid by the Austrian Commission, and the exhibitor has only to supply the connecting-pipes with his machines.

Coals from the best Austrian and Prussian coal mines, and feeding water for boilers, &c., will be supplied by the Austrian Commission free of expense. Stokers will also be provided for the steam boilers lent for service in the exhibition, or, if the exhibitor should prefer to employ his own people, the wages of the latter will be paid by the Austrian Commission, according to the fixed tariff.

The whole exhibition ground will be drained by a system of drainage-pipes, carrying water and liquids to the Danube, and every measure has been taken to have a sufficient supply of water in all parts of the exhibition. Water will be furnished at a pressure of about 24ft. at low pressure, and about 120ft. at high pressure. Gas will be furnished by the Imperial Continental Gas Company at the usual pressure.

Steam pressure generally at five atmospheres, but in foreign boilers is not limited, although they will be subject to the Austrian laws and regulations. Single boiler-houses are erected at the rear of the Machinery Hall, about 40ft. distant, but a special boiler-house for British boilers will be built by the Austrian Commission.

Traction engines, locomotive steam carriages for ordinary roads, steam omnibuses, and similar kinds of self-propelling vehicles, will be allowed to run about during the exhibition, in some parts of the park and the exhibition grounds. In fact, traction engines, road rollers, self-propelling steam carriages, steam omnibuses, and steam pleasure-carriages, will be very welcome. There will be some work of importance to be done by steam road-rollers, and, in case of any work performed for the installation by traction engines or road-rollers, all expenses will be paid by the Austrian Commission.

In case of railway locomotive engines and carriages being sent to the exhibition, the rails for them to stand upon must be provided by the exhibitors, and it is very much desired that rails from England should be sent to Vienna as exhibition articles.

There will be competitive trials with steam fire-engines, and the jury and exhibitors are invited to send special engines for this purpose. Such engines will be considered as objects of exhibition, and, if lent for use, fuel and care will be at the charge of the Imperial Austrian Commission.

There will likewise be special trials held with agricultural machines and implements in fields in the neighbourhood of Vienna, or in such places as can be easily reached by the Exhibition Railway. Agricultural machines will be exhibited in a pavilion specially built for that purpose. All machines, &c., intended for the exhibition will be admitted to the Machinery Hall from the 1st of February till the 15th of April, 1873, inclusive, and must be set up by the 25th of April. Machines and apparatus arriving in pieces, and consisting of heavy and bulky parts, must be set up by the 15th of April.

Slate is particularly desired to be sent to Vienna to the exhibition; the slate will stand a chance of being sold at a good price at the close of the exhibition, the Austrian slate being only fit for roofing.

It is also desired by the Director-General that fittings, show-cases, cloth for the covering of walls, window-glass, &c., should be sent from England to Vienna; these would be considered as exhibition objects, and could be sold at the close of the exhibition.

The Director-General has also made special arrangements for storing "empties," which he offers gratis to the foreign commissions.

INSECT METAMORPHOSIS.

THE following lecture was delivered by Professor P. Martin Duncan, F.R.S., at the meeting of the British Association:—Everybody, whether learned or unlearned, is aware that insects undergo changes in their shapes and habits. Great numbers of popular works on natural history have made the description of these changes or metamorphoses familiar to the public, and others have informed the scientific world upon the anatomical and minute changes of structure which accompany the wonderful varieties in form and in method of life. The array of facts is enormous, and yet with all this vast amount of sterling knowledge very little progress has been made towards recognising the cause and meaning of metamorphosis in biology—in the science of life. The facts and details of the subject have been accumulating, but the nature of its philosophy has been studied by very few naturalists, and it is only of late years that Lubbock and Fritz Muller, and a few others, have been stimulated by the light of the theory of evolution to examine into it. Believing that the subject is increasing in interest, and that its consideration bears upon some of the most important theories respecting life, it is proposed to devote this lecture to a description of the different kinds of metamorphoses in insects, and to a consideration of the biological meaning of the phenomena. Let me recall to your recollection two instances of what may be called perfect and complete metamorphoses.

Butterflies and Caterpillars.

When the tenderest cabbages are growing in the early summer, a number of very small caterpillars or larvæ may be seen upon the leaves, devouring them in a regular and systematic manner. Avoiding the leaf-veins as indigestible, they nibble the juicy leaf, and consume daily more than their own weight. These pests of the gardener have small heads and ends, and the body is greenish, and striped with yellow bands, being at the same time hairy. At first very small in size, the caterpillars do not attract much attention, and especially, as after living for a few days, they hide up out of the light, and look shrivelled and ill. After a short time, the caterpillar in retreat bends its back violently, and splits the skin of one of the rings or segments of the part nearest the head, then a vigorous struggle enables the legs and the head to be withdrawn through the crack, and the larva is noticed to have attained a new skin within the old one. It crawls on to its favourite plant and makes up for lost time, grows rapidly, and really may be said to live to eat. It cares not for its fellows, nor for any other leaves; it is content with its own cabbage, and has no ambition and no desire to quarrel or to move away. During growth the powers of mastication and of digestion increase, but they are checked several times by the larva having to pass a period of quietude whilst a new skin is finished under the old, and whilst this is cast off. These skin sheddings have a definite relation to the increasing size of the insect, but they are not simple changes of skin because the old one has become too tight for its rapidly growing possessor. They accompany certain important changes within the insect, and not only is the outside skin shed, but the mucous membrane of the digestive organs and of the air tubes which enable the creature to breathe, suffers also. They are really important elements in the metamorphosis, which term includes the sum of the changes of shape, habit, and instinct. When full growth has been attained, the caterpillar crawls off his cabbage and wanders restlessly about, even to considerable distances, in search of a dry sheltered spot. After having discovered such a locality, it fills up the space between its hind legs with silk, and attaches this part of the body to the wood or stone as the case may be. The larva then hangs head downwards, and forthwith begins to bend its head backwards, upwards, and then from side to side, until, after a little practice, it is enabled to touch the solid substance to which it is hanging on either side of its body. Then some silk is secreted, and by applying the mouth to the spots touched one after the other, a fine sling of silk thread binds the insect down and prevents it from being swayed to and fro by the wind. This is the last act of the larva which shows any evidence of will. Then it begins to look shrivelled, shorter than before, and broader behind the head, and after a time the skin splits, and is shed with greater or less wriggling. A sticky, varnish-looking moisture covers the very different looking thing which now presents itself, and dries rapidly, and forms a case over the skin of the pupa beneath. The alterations within and without the insect at this time, that is to say, during three or four days after leaving the cabbage, are carried out with great rapidity, and the future butterfly is well foreshadowed at this period in the structure of the chrysalis or pupa. Hanging as a chrysalis or pupa in a perfectly immobile condition, neither seeing, hearing, nor tasting, and losing very little weight from the exhalation of its moisture, the insect lives on for many months, and until spring has nearly ended. Then the dark case splits, and a tender white butterfly crawls forth, and, under the influence of warmth, and the sun, becomes dry, stretches, and unfolds its crumpled-up wings, walks feebly upon long legs, trails a short body, moves a curious flexible trunk in front of its head, the result of the modification of its former jaws, and takes to flight. The common white butterfly, whose solitary flight is so zigzag and wandering, and whose flight in company is so tumultous, ascending, and vibrating, lives for love. It has a soul above cabbages, and rarely condescends even to sip or suck the daintiest nectar from flowers. After a longer or shorter existence, it begins to lay eggs, and places them in the immediate neighbourhood of the favourite food of the larvæ, which are to come from them.

The Life Cycle of a False Wasp.

Another familiar example of perfect metamorphosis may be studied in the instance of one of the false wasps *Odynerus parietum*. This small wasp-like insect may be seen on the other side of the Channel in great companies on lucerne and clover when in full flower. It is a solitary kind, and the male and female care nothing for their companions, who rush and tumble over, in, and about the flowers, sucking their sweetness, and squabbling and flying for the freshest corollas. Day after day this buzzing, busy crowd may be seen leading a life of happy enjoyment, feeding, playing, and flirting, but after a while an unusual excitement is noticed amongst a large number of the insects. These extend their flight beyond the favourite field, and seek the neighbourhood of sandy, clayey banks close by. They may be observed digging their heads into the sand with great assiduity, and pulling out sand grains, and gradually forming a hole. Each wasp works independently of its neighbours. As soon as the hole is large enough to admit the wasp's body, the legs remove, by a process of brushing, the particles loosened by the jaws. After a short time the wasp will be found to have made a tunnel, and the constant out-pour of sand and clay indicates that excavation is still proceeding out of sight. Soon the Odynerus perfects two or three chambers deep in the bank and opening into the tunnel. She (for it is the female who does the work) carefully pounds the insides of the cavities and removes all roughness from them, and leaves them as commodious hollows, water-tight, and not likely to fall in. This is not all. On coming back into the light the wasp seizes cylindrical pieces of earth and moulds them, more or less, into shape with her jaws, and places them in front of each other, and side by side, so as to form a hollow tube which sticks out from the bank, and opens into the tunnel. The free end of this ante-chamber is left open, and the pieces of which the whole is formed are gummed together and pressed. The tube is extremely fragile, and the pieces of it are not in contact everywhere. Nevertheless, the Odynerus passes along it readily enough, but no other insect of its size can do so. All this work is carried on whilst the wasp appears to be in an intense state of excitement, and when it is completed the insect flies off to the flowers again; but not to return to its former habits. On the contrary, the purposeless tumbling about of flowers, and the occasional sip of nectar, are forgotten, and the flighty little vegetarian becomes a ferocious and ardent huntress of prey. She seeks the small larvæ of a species of weevil which abound about the plants, and seizing one, digs her sting into it so that a weak venom is introduced close to the nervous system of the victim. The larva is paralysed at once, but not killed; on the contrary, it remains motionless but lives. She then flies off with her prey to the bank, enters the tubular antechamber, traverses the tunnel, and reaches one of the chambers. Here she deposits her insensible victim, and lays one egg close to it. Returning again to the field, she seizes another larva, stings it, and carries it off to deposit it close to the first. This procedure is repeated as many as thirty times, and the chamber becomes full of insensible weevil larvæ and one Odynerus egg. The other chambers are filled in the same manner, and an egg is laid in each. Then the wasp comes out of the tunnel for the last time, breaks down the tubular antechamber, so as to hide the entrance to the tunnel and chambers, flies off, and dies. She never sees her offspring, for which she, a vegetarian, has provided animal food in abundance. The egg is soon hatched in each chamber, and a small, legless, and extremely delicate larva crawls forth, and fixes upon the miserable victim close to it. So tender is the larva that the least roughness of the sides of the chamber would destroy it, and the least struggle on the part of the poisoned weevil grubs would kill it; but all this has been made safe, and the little thing eats into its living prey, and when one is finished it attacks another, until all are eaten up. This is the life of the larva; it is incapable of walking any distance, and simply leads a life of gormandising on the flesh and juices of weevil grubs. It never emerges from the chamber, and when it has no more to eat spins a cocoon of silk around itself, and sleeps therein during the late autumn, the winter, and until the spring. Then a change in form ensues, and a pupa, which greatly resembles the perfect insect, appears under the skin which is shed. In the course of a few weeks the perfect false wasp escapes from the pupa skin, digs its way into the world, and emerges to enjoy the destiny already described. Many other false wasps which belong to the same group of insects as this Odynerus have a corresponding life cycle, and choose many curious kinds of prey, but the formation of the safeguard of the tubular ante-chamber places this kind in advance of all others. It is, then, an example of very perfect metamorphosis with high instinct, and like all other instances of what is termed perfect metamorphosis, there is an intermediate stage of a quiescent pupa between that of the larva and imago, both of which are able to lead independent and distinct sorts of lives, and to take food.

(*To be concluded next week.*)

MECHANISM.*

(*Continued from p. 633.*)

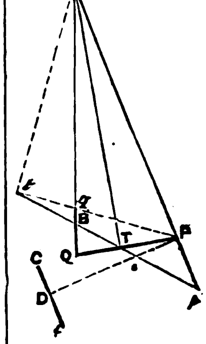
"MOTIONS produced by links," which is the title of this evening's lecture, is a phrase expressive of the leading branch of it only. Mechanicians may have a very clear idea of the meaning intended by it, but to others very varied may be the ideas which the title conveys. Practical mechanics, by the word "links," may have entered the room with an impression that they were about to listen to a discourse upon the elemental pieces of which chains are made. Social science enthusiasts may be anticipating a discussion upon friendship, and even marriage and upon the proclivities of individuals to walk "linking." Antiquarians' thoughts will probably turn to those ornamental extinguishers high above the railings at the doors of aristocratic houses, by means of which, during the last century, "link" boys extinguished their torches. Landowners may be thinking of estates, from the fact of there being generally so many "links" in an acre. A Scotchman's thoughts may revert to one of his country's rivers, and the grounds called "links" lying along its windings; and Americans, if there be any present, may not unreasonably be expecting some description of London sausages, for sausages are called "links" in America. All these expectations must be disappointed. "Link," in an antiquarian's view, is from a Greek word which signifies a lamp; but we have nothing to do with that. In the other sense it is from a German word which signifies "a joint," and it is in the simple sense of a piece joining two pieces, and by which the motion of one may be conveyed to the other, that the word is generally used by engineers. Such a link is either rigid, as in the case of wood or metal, or flexible, as in the case of rope or wire; and it is a means by which the motion of one moving piece is transferred to another. Thus employed, it truly comes under the ordinary definition of "a connecting or joining piece."

A link, therefore, is now to be regarded simply as the connecting piece of two movable pieces; the form and the material are not in any way concerned. Contacts in rolling and sliding cease when we deal with links—flexibility, as in cords, is neither an essential nor a hindrance. It may be well, therefore, to take a preliminary example of a link, for those who have not given the subject attention may be informed that the complexities of link movements far surpass the complexities of cam movements. On the board are a couple of pieces of wood joined by a link, quite sufficient to illustrate the general idea. These two pieces are capable of motion about two drawing pins as centres. A third piece, connecting these two, is the link. If now this third piece be connected with the two movable arms at varying distances from the centres of motion, the paths of the driver and follower will be very different, the variations depending entirely upon the relative lengths of the arms. Sometimes an oscillatory motion of the driver will communicate a circular one to the follower. Sometimes these relations will be reversed. Under other circumstances a continuous communication of motion is impossible, in consequence of a locking of one or other of the arms, owing to the rigidity and length of the connecting link.

The first question to be solved by those who deal with link movements is, what is the law which governs the motions of the two arms when they are under the influence of a link? The law is a very simple one; simple in expression, but complicated in result. It is one of those simple laws that produce very singular consequences; it depends upon the inclination of the link to the line joining the centres of motion of the arms.

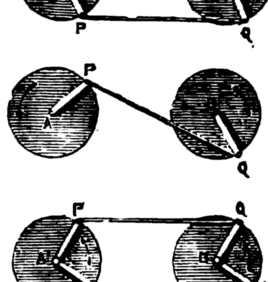
Let A P and B Q or B *q* (Fig. 29) be the arms, movable in the same plane about A and B, P Q or P *q* be the link, then the link will cut the line A B. either in T or (produced if necessary) in *t*. Wherever it cuts, whether between or beyond the centres of motion A B, this law holds good that the velocity ratio of one arm is to the velocity ratio of the other arm inversely as the segments into which this line of centres is divided by T or *t*. Or take it in another form (one more convenient probably in some respects), the velocity of P is to the velocity of Q, as a line drawn from A square upon the link is to a line from B drawn square upon the same link. Observe for a moment the nature of these motions. Assume the shorter arm to be the driver, that driver therefore conveys a very small motion to the driven and longer arm, in certain positions it ceases to convey any motion. For example, in this position, viz., B Q and Q P in one straight line, it cannot convey motion. Putting it in other positions will show the relations more plainly. Observe how slight the motion is upon one arm, and now that the perpendicular from B upon the link is passing from one side to the other, the directional relation of motion also is changed. This is a serious question with links; there is a continual change of the direction and velocity ratio. Through a small motion of either arm there may be what is, for all practical purposes, a communication of uniform motion. This is the case when the direction of the links being produced and meeting as in K, the line joining K and T is at right angles to the link.

FIG. 29



On the table are a number of examples of links; let us follow the action in this one. A and B are the centres of two equal wheels, P and Q pins near the circumferences, P Q the link. If slow motion be communicated to A, then through the intervening link, P Q, a motion will be communicated to B. So long as by the hand or otherwise, P Q moves parallel to A B, then clearly whatever be the motion of A it will be repeated in B. This is the principle on which the ordinary parallel ruler is made. For, in this case of parallelism, the link never cuts the line of centres, the ratio of the velocities of A P and B Q will be constant and equal. You may observe that the motion is apparently communicated with great regularity. In truth it is not so, for the link cannot be left to itself. The hand by which the link P Q has been hitherto supported and guided, is now withdrawn, and you will notice a failure of motion takes place when the pin, P, is in the same line with A B. In fact, there are then two paths which this link, P Q, may take; it has the choice either of ascending or descending, and it will probably take sometimes one course and sometimes the other. The nature of the motion is thus changed, sometimes there will be a complete revolution communicated to B Q, and at other times an oscillating motion only. Conse-

FIG. 30

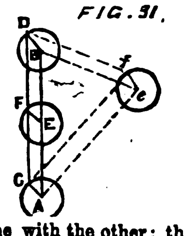


* By the Rev. ARTHUR RIGG, M.A., being the Cantor Lectures delivered before the Society of Arts.

quently, to place a link upon two arms and leave it freely to act, is a matter that is quite hopeless if continued systematic action is required. The second and third parts of Fig. 30 illustrate, by the position of the link and directions of the arrows, what takes place. There must, therefore, be some plan by which this link shall not have a choice of paths.

There are three modes of doing this. In the one case, if we place a third equal crank, and connect it to the others by links, observe the way in which it acts. A C, B D (Fig. 31) are the original cranks, E F (or e f), is a third crank. The link, C, F, D, cannot now leave the prescribed course. A fourth or fifth crank may be added, in fact we may take any number, and we obtain a system of bars capable of a very regular motion one with the other; they move parallel to each other. On the table there are bars so arranged. The link connecting those arms is not free to move, being bound by another arm, and the links are parallel in all positions of the cranks.

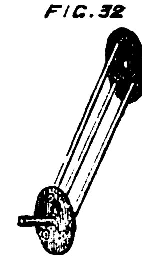
FIG. 31.



There is another mode of preventing an uncertainty in the path, by putting an additional pair of cranks and a second link. Observe, there is now no longer any freedom of position, for each link is compelled by this second arm to retain a preordained course, and the consequence is we have uniform motion in these arms. This is the most simple mode of overcoming the difficulty of variableness in the direction of the link, and it is the plan adopted in all locomotives. You see a link generally on each side of a locomotive, the object being to prevent the accident that has been described, which is sure to happen when there is only one link.

There is still a third plan, viz., to multiply the links. Here (Fig. 32) are two shafts parallel to each other, but the ends are not vertically one over the other. If you look at this yellow bar [the three sloping bars in Fig. 32 were painted three different colours in the model] you will see it is in reality acting as a link. If there was only one bar it might assume a cross position. Owing to the other bars being constrained to follow the path that has been allotted for them, the yellow bar cannot take a cross position. Hence this mode of transferring motion by links from one shaft to another as freely and uniformly as though they were straps. The motion is not very old, having been invented in 1834, when the Society of Arts awarded a silver medal for it. It is mentioned in the "Transactions" for the year 1834, p. 83, and "the silver medal was presented to M. Victor Baum, member of the Royal Chapel of Munich, for a method of communicating rotary motion, a model of which has been placed in the Society's repository."

FIG. 32.



With these three contrivances, links can be safely carried over what are called their centres. These centres are peculiar, and the laws of them are important. You have seen that when a link is in a certain position there is an option of two paths. Both of those paths cannot be followed. Owing to there being, as it were, no decision on the part of the driver, and, in fact, at that particular point, no motion communicated by the driver, it has been called a "dead centre," simply because there is no living motion in it. Mechanics have tried in various ways to overcome a difficulty which, under the influence of a fly-wheel, is more theoretical than practical. On the table is one plan. Here is a section of the vertical cylinder of a steam-engine. When the piston is at the lower part of the cylinder it cannot move the crank, but when it has risen a short distance it is capable of acting upon the crank. This very short additional cylinder causes the double action of another link. By allowing steam to operate in this very small second cylinder, at the instant that the crank reaches a dead centre it is thrown over, and thus the crank of the engine is placed in position for the continued action of its own piston.

On the table are some peculiarities of link motion. Multiplicity of links leads to multiplicity of arrangements and results. [The lecturer here referred to models, which consisted of cranks or arms, acting under the influence of connected links. They were produced to show how rapidly motions could be multiplied by means of links. In one contrivance there were three links and four arms. These caused eight movements in one pointer, consequent upon one rotation of the first crank. In another grouping of links and arms one revolution of the crank produced at the two extremities of the combination alternate rest and oscillatory movement.]

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, *31, Tavistock-street, Covent Garden, W.C.*

All Cheques and Post Office Orders to be made payable to J. PASSMORE EDWARDS.

"I would have every one write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

**** In order to facilitate reference, Correspondents when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

THE FLOOR OF PLATO.

[4856.]—THE darkening of the floor of Plato, as the sun rises higher above its level, is a phenomenon of so much interest and importance (if fully established) that Mr. Birt will probably not be unwilling to explain certain points in connection with it.

I wish particularly to know whether he has by any test *proved* the darkening to be *absolute*. The determination of the comparative brightness of different regions is so uncertain that one can scarcely tell what reliance to place on observations going no farther. Plato is so much larger than any region of similar extent in the neighbourhood that I find it difficult to understand how the relation in question has been demonstrated.

Another difficulty which presents itself on a perusal of one of Mr. Birt's papers is connected with the curves by which he indicates the sun's altitude and the luminosity of Plato. Having drawn a curve to indicate the sun's altitude in lunar latitude 50° at the equinoxes, and having assumed a very light tint of Plato (0·80 of his scale) to correspond with solar altitude 0°, and a very dark tint (0·70 of his scale) to correspond with solar altitude 40° (this corresponding closely with observation), he says of the resulting curves "one very remarkable feature is that the chromatic curve lies almost wholly within that of altitude, from which it may be inferred that the full effect of the sun's influence is scarcely attained, &c." But so far as I can judge from Mr. Birt's paper, the selection of the relation between the two scales—that of altitude, and that of tint, is altogether arbitrary. Why should not a medium tint, 0·60, for example, have been associated with the solar altitude most nearly corresponding? This, with tint 0·30 for altitude 0°, would have altered the scale. Again, why should not the curve of altitudes be replaced by the curve of sines of altitudes, since the sun's illuminating power on a surface varies as the sine of his altitude above the surface?

I merely submit these points so that I may have Mr. Birt's explanation. I have doubtless misapprehended him in some way or other.

I must confess I cannot accept as decisive Mr. Birt's reasoning (*Monthly Notices*, Vol. XXXI., p. 81) that the want of agreement among the curves of visibility for different spots is at once conclusive that *all* the variations in visibility are not dependent on extraneous circumstances, such as solar illumination, alteration of position on the moon's disc by librations, &c. Much would depend on the nature of the surface. Take half a dozen or more spots on the moon, each a few miles long and broad, and suppose one to be a surface covered with sugar-loaf hills, another covered with domed hills, a third covered with saucer-shaped hills, a fourth covered with saucer-shaped hollows, a fifth with relatively minute walled craters, a sixth with hemispherical depressions, and so on; then these spots would be very differently affected by variations in the sun's altitude above their mean level. As we see these spots, even with the best instruments and under the best conditions, as we should see a terrestrial surface two or three hundred miles away, it is not easy to tell what the structure of their surface may be. (Of course I am not for a moment supposing that the spots are actually covered as above. But, on the other hand, it seems unsafe to suppose that they are all alike as to the general confirmation of their surface.)

RICHARD A. PROCTOR.

THE MOON.

[4857.]—I VENTURE to point out a slight error in the remarks of "F.R.A.S." (let. 4823, p. 639) on this subject. He says that the motion of the perigee is direct when the moon is in conjunction, and retrograde when she is in opposition. There is, however, no necessary connection between the moon's age and the motion of the perigee. The motion is direct (on the whole, during the lunation) when the perigee is in or near conjunction or opposition, and retrograde when the perigee is in or near quadrature. But during the progress of any lunation the motion is sometimes direct and sometimes retrograde, its character when the moon has any given age depending on the position of the perigee with respect to the sun.

Having thought it desirable to go through the calculations respecting the moon on which the numbers given in my answer to W. L. Brown (let. 4790, p. 614) were based, I detected a slight error. The mean advance of the perigee from the node is accomplished at the rate of 60° 1′ 49·4″ (not 59° 58′ 4·8″ as stated in that letter) *per annum*, or almost as much over 60° as the former estimate was under. The mistake arose from my writing in one place 346·667 instead of 346·607 for the mean interval between successive conjunctions of the sun and the moon's rising node. The value now given is the final value, as it is to be entered in my book on the moon.

It follows that the mean interval between successive conjunctions of rising node and perigee is 2190·348 days, or about $1^{1}/_{9}$ day less than six years.

I need hardly say that for 18 years 110 days, I should have written 18 years 11 days for the length of the Saros. I probably wrote 11·0 days (which, be it noted, is not exactly the same thing as 11 days). I may take this opportunity of mentioning that having had occasion to examine the values given in our books for the moon's mean and maximum librations in latitude and longitude, I find slight errors. The computers seem, so far as I can judge from their results, to have overlooked the consideration that the inclination of the moon's orbit cannot have its maximum value at the time of maximum libration in latitude; and, again, that the eccentricity cannot have its maximum value at the time of maximum libration in longitude. The difference is slight, however. Thus I get 7° 45′ instead of 7° 55′ for the maximum libration in longitude, and 6° 44′ instead of 6° 47′ for the maximum libration in latitude, giving 10° 16′ instead of 10° 24′ as the absolute maximum libration. But a more important error has been made as to the extent of the moon's surface brought into view by libration. Instead of a seventh, very nearly a sixth of the farther hemisphere is brought into view, without taking into account the diurnal libration, which raises the proportion to about $^{8}/_{15}$ths. In Klein's "Das Sonnensystem" the invisible part of the moon is set at 0·4248 of the whole surface. This is much better than Arago's estimate; but with the accepted value of the librations (which Klein adopts) should have been 0·4183, without taking diurnal libration into account.

RICHARD A. PROCTOR.

THE MOON'S LIBRATION.

[4858.]—THANKS to Mr. Proctor for pointing out the mistake in my paper (ENGLISH MECHANIC, No. 330, July 21, 1871, p. 424), which most probably arose from my not noticing, at the time of writing, the different directions of the apsidal and nodal revolutions. Although it does not alter the general reasoning, it necessitates a correction of the passage in which it occurs, which should read thus: "As the moon moves from the point of mean distance to that of her greatest distance (apogee), the point of intersection of her equator and first meridian approaches the centre of the apparent disc, and as the period of her motion with respect to the line of apsides is not coincident with that between her passages of the ascending and descending nodes, but is of *longer* duration, the equator *at the epoch of apogee is south* of a line at right angles to the first meridian, which crosses the apparent disc from north to south. When the moon is in apogee under these circumstances, the libration of the centre, which at perigee, was nothing in latitude and longitude, is nothing in longitude, but a measurable quantity in latitude; in other words, the line of libration no longer cuts the centre of the apparent disc at the point of intersection of the equator and first meridian, but at a point having *north* latitude, or *north* of the moon's equator; so that when the moon *arrived* at her descending node the first meridian *was still eastward* of the centre of the apparent disc. [Note.—The *italicised* words indicate the corrections to be made.]

May I be permitted to offer a remark on that part of Mr. Proctor's letter (4790) in which he states "that the interval between successive conjunctions of the perigee and rising node is slightly greater than six years"? From this I apprehend the reader might infer that the three-yearly interval between mean libration occurs alternately with ascending and descending nodes at perigee, so that at the end of every six years from any given epoch of mean libration the returns would be in the same order. Beer and Mädler give the following formula for finding the interval. Half the revolution of the line of apsides = 4·42 years; half the revolution of the line of nodes = 9·31 years, therefore

$$\frac{4{\cdot}42 \times 9{\cdot}31}{4{\cdot}42 + 9{\cdot}31} = 2{\cdot}997 \text{ years,}$$

which is slightly less than three years. In 1865, as stated in my paper, mean libration occurred on October 4, moon in perigee, and descending node. Six years after, epoch of mean libration October 4, moon in apogee and ascending node. In this year, 1871, the perigee coincided with the descending node, not the rising. In 1868 mean libration occurred on October 12, moon in perigee, just past the ascending node; in 1874 it will occur on October 11, just past the descending node. The alternations are, therefore, as follows:—1865 Perigee: Descending node. 1868 Perigee: Ascending node. 1871 Apogee: Ascending node. 1874 Apogee: Descending node. Longitudes of ascending node:—1865, October 8, 201° 12·7′. 1868, October 7, 143° 18·6′. 1871, October 8, 85° 11·4′. 1874, October 8, 27° 9·1′. Time—3,287 days, being less than half a revolution of the line of nodes, and greater than one revolution of the line of apsides. Mean libration on or near October 4, perigee: Descending node and apogee: ascending node. Interval, six years, nearly. Mean libration on or near October 11, perigee: Ascending node and apogee: descending node. Interval, six years, nearly.

From the above it appears that the conjunctions of the perigee and rising node alluded to by Mr. Proctor, attended with a state of mean libration, take place at intervals of twelve years (nearly). Mean libration at the intermediate six yearly interval occurring, with the apogee and descending node. W. R. Birt.

LUNAR ATMOSPHERE.

[4859.]—The following extracts from Mr. De la Rue's address to the Mathematical and Physical Section of the British Association are of interest in connection with the question of the moon's atmosphere:—

"The vaporisation of even solid bodies at low temperatures suggests that a mass of matter in space will ultimately surround itself with its own vapour, the tension of which will depend upon the mass of the body (that is, upon its gravitating energy) and the temperature. If the mass of the body is so small that its attractive force is insufficient to give to the enveloping vapour its maximum tension for the existing temperature, the evolution of vapour will be continuous until the whole mass is converted into it. It is proved by analysis that such a mass of gas or vapour in empty and unlimited space is in a condition of unstable equilibrium, and must become dissipated by continual expansion and consequent decrease of density. It follows that celestial spaces, at least within the limits of the stellar universe, must be filled with matter in the form of gas."

"Professor Zöllner finds, by calculation, that the density of air forming an atmosphere round the moon must be $\frac{1}{10^{334}}$ of that of the air of the earth's surface."

The different tints indicative of the different reflective powers of the materials composing the moon's surface are conclusive as to the *variety* of such materials, and from this it follows that the moon's atmosphere cannot be strictly homogeneous, but must contain vapours given off from each material. The question now for solution is the possibility of the condensation of such vapours in the *immediate* neighbourhood of the moon's surface. W. R. Birt.

LUNAR OBJECTS FOR OBSERVATION, OCTOBER, 1872.

[4860.]—October 5.—Picard A and B of Beer and Mädler with other craters in the interior of the Mare Crisium (*a*). October 6.—Fabricius (*b*), Metius, Steinheil. October 7.—Theophilus; the central mountain is a fine study if coming into sunlight. October 8.—Ariadæus, Silberschlag, Hyginus. October 9.—Cassini, Sulpicius Gallus, Menelaus, Manilius. October 10.—Craters and mountains between Archimedes and Plato. October 11.—The Alps and wedge-shaped valley, the interior of which may be examined for craterlets. October 12.—Plato; the Hartwell ledge on the S.W. border is visible as a fine streak of light fringing the shadow of the mountains on the S.W. of Plato for 48 hours only; if not detected on the 12th, look for it on the 13th. October 13.—Horrebow, its interior wall dividing the crater. October 14.—Hippalus, its divided interior, diverse floors, and included craters. October 15.—Wargentin, Schiller.—October 16.—Full moon, aspect of the interiors of craters, particularly of Maginus and Geminus.

(*a*) A decided instance of change has taken place in the Mare Crisium. Formerly, about 10 or 11 years ago, I *constantly* observed under a high illumination a large white cloudy patch west of Picard; it was larger than the crater, and on its side under a low illumination, I detected a small pit-like marking, very distinguishable from the rest of the surface by its whiteness. Subsequently, two small craters were discovered by Mr. Knott in this pit-like marking, and of late years the cloudy patch has been much reduced in size. 1872, August 18, about the time of full moon, when the light spots on the surface are very perceptible, I observed the locality, and made the following record: "The large cloudy spot west of Picard is not present; its locality is marked by a very faint light spot." The phenomena lately ascertained as characterising Plato render this instance more interesting than it would otherwise be.

(*b*) On the south of Fabricius is a large depression with an elongated central elevation which stretches from the south border of Fabricius. It is proposed to name it Janssen.

Attention is especially directed to the region SS.E. of the Mare Serenitatis, containing several dark spots, among which are Julius Cæsar, the Boscovich of Schröter, and the Boscovich of Lohrmann.

W. R. Birt.

THE AUGUST METEORS, 1872.

[4861.]—I read with much interest the communication from Mr. W. Davenport, which appeared in your last number, having reference to these phenomena, and hope that some further observations may be supplied by any of your subscribers in whose localities the weather was sufficiently favourable. The sky was almost entirely overcast at Bristol on the nights of August 9, 10, and 11, and at Weston-super-Mare, where I was then staying, clouds also interfered with observation. On the 8th, however, several meteors were witnessed, but they were very insignificant objects, and not brighter than stars of the 3rd mag. One bright one was seen on the 12th at 10h. 15m. It passed down the western sky and left a trail of light, which endured but for a moment. Another brilliant meteor, equalling, or even exceeding in magnitude, any of the brighter stars, came under my observation on the 19th at 8h. 50m. It was visible in the E.N.E. part of the sky, and was very star-like in appearance. It did not leave any train of light marking the path it had traversed, and it was of a blue colour. On the 20th I saw another at 9h. 40m. It was rather bright, but its duration was very brief. It passed through Ursa Major.

The Rev. S. J. Johnson, F.R.A.S., of Crediton, Devon, says, in a letter to me, "I only saw three meteors on the 8th up to 11h. 30m., though with clear sky. 9th, a densely-clouded night. 10th, windy. Partly clear at intervals. Watched from 10h. 45m. to 12h. The first meteor glanced through a break in the clouds at 11h. Between 11h. and 12h. I observed twelve. 11th, watching from 10h. 50m. to 11h. 30m., with a clear sky, I saw eleven meteors only. One on the 10th and one on the 11th equalled 1st mag. stars."

Referring again to the letter of Mr. Davenport, it will be seen that he found the radiant point of the meteors which came under his observation was somewhere near 22 Andromedæ. The majority of those meteors which I observed in August last year appeared to emanate from B Camelopardi, or from a point in close proximity to that star. I noticed several meteors distant only two or three degrees from the place I have indicated, and from their paths it was evident that a radiant point existed at B Camelopardi. Each of these meteors had very short paths, and were faint objects, enduring but the fraction of a second. Several other radiant points of the August meteors have been determined. Prof. A. S. Herschel writes:—"The chief radiant point of the August meteors, as observed last year, was certainly northwards from χ Persei (about 3° or 4° towards ι Cassiopeiæ), and it will be interesting to watch if it remains in this position, or returns to a more southerly place, near η or γ Persei, or to B Camelopardi. The position of the radiant point in Pegasus was most imperfectly indicated by the many meteor tracks from the southern constellations, which were recorded among the unconformable meteors noted in last year's shower; but its position seemed at last to be quite distinctly fixed about 3° north of α Pegasi (at R.A. 346°, N.D. 17°) with two other contemporaneous radiant points, one at least of them producing as many meteors as the radiant point in Pegasus, and very definitely marked at R.A. 342°, S.D. 32° (close to Fomalhaut), agreeing remarkably with a radiant point at R.A. 338°, S.D. 28, observed on the 28th of July, 1865. The agreement of the positions is complete (although quite independent) from the observations of both dates, and it will be interesting to trace the return of this radiant point if it should occur again among the unconformable meteors noted in this year's August shower." Unfortunately, however, there have been but few meteors seen during the past month, in consequence of the generally cloudy state of the atmosphere. At some stations, perhaps, the weather may have been more favourable; and if so, the observations made might tend to an augmentation to our knowledge of the radiant points, &c., of the meteor shower of August. There is no reason to suppose that during the last few years the August meteors have become less numerous than formerly; on the contrary, it seems probable from the number seen last year that they have increased.

In regard to the solar observation made by Mr. J. H. Whistle (let. 4792, p. 614), it is not unfrequently the case that the umbra of a solar *macula* is encroached upon by a luminous vein or spot (facula). Previously to the dissolution of all the larger spots, streaks of bright light may be observed encroaching upon the penumbra and umbra. This was particularly the case in regard to the immense spot of September, 1870, as will be seen by a reference to some sketches of its appearance on p. 25, Vol. XIII. of the English Mechanic. It is not, however, very often the case that an isolated bright spot is detected in the centre of the umbra of a spot, and it is probable that if your correspondent had used an instrument of greater power, he would have probably seen that the luminous appearance which came under his observation was connected with the edge of the spot by a thin vein or streak of light. Still, observers have noticed occasionally bright spots within the penumbræ of maculæ, and quite possibly Mr. Whistle has made a similar observation. In the immediate neighbourhood of all large solar spots or groups of spots, the faculæ always exist in abundance, and it is not surprising that they should sometimes be observed upon the umbræ or penumbræ of the darker spots when we consider the disturbed condition of the solar surface in which they are situated.

On observing the sun to-day with a 4in. metallic mirror reflector, I saw several conspicuous spots, but none were of great dimensions. They were situated on the eastern portion of the disc. There have occurred lately several exhibitions of the Aurora Borealis. On August 3 and 8 I witnessed the phenomenon. Neither of these displays were exceptionally brilliant, though several well-marked streamers were visible at times, enveloping the stars in Ursa Major and Auriga. A strong auroral glow was also strikingly manifest on both evenings of observation.

Bristol, September 2. William F. Denning.

INTERIOR OF THE EARTH.

[4862.]—"Philanthropist" (answer to qy. 12681, p. 647), is quite mistaken in the reason he assigns for the slower vibration of a pendulum at the bottom of a mine. (In the Hartley Colliery experiment the pendulum vibrated more quickly at the bottom of the mine; but that is a detail.) The portion of the earth above the pendulum (that is, all the matter further away from the earth's centre) cannot under any circumstances oppose the attraction of the rest, but must always (in the case of a mine) tend to increase that attraction. Whether the increase is sufficient to make up for, or more than make up for, the reduction in the actual mass lying nearer to the centre than the pendulum does (as compared with the mass so situated with respect to a pendulum at the surface), depends on the shape and extent of the mine.

Richard A. Proctor.

PROCTOR'S SMALLER STAR ATLAS.

[4863.]—Referring to Mr. Proctor's letter (4699, p. 560), will he please to say if this contains as many objects as the larger atlas? He speaks of each being a companion to a different work. Smyth's "Cycle" is in the hands of very few amateurs. Webb's work is possessed by every one, but it contains many objects not in the "Cycle." T. T.

GULF STREAM AND MAP PROJECTIONS.

[4864.]—To speak of "a map" as "solely intended to give true areas" (let. 4755, p. 583), and having "no occasion whatever to illustrate forms" (par. 2), would strike most people, I think, as mere paradox. The proper means of doing this would surely be a *table* of mere numbers and names, as Mr. Bottone's chemical one on p. 578; and I regard the grotesque figure that Mr. Proctor conceived to illustrate his excellent "Gulf Stream" criticism rather as an awkward table than a map, good or bad. The essay could hardly be said to need any graphic or tabular illustration at all, beyond such a mental one as most people who have atlases or globes, or have been to school, would carry in their eye. The present deluge of misapplied Mercator charts, however, infects us all with monstrously false ideas of the relative areas of the arctic and tropical regions, whether lands or seas, and was doubtless a main cause of the ridiculous theories he wanted to expose. By the way, he surely does not suppose there was anything newer in his views on the cause of the Stream than in my remarks on different map projections. In what book, or how I first heard of the "Gulf Stream," quite passes my recollection. Probably it was at some lecture; but wherever learnt, I certainly, at a first Atlantic voyage at the age of 20, had precisely the same view of the circulation, its rationale, and its independence of all wind action, as now. Constant evaporation from the hot latitudes, only very partially made up by rain and river returns in the same climates, or indeed anywhere, but mainly by the melting of polar ice, must needs cause a predominant set of the surface waters from the cold latitudes to the warm. On a globe without land, this would be the universal surface motion; but its rotation must make any such currents easterly ones, because each particle, going from a lesser to a larger circle of latitude, carries the slower motion due to the former into a quicker moving zone, and is thus constantly left behind by the ground over which it is arriving; or, in other words, must be constantly moving (relatively to the ground) westward, like the trade winds. Within the range of those winds, then, the surface of sea, and lowest layer of air, have each, independently of the other, a set in the same direction. Were the sea frozen, the winds would, for aught that appears, be the same; and were there no air, the surface water would equally have this set—namely, outside the tropics nearly due westward, but within them turning more and more meridionally, as the westing diminishes, by the successive parallels and their rotative speeds growing less unequal in approaching their maximum. If the currents either of air or water, from the two tropics, continued sensible to their very meeting, at the warmest parallel (which shifts according to the seasons, from about 12° N. to 5° S.), their encounter would be direct, one due N. and the other due S., when meeting at the equator, and equally opposite when at any other parallel. But, in fact, they cannot ever be traced to within some degrees of this line of theoretic meeting. Between them is the zone of "doldrums," at the borders of which, becoming imperceptible, their last traces are still, in the case of the winds, NE. and SE.; and if we suppose any general momentum impressed by either these or the water-currents on the belt of warmest water, its direction must be westward. I am not aware of any such predominant set being observed either in the equatorial air or water; and should rather, in a map of currents, leave the "doldrum" zone blank, as a kind of vast backwater, whose evaporation is the main exciter of the currents of both hemispheres without itself participating in either. Among all the cases of drifting to great distances, I never heard of anything carried from the southern hemisphere into the northern, or *vice versâ*; and therefore should not, like Mr. Proctor, carry the current lines across the equator, but regard our North Atlantic circulation rather as a distinct self-contained system, that would probably be not sensibly different were it made a real lake, by a barrier of land (instead of still water) closing it southward between Guinea and Pernambuco, and a closing also of Behring Strait, or even exclusion of the whole Arctic sea by lands joining Scotland to Greenland. In any such great lake, extending across our north temperate zone, it is easily seen there would be a necessary circulation in the direction of the hands of a clock; and if it were in the southern hemisphere, in the contrary direction. The locality of the origin or exciting cause could only be said, in either case, to be the whole eastern coast of such lake or basin; and in our case, the whole trend of the European and African coasts, from Norway to Cape Verde, being south-westward, like the current the sun would excite were there no land, this tends to confine and regularise the motion, and to throw the whole ultimately on the Brazilian and Guayana coasts. These can, by their form, only deflect it north-westward, into the great central American recess; whose coast-line for some 4,000 miles, from the equator to the Florida

Strait, is so formed as to gather and intensify the whole motion into a current constantly more confined and more rapid, up to its maximum at the escape between Cuba and Florida. The islands south of Porto Rico are too sparse and separated by deep water to present any obstacle; and Hayti and Cuba, meeting the westward set of surface-water about where its westing (to judge by that of the wind) is strongest, repeat in their coast-lines the very trend of the Brazilian coast, in a latitude where the mainland has ceased to do so, and thus contribute in conducting the whole of the inter-tropical currents into the singular trap formed by the Mexican Gulf, for detaining, heating, and concentrating them. Mr. Proctor is certainly wrong in carrying the lines northward past this Strait, for navigators have many tales of the two contrary currents always occupying it, the westward one along the Cuban coast, and the stronger "Florida Stream" proper, confined to the northern half of the channel. In fact, as we have no drop of blood that has not, within a few minutes, been through the heart, there would seem to be no water in the North Atlantic that has not recently made the Mexican tour, and been expelled past Florida, this gulf acting the part of boiler to the whole self-contained system. Without the long detour, under a hot sun, that the peculiar form of the Mexican coasts obliges it to make, this whole ocean and its surrounding lands, especially north-eastward, would certainly be colder; and, in fact, we and Scandinavia have the warmest climates, for our latitude, in the world.

For a map to illustrate any of this (or, indeed, anything else), its main concern is surely with forms. In regard to areas, all it needs is not to exaggerate uselessly the polar regions. Now, Mr. Proctor's wonderful caricature does, to all intents, more than double them. He has to explain that it includes the *whole* polar circle, but as this is converted into a sector, less than a semi-circle, the fact of its equalling in area the whole true circle makes it equivalent to an exaggeration of that circle to the full size of that whereof the sector is a part. For no mind, however practised in maps, is adequate to realising that the sector means a whole circle, and two lines nearly as widely separated as possible are "one and the same meridian," when, if joined, they would obviously make the map a tall extinguisher, instead of any approach to part of a globe. Continuity of surface is before any correctness of either forms or areas. I will venture to say that, whatever way Mr. Proctor may define "the purposes he had in view in constructing the map," the very first plate of Phillips' "Library Atlas" presents two constructions, each fulfilling them far better. There are three pairs of hemisphere maps, each differently divided, and each also on different projections, but none with other than circular curves. The large pair, divided by a meridian (as usual through Iceland) are on the fancy projection made by dividing each of the four radii equally and the circumference also equally, and making every meridian or parallel an arc through three of the points thus determined. It may be called a compromise between the equal-surfaced and equal-angled (or stereographic) methods, and inferior for any one purpose, I think, to either. A smaller pair are divided by the equator, and another, of the same size, by the horizon of London; and these exhibit the two rational methods in their purity, the former that of true areas, the latter of true angles and therefore forms, its linear scale at the extreme margin being just double, and therefore scale of area quadruple, of that at the centre (not double, as I inadvertently called it, p. 566). Even this variation of scale I do not call "monstrous," but rather trifling compared to what is now everywhere thrust upon us by the lazy Mercator mappers; and a care to mark all the parallels (not the meridians) to single degrees, either on the water or land (whichever is least written on) would quite obviate any false impression, by thrusting prominently on the dullest eye the fact, and precise degree, of such variation. Now, either of these two projections would have given Mr. Proctor the whole contents he has indicated, in less space than on p. 499. From the first of them, the equal-surface map, with pole in the centre, all that is north of the equator might be directly *traced*; and from the other, the stereographic with London in the centre, the meridians and parallels would be unchanged, but the places shifted 40° eastward; for it happens, oddly enough, that the latitude of London is exactly the middle parallel he required. He goes southward 10° beyond the equator, say 62° from this parallel, and northward 23½° beyond the pole, giving also 38½° + 23½° = 62°. Only two extreme points are beyond 60° from the centre, and at this distance the stereographic increase of scale is but as $\sqrt{3}$ to 2 lineally, or 3 to 4 in area; few maps that include more than one country having so little variation. With degree parallels marked as above said, I should call it perfectly "immaterial," or incapable of misleading, even if involving the making 3,000,000 square miles in one part equivalent to 4,000,000 in another; which "monstrous" difference, however, to which Mr. Proctor leaps, could by no means exist; for it is only in two extremities that, perhaps, thirty square miles at the utmost are swelled to the area of forty at the very centre. From the other map of Phillips, however, he had only to trace one rigorously equal-surfaced, if that was his crotchet.

If this or any of the maps to which I have seen his name are fair specimens of the "thousand" alluded to, p. 588, I venture to say that he thinks quite erroneously he has "a much wider practical experience of all modes of projection than 'E. L. G.'" Not that I mean to imply his experience may not have extended to some reasonably well-planned maps, but that it includes far too many bad ones. There is one set of his star maps which, though bad in style of figuring and almost every matter of detail, are in reality the best projection for their purpose, the twelve gnomonic circles circumscribing 12 pentagons; the same I had begun in a much better style of execution years before, but was assured there was no public for any fresh star maps. In another dozen, however, his planispheres for each second hour, on the horizon of London, the construction is as ill-chosen as possible. The stereographic (in this case the easiest by far) was the only right one, not only because alone giving each constellation its true form, whether high or low, but having a peculiarly happy adaptation to this purpose, by its enlarging their scale towards the horizon exactly as our common error of judgment makes them seem larger, as noted in the recent letters on Perspective (Mr. Proctor's, 4706, p. 560, &c.). As we grow older, this fancied difference of scale between the same object when isolated high in the sky, and when adjacent to terrestrial objects, diminishes; but I well remember, as a boy, estimating the lineal scale of the constellation Lyra, when at the zenith or the north horizon, to differ as 1 to 2. Now, this is the precise difference that a stereographic projection of the whole visible sky (the only one preserving the *form* identical in both positions) actually gives. There is no kind of map, terrestrial or celestial, about whose right projection there could be so marvellously little doubt, as this wherein the "wide practical experience" wandered so hugely astray.

E. L. G.

[4865.]—IN "Oceanic Circulation" (p. 500, *ante*) there is a quotation from Maury containing statistics which appear to me to be capable of a different interpretation to that educed by Mr. Proctor, who follows Captain Maury's line of reasoning in the particular sentence referred to. Writing of examinations of log-books, Maury says:—"The results show that within these latitudes—and on the average—the wind from the north-east is in excess of the wind from the south-west only 111 days out of the 366. Now, can the north-east trades, by blowing for less than one-third of the time, cause the Gulf Stream to run all the time, and without varying its velocity either in force or prevalence." If the wind blew from the north-east only for 111 days in the year, the deduction would be logical that it blew from that point for less than one-third of the time; but this is not how the quotation reads. As it stands, we may reasonably infer that the wind blows during 255 days equally from north-east and from south-west—that is to say, half that time from each point; and that, besides this, it also blows for 111 days entirely from north-east, for are we not plainly told that the wind from the north-east is in excess of that from the south-west for 111 days? so that it may blow but 127½ days from the south-west, 127½ from the north-east, plus an excess—viz., 111 days, also from the north-east, or 238½ from the latter point, and not 111, or "less than one-third," as Maury reasons, unless he states what he does not mean. As an approximately correct knowledge of the intertropical wind currents is so important in any inquiry into the origin and maintaining cause of the Gulf Stream, no doubt Mr. Proctor will speak to the point, as he is always so competent to do.

F. D.

"E. L. G."

[4866.]—IT has been to me a source of wonderment that no notice appears to have been taken of that extraordinary communication of our "roaring lion" (let. 4630, p. 511). Obviously it is the interest of any body (heavenly or earthly) to avoid colliding with a comet whose vapours are pretty certain to condense, upon contact, into a diluvial torrent of adverbs, substantives, and adjectives, but, notwithstanding and nevertheless, in the interests of social and moral progress, I desire to say a few words on the subject-matter of the letter under review, without wishing to enter into the vexed discussion on co-operative stores.

A gentleman of the order of mind of "E. L. G." should hardly need reminding that the bare announcement of mental deductions, decidedly in advance of the time, on any subject upon which the world at large almost universally holds opposite views is just time lost, and the labour expended in hammering in repugnant ethics into unprepared minds is, like trying to drive a wedge wrong end first, a simple waste of energy; something like attempting to teach a schoolboy the principles of geometry by beginning at the tenth book. Such a course is fatal to the successful propagation of any new theory, more especially when it comes recommended by such language as "polluting debasements of soul;" "such damning and unalterable truths as the essential defilement of the touch of all 'trade' as now understood." What can the uninitiated make of all this sort of talk? Where is the close and orderly sequence of argument to convince their sceptical minds? Language admittedly loses weight and force from a superfluity of big words, and especially when thundering maledictions are hurled broadcast at what people have, in their ignorance, come to regard as just and proper things, however much such things may merit bad names—for, until the public mind is educated up to the requisite point to see the fitness of the denunciations, the only effect of such strong language as quoted is to cause its author to be regarded as an enthusiast or a fanatic by the ordinary reader. Teach the public scientifically—by which, I mean begin at the beginning, and teach the science of trade or "equitable commerce" as "Sigma" teaches of electricity, &c., or as S. R. Bottone teaches chemistry—by grounding the learner in first principles, and presenting to his mind a coherent and intelligible system, and then some one may give attention to the subject, but, until then, it will just be the old complaint—"We have mourned unto you and ye have not lamented." I believe one mind out of a thousand cannot tell what "E. L. G." is driving at, and the mercantile mind—on whom the fire is directed—is quite capable of taking up the defensive attitude against such sweeping principles, coming as they do, recommended by averments like this:—"Every one who is not combining to supersede butcher, baker, &c., by establishing shops and shopkeepers of their own, had better for mankind not have been born." And they sadly need enlightenment as to the meaning of "competition in righteousness, instead of dark pelf filching." Is the above meant to do away with private enterprise for all future time, and am I a rogue and swindler because I don't entertain the public with a schedule of my profits, every item of which would be, of course, unquestionably true? This is how the majority of readers understand the argument and reason upon it. There are also men in the religious world sufficiently captious to consider as an attack on Christianity — and not without apparent reason—such indoctrination as that "combination against the trade class, and for the restraint of 'trade' as now defined [how?] is the only religious act possible to us English of these days, the only worship of the Almighty." This is one way of setting about the education of the masses of us poor ignorant readers into sounder commercial and Christian principles. But, if I may venture to generalise, the chances are a thousand to one that those anxious to do what is right are deterred by such a passage as last quoted from giving the assertions which appear in the same company a second or serious thought; they will conclude, probably, that much learning hath made him mad, and perhaps this is the correct explanation of the fact that no one seems to have taken the trouble to notice them. At any rate, a topical treatment of so large a subject as that "E. L. G." touches upon, interspersed with such smart sentences as instanced, is nothing short of injurious to the cause the author has in view—whatever that may be—and, as a sad waste of the precious space of "our" journal, is, I think, to be deprecated.

F. D.

CHANGES OF LEVEL IN LAND AND SEA.

[4867.]—THE "Antiquity of Man," quoted by "Saul Rymea" (let. 4819), is the only one of Lyell's books that I can say I have thoroughly read, and I did so at its first appearance, having till then been in as complete fog as Mr. Taylor and others complain they now are on this interesting question; for how long, before the great revolution of fifty centuries ago, can traces of man be carried back? Cuvier, while irrefutably proving the date, simultaneity, and vastness of that event, was ignorant as to whether man existed before it, and even Mantell and Buckland seem to have been without positive evidence on the point. Since their day it had been placed beyond doubt, by antediluvian human traces, both in Europe and America; but whether going back one or ten thousand years earlier I was quite in the dark. Now Lyell's book, though purely negative, seemed to settle the absence hitherto of any evidence for men above a few centuries before that catastrophe, because nothing can be plainer than his great desire to make out an extreme antiquity, unless his complete failure to find such evidence beyond 60 or 70 centuries back. If "Saul Rymea" would read the book through, he would find, I think, the most striking and novel feature to be the vain attempt I noticed, to make a geo-chronometer of what is the most utterly uncertain and unfit of all known motions for such a purpose, the insensible rise or fall of land; on the assumption of *either* moment always averaging the present mean rise of the centre of Norway (which is rising most at one end, and slightly sinking at the other!). Raised beaches rather testify a long former resting at a certain level than a raising by jerks. But at all events, let books, and Lyell's particularly, be examined for *facts*, and not for *opinions*, or with any such superstition as that "there must be" something "enabling geologists to arrive at an opinion," this or that; which is the essence of Mediæval grovelling and obscuration. On the same principle there "must be" proof of astrology.

E. L. G.

MONOLITHIC BUILDING.

[4868.]—I HAVE been much interested in the letters that have appeared in "ours" on this subject, and hope that any subscribers who can give any practical hints or details of working, cost, &c., will not fail to send them for publication. I am about to erect a small residence for myself in the neighbourhood of Birmingham, and would like to have some idea of what it ought to cost; as not being burdened with a superabundance of "siller," I want as much good, substantial work as I can get, in these high-priced times, for my money. The sort of house I fancy is one with two living rooms, each about 16ft. by 18ft., kitchen about 12ft. square, four decent sized bedrooms, and all necessary offices. The rooms about 10ft. high, walls of concrete, floors and ceilings of rolled light iron girders with concrete arches, or rather arched slabs, the girders about 6ft. apart, the stairs also of concrete. With the object of saving coal, and promoting comfort, I think of heating by means of hot-water pipes from a boiler in the kitchen, running a 4in. pipe round the rooms with a coil in some convenient place in the room. Ventilation by means of a pipe carried from the ceiling of each room into a shaft kept warm by being placed contiguous to the kitchen flue. The roof I should have flat, or with only a very gentle slope for drainage, and a parapet round, so as to form a promenade, or site for an arbour wherein to enjoy the fragrant weed, and take a look around. Any remarks, suggestions, &c., on the above will be gladly received, I dare say, by many others besides

BRYM.

GYROSCOPIC MYSTERIES.

[4869.]—I beg to offer the cases of a wheel or hoop trundled along a level surface for the consideration of those who are perplexed with the subject of rotary motion, as affording instances under different conditions to those given by the spinning-top; with rapid motion such bodies are stable, and they fall as the velocity of rotation diminishes. No doubt clear mechanical ideas are requisite for comprehending gyroscopic mysteries—more definite than are usually imparted by a course of "popular" reading, and it is in this sense that I understand Mr. Proctor to state that it is impossible to give a popular explanation of gyroscopic motion, and not that a man must be versed in the subtleties of mathematical analysis, including "polhode," "herpolhode," "couple of impulse," "ellipsoid of gyration," "reciprocal surface of the momental ellipsoid," &c., to account for individual cases. This I should think is practicable in the same way that Airy has in popular language explained the lunar theory and brought it within the compass of those who have little more than a "popular" knowledge of geometry and mechanics. Gyroscopic motion is no doubt a more difficult subject, but need not, I should think, be considered beyond the pale of those who have not mastered the principles of rigid dynamics. A man may understand why a ball flies furthest from the blow of a bat, that does not sting the hand, without a mathematical demonstration respecting moments of inertia or centres of percussion. I may have misunderstood Mr. Proctor, or I may be wrong, but I apprehended that for individual cases there are clearer (or I should say simpler) methods of explanation than the process of interpreting a general mathematical solution of the question.

I speak with diffidence, for I have read neither Poinsot's or Routh's treatise on the subject, and it is truly said that one thing becomes very clear to the unprejudiced inquirer after truth—viz., the amount of his own ignorance. This remark may apply in my own case to the following sentence quoted by "R.A.P." from Routh. I do not know to whom the italics are due. "In the game of cup and ball any motion caused by a wrong pull of the string *or by gravity* will not, if the ball is spinning round a vertical axis, produce so great a change of motion as it would have done if the ball had been initially at rest." By spinning the ball the verticality of the spike hole is no doubt secured against the disturbing effect of a side pull, or if the spike-hole be slightly inclined, it is steadied by rotation of the ball from the effect of any upward vertical pull, but I cannot see how the action of gravity is modified by the rotation of the ball, unless the conical form of the hole is taken into consideration, which would affect the homogeneity of the ball, and to a very slight extent in certain positions its motion as affected by gravity, &c., but these positions are excluded by the supposition of the verticality of the ball's axis, so that there only appears to remain for consideration the parabolic motion of the ball, which is independent of its rotary motion and uninfluenced by it. M. A.

THE BRITISH ASSOCIATION, AND THE MECHANICAL EQUIVALENT OF HEAT.

[4870.]—The British Association appointed a committee to investigate the subject of the mechanical equivalent of heat. That committee has been appointed now three years, and has drawn money for its expenses, but has not made public a single word by way of report, or given any reason why it has not done so. I sent in a paper on the subject to the Mechanical Section, but they said that as a committee had been appointed to investigate the matter, they thought it better to send on the paper to them. In the Chemical Section I took an opportunity of denouncing that part of the theory which makes −278° C. to be the absence of all heat, or absolute zero, and I could not find a single member to defend the point. On the contrary, one of the most eminent authorities on the subject of heat took the same view of the subject as myself. From an article in the *London Quarterly Review*, it would appear that Joule himself has in some way modified or given up his theory, but the writer, though authorised by Joule himself to say what he says, speaks rather ambiguously.

Putney, Sept. 2. H. Highton.

DR. CARPENTER AND GEOMETRY.

[4871.]—The axiom that "the whole is greater than a part" referred to by "Tyro," qy. 12860, p. 651, cannot be demonstrated, because we cannot experiment on *every* whole and *every* part. It can only be illustrated by example. Nothing can make it more obvious than it is in itself. Nor can we *prove* in any way that two straight lines cannot inclose a space. Our conceptions of a straight line alone render the axiom obvious to us.

By the way, Professor Clifford, following several eminent German and English mathematicians, holds in the possible non-universality of the truth of certain geometrical axioms. See his address in last number of English Mechanic. Their hypothesis is that as conceptions relating to space of two dimensions are inadequate to deal with the relations of space of three dimensions, so our common ideas relating to space of three dimensions may not be true with respect to possible space of four dimensions or more.

Richard A. Proctor.

THE PLANET JUPITER.

[4872.]—Now that this planet is receding from the sun, and will soon be favourably situated for telescopic examination in the morning hours, the two following sketches of his appearance (made in the early part of the present year), may be considered interesting, and may also be found valuable for comparison with other drawings of the planet that will be made during the ensuing winter months:—

Fig. 1 represents the planet as observed January 5, 1872, at 15h., by Mr. E. B. Knobel, who employed an 8¼in. silvered glass reflector, power 212. Fig. 2 was made on the following evening at 10h. Mr. Knobel says:—"I should call attention to the curious slanting streak in the S. hemisphere, which has been most persistent. I observed it first on January 5, 1872, and also saw it on the evenings of January 6, February 2, April 11, 16, and 28. This slanting streak is shown in Mr. Birmingham's sketch in the *Astronomical Register* for February, and is also mentioned in the March number as having been observed by Mr. Gledhill on February 2, but I can find no notice of it by any observer prior to January 6. In my sketch of Jupiter made on January 5, the slanting streak is not shown so extensive as on the following evening, and it would be interesting to know whether my drawing of January 5 is correct, or whether the streak was observed, prior to that date, as fully developed as in my sketch of January 6, or Mr. Birmingham's in the *Astronomical Register*."

In Fig. 1 a well-defined, circular, dark spot is delineated near the E. limb and just S. of the equatorial belt. This object was the shadow of satellite 3, which entered upon the surface of the planet at 14h. 39m. on January 5. Mr. Knobel adds it is necessary to mention that the belts and dark spaces in the equatorial zone of Jupiter as represented in the sketches are somewhat too dark.

Bristol, September 3. William F. Denning.

FIG. 1

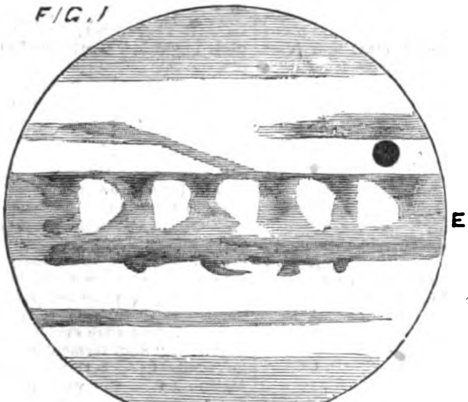
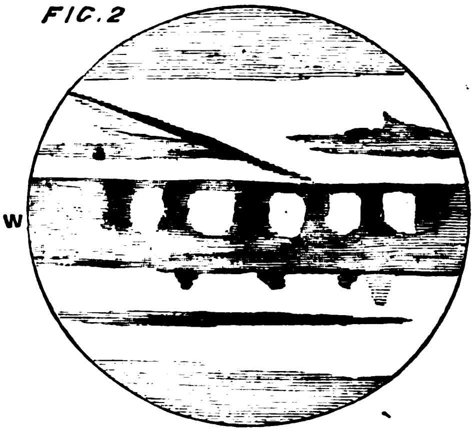


FIG. 2



PERSPECTIVE.

[4873.]—Mr. Proctor (letter 4802, p. 617) considers that further reasoning would be thrown away upon me because I spoke of "plumb-lines converging in the zenith," but Mr. Proctor himself, in letter 4621, p. 509, states that the "vanishing point of any plumb-lines is the zenith," so that I fail exactly to see wherein I have so grievously erred. I take it that if two plumb-lines were placed a few feet apart the convexity of the earth would not prevent their appearing to vanish in the zenith. In another letter Mr. Proctor intimates that I am making two parallel straight lines inclose a space optically; that is quite possible, just as it is possible for two parallel straight lines to meet in a vanishing point.

I grieve to state that it is many years since I limped over the "Pons Asinorum," and therefore I may forget my Euclid. I cannot remember any proposition in which there was a plane parallel to a given line, and I am sorry Mr. Proctor has not favoured us with a diagram showing this case of parallelism. I have, however, carefully looked through all the portion of Euclid he recommends so touchingly to his youthful protégés, but have failed to see how it supports the following monstrous assertion, made, not exceptionally, in a well-known work on perspective: "Perspective is said to be the art of representing an object, or combination of objects, on a plane, such as a sheet of paper or canvas, as they would appear to the spectator looking through a sheet of glass or window interposed between himself and the objects to be delineated. This sheet of glass or window is a most important feature in perspective drawing, and though views are more frequently taken in the open air than from a room, an intervening sheet of glass, or transparent plane, is always supposed to exist between the spectator and the original objects, and this supposed intermediate plane is called the plane of delineation." Now, I think I have proved that this sheet of glass will show convergence in the tower, and therefore we cannot use it as above advised as a guide to pictorial representation. In fact, the glass would delineate what we see, while our paper or canvas must from one point of view exhibit what we do not see, in order that we may by means of this opaque plane of delineation produce the required effect. I have not maintained that the tower must be made to converge on the canvas, but that, considering the way a picture is generally viewed, the artist may, if he thinks fit, make it do so. The question is an artist's and not a mathematician's. M. Paris.

P.S.—I do not profess to be a mathematician, but I venture to doubt the assertion that two planes must intersect if one plane be parallel to a given line in the other, because the two planes may be themselves parallel. Mr. Proctor undertook an impossible task, and has egregiously failed. His letter is quite in the style of Buzfuz to that stupid witness, Weller. If we had lived in dome-shaped houses we should never have heard of a plane of projection or delineation. It is a purely technical matter, and adopted to meet the exigencies of flat mural decoration. In this question there are three things to be taken separately into consideration, the tower, the teacher's sheet of glass, and the sketcher's paper or canvas. The lines passing through the glass, if fixed, would not coincide with those drawn by an artist on an opaque plane, assuming perfection of work and the position being the same; therefore, even if Mr. Proctor's rider held good for the paper or canvas, it would not for the glass, so that all writers on perspective, as far as I have studied them, are simply misleading the student. I cannot see that solid geometry is involved in this matter; we are dealing with a superficies, *i.e.*, the face of the tower.

M. Paris.

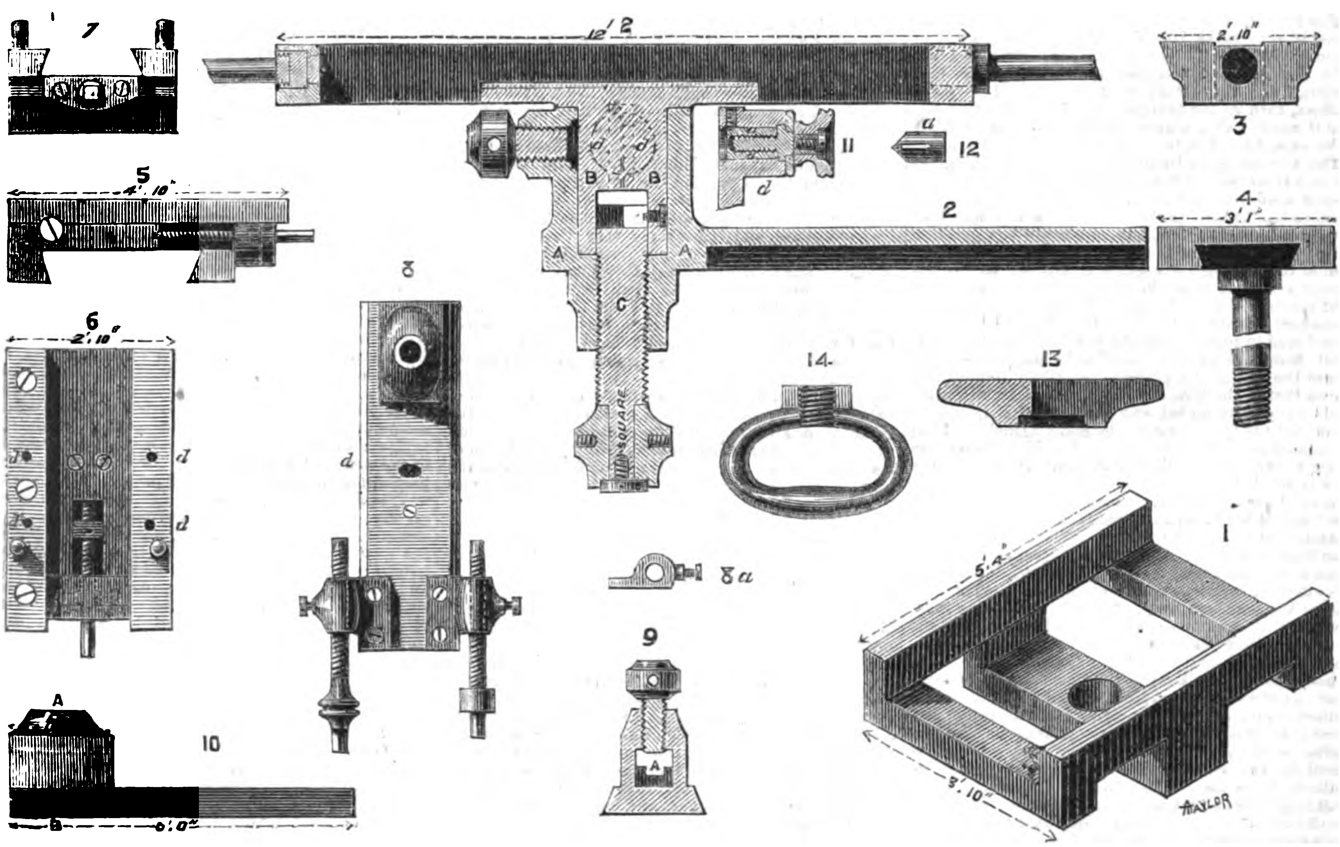
[4874.]—Mr. Proctor (let. 4802, p. 617) misquotes me, and places his misquotation in inverted commas. I did not say that a vertical line should be represented by a curve. An optically vertical line should, of course, be represented vertical; but such vertical line must, to appear vertical, be in the exact position to which the axis of the cone of vision is pointed. Let this vertical line be A, let there be two other naturally vertical lines B C at equal distances on each side of A, let all three lines be produced to the vanishing point in the zenith, then A, though it must be represented by a vertical line, will in nature appear to bend over the spectator in a curve; the lines B and C will also in like manner bend over to the zenith, and being both convergent to A, they must appear to reach the zenith in curves in the same plane as A.

As to Mr. Proctor's sneer about "that singular curve," it is quite beside the mark. I meant the word singular in the colloquial sense of curious or remarkable, not as solitary or unique. Bobo.

[4875.]—There have been lately several letters upon this subject, and plans to enable a person to draw correctly. They are all troublesome, more or less. I beg to send a description of a small affair I made to enable a person who can draw but cannot sketch to do so. It consists of two pieces of thin wood, about 8in. long and ½in. wide, jointed about 2in. from one end, so as to open and shut. To use it you fix upon one perpendicular line, or any straight convenient line, and apply the inner edge of one long leg so as to be parallel to it; and then move the other leg so as to be parallel to some other part of the object, then lay the nstrument down upon the paper and mark the two ines, and so you go on. I have now before me a drawing very nicely done by a young lady for whom I made one, and who could not sketch at all, but who at once succeeded when using my instrument. The picture is painted in sepia, and is a view of part of a village containing trees, animals, houses, church, and so on, so that there was a good deal of work in it, and shows how easy the instrument is to use. E. T. S.

ORNAMENTAL SLIDE-REST.

[4876.]—I SEND the drawings and description of the long promised slide-rest:—Fig. 1 represents the cradle of slide-rest, drawn isometrically to avoid three views of one rectangular object, and will be understood at once. Fig. 2 shows the whole of the principal parts of the slide-rest taken in section through the middle of Fig. 8, which shows the shape of either end of the slide; this upper piece is cast open the width of the dotted lines in Fig. 8, except at the part shown in section forming the connection with the stem B B. A A is the socket in which the stem is carefully fitted; the lower part at right angles is grooved on the under side in the usual way of a T rest, to carry the head of holding down bolt; the breadth of this piece is shown in Fig. 4, where the bolt is shown in position. I shall return to these two pieces later on. Fig. 5 is side view of the slide which travels on the face of Fig. 2; Fig. 6 is plan view, and Fig. 7 end view of the same; Fig. 8 is plan of the tool-holder slide, Fig. 10 side view (adjusting screws removed), and Fig. 9 end view in section through A B Fig. 10, this slide, of a (Fig. 12) is tapped to carry the screw, retained in position by a small plate bearing against a shoulder on the screw, and fastened to the stem by three small screws (not seen); the end of cylinder is shaped like a V, and the stem of the rest has two similarly shaped grooves cut along the whole length at right angles to each other, one of these is shown dotted between *d d*. Now, if the tightening screw is slacked, and the cylinder is in the position shown in the drawing, the rest may be moved about its centre in any direction, but if it is wished to set the rest to either of its right angled positions, it is readily done by moving it round a quarter circle (by estimation), and then by turning the milled head on the end of the screw the small cylinder will force its way into the groove, and set the stem fast in the required position; the end of the small screw seen bedded in the thickness of the stem works in the little groove on the upper side of the cylinder (Fig. 12), and keeps it in proper position. The lower end of socket A A is extended downward, and tapped to receive the screw C, of which the upper cylindrical part is accurately fitted to a hole bored up in B; on the lower end of the screw a boss is fitted, with holes drilled round the circumference for turning the screw with a lever. For the purpose of causing the screw to draw the slide down, as well as push it up, a recess is turned away near the top to the depth of the dark shading, and to it is fitted a steel ring cut in halves, and kept from revolving by the points of two split-headed screws which bear in a shallow hole drilled in each half ring. There is nothing in the construction of the upper slide calling for any particular explanation, beyond that the shaded piece A seen



course, fits into Fig. 6 and 7. Fig. 8*a* is an end view of one of the pieces into which the adjusting screws are tapped. This rest differs in two essential points from those in general use; one is, the means furnished for raising the slide above the centre, the other, the plan for setting the rest parallel, or at right angles with the bed of the lathe; these I shall explain later on. To return to No. 1, this piece is cast solid, and fitted between the bearers of lathe by its mid rib, if the heads of the lathe fit internally; or, by the outer strips, if outside fittings, in which case the end strip is separate and screwed on from the underside, and set up to its place by the adjusting screws, of which the corners are just seen in the drawing. To this the parallel tail piece of the rest is fitted, and held down by the bolt clip 13, and handle 14. The clip is circular, and has a slot of the diameter of the bolt cut out from circumference to centre, to admit of its being slipped on or off the bolt, which enables the whole apparatus to be lifted off the lathe bed without disconnecting the cradle. The long slide has its screw and nut as usual, but the ends of screw are carried through the rest, and the cranked handle fits both ends; the right-hand end of screw fits against the flat end of slide with a boss, divided on its circumference into fifty divisions, which read against a scratch on the upper face of slide, which is divided from end to end in inches and tenths, so that the 500th of an inch is easily read off. The socket A A has two circular projections at right angles to each other, one carrying the tightening screw as seen to the left, the other *d d*, shown in section *d d* Fig. 11, and supposed to be broken off to show its construction, which is merely that of a miniature cylinder poppet head; the cylinder in the mouth of the pent house (as we call the tool-holder in Fig. 9) is a loose piece planed to fit the width and height to centre of the ornamental turning tools usually sold in sets; the two pillars standing up in Fig. 6 and 7 are the stops for the adjusting screws of Fig. 8; *d d d d* in Fig. 6 and *d* in Fig. 8 are respectively the holes and oblong slot in which a forked lever works when the slide is disconnected from its drawing screw. A friend who made a rest of this pattern, and who had ½in. more to spare in the height of his centre, improved on the upper part by putting an additional slide over the one shown (supposing the pent house cut away) pivoted in front, and secured at the rear end by a milled headed screw working through a quadrant; this enabled him to set the upper slide to an angle without moving the stem of rest. The description of this tool has reached a very unexpected length, and will appear tedious to some of your readers, but it must be borne in mind that I am writing for the information of such as may be inclined to try their hands at making the tool, and who may not have any opportunity of inspecting one, far less of pulling it to pieces. In conclusion, the pent house tool-holder, as will be seen, can only take a drilling or cutting instrument of rectangular form which can slide through it from one or other end, therefore, if it is proposed to use the ellipse or rose cutting frames, which have tangent wheels on the end, another form of tool-holder, called the receptacle holder, must be substituted; in this the tool is dropped in from the upper side, and held in position by a pinching screw passing through a rectangular piece sliding in a recess planed out in the upper part of the holder. WAKENAAM.

SOUND OR UNSOUND THEORY.—To "F.R.A.S."

[4877.]—I TRUST if I again trouble you on the above subject you will attribute my doing so to my earnest desire for that knowledge of which I feel myself very deficient, and not a mere unworthy determination to have the last word.

It is on the fact that "a confined mass of air may be made to vibrate rhythmically" we build all our organ pipes and similar contrivances, but to enable this fact to augment the mere loudness of the sounds produced by vibrating bodies (be they tamburi, bars or plates of wood, glass, or metal, or even soundboards moved by strings) I have hitherto supposed it was an essential condition that the said masses of air should be of such dimensions that their vibrations must either be unisonous with, or bear some definite harmonic relation to, those of the vibrating body which causes their motion or communicates its motion to them.

When a tuning-fork or bell is employed to perform the function of the reed of an organ pipe—*i e.*, to put the air in a tube into sonorous vibrations—it is customary to adjust the length of the tube, often by pouring water into it, until its upper portion becomes capable of containing a column of air whose length is such that it vibrates in unison with, or harmonic relation to, the fork. Under these conditions the phenomenon termed resonance is powerfully developed, but not—so far as my experience extends—otherwise; and we do much the same thing by reverse means when we alter the length (and consequently its rate of vibration) of an organ reed until its vibrations become nearly, if not quite—it should be quite—synchronous with those of the air in the pipe.

In the instances of the harp and violin little or nothing of this kind is effected; truly, some very rough approximation is attempted in the former by making its "box" larger at the bass end than at the treble. Even this most primitive attempt at correct proportion is not carried out in the ordinary violin, excepting so far as it may be said to be done by making the cubic capacity of a viola greater than that of the violin, that of the "cello" yet larger, and that of the contra-bass of varying dimensions until it becomes "the giant" No. 204 of the catalogue of ancient musical instruments at South Kensington Museum. It would puzzle Apollo, although the god of music, and the Muses nine into the bargain, to make one organ pipe which should produce sounds whose pitches vary from fiddle G to E (not to say the F above in altissimo) without its length undergoing any alteration. Now, this is just what the one mass of air confined between the back and belly of a fiddle (whose volume is unvariable) must do if it really be resonant to all the sounds of different pitches which the varied lengths (and consequent varied rates of vibration) of its strings compel its soundboard to produce.

It will be understood the above observations apply only to loudness. That the included air may—probably does—modify the soundboard's vibrations, so that the timbre or quality of the sounds we hear differs considerably from that of the sounds we should hear, were the soundboard "naked, and not ashamed," as it would be, if both its sides were exposed. Perhaps the "'melioration"—as the old harpsichord makers were accustomed to express it—of the abominable sounds of that slightly unsavoury "man and brother," the nigger's very primitive banjo may partly be caused by its not being "backed up" as the lute, chitarrone, theorbo, and mandoline are; but the very different proportions of its strings, the different shape, material, and condition of its soundboard, seem to me quite sufficient to account for the superior quality of the tones of the guitar to those of its "black brother," without any aid from that "backing up" long since disused in the pianoforte.

As regards making my fiddle. I must quote the wise Frenchman, who said "let us wait awhile, so that we may make an end the sooner." No doubt "the proof of the pudding is in the eating," and no one could be more ready than the writer to report the result of experiment, even if unsuccessful, because like the announcement "Dangerous" on thin ice, it saves or should save others from being lost. It is my full intention to have this "pudding" made, but before doing so I should like a trifle more of "good advice," especially from Mr. P. Davidson.

THE HARMONIOUS BLACKSMITH.

THE PRIMITIVE CONDITION OF MAN.

[4878.]—SIR JOHN LUBBOCK, in a paper read before the British Association in 1867, attempted to show that the primitive condition of man was one of "utter barbarism," and in order to prove it endeavoured to establish the following propositions:—1. That there are signs and traces of a "stone age" in most countries, which prove the barbarism of their earliest inhabitants; 2. That there are signs of progress among savages; 3. That there are traces of early barbarism among civilised nations. Let us briefly examine each of these points in their order.

The phrase, a "stone age," is, of course, ambiguous, since it may mean either "polished stone age" or "rough stone age." Now, no one for a moment would hold that polished weapons indicated "utter barbarism," for they were used by ancient civilised nations, such as the Ethiopians, as Herodotus tells us; and it needs but a glance at the beautiful polished stone axes, figured in the recent work of Mr. Evans on "The Ancient Stone Implements of Great Britain," to see that their makers must have been very far indeed from a condition of "utter barbarism." It must be, then, to the "rough stone" or Palæolithic age that Sir John Lubbock refers, but here again the question arises whether it is the period of the bone-caves or that of the river gravels which is alluded to. If the former is meant, then the statement that these show that the primitive condition of Man was one of "utter barbarism" is simply contrary to fact, for pottery has been found in some of the oldest caves, and the oldest skull from the caverns (the Engis) might have contained the brains of a philosopher, while Dupont has shown that at the time of the bone-caves an extensive trade was carried on between France and Belgium. I know that the bone-caves are by many thought to be of the same age as the river gravels, but Mr. Flower has lately shown (*Anthropological Journal*, 1872) that the idea is refuted by palæontological and geological evidence. It must follow, therefore, that the "stone age" meant by Sir John Lubbock is that of the drift-gravels, but we cannot infer the barbarism of the men who made the drift "implements," because no traces remain of them except their weapons, and these alone are utterly insufficient to tell us how civilised or barbarous their makers were, for very rude stone weapons may exist among semi-civilised tribes. Thus the natives of New Caledonia have the roughest stone-pointed javelins, and yet Captain Cook says their plantations were well cultivated, their houses were of more than one story with carved door-posts, and they made pottery, which is in itself a sign of considerable progress in civilisation. If these rough weapons alone remained of the New Caledonians, how very fallacious would be the conclusion that these savages were "utterly barbarous." Mr. Evans says, of the river-drift implements, that of themselves they "afford but insufficient means of judging" of the civilisation of their makers (see "Ancient Stone Implements" p. 573), so that we may dismiss the first of the three propositions with the verdict of "not proven."

The second is—"There are signs of progress among savages," but here it is plain to all that unless these "signs of progress" can be proved to have originated from unaided efforts of savages, and not from foreign influences, they are utterly useless; when, therefore, we find this proof not attempted we may safely reject the so-called "sign of progress" as worthless. We are told that the Wajiji, of East Africa have just learnt to make brass, but, as Burton says they learnt this from the Arabs, the fact of it is of no avail for the theory. Then comes the statement that the Andamaners have "recently" introduced outriggers, but in order to make this good, it must be shown that they never before had them, and that they did not borrow the invention from others; neither of these is proved, and it is very curious that Sir John Lubbock says such a case as the above probably arises, not from invention of a new art, but from an oversight of early travellers; his words are "Suppose an early traveller mentioned the absence of some art or knowledge among a race visited by him, and that later ones found the natives in possession of it. Most people would hesitate to receive this as a clear evidence of progress, and be disposed to suspect that later travellers with better opportunities had seen what their predecessors had overlooked," and he shows in this way that the Ladrone islanders were not ignorant of fire, as was first supposed, but in the same way the Andamaners might have made outriggers, but early travellers might not have seen them. The Bachapins have recently commenced to work iron; but here again it cannot be proved that they did not learn this from others, as the Wajiji learnt to make brass from the Arabs. Lastly, the boomerang is said to be an invention of the Australians, as it is confined to them, but this is contrary to fact, for Denham found it in Central Africa, and the Bishareen Arabs use it to this day, while a convincing proof of the antiquity of the weapon is that it is found on the Egyptian monuments, and in the sculptures at Nineveh. Thus each "sign of progress" cannot be proved to be an original invention, and as all the "signs" might thus be shown to be wanting in this point, the argument from them completely breaks down. Concerning the non-progressive character of the Africans, Denham says "Every approach which the Central African has made towards civilisation is attributable to the intrepid Arab spirit, which has alone penetrated to any extent into the country of these before unenlightened savages" ("Travels in Central Africa," p. 331), and Captain Burton, in his "Mission to Dahome" is equally emphatic, for he says, "The so-called civilisation of the negro is from without; he cannot find it within. As an adult he is the victim of imitation, the surest sign of deference; he freely accepts foreign customs and manners however incongruous."

Further, if the weapons and arts of savages were all independently invented, then we ought never to find that the civilised tribes were ignorant of an invention possessed by their barbarous neighbours, but we do find this occurring frequently, and it is an awkward fact for the upholders of the "savage theory" to face. Thus, the semi-civilised Tahitians had no pottery, while the barbarous Pelew islanders and other western tribes had; the Tahitians had bad canoes, while the more savage Maories had good ones (although, strange to say, Sir J. Lubbock says bad ones—"Pre-historic Times," p. 475—contradicting his own previous statements); the clever Kaffirs had no bows, while the miserable Bushmen and Fuegians possessed them; lastly, the wretched natives of Easter Island cultivated yams, plantains, and sugar-canes, while among the more civilised Hottentots agriculture was unknown. Now, if the lowest savages had independently discovered agriculture, pottery, bows and arrows, and the making of good canoes, how comes it that their more civilised brethren had not found out these things too? They have had opportunity to do so, and the inventions would have been of inestimable advantage to them. Well may Sir John Lubbock say these are "most remarkable" facts, for so they are, and they are so very "remarkable" that they go a long way towards overturning his theory. We now come to the third point—"There are signs of primitive barbarism among civilised nations." The fallacy here has been pointed out by the Duke of Argyll: it is this, that whenever a barbarous custom is found it is at once assumed to have been primeval, whereas the custom may have originated in later times, and this glaring assumption is again and again brought forward. Rude customs may show that nations once passed through a savage state, but as the Duke of Argyll says, "They afford no presumption whatever that barbarism was the primeval condition of man, any more than the traces of feudalism in the laws of modern Europe prove that feudal principles were born with the human race." ("Primeval Man," p. 133.) As we know that savages have been corrupted by acquaintance with other communities, and as Sir John Lubbock seems to admit the unnatural customs were not primeval, we may, I think, reject the third point.

But if it cannot be proved that "civilised nations show traces of primitive barbarism" the counter-proposition is undeniable, viz.—"There are among savages indications of early culture and civilisation." Casalis has shown that among the Bechuanas he found in their language proofs that they were once more enlightened than at present. Among the Makololo; Livingstone found the agricultural implements wonderfully to resemble those of the Egyptians, and the same was found to be the case with the spinning and weaving of the natives of Angola; and in another place he says that the numerous hoes and baskets of the Maravi men were all so exactly alike that they must have come from a common source ("Zambesi and its Tributaries," p. 507). Dr. Krapf speaks of the ancient civilisation of Senjero in East Africa, while in Easter Island, and in the groups north of New Guinea, huge buildings and statues have been found which show that the early inhabitants were skilful and ingenious.

In the present condition of science it is our duty carefully to examine those theories which are so confidently and dogmatically brought forward; the time has long gone by when mere assertions were received without question, and it is useless for the maintainers of the "savage theory" to attempt to force their ideas on the public by reiterated assertions, mingled with sneers at their opponents. I trust your readers will fairly examine both sides of the question, and I feel confident that they will then reject the theory on the ground of its being supported by insufficient evidence, and opposed by insoluble objections. D. G. W.

WARMING RAILWAY CARRIAGES.

[4879.]—IN answer to let. 4816, p. 620, I beg to inform "Philo" that the warming of railway carriages described by me is quite new, and the coal is a purely chemical-prepared one. The only substances besides charcoal are only chemical, which give the time of burning and the degree of heat they shall develop. Both heat and time can be regulated by the manufacturer. No clay is used whatsoever. The invention is such a simple and convenient one that the Prussian Ministerium has recommended that all State railways shall be warmed in that way, and several other railways are preparing their carriages for this system of warming MENZ.

ENGLISH BLACK v. LIGURIAN BEES.

[4880.]—THERE seems a very strong desire in the minds of many of our bee-keepers to set in the foremost ranks a stranger from Italy, and put aside our old and long-tried friend the English black bee. Mr. F. Cheshire (let. 4629, p. 511) would have us believe that he obtains a full title or claim to the laurels of the first order. Now, as no one else has taken the trouble to defend the character of an old friend, I have humbly undertaken the task, as I have a swarm of the black bees that have no cause to blush when placed by the side of his ligurians. I see he received his swarm on April 28, 1872; I suppose they had swarmed at least one or two days before he received them, and they had placed or packed in his different rooms something like 110lb. of honey and comb; now this certainly looks something like being very sweet. Now. I will just compare things a little. My bees swarmed May 25, two days within a month later than the strangers. We had, like my brother bee-keeper, a week of very bad weather, but in about three weeks they had filled their stock hive, which contains about 60lb. of honey. I placed on a collateral or side box, into which they soon placed 38lb. I then put on a super, into which they literally crammed 37lb.; these two boxes I took for myself, amounting to 75lb., and left them the 60lb. for their winter supply, making a total of 135lb. I, like my joyous friend, gave a little soothing syrup, and I think they have amply repaid me for it. Another of my stocks, an old one, swarmed on the 23rd of May and cast five days later, and after that filled me a glass, containing (with the glass) [illegible] of honey. A LINCOLNSHIRE BEEKEEPER.

POTATO DISEASE.

[4881.]—IT may benefit some of my fellow readers to learn the plan very successfully used here by myself and many brother mechanics for several years past to arrest the destructive effects of the potato disease, which is simply to pull up all the haulms in our gardens as soon as any brown spots are seen on the haulms, and to put back and cover up any potatoes that are pulled, and there leave them to be taken up as required until the frost sets in, when they are pitted as usual.

Aberavon. PERCIVAL NORTON.

THE PROPER MANIPULATION OF CONCRETE.

[4882.]—I READ with much interest the account of the concrete bridge between Gloucester-road and Earl's-court-road stations on the District Railway given in No. 388 of the ENGLISH MECHANIC, p. 617, and am gratified at finding so effectual a step in the right direction. But I may, perhaps, be permitted to point out the inconsistency with the correct treatment of concrete materials indicated by the closing paragraph, in which it is remarked that:—"Nevertheless, the porous nature of even such good concrete as that used in the bridge is shown by the fact of rain passing through it in the course of a few hours." Now, in my practice I have always found that concrete properly manipulated was exceedingly impervious, and capable of much greater degrees of cohesion and strength than it is commonly allowed to attain. I have recently made a flat roof 6in. thick, one half of it chiefly lime and ballast (with the constructional details of my patent), and although exposed to the violent storms of the summer it has never once leaked. I inclose a statement of experiments and other matters connected with this system, which I trust may merit your attention.

PHILIP BRANNON.

"E. L. G." AND CO-OPERATION.

[4883.]—REALLY, I wonder such a letter as that of "E. L. G." upon co-operative stores was not consigned to your waste-paper basket, for the expressions of which it is full—"blasting the souls of wretched traders" with pennies, "pestilent hoards for furthering all iniquity," Satans, Armageddon, and all the rest of it, as well as the temper in which it is written, seem hardly consistent with the character of a scientific journal. Argument there is none. "E. L. G." simply lays down the law, says that such and such a man was made by the Creator, such another by the Prince of Darkness, that coin is a badge of conquest and slavery, which should be at once superseded by a complicated system of what he calls "labour notes," and all who differ from him are corrupting the nation and race, spreading moral pest, and doing all manner of horrible things, from which he, the high priest of the co-operative religion, is the destined deliverer. Surely, this is more suitable to the columns of the *Beehive*, the *Iconoclast*, or *Reynolds's Newspaper*, than for those of the ENGLISH MECHANIC.

His grand mistake in reference to the currency is that for a medium of exchange like coin, whose value is absolute and certain, or at any rate whose standard is only subject to slow and almost imperceptible depreciation, he would substitute a system of payment in labour—one of the most inconstant and variable things that can well be picked out. We all know the value of a sovereign, and what it will buy, but how many can as accurately estimate the result of an hour's labour? One sovereign is a sample of all, but is one man's labour always of the same value as another's? Does "E. L. G." mean to tell us that the labour of an ignorant, lazy, or unskilful man is worth as much as that of an honest, painstaking, and industrious one? Can he, for instance, give the exact proportion between a lazy man's hour at carpenter's work and a diligent man's hour at writing? In fact, for a simple and uniform standard of value, such as coin, we should have, not one, but a thousand standards, varying in relative worth from day to day as the dispositions of ilities of those by whom the notes would have to be leemed.

One of the notes quoted by "E. L. G." is apparently r house rent, which, therefore, we may conclude he inks equitable and just. But at the same time that allows it to be right for a man to let his house on re, he grows in a furious passion at the idea of his oing the same thing with his money. It is right, erefore, for me to spend a thousand pounds in building a house and then to lend it to somebody for fifty unds a year, but wrong in the highest degree to lend e thousand pounds for the building of the house, and receive fifty pounds a year for the use of the money. e does not seem to see that rent and interest are nvertible terms, entirely identical in principle, so at the fundholder is no more a "lower animal" an is the landlord. VERTUMNUS.

CO-OPERATIVE AND OTHER CRUDITIES.

[4884.]—REALLY "E. L. G." seems to find some of y remarks upon the frightful crudities he tries to rce upon us to stick in his throat like a fish-bone; least, I suppose so, from the way in which he keeps oking over them. But I must really correct him as his observations in let. 4803, p. 617. I never ob-cted to any space occupied by any efforts of his to stinguish plainly points he was, as he says, quite norant upon. Doubtless, the space occupied did ove that (or, at all events, the mode in which it was ccupied), but that was an accidental and unintentional sult. The object of "E. L. G." was to prove that he new all about the matter, and my objection was to eing so many columns wasted over mere guesses, any ridiculous, some amusing, and a few ingenious, t all mere guesses set forth as facts and argued from actual data.

It is exactly the same with the present subject of -operation; it is an important one, worth wise discus-on, and it is one on which I could very well say mething; the place, however, is occupied by E. L. G." in much the fashion in which a mad man ight amuse himself in a fireworks' store, and it is, erefore, useless for a reasonable and moderate person approach it.

It is really sad to see a person who has the ability guide others, so utterly waste his own and other eoples' powers as does "E. L. G." upon the various oints upon which he is afflicted with temporary in-anity (it is not monomania, because there are so many f them). Can he not see that when he begins raving, e renders argument impossible, and that he takes up position to assail which irony and ridicule are the nly possible weapons? What on earth can one say to man who asserts that when a poor honest man, who as saved a few pounds, sets up therewith a green-rocer's shop, and gets his wife to look after it while he at work, he is doing "something to blast the retched trader's soul, increase all degradation, and ile up pestilent funds" (say the savings for a trip to largate), "for furthering all iniquity"? There is nly one possible answer to such high-falutin' twaddle—iz., to laugh, and say—Bosh.

What argument is possible with a man who can ssert that money, that is, a certified value which ordi-ary people cannot otherwise estimate, is no more ne-essary than certified weights of cheese or soap which ny one can value, and which, furthermore, are com-only made up in just such certified values, or packets, y the salesman? If "E. L. G." wishes to convince thers, or to meet with any response except amused aughter or a pitying smile, he must really learn not nly to talk sense, but to talk it in a sensible manner. hen neither I nor any one will complain of any space e may take up. SIGMA.

HAIRSPRINGS.

[4885.]—HAVING dabbled in watch repairs as well as ther things, I will merely state my reason for coming o that conclusion; having purchased several reels of ire for the purpose of making my own pendulum prings, I had a job come in—viz., to put a spring in detached lever watch, the spring of which was very elicate. Upon turning over the stock, knowing I ad some, I found it damaged (*i.e.*, rusty), and therefore seless. I forwarded the number of reel and had the ounterpart sent me and did the job, &c. These reels vere numbered. Now if not gauged, why numbered? never saw a gauge. JACK OF ALL TRADES.

GRAPHITE BATTERIES.

[4886.]—IN reply to "H. H. G." (let. 4780, p. 593), he size and arrangement he proposes will answer ery well. I should advise the porous cell to be about 1½in. or 2in. across, and to come clear through the overing disc, having a separate cover of its own. The size of zinc is immaterial, ⅜in. rod is perhaps the best if cast; the graphite may be ⅛in. square, but a plate is better, as pieces may be packed between it and the cells, and thus more points of contact secured. It is not advisable to make holes in the porous cell, as the manganese may work through, nor do I think well of the graphite porous cell. I have used and much prefer an outer containing cell of graphite material into which the carbon and manganese are packed; this serves instead of the conducting-rod and gives large contact; the only objection to this is the cost.

As to the solution, chloride of ammonium gives the greatest force; with sulphate an extra cell or two might be required, but I am inclined to think that it would be more enduring and steady for bell purposes, as it would not, I believe, form crystals over the zinc and porous cell, which is a great nuisance and loss with the chloride. I should use a solution only three parts saturated, and of course no crystals. "H. H. G." must not omit the pipe for supplying fresh liquid, and must always take care to leave a small hole or pipe (a mere pinhole is enough) to allow the ammonia set free to escape; the best plan is to tie a piece of india-rubber over the mouth of a tube and slit it across, this forms an excellent valve; I rather think that this is really the one thing patentable in the Leclanché specification, and that one thing I do not remember to have seen ever used in a Leclanché cell.

The proposed connection with the graphite is not reliable, and there would be an action on the lead which would probably split the carbon, though very perfect saturation with paraffin might prevent this; it is better to cast a solid cap over the carbon, better still to electrotype on a copper cap, and perfectly saturate afterwards. SIGMA.

DISTANT SIGNALS ON THE MIDLAND RAILWAY.—To A. G. BOYD (P. 621).

[4887.]—THERE is not much advantage whether the distant signals are arms or discs, but I find that engine-drivers very much prefer the disc signal as shown on p. 541. Drivers tell me that at large junctions and sidings, where there are many signals, that where the distant signals are arm signals, they look just the same as starting signals, and that often drivers have been deceived, and taken the distant signal for a starting signal, and thought that it applied to the sidings, when really it was a main line distant signal, and frequently collisions occur through this error; but where the distant signals are discs as shown p. 541, no matter how many starting signals or junctions, a driver on the main line can always distinguish the distant signal, and since the alteration shown in my drawing p. 341, there is now no fear of a driver taking the back of a distant signal. The altered form of the disc on the Midland Railway is giving great satisfaction. There is also another advantage in distant signals being discs, as the semaphore arm signals at all places on the Midland are absolute "stop" signals, and every train must stop clear of them, not so the distant signals, which are only to protect a stopping train, and trains do not stop at them, but run cautiously by up to the place of obstruction (see Vol. XIV., p. 42, Railway Accidents, 36 lines from the top) where the use of distant signals is described. As the use of the distant signal, and the semaphore signal is so very different I think it is very important that there should be so much difference between them that a driver shall know at a glance which is which. This I am sure the disc signals do, as it is impossible to mistake them. C. E. S.

OBJECT-GLASSES.

[4888.]—MR. W. OLDFIELD (let. 4844, p. 643) is in error in supposing that I have ever recommended one form of object-glass over another, at least in the pages of the ENGLISH MECHANIC. If he will kindly refer to my letter he will see that I simply gave what Mr. Cash wanted, the proper curves for an object-glass on Herschel's principle, and that without saying one word in its favour or against it. I know very well that it is not the best form of object-glass, I also know why it is not the best form, and I have no doubt, too, that I could find out the very best possible form for any particular case if I wished, but the calculation would necessarily be so tedious that I have never yet had the courage to attempt it. It seems to me, too, that Mr. Oldfield has misunderstood Mr. Cash. I fancied myself that Mr. Cash was in doubt whether the thickness of his flint lens had not something to do with spherical aberration, having in his mind no doubt the quantity called the thickness in some of the formulæ for spherical aberration. I may tell Mr. Cash that the thickness of his glass does not alter that quantity in the least. I myself make use of a method I have discovered, I suppose I may say, by which the surfaces of an object-glass may be found without employing any of the formulæ for aberration, or once considering that confoundedly troublesome quantity. The whole of the computations may be performed in an hour or two, and with all necessary accuracy in the results. As a matter of course, like all other inventors, I consider it about the best thing ever done, and as the provisions for patents won't apply, intend to keep it a profound secret, but if Mr. Oldfield were a B.A., a F.R.A.S., or some learned gentleman, I might perhaps, by way of giving him an idea of the enormous research and ingenuity requisite, allow him to have a peep at (say) half a sheet of the computation. Why does not Mr. Oldfield write a little more carefully? Who on earth is to understand that part of his letter which commences with—"viz.," and ends "72in."? HENRY T. VIVIAN.

ON INTONATION.—To "FIDDLER."

[4889.]—IN your letter 4740, p. 567, you say "imperfect intonation has become—query, always was—so great a nuisance that you are surprised nothing has been done to remedy it. I beg to inform you and my other fellow readers that a great deal has been done with more or less success for the purpose of remedying this admitted evil in most musical instruments with fixed sounds. The thing has been done over and over again, but probably because we are descended from ancestors who less than a century ago considered one sound near enough to the required pitch to serve for FF and FF♯, it is one of those things which don't pay, at least in the pecuniary sense, and that is for all practical purposes the only sense.

Archicembalos—literally many harpsichords in one case, some of them having four or even six ranks of keys—have been constructed in Italy, and many patents obtained during the last century in England for improving intonation by various means, a favourite means being to vary the lengths of strings after the fashion of the pedal harp, *par exemple*, the telecohordon of Dr. Clagget, that being one of the earliest. Organs have been built which were also designed for the same purpose with many additional pipes, and others in which the pitch of the sounds produced by a single pipe could be varied, *par exemple*, by Liston's movable shades to organ pipes, notably the so-called enharmonic organ of the late Colonel Perronet Thompson. The same "awfully clevar party" also constructed an enharmonic guitar and a phonometer, all of which I hope to see added to the permanent collection at South Kensington, a collection all should help to render yet more complete.

If I am not greatly mistaken, all the contrivances you mention have long been used. Dr. Clagget, A.D. 1788, in his teleochordon, claims dividing the octave into 39 intervals by means of additional bridges (also applied to harpsichords and pianos) which were made to shorten the vibrating portions of their strings by pedal actions. D. Loeschman, A.D. 1809, divided the octave into 24 which was the number of keys in a spinett belonging to Dr. Pepusch, which my late friend J. J. Hawkins saw at Rome about 1832. I think, Thompson, A.D. 1862, carries this much farther, dividing the octave into 41 intervals, which he said would "afford, in just intonation, every major or minor scale in a series progressing upwards by fifths from C flat through C natural to C♯, or from 7 flats through C natural to 7 sharps to adopt the signatures generally used in music, with the chromatic and enharmonic of each," whatever those scales, or rather the latter one, may mean. Col. Thompson says the Greeks employed the term enharmonic simply to signify what we mean by the expression "being in tune."

Organ pipes with holes in their sides *à la* flute or bassoon, are very far indeed from being novelties. The French organ in the 1851 Exhibition had but one pedal pipe for 11 semitones, so of course one organ pipe may be made to produce two sounds differing so little as the major seventh does from the octave of its key note without altering its mouth, which is more than it well can be made to do in the instance of its producing 11 sounds differing in pitch from each other a semitone. The practical economy of making one pipe serve for two semitones is altogether another matter, concerning which our "Adept," if yet alive, could afford "Fiddler" some valuable information. No doubt the extraordinary luxury of sounding B and C together—to the writer this luxury is what Artemus Ward would have called an unmitigated "noosance"—is not often indulged in by "ordinary" composers who know it is "contrary to rule," which only "extra-ordinary" composers, alias "lunaticks"—with much method in their madness—such as Beethoven, can afford to disregard. To the writer the effect of sounding simultaneously the sharp seventh and octave of the key note is simply vile, "playing out of tune" with a vengeance.

Your proposal to make six strings in the piano do the work of twelve is similar to making one pipe of the organ serve for two sounds. It would, of course, serve for more melody. Your experience as a "fiddler" must render you familiar with the fact that one long string might be made to produce all the different sounds in the compass of the pianoforte, which would rival, if not surpass Paganini; but, *cui bono*. We want pianos capable of both harmony and modulation; neither can be facilitated by stringing them *à la* harp, even if the Erard double action be applied to them. In the harp, many strings are in the way of the fingers—the complex Welsh harp, to wit; but we can manage twelve (if not twenty-four) manual keys to each octave in the piano, &c.; probably because we are accustomed to twelve and not used to twenty-four. It is far easier to execute rapid chromatic passages on the piano than on any harp, Irish, Welsh, or French, even if provided with "double action."

That the costly piano, with all its strings oblique in one direction, you lately saw, was less powerful than another with all its strings nearly upright is just what might have been expected by any one who has mastered the elementary truth, that the soundboard is, for all practical purposes, the sound generator. Any instrument, be it virginal, spinet, or piano, whose strings are all nearly parallel, and situated obliquely to its keys, must have its strings crowded together on its belly-bridge. As a mere matter of course, the surface of its soundboard (between the strings of each note) must be smaller than in horizontal grand and ordinary upright pianos. I may, however, remark, *en passant*, that the obliquity of strings need not necessarily be accompanied by their parallelism. On the contrary, they may be radiated, or spread out, on the soundboard bridge over quite double the space parallel strings occupy, which is equal to that occupied by their keys and hammers. See my design for grand upright 8-octaves cottage piano in No. 235, and another which I will send shortly for a very powerful piano only 40in. high.

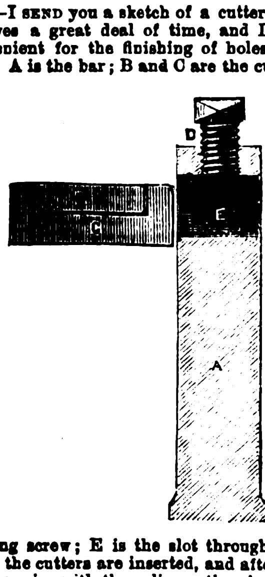
THE HARMONIOUS BLACKSMITH.

NEW SOUNDBOARDS.

[4890.]—IF I have understood the recent papers on soundboards rightly, it is a sine quâ non that opposite kinds of wood should be used close together. I have never seen a violin whose breast was made of hard and soft wood glued in two halves, and should very much like to know how it would sound. I do not see how it could be wrong, for is not the back made of hard wood, and by the soundpost connected with the breast, making a continuous soundboard with the sides, in fact, all round the violin? If it is a continuous soundboard, then Mr. Schucht is right, but why have a soundpost? would not the sides do by themselves? Yes, if the string is bowed on the side instead of on the top, but when bowed in the usual way a soundpost is necessary. We might understand this better if we could see in what direction the waves of sound move. Mr. Schucht in his diagram makes the vibrations wave along the surface of the breast from end to end, and continue round the back, and then I presume along the breast again; but is this the right direction? Might not the wave or vibration affect the air in just the opposite way, from side to side, and round the back, as though I twirled a hoop perpendicularly round the violin held horizontally. Now, I think, that if I pull the string by the action of the bow on the top, as is usual, I cause the wave to move in the same direction as the bow is drawn, and as the wave has to right itself by rising higher, so as to form a circle round the violin, the soundpost may have a tendency to direct the wave of sound in this position, not to remain there, but form almost instantaneous rills of sound as far as it is heard. But if I begin the sound by drawing the bow on the side of the string (near the top of the finger board), the wave commences in the proper direction, that is upwards, and then round the violin, and not requiring a soundpost to direct it into a proper position. If this theory is wrong, please say why a soundpost is not required when the bow is used on the side of the string, but is an obstruction to the sound, as any one may perceive if they will inquire? Again, if the vibrations flow from end to end, why have a wide soundboard? The same quantity of wood made into a long narrow soundboard would do better, either with or without a back; the four strings of the violin, or even a fifth, could be placed on the same sized bridge as the present, and the soundboard continued below the bridge, so that the instrument could be played as a violoncello is held, in front of the performer in the Turkish style. It may be asked. But how could the different sorts of wood be made to go in such a narrow soundboard? This would depend on the thickness of the soundboard; if thick, then in layers; if thin, then side by side. It is doubtful even if the waves run along the breast that the sound would be improved, because there would be so little for the tone to sound or be formed in. I think, then, a series of soundboards could be placed under the narrow breast, all of them being attached by their edges to the upper soundboard or breast, and hanging down, as it were, like inverted tuning-forks. It is certain that if these inverted soundboards were glued their whole length to the upper soundboard or breast, the whole affair would be too rigid or stiff; but this could be obviated by cutting one edge of each in a half circle, or, perhaps, in a wave line, so as to be attached by three or four points instead of their whole length, thus allowing fuller play to the breast. Or these extra tuning-boards might be fixed on the extreme end of the narrow breast in the same way that the metal projects from the bass vibrators of a musical-box. I think we have all heard of the genius who introduced iron into pianos, under the idea that the wires would sound louder if a number of tubes could be made to sound sympathetically or synchronously; the reason why he failed was, because the wire could only vibrate a soundboard, and had not sufficient strength to move the air in the tube so as to make the desired increase of tone. I am afraid the same cause will operate against all our funny fiddles and soundboards, unless we can bring them all into intimate connection with the vibrating string, and find a way of moving the soundboard more than is done at present. We want a stronger string (not wire) yet sufficiently elastic to be played on with a bow. May I beg a few suggestions from our numerous thinkers, for as the tone of the piano has been improved by imposing heavier steel wires, so I want to improve the violin by bowing a string that shall move the soundboard more, and a larger soundboard than is used at present? FIDDLER.

CUTTER-BAR.

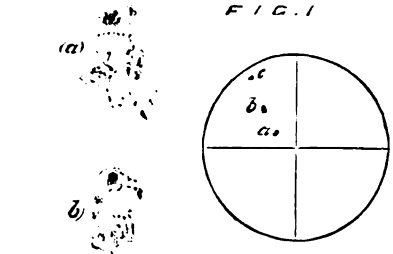
[4891.]—I SEND you a sketch of a cutter-bar, which I find saves a great deal of time, and I consider it very convenient for the finishing of holes of various diameters. A is the bar; B and C are the cutters; D is



the pinching screw; E is the slot through end of bar into which the cutters are inserted, and after being set to the proper size with the calipers the pinching screw D is tightened up to hold them in position; when they get so much reduced in size that the rymer has too much to do, unloose the screw E and take out the cutter a little; they will serve for finishing holes of various sizes. Of course, when one pair of cutters comes to be too small for the holes to be bored, you have only to insert a pair of larger ones, avoiding the necessity of going to the smithy to have your drills hammered out, which, after being done, if not carefully ground, may have to be taken back again to the smithy. I do not know if these are in use anywhere; if so, please say. JOHN KEARY.

SPOTS ON THE SUN.

[4892.]—IN the months of April, May, June, and July, I was able to observe the same cluster of spots during four revolutions of the sun. The telescope I used was of only 2¾in. aperture, with a power of 140. In Fig. 1, *a* is the copy (inverted) of a sketch I made of a cluster on April 24 at 5 p.m. On April 25, at 4.45 p.m., I made another sketch of the same cluster, which had changed considerably (Fig. 1, *b*). Its position on each date is marked in the circle on the right. *c* represents its position on April 28 at 6 p.m., when it was passing off the disc. On May 14 I saw the cluster again, but only identified it by the position it occupied on the sun's disc. In Fig. 2, *a* represents the cluster as seen on May 16 at 7 p.m., and *b* on May 20 at 5.30 p.m; *c* and *d* represent the largest spot in the cluster on May 21 at 6.30 p.m. and May 22 at 5.20 p.m respectively. The different positions of the largest spot on each occasion are shown on the right. In June I saw the spots again performing another revo-



lution, but had no opportunity for sketching them. On July 10, at 6.30 p.m., I observed them again on their fourth appearance, considerably within the disc (*a*, Fig. 3); it was too hazy for delineation. Fig. 3 (*b*) represents their appearance and position on July 12 at 6.15 p.m. The spots have since disappeared.

Bordyke House, Tonbridge. R. W. BARBER.

[4893.]—THE theory of "A." (let. 4453 and 4830, p. 640) accords well with one or two phenomena of the solar spots, but is negatived by many others. I should explain that in speaking of "broken umbræ," I did not mean to describe an appearance as though a dark region were broken *across*, but to describe that apparent "breaking in" of the boundary of certain spots at one side which is so familiar to the telescopist. A spot shall have its penumbra well defined for seven-eighths of its circumference, but on the remaining eighth it shall have no penumbra at all, but either appear as though the photosphere had here broken through to the umbra, or (more commonly) as though the umbra had broken through to the photosphere.

"T. H. B." (let. 4831) does not seem to have read my letter very carefully, since I explained in it why I did not draw the granulations. To have drawn all I could see during moments of favourable definition, in the spot-region actually pictured, would have required four good hours, and I had barely half an hour. Moreover, the great interest of the region depended on its general features. I think that the 2¼in. Dollond with which I drew the picture forming the frontispiece of my "Sun" would have shown all the features actually included in my sketch. I may notice that in the frontispiece to Schellen's German version of Secchi's "Le Soleil," a photograph of the sun shows the same great spots as my picture, and from a careful comparison of the successive enlarged photos. of this spot on the 23rd, 24th, and 25th of September, 1870, all the details of my drawing are justified.

I do not know what "T. H. B." means by a "much smaller telescope" than the $4^{7}/_{10}$in. instrument I used. The latter shows the granules all over the sun, as well as in the neighbourhood of spots. But a *much* smaller instrument cannot possibly do this, no matter how acute the vision of its possessor, or how favourable the atmospheric conditions. It is calculable that with an aperture below 3¼in. or 3⅜in., diffraction must cause the images of the granules to coalesce.

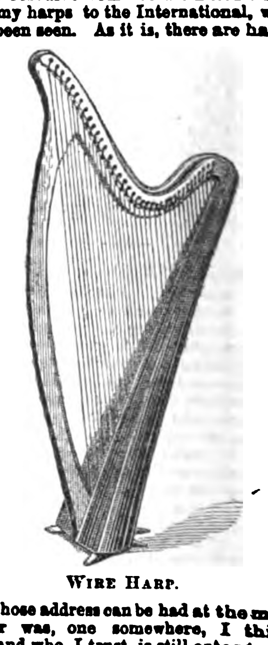
This case is quite different from that to which "F.R.A.S." refers (let. 4823, p. 639, 2nd column). It can scarcely be doubted that acuteness of vision is an essential circumstance in the recognition of minute points of light, faint illumination, and so on; so that while thoroughly agreeing with "F.R.A.S." that the 6th star in θ^1 Orionis cannot possibly be visible in the 3in. telescope, I wished to remove a misapprehension which might have suggested itself to some who read his letter on the subject. To say the truth, some of the feats of Dawes and Goldschmidt would have to be regarded as impossible, if a hard and fast line were drawn as to such observational tests as these.

Since I wrote my last I have tried 57 M. under favourable conditions. The faint light in the interior can readily be seen with three-fourths of the light-gathering power of the $4^{7}/_{10}$in. telescope.

RICHARD A. PROCTOR.

THE HARP.

[4894.]—I HEREWITH inclose the photograph of a wire harp, to which I trust you will kindly yield insertion. The original is of pleasing tone, and, although only capable of being played in one major key, or that of G with F♯, is calculated to realise very pleasing results. No one, I think, who should hear played upon it, as I have often heard played upon it, our old Irish, Scottish, and English airs, could listen quite unmoved. It is not so perfect as is the double or even the single action harp, but it is perfect as far as it goes, and vastly less costly in construction and maintenance than the more elaborate pedal harp. My idea was, and is, that the cheap wire harp might be turned to account in cases where the expense of the more costly and elaborate instrument could not be afforded. Half a loaf is better than no bread. If a double-action harp cannot be had, is the more humble and yet sweetly satisfying wire harp to be discarded? I was going along Paternoster-row a few days since as in one of the side passages a pedal harp, with flute accompaniment, produced music that might have graced many a drawing-room. For a small piece of silver, the performer played for me two or three of Verdi's divine airs more than passably well. As I listened to the poor fellow it set me a-thinking, and I asked myself whether it might not be possible to combine the gut and wire harp, and so arrange the gut-strings as by means of a simple pedal action to produce the half tones, the F and C regarded, and secure at pleasure the desirable modulation. This the wire string does not permit. We might thus, it strikes me, at least in a measure, cheaply combine the excellencies of both instruments, for cheapness with efficiency is, I submit, the great desideratum in the harp of the future, and the talent of the contributors to the ENGLISH MECHANIC is such that I am disposed to think that everything reasonably practicable is at their command. The Welsh harpers have multiple strings to secure the wished-for results. Half notes, to be sure, at least as regards the F's and C's, might be introduced into the Irish or wire harp, but it would considerably augment the number of the strings, and, after all, the resource would be a limited one. I wish I had sent my harps to the International, where they could have been seen. As it is, there are harp-makers



WIRE HARP.

in London whose address can be had at the music shop. There is, or was, one somewhere, I think, called Hafernack, and who, I trust, is still extant. Harps are to be seen in the shop windows of music-sellers in ever large town, and if inquirers and intending constructors would take the trouble of looking in when it would not interfere with the business of the day, few would be found so churlish as to refuse inspection. I only wish I could offer suggestions yet more available than the foregoing—suggestions calculated to bring, or tend to bring, within the reach of every one the refining solace, the almost unlimited gratification, which the music of the harp, when well played upon, is calculated to yield.

IXION.

THE HARP.—To "FIDDLER."

[4895.]—YOU say, let. 5497, "Wires would do for the treble, but be too twangy for the bass." Practically, wires will and have done for both (better or worse). They have "done" for the Irish harp, and would—in another sense—soon "do" for any harp with a moderately long scale, if as thick as those specified by "Ixion" for his favourite "green" instrument, for no ordinarily-constructed harp could bear a tension of (say) nearly 200lb. per string. "Cat—hys—gut" being much less heavy, and perhaps quite as elastic as steel wire, makes better harp, guitar, and fiddle strings, than steel, without any danger of "making both ends meet," which the enormous tensile force required for steel wire might possibly do in a very uneconomical sense, not to mention that a thick and tight steel wire would be rather difficult to deflect down to the finger-board, and to stop in tune. Steel wire is far more suitable for strings whose vibrating lengths are not varied—like those of virginals, spinetts, harpsichords, and pianos—than for fiddles, lutes, or guitars.

For the lowest bass strings of the harp steel wire, loaded by covering it with whitened brass wire, is now very generally employed, and the tone is both powerful and good in quality. There is no novelty in employing steel wire for the bass of the harp. As early as 1828 Deakin used fire-hardened and spring-tempered steel wire for harps and pianofortes. Even then it was not new, for the steel strings of the monster unichord grand piano (grand, in this case, certainly signifying great), constructed for Earl Stanhope, by Loeschman, had fire-hardened and tempered strings, some of which were about 8ft. long between their bridges, and one-sixth inch diameter—by the way, I should be very much obliged by being informed what has become of this "monster." Similar strings were afterwards used by M. Pape, and some one alleged such strings never went out of tune, which I take the liberty of doubting, whoever the "allegator" may be; no doubt, they would stand in tune exceedingly well, just as Horsfall's patent-hardened and (blue) tempered wire did, which, I am sorry to say, is now unpurchasable.

I have sometimes thought catgut strings, if thick enough, and sufficiently loaded, would produce finer sounds than those obtained by covered steel strings in the bass of the harp. They would more nearly resemble the sounds of the double bass where its open strings are pulled by the finger, which I consider the *ne plus ultra* of bass string tone. Some harps do produce bass sounds approximately to these. The clever harpist of the Christy Minstrels (who "never perform out of London") almost deceived me once into supposing a double bass string was being plucked, so fine and powerful were the sounds his Erard harp produced. Very thick—about No. 30 to 36—steel wire (say 8ft. between bridges, and heavily loaded, so that its tension is necessarily great), produces similar sounds in a modern pedal harpsichord, if its plectra be covered—on their acting surfaces—by thick doeskin leather: about a 10lb. touch is required for two strings.

THE HARMONIOUS BLACKSMITH.

ATOMIC PROPORTIONED ALLOYS.

[4896.]—IN "E. L. G.'s" letter (No. 4766, p. 590), chemical contributors are requested to mention any useful alloy having its more fusible component in excess, the writer expressing an opinion that the opposite rule—the less fusible metal to prevail in quantity—has the force of a law in useful alloys. The compositions of following everyday alloys are in direct opposition to "E. L. G.'s" supposed "law":—

1. Britannia metal is an alloy of 10 or 12 parts of the more fusible metal, tin, to 1 of antimony, with sometimes a little copper.
2. Pewter is composed of 4 parts of tin and 1 of lead, the latter being the less fusible metal.
3. Type metal, when of superior quality, contains 1 part of the less fusible antimony to 1 of tin and 2 of lead.
4. German silver contains at least 80 per cent. of the more fusible metals, copper and zinc, to 20 or less of the highly refractory nickel.
5. Silver coinage contains 92·5 per cent. of the more fusible metal, silver.

Alas! for the theory of "E. L. G."

ALFRED H. ALLEN.

THE ORGAN BUILT.—XI.

[4897.]—BEFORE going on with the key movement, I must point out an error in Fig. 2 in my last letter. The trackers from the rollers to the pedals are all shown at equal distances from each other, but they ought to be arranged to correspond with the pedals—viz., leaving a space between the fifth and sixth, twelfth and thirteenth, &c.

The next part to get out will be the backfalls for the great organ. Get a board as long as the windchest, and as wide as from the pullwires to exactly the back of the great organ keys; along one side of the board make a mark corresponding with the pulls, and on the other side a mark corresponding with the centre of the key. Now draw lines across from the first pull (CC) to the corresponding key, and go on, remembering that the second pull belongs to the third key DD, and the third pull to E, as six of the bass pipes are on the treble side of the soundboard. Now continue the marks until you come to the upper note, and then mark out the six bass notes, as if there were six more keys. Having carefully marked out the position of the backfalls, proceed to get them out as described in my last, with this exception, that separate centre wires are only required for the six at each end, and one length of wire for all the rest. Now get the rail out and fit the backfalls into the grooves; a little play should be allowed them, so that they will not stick fast in damp weather, and a very good plan is to blacklead that part of the backfall which goes into the groove of the rail. A roller board will be required to carry the movement from the six transferred pipes to their keys; one arm of the roller is over the key and the other arm under the proper backfall. The position of the roller board is shown at A in Fig. 1.

FIG. 1

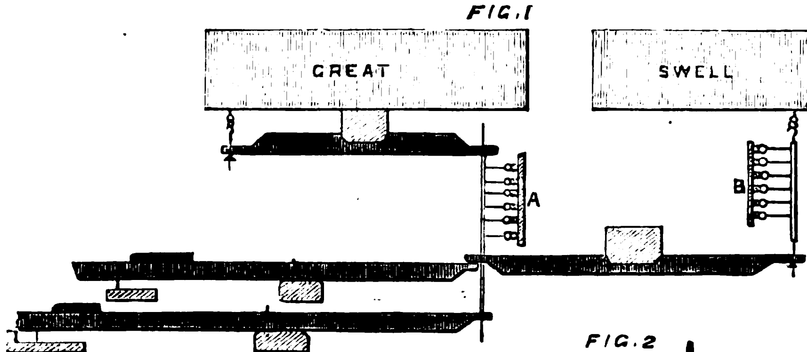
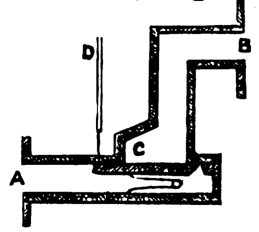
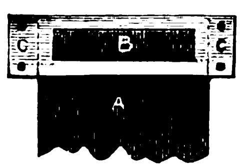


FIG. 2





Backfalls for the swell organ will now require getting out: proceed in the same manner as for the great organ, only that the backfalls for the transferred pipes are to be placed over their proper keys, the other end coming between the pulls in the windchest, and pulling down the arm of the roller. This roller board is shown at B in Fig. 1.

The rails and backfalls having been completed, screw the great organ rail to the windchest so that the hole in the backfall is exactly opposite the pull, and to each pull attach a tapped wire, placing a leather disc between the two. The screwed end of the wire goes through the hole in the backfall, and a cloth washer and leather button placed on in the usual way. This windchest may now be put into its place on the frame; it is only laid on and kept from slipping by two dowel pins on each side, the dowels being fixed in the frame, and corresponding holes bored in the windchest, the front part of the windchest being level with the front of the framing; also put the swell windchest on the frame in a similar manner, and leave a space of 6in. between them. I am, of course, presuming that the swell may be tuned from the back, and am therefore putting the organ together in as little room as possible; but if that arrangement is impracticable, space must be left between the windchests for the tuner, and a board placed for him to stand upon, the backfalls and other movements being made to correspond. The great organ stickers are now to be got out; they are thin round rods of pine, ⅜in. in diameter, the length of them is the distance between the keys and the backfalls. The easiest plan to get them out is to use a ⅜in. beading plane, but they may be got out square and rounded with a smoothing plane. Stickers of suitable length go from the keys to the roller arms, and at the other end from the roller arms to the backfalls. The connection between the swell backfalls and the pulls of the windchest is by trackers, made as described in my last letter, a hook being used at the end near the windchest, and a screw wire at the other; in this case the rollers are attached by trackers to the backfalls at one end and to the pulls at the other end. The windtrunks are now to be made; they are flat tubes to convey the wind from the bellows to the windchests. The internal diameter of those to the great and swell should be 9in. by 2½in., those to the pedal organ 8in. by 3in., but a valve is to be placed in these two for the draw stop to move. A plan is shown in Fig. 2, where A is the entrance from the bellows, B the entrance to the windchest, C the valve which is pushed open by the sticker D, this sticker being moved by the stop knob. All the windtrunks are fastened in their places by flange plates, which are firmly glued and fixed to the trunk, and then screwed with four screws to the trunk band of the bellows or the windchest. These plates are generally made of 1in. mahogany, of such a size that they can have a hole cut of the size of the hole they are to cover, and leave a margin of ⅜in. at the top and bottom, and also project an inch on each side of the windtrunk. See Fig 3, which shows a flange plate on a trunk: A is the trunk, B the aperture the wind goes through, C the flange plate.

J. D.

INFLUENCE OF LIGHT ON ANIMAL LIFE.

[4898.]—IN a paper on this subject in the *Revue des Deux Mondes*, extracts from which were furnished by a correspondent, it is stated (p. 606) that "the phenomena of sunstroke arise from the action of light, not from elevation of temperature." In a recent number of the ENGLISH MECHANIC the opinion of competent medical authorities is quoted, which contradicts this explanation. Many years ago I noted cases of "sunstroke" without sun occurring frequently among stokers in the tropics, and I think I am correct in stating that the opinion of medical men in this country is decidedly in favour of the cause of heat-apoplexy being an increase of the temperature of the blood.

In the same abrégé it is stated that the Hindus of the Himalayas are nearly blind; this must, surely, be a misprint. Again, light cannot be the sole cause of the black skin of the negro, unless we are to believe an hereditary proclivity to blackness, originally due to solar light, exists. For, if so, the negro child born reddish, and clothed and living in temperate climates, would not blacken as it grew up. Far more likely does it appear that blackness was given to the skin of certain races to favour radiation, and that the amount of heat to be endured was considered in their creation. It is well known that the depth of shade does not correspond with the intensity of solar light, and, what is still more significant, the internal organs of the negro are melanotic or smoky-tinted.

M. PARIS.

OUR MATHEMATICAL COLUMN.

[4899.]—FOR a long time I have entertained the idea that a column devoted to the consideration and solution of mathematical problems would be of very great service to a large number of readers. Every now and then friends write to me asking for the solution of this or that problem, and continually the list of queries in the ENGLISH MECHANIC contains several problems for solution.

Now, to a great extent, problems, like words, may be divided into classes, and if the student can interpret this or that reasoning, he is able to solve a class of questions. Whilst problems are given indiscriminately amongst other queries, this classification cannot be carried out, and space is consequently occupied by the solution of similar (*i.e.*, belonging to the same class) problems. My idea is to assist students generally, the amateur as well as the professor. The explanation of a fraction or a decimal will be of as much value to one class of readers as the discussion of the simplest manner of "taking out strains" will be to a second class, or the discussion of chemical formulæ to a third.

No branch of trade can be carried on without some knowledge of mathematics, and, unfortunately, the major portion of the community is not before its requirements. It would, therefore, benefit many to have their difficulties solved quickly, easily, and cheaply. The aim of this column will be to serve the mass, and not those select few whose study is in the van of science and scientific thought. If, then, a number of problems are given, and solved weekly, and if to these be added short notices of new mathematical books, or papers read at the meetings of the various scientific societies, the wants of readers, we imagine, will be satisfied.

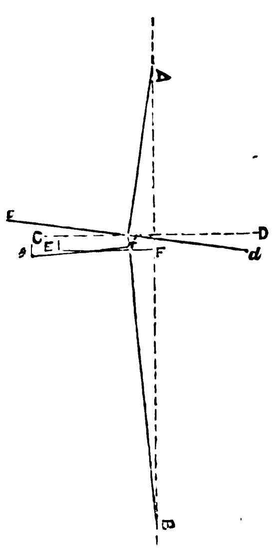
Personally, I should have preferred to have seen Mr. Proctor, or some equally competent hand, conduct this portion of our cosmopolitan journal; but, I fear, owing to his manifold engagements, we must be satisfied with what we can get from him in other ways. I know he will be only too pleased to give any assistance that he can, and I would appeal to all mathematical readers to endeavour to make this column as useful and interesting as possible.

C. H. W. B.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[11313.]—**Setting Lathe.**—In looking over some back numbers I noticed this query, and also "J. K. P.'s" answer to it on p. 48, as also his additional answer on p. 154, but neither give the desired information. It is rather late to answer a question asked the 22nd of last March, but I hope not too late to prevent F. Hume from spoiling his lathe by adopting any fixture or wedge device for setting his lathe headstock. The screw he mentions as fitting between the sides of his lathe bed is a very proper and necessary adjunct to any good lathe, particularly a slide lathe, which I opine F. Hume's to be. The proper way to set the headstock by means of this screw, is this:—First screw the large face plate on to the spindle nose—said plate must run dead true—then, premising that said face plate allows, as it ought to do, the centre to be placed in the spindle nose, which centre should also run dead true, get a piece of stout iron wire and bend one end into a ring which will jam tight on to the end of a mandril, the centres of which are good. The wire must then be bent at right angles to its length, and to the plane of the ring at its end at about an inch less than the radius of the face plate from the centre of said ring, and cut off about 2in. from the angle, and the extremity of the above-described contrivance must be then filed to a point. It must then be jammed on to the end of the mandril, and the two together set in between the centres of the lathe, the point of the wire, which should now be at a very little distance from—in fact, nearly touching—the surface of the face plate, upon being handed round to different points on the face plate, will show by its distance at those points which way the headstock is out of adjustment, as, if perfectly true, the point would keep an equal distance from the plate all the way round. So if the point of the wire is furthest from the plate at the front side of the lathe, the head wants setting back, and if at the back, then it wants to come forward. Perhaps the sketch I send, if worth the



trouble of cutting, will give an idea of what is required. The dotted line A B represents the true line of parallelism of the lathe. The dotted line C D, at right angles to A B, the (consequently true) position of the face plate. E F, the wire described fixed to the mandril (supposed) F B. The full lines represent in an exaggerated form the positions of the several parts when out of truth.—Hone Ko Io.

[12433.]—**Pie Heater (U.Q.).**—There are various ways of doing this: some are pans supplied with steam from the boiler used for general cooking purposes, whilst others are pans perforated, and heated by gas jet; a pipe conveyed from one corner of the tin is passed out either at one corner or out at the top of window; in some cases down in the cellar.—Jack of All Trades.

[12457.]—**Geometry.**—"Bobo" has himself fallen into two mistakes in finding fault with "E. L. G.'s" answer. "P. W. H. J.'s" method does produce a rhomboid, which "Bobo" would have seen had he read the answer. Also, "E. L. G." produces a rhombus, though not the rhombus required, he having overlooked the condition that one corner must coincide with a given point. I would like very much to see the true answer to this problem.—Xenophon.

[12460.]—**Four-Valved Cornet (U.Q.).**—I don't know, but should imagine the "four-valved cornet" would have the same fingering as the baritone euphonium, or bombardon, has with four valves; if so, "H." may first learn the scale as though the instrument had but three. The fourth is extra; it is equal to the first and fourth—*i.e.*, you may finger D below the first, or G below the second ledger below the staff (treble cleff) with the first and third or fourth (the latter is generally preferred); the same notes flatted, thus D flat and G flat, may be made with second and fourth, instead of first, second, and third, thus avoiding the use of one valve. Again, it is useful in shaking on C (on first ledger line below), using the fourth instead of first and third for D, the note above the shake. In instruction books they give the fingering of the scale chromatically down to C, making the compass of the instrument three octaves, but every note below G is too sharp.—L. C.

[12468.]—**Exhibited Inventions (U.Q.).**—I have seen the same in print, but know not where. Apply to the officials.—Jack of All Trades.

[12471.]—**Wheels.**—The face spokes of wooden wheels are those nearest the nose of stock or front side of wheel, so face arms would be those nearest front side of a metal wheel.—Zax.

[12472.]—**Electrical.**—1. If the wire of the galvanometer is short and thick, it will not be deflected, because the quantity of electricity transmitted by the induced direct and inverse currents is the same; but if the wire of the galvanometer coil is long and fine, there will be a deflection, because although the direct and inverse currents are equal in quantity, they are unequal in intensity, the direct current having highest tension. 2. Hedreder's is the best coil for medical purposes, but the ordinary so-called "shocking coil" does for passing the induced currents through the body for relieving rheumatism. Magneto-electric are useful in dispensing with all the trouble of battery, &c., and the currents can be obtained from them in similar forms to those of ordinary induction coils. 3. Daniell's is a good constant battery, but expensive. Smee's is a very useful battery when made with lifting gear (so that it may be dropped into the solution when required, and raised out again as soon as done with), is moderate in price, simple, and I think would suit your purpose well. The sulphate of mercury battery will keep in order from six months to a year, is also moderate in price, but not very powerful.—Zax.

[12504.]—**Sketching from Nature.**—I regret that I should have troubled any of your readers, especially a lady, to make further inquiries by my not being sufficiently explicit. I tender my apologies, and ask the fair "Julia's" pardon. I presume that the student having traced the outline on the glass proceeds to copy it on paper, and from time to time lays the glass over the same (the sketch) to see how he gets on. Next the gummed side of No. 1, on which the drawing is traced, is laid gummed side down on white paper. Over this glass No. 2 gummed side upwards is laid, and a charcoal tracing is made thereon; on this plate, No. 2, the drawing is laid, and rubbed on the back. Then it is removed, and the outline traced with lead pencil. I hope this is sufficiently clear. I would add, that it would be well to have several holes in a line towards the glass, made for the upright *a* to increase or diminish the size of the picture. A student who practises this method for a short time will soon be able to lay it aside and sketch freely without any mechanical assistance.—Old Boots.

[12528.]—**Hay Asthma.**—"Alfred S." (p. 622), is "sorry that I recommend the inhalation of creosote;" as "in any shape or form it will inevitably cause nervous twitching, and even paralysis!" How benighted, then, must have been the General Medical Council, composed of the foremost men of the United Kingdom, who, in 1867, issued the "British Pharmacopœia" with formulæ for "Creosote Inhalation," mixture and ointment—creosote in these various "shapes and forms," and yet not one word of caution as to "twitches and paralysis"! I have no objection, if "Kate" has not, to "Alfred S.'s" Epsom Salts. Eau de Cologne is as useless as it is expensive.—Lambda.

[12529.]—**Improved Machine for Making Aerated Drinks.**—I believe the gas for all aërated or mineral waters is produced from diluted sulphuric acid and whiting; it is for all the machines I have seen. I do not see any improvement in the machine "H. B. E." recommended, as I tried that principle years ago, and it was quite a failure.—L. W. D.

[12529.]—**Improved Machine for Making Aerated Drinks.**—I see you have many inquiries on this subject. I am one of the earliest makers of them in England, but gave up the manufacture many years ago. No one can make them properly without a machine. One made on the best principle may now be had at from £30 to £80, according to size. The principle on which all aërated waters are made is simply this:—A leaden retort is filled half full with whiting and water. Into this mixture a very little sulphuric acid is poured at once, which instantly liberates a quantity of carbonic acid gas. When that acid is spent, a little more is introduced, and more gas liberated. The gas thus liberated passes through water into a gasometer. Thence it is pumped into a metal cylinder containing water, or soda and water, &c., and very powerfully compressed, being well mixed by means of an agitator, or, as we used to call it, an "O'Connelliser," very rapidly revolved. When the liquor has absorbed sufficient gas, it is conveyed by pipes to the bottling machine, bottled, corked, and tied over. It is then quite ready for use. If requested, I shall be happy to send drawings and a detailed explanation.—Kelby.

[12537.]—**Compressing Air.**—At p. 622 there is given the result of some experiments on the compression of air and resulting temperature. The theory of a perfect gas, supposed to consist of free and perfectly elastic molecules in a state of motion, the mean square velocity of the motion being proportional to the absolute temperature, reckoning it from $-461°$ Fahr.—the zero of gaseous tension—gives the mutual ratio of change of pressure, density, and temperature when the gas is suddenly compressed or dilated. The rule for computing may be inferred from the following proposition:—$t \propto \sqrt[4]{p} \times \sqrt[3]{d}$, in which t is the absolute temperature, p the pressure, and d the density. As an example of the computation, take the experiment that lasted two hours, in which the valve was loaded with 45lb. to the square inch, making the whole pressure or tension of the compressed air to be $45 + 15 = 60$lb. Before compression we have $t = 461 + 42 = 503$, $p = 15$, and $d = 1$. After compression, $p = 60$, and d is less than 4, because of the rise of temperature, $256 - 42 = 214$, the absolute temperature being $461 + 256 = 717°$, so the density has to be reduced in the ratio of 503 to 717 (Dalton and Gay Lussac's law), or $\frac{503}{717} \times 4 = 2{\cdot}806 = d$. To find the theoretical value of the absolute temperature, t, the following is the proportion:—$\sqrt[3]{1} : \sqrt[3]{2{\cdot}806} :: 503° : 709°$, which is thus 8° less than the result of experiment. This may, perhaps, be accounted for by the heating of the cylinder, and consequently of the entrant air before it is compressed. In another experiment, with load of 58lb. on square inch—which was also continued for upwards of an hour—the same computation gives 277° Fahr., instead of 296°, or 19° less. From newspaper accounts, it appears that the Americans are applying compressed air to locomotion on tramways. It is to be hoped they will be successful, on account of the poor horses. In the economic application of such power, it is obvious that artificial cooling is required during the compressing or storing, and artificial heating during the expansion or delivery of the power.—N. S. N.

[12551.] — **Picture Framing.** — Errata.—For "springs," read spring bit.—A., Liverpool.

[12557.]—**Nickel Silver.**—May I request the attention of "E. L. G." to the extract from Montaigne's Essays which heads the correspondence in "Ours." The advice there given would be very serviceable to him in particular, and possibly some other of our friends who are sufferers from that distressing affection "cacoethes scribendi." In answer (No. 12557, p. 573), I explained the composition of German and nickel silver, and stated that pure nickel unmixed with other metals was never employed, while on page 623 "E. L. G." takes the trouble to contradict this statement and say that pure nickel is employed for coinage, mentioning the Belgian sous as the nearest example to hand. Now, as a matter of fact, the coin mentioned is not pure nickel, nor is there any coin in circulation that is composed of nickel only. The Belgian "sous" (or 5 centime piece) was formerly made of German silver, but is now composed of an alloy of nickel and copper, with sometimes a little iron. I have not analysed a piece quantitatively, but believe the copper to amount to about 30 per cent. of the coin. As "E. L. G." is evidently not a chemist, I may inform him that he can readily detect the presence of abundance of copper in the coins he erroneously took for pure nickel, by pouring on the piece a few drops of nitric acid (the coin is not defaced), allowing it to act for a minute or two, rinsing off with a little water, and dropping a small piece of iron (a tack or needle) into the liquid, when he will find a deposit of metallic copper will be speedily produced. Before "E. L. G." again contradicts a perfectly correct statement, he will do well to remember that it has a very bad appearance, and may induce his numerous admirers to pause more frequently before they swallow his many fanciful theories, from cometary deluges downwards.—Alfred A. Allen.

[12621.]—**Black Dye for Leather.**—If "Kendal Saddler" would give his recipe for dyeing leather black on a large scale, he would greatly oblige—Experimenter.

[12642.] — **Ice Cream.** — A cheap and effective mode for the above is to first make a composition of the following:—Beat three eggs with half a pound of loaf sugar, till well mixed, then add a pint and a half of milk, and bring to boil on a quick fire, keeping it well stirred. Add half a pint more milk and put it in a cool place, stirring it occasionally. To freeze the same pour the composition into the freezing-pot, which is a vessel made of either pewter or zinc, the latter being much the cheapest, with a lid having a handle over across the top, and watertight; place the pot in a pail, and pack a mixture of rough ice and coarse salt round the pot in the pail so as to bed it in, put a thin sprinkling of salt on top, then cover the ice round with an old flannel, and work the pot containing the composition backwards and forwards for a minute or two. Take the lid off, and scrape what adheres to the side, and again work the pot round and scrape with a wooden spoon, as before, continuing this process till it becomes the proper consistency, which should be as stiff as butter; a little vanilla added greatly adds to the flavour; then throw the melted ice and salt away, replacing with fresh, which will then keep it stiff for six hours. For 12lb. of broken rough ice put 3lb. or 4lb. of coarse salt. On no account let any of the ice mixture get in the composition in the freezing-pot or it will never freeze.—Louis.

[12650.]—**Government School.**—Candidates for engineer studentships must be between 15 and 16 years of age. They are examined every June and December by the Civil Service Commissioners at Devonport, Portsmouth, Chatham, and Sheerness. The examination is open and competitive: on this account it is competed for by large numbers of clever youths, which renders it very stiff indeed. "W. M." may, on application to the office of the Admiral Superintendent at either of the above-mentioned yards (surely "W. M." must have known that Woolwich yard was closed), obtain nomination papers and also papers containing all requisite information.—E. S.

[12653.]—**Poultry Keeping.**—I kept twenty fowls in an ordinary poultry house, and one night saw thieves at the door. I went upstairs and fired at them a revolver out of the window, they quickly disappeared, and have not come again since, but my poultry being valuable, and not wishing to trust to the chance of knowing when thieves might come again, I constructed a new poultry house of corrugated galvanised iron, which is perfectly thief proof. It is 4ft. wide and 8ft. long on the ground plan, and 6½ft. high at the back and 4½ft. in front. The house consists of five pieces, back, front, two ends, and roof, they are put together by bolts and nuts, the nuts being inside the house. Part of the front is the iron door; it is secured by a stout chain and padlock, the chain going through a hole in the door and a hole in the end of the house. At the other end a hole is made just big enough for the fowls to go in and out. To prevent the house being too warm in summer and too cold in winter it is lined with ½in. boards.—J. L. H.

[12667.]—**Organ.**—"W. Z." has not carefully read my letters on "The Organ Built," or, I think, he would not have asked such a question. Refer to letters three and four in "ours" of January 26 and February 9 of this year, and see if full directions for fixing pallets and guide pins are given. I think they are, but if "W. Z." still remains in a fog I will try to enlighten him. No covering board is placed over the paper on the bars.—J. D.

[12681.]—**Is the Interior of the Globe Vacuum?**—"Rasselas" has quoted an extract from Ansted's "Physical Geography," which indorses the views of Prof. Sir W. Thomson and Mr. W. Hopkins, Cambridge. M. Delaunay, the lamented director of the Observatory in Paris, has come to a different conclusion. According to that eminent mathematician and astronomer, in order that the reasoning of Professor Thomson might be entertained, we must admit in liquids an absolute mobility. But this does not exist, for all liquids are more or less viscous. When a sudden rotation is communicated to a solid, which envelops a liquid on all sides, the solid alone turns, the liquid remains behind, which it is easy to ascertain by observing sawdust which has been put in that liquid. But it is no longer so, when we turn the balloon slowly, in that case inertia makes the liquid adhere to the inside of the vessel, which carries it in its motion. The hypothesis of the central fire is not contrary to the astronomical phenomena, according to M. Delaunay, who pretends that the action of the sun and the moon is exerted on the whole mass of the globe, and that thus the phenomenon called precession is not an objection to the fluidity of the central part of the globe.—F. T.

[12684.]—**Canoe.**—In reply to "Aquarius," I have much pleasure in giving him the dimensions of a canoe which ought, I think, to suit his purpose. Length, 12ft.; beam amidships, 30in.; depth from rabbet of keel to gunwales, 10in.; depth of keel, 1½in.; sheer of gunwales, 5in. The well to be 32in. long by 20in. wide, the back of the well to be 21in. abaft the centre of the canoe. The deck to be of cedar or mahogany (the former preferable), and have about 3in. arch amidships; the stem and stern posts of oak or ash; the keel of same timber or American elm; the planking of oak if for travelling and knocking about much, otherwise of yellow pine, or spruce, or cedar, and the ribs or timbers of oak, or ash, or birch. Step the mast 3ft. 10in. from bow, and rig with a standing lugsail of following size: Fore leach, 8ft. 6in.; after leach, 7ft. 6in.; head, 5ft. 3in.; foot, 5ft, 3in. Rig a dandy also, abaft the well, of a jib shape, 3ft. 6in. leach and foot. I do not know anything of sheeting a canoe with zinc, but do not think it would suit at all. Any other information required by "Aquarius" I will be happy to give, if in my power.—CANOEIST.

[12696.]—**Atmospheric Pressures.**—The Board of Trade's "Barometer Manual," Stanford, Charing-Cross, price 1s.—E. L. G.

[12703.]—**Fuchsias.**—Fuchsias are very susceptible of change of place. I have known some affected to the falling off of leaves and flowers by being shifted from one room to another, nay, from one side of a room to another. It is but reasonable, then, that they will go to the bad when brought from a greenhouse or nursery, where they have been forced, perhaps, into premature bloom, and placed in an atmosphere many degrees lower. I have spoiled a magnificent plant this summer by putting it outside the window one day and inside the next, as I thought the weather suited; at last I put it in the ground to save it. It is now in full and luxuriant foliage, but it has not shown a bloom this year. Also too much water, or too little, will cause buds and leaves to fall off. In future all my fuchsias will go into the flower-beds in the spring, to be shaded by an awning (as is or should be done with tulips) from heavy rains and strong sunshine. I have some very fine fuchsias, but no greenhouse, and in that case my experience has convinced me that the plants do much better in the beds.—H. G. W.

[12705.]—**Extracting Vegetable Colouring Matter.**—The green colouring matter of leaves, known as chlorophyll, can be extracted by chopping up green leaves or grass with a knife, and digesting with strong alcohol. A deep green solution is produced, which is strongly fluorescent. If this solution be evaporated gently to dryness, a splendid red colour often appears on the edges of the residue, while comparatively pure chlorophyll is deposited in the centre. This red colour, found principally in autumn, and called erythrophyll, is an oxidation product, and may be extracted from the residue by treatment with water. On redissolving the purified residue in alcohol or carbon disulphide, the green colouring matter may be obtained almost pure. Analogous processes may be employed for most other vegetable colouring matters, comparatively few being soluble in water. Many yellow and orange colours may be separated by shaking the alcoholic solution with carbon disulphide, when the yellow colour becomes in a great measure dissolved in the heavier liquid which settles to the bottom.—ALFRED H. ALLEN.

[12706.]—**Laboratory Purification.**—Processes producing disagreeable fumes or gases are usually conducted in a glass case or "stink-cupboard," having an opening into a chimney, or, better still, into a separate flue. When the action is imperfect, it may be increased by lighting a gas jet placed under an iron tube which passes through the aperture into the flue. This tube may, with advantage, be made large enough to fill the hole, but as the latter must be nearly at the top of the case, the gas-burner must be raised accordingly. A small case can be constructed out of a large box or packing-case, fitted with sufficient glass to allow of the operations being watched from without. If sulphuretted hydrogen is the principal annoyance, it may be got rid of by always treating the solutions in a bottle fitted with tubes, so that the excess of gas can be passed into a tube or bottle filled with acetate of lead, sulphate of copper, or a mixture of ferrous sulphate and slaked lime, either of which will absorb it pretty completely. The last is the cheapest, and may be used over again after being turned out and freely exposed to the air.—ALFRED H. ALLEN.

[12706.]—**Laboratory Purification.**—Make an opening into a chimney, of course close to ceiling. The best way is to close in a recess with a sliding window; make the opening in this recess and carry on all offensive operations therein, closing the case as much as possible. In this way, and by using refrigerating tubes of my own device to condense the fumes, I sometimes keep acids boiling for hours at a time without making the laboratory itself unpleasant, while no fumes reach the rest of the house at all.—SIGMA.

[12707.]—**Geometrical Query.**—The projection of a circle is proved to be an ellipse at p. 326 of Todhunter's "Conic Sections." I will send the proof if required.—XENOPHON.

[12707.]—**Geometrical Query.**—The sole condition for having a circle projected perspectively as a parabola is, that the ray from one point of its circumference (and from only one) to your eye shall be parallel to the plane of the picture. There is an engraved interior view of S. Paul's, taken from under one of the diagonal arches of the central octagon, and as the circular cornices about the base of the dome have one point vertically over the spectator (the picture plane being also a vertical one as usual) all their lines become nearly parabolas. This view (unless as a cosmorama or peep-show) does not make a satisfactory picture, for the reasons I explained to M. Paris. Views within the Pantheon at Rome, similarly taken from the exact line of wall base, would make all the circular lines of the full diameter parabolas, and if the spectator advanced to (say) 50ft. from the centre, they, and all of more than 100ft. diameter, would become hyperbolas; one alone (that one in the dome whose radius is 50) being a parabola. But as views of this building, so far as I know, are always from the back of some recess, they project all the lines as ellipses. A view from the top cornice, or springing of the cupola, would make every line above that one circular, as in the stereographic map projection. A circle's projection can only be a conic section; a straight line, ellipse or circle, whenever the picture, indefinitely extended, would enable you to show the whole of it; and a straight line, hyperbola or parabola, whenever it could not embrace the whole.—E. L. G.

[12710.]—**Aerated Ginger Beer.**—Perhaps "Sodawater" uses too much essence of ginger; about ½oz. of good essence to 3lb. of sugar with tartaric acid to suit the palate is a firstrate flavour, and it will not make the water scarcely at all cloudy, but all essences will if too much is used. Perhaps the gas is not sufficiently washed, or not properly generated. If he will say how the gas is made for his machine, and what class machine, I could better say, and give him a more definite answer.—L. W. D.

[12711.]—**Height of Mountain.**—At A, take the top's angular altitude and angular distance from B; at B the same two relations to A; and measure the distance between A B (not less than a tenth its distance from either) and also their difference of level.—E. L. G.

[12718.]—**Potato Stains.**—If "Anti-Acid" will go to any oil warehouse, and purchase a piece of pumice-stone, and first rub a little soap on his fingers, and then rub with the stone, it will soon remove the stains without injury to the skin. Proved.—J. W. PEARSON.

[12720.]—**Medical Coil.**—These cannot give a continuous current under any circumstances. They can and ought to be made to give one in one direction only, and the way to do this is to connect the beginning of the secondary to the end of the primary wire. A bichromate cell will be found more convenient than the Daniell. The latter will also work to much less advantage than the Leclanché for a clock, or for any use requiring currents of small quantity.—SIGMA.

[12725.]—**Fused Chloride of Silver.**—"Argentum" has probably not dried his chloride before fusing. It should be well dried, and then it fuses with perfect ease over a Bunsen gas-burner or spirit lamp, and may be cast into rods or plates; the battery as made, however, is a very expensive toy.—SIGMA.

[12726.]—**Motion of a Sailing Boat.**—Everybody can understand how a boat can sail before the wind, but to sail with the wind on the side, or to make way against the wind, is far more difficult; in fact, persons unaccustomed to it often doubt the possibility of doing so. In explaining this we will consider the sails as quite flat, for the nearer they can be brought to flatness the better. Supposing the sails, then, to be flat, and the wind to strike them, part of the force is lost, as will be understood on mechanical principles, part of it presses against the flat surface of the sail, and perpendicularly to it, this, then, tends partly to drive the boat ahead, partly to drive the boat bodily to leeward, and if the boat were a box or a tub, she would go in a direction between the two, but as boats are constructed sharp at the fore end, the surface opposed in that direction is not more than one-seventh of the surface which the nearly flat side opposes. Thus the boat is driven easily ahead, but only a little to leeward. I cannot attempt to explain the latter part of the query without disregarding the advice contained in Montaigne's Essay.—CAMBRIA.

[12736.]—**Cement on Postage Stamps.**—British gum, made, I believe, by heating starch until it assumes a brown tint.—AROMA.

[12736.]—**Cement on Postage Stamps.**—It is dextrine, or British gum, made from starch by exposure to heat. It may also be prepared by the action of acids and diastase (a substance formed in malt), and by a limited fermentation.—SIGMA.

[12739.]—**Geometry.**—Let P be the intersection of A B and F C. Since the angle B A D equals B F C, and A P C equals F P B (i. 15), therefore A (1) P equals F B A, equals a right angle. Therefore the angle A (1)(2) equals a right angle. In the same way the angle A (3)(2) equals a right angle. Therefore a circle can be described round A (1) (2) (3).—XENOPHON.

[12756.]—**Etching on Stone.**—Very fine lines can be etched on stone. Instead of a grained stone it should be what is termed a polished stone, produced with pumice-stone, cake colours being used the same as water colours, and drawn with a lithographic pen. I have done the same myself for gold and colour printing.—JOSEPH WILLIAM FENNELL.

[12757.]—**Hand Railing.**—Templets being made for every pattern of bend or curve, planes most suitable for the same with paring chisels, gouges and rasps finish the same. See "Hand Railing," in *Building News*, which will furnish every particular.—JOSEPH WILLIAM FENNELL.

[12757.]—**Hand Railing.**—After the wreath has been truly squared there is nothing better than the two-handled draw-knife for reducing it nearly to the mould, then use routers of the spoke-shave pattern, but having for a cutter the plane-iron taken out of the planes, used for moulding the straight lengths of rail. Your ingenuity should devise the rest. No two men pursue exactly the same method.—OLD PLOUGHMAN.

[12758.]—**Socket Handles.**—By making a pair of hollow clams, to work by a screw or lever, the same as vice jaws, you could do them almost as fast as counting them. Make the plate to the proper taper, heat them, lay them between the jaws, and the mandril upon the top, and pinch up with either a screw or lever.—JACK OF ALL TRADES.

[12759.]—**Leaking Indiarubber Bottle.**—Get some indiarubber solution, and put a patch on the inside; it will require some considerable time to get dry.—JACK OF ALL TRADES.

[12759.]—**Leaking Indiarubber Bottle.**—Stick it together with indiarubber cement, and, if necessary, stick a new piece over leaky place with same.—ZAX.

[12760.]—**Bringing Slate to Surface of Quarry.**—Use a wire rope and horizontal drum, using two tramways and two trucks, the one going down whilst the other is coming up.—JACK OF ALL TRADES.

[12760.]—**Bringing Slate to Surface of Quarry.**—It is quite practicable to wind up the stone in the manner mentioned. If the weight of the load, including the weight of the waggon and friction, be 1 ton, the incline 1 in 6, and the height 60ft., it will require 4 horse-power to land each load in one minute, which would be a speed of about 6ft. per second, or about 4 miles per hour. These are all approximate numbers. It would be a question depending on further details of the situation whether a vertical lift would not be preferable to an incline. It would cost less.—C.S.

[12760.]—**Bringing Slate to Surface of Quarry.**—"A Poor Irishman" may bring slates to the surface of quarry with his present engine by fitting up a barrel for wire rope and laying down tramway; the barrel would require to be 3ft. diameter and 4ft. long, and make about fifteen revolutions per minute; it will require a sliding coupling on driving shaft for disconnecting from engine, and a brake on end of barrel for running down empty waggon, wire rope ⅝in. diameter; it will require small rollers or pulleys placed between rails 9ft. apart to prevent rope from rubbing on the ground; it will bring up a ton at a time. If the barrel cannot be placed in a line with tramway the rope can be guided to it with pulleys; it will work more satisfactory than a steam winch, and much cheaper.—P. C. E.

[12762.]—**Curve of Mirror.**—The surface of the concave speculum of a reflecting telescope must be worked to a parabolic curve. Various machines have been devised for producing this figure with certainty. Valuable information on this subject may be found in the columns of the ENGLISH MECHANIC, where the subject is fully treated by "Arcturus," W. Purkiss, &c. I should recommend "Zeta" to read carefully "Herschel on the Telescope," and the back numbers of the ENGLISH MECHANIC. I am using a mirror 5⅜in. diameter and 51¼in. focal length, which I made by hand only, without any machine whatever, and which is of excellent quality. It will divide 36 Andromedæ, π Aquilæ, and ι Arietis with a power of 250 diameters.—A. WOOLSEY BLACKLOCK, M.D.

[12762.]—**Curve of Mirror.**—The curve of the mirror of a reflecting telescope is a parabola. The mirrors are ground by a machine. The process is a very delicate one.—ALFRED H. ALLEN.

[12763.]—**Preparation of Carbon.** — Carbon may be prepared from sugar: 1. By the action of superheated steam; 2. By placing in a receiver with Nordhausen sulphuric acid H_2SO_4, or English acid $2H_2OSO_3$, or by the oxidising effect of nitric acid.—C. B.

[12763.]—**Preparation of Carbon.**—Heat the sugar to a red heat, without access of air.—ZAX.

[12765.]—**Sun Dials.**—A horizontal dial for 40° N. latitude can easily be constructed. The gnomon must point to the pole, its angle is thus equal to the latitude of the place, which should therefore be accurately known. The XII. o'clock hour-line should be fixed in the astronomical rather than the magnetic meridian. A true meridian-line can be found by equal shadows of a blunt rod, or by observations of stars having the same right ascension. The angles which the various hour-lines make with the XII. o'clock line are readily found. For 40° N. latitude they are as follows, being equal for hours equi-distant from the meridian:—

Hour-lines.		Angle with Meridian.	
XI a.m. and	I p.m.	9°	46′
X	II	20	22
IX	III	32	44
VIII	IV	48	4
VII	V	67	23
VI	VI	90	...
V	VII	67	23
IV	VIII	48	4
III	IX	32	44

The last three angles are of course on the opposite side of the VI. o'clock hour-lines. I shall be happy to supply "Emigrant" with any further information on this subject. The best treatise I know on the subject is one in the "Edinburgh Encyclopædia," article "Dialling," Vol. VII. Your correspondent will there find an excellent description of all kinds of dials, from the "Portable Dial on a Card," to the "Universal Dial on a Cross."—TAG.

[12766.]—**Fiddles and Fiddling.**—I have no doubt "H. H." will find the cause of his trouble is in the bow, the hair being greasy. If so, take a clean tallow candle and rub the tallow well into the hair with finger and thumb from end to end; then take a clean duster and rub the tallow off (be careful to get the hair perfectly clean); then take a little clean flour and rub it well in as before; then take a clean duster and clean the hair as before; then powder a little rosin, and rub it well in; then "rosin the bow" in the usual way, and you will find it will go as free and as beautiful as if it was new. And when clean, you should never touch the hair with your fingers.—C. M. B.

[12766.]—**Fiddlers and Fiddling.**—In answer to your correspondent "H. H.," requesting to know the reason his bow slips and makes "squeaky and offensive" notes, I would suggest it is the fault of "him that boweth," for if "H. H." will pay due observance to the rules which govern "fiddling," he will see that he must press his fingers very firmly on the strings, and next, he must hold his bow firmly, and pass it in a direct line between the bridge and the end of the finger-board. If the bow should deviate from that line, and wander too near the bridge, it will create the offensive notes complained of: or if the bow, on the other hand, be allowed to wander too near the finger-board, it will very likely slip, and squeaky notes be produced; or if the fingers are not pressed very tightly on the strings (never mind corns), the same disagreeable results will follow.—A. DEANE.

[12767.]—**Puddling Fishponds, &c.** — The thickness of the puddle should not be less than 8in., and if clay is plentiful, 12in. is a better thickness. Whatever the thickness may be it should be worked in two layers, so that the imperfections of either may not be continuous through the whole mass. Two inches thickness of lime is sufficient. The same thickness of smith's ashes will do instead. Mixing gravel with the clay tends to prevent the burrowing of rats or other vermin, but it requires to be carefully done, so that the mixture shall be uniform.—C. S.

[12767.]—**Puddling Fishponds, &c.**—You will need at least 2ft. of clay, use it as stiff as possible, and with a little water; well ram it down; if you can get a layer of cinders or ashes in your bottom, it will be better than lime.—JACK OF ALL TRADES.

[12770.]—**Boring for Water Jet.**—These wells have been in use, undoubtedly, for several centuries in the north of France and Italy, but it is not more than eighty or ninety years since they became known in England and Germany. In August, 1823, Mr. John Good, of Tottenham, took out a patent for "certain improvements in implements for boring the earth for water," but the first modern well of great depth (which drew public attention to well-boring) was that bored by Mulot for the city of Paris at Grenelle, commenced in the year 1832, and water rose after incessant labour, on the 26th February, 1842, from the total depth of 1,798 feet. The well at Passy was commenced by Kind, in 1856, and water was struck on the 24th September, 1861, at a cost of more than £40,000, the yield of water being 17,000 metres of water per day. There is a long account of it just published in the *Engineer*. I wish that I could give our valuable and valued friend, "The Harmonious Blacksmith," more information on this subject, but perhaps some talented correspondent will enlighten us both on this matter.—ZAX.

[12771.]—**Colorado, U.S.**—By National Line to New York, expense about £18 to Denver City, by steamer and rail; the cost of living I do not know. My information is derived from a friend who went to Denver with the same idea as "Emigrant." He writes:—"The country is completely overdone by emigrants, there are thousands living at the various ranches throughout the state, working for the farmers, and receiving their board and lodging only as pay. The soil may be good, but there is literally no water, and in summer if you succeed in growing anything the grasshoppers eat it. The climate, which is described as being the finest in the world, is tremendously hot in summer, and although the papers describe the winters as being so mild that cattle can be left to take care of themselves, at the time I write (the end of February), the ground is covered with snow 8ft. deep, and has been for six weeks; the thermometer is below zero. Cases of frostbite are frequent, and if I could get away, even at a loss, I should be glad." In fact (from my friend's statements), the country is written up by Yankee land speculators, who have lots they wish to dispose of to credulous investors. If you want to emigrate, why not go to Canada?—A CONSTANT READER.

[12771.] — **Colorado, U.S.** — "Emigrant" and others would do well to write to U.S. Consul at Liverpool to send them a copy of "Information for Emigrants," an official work, by Edward Young, Chief of U.S. Bureau of Statistics, giving the only complete and reliable information to be obtained about that country, and presented on a new plan by which one need not read more of the work than relates to the part in question. This will be sent to any one who will forward stamps to pay the postage. As to the best way of getting to Colorado I would recommend New York, as the fares are much less than by any other city. As I have never been in the western part of the United States I cannot inform him as to climate and expenses. I would heartily recommend him to go to New York by the White Star line of steamers, as they are by far the finest and best, as well as the cheapest, and whether "Emigrant" be a scientific man or an epicure, he will find abundant means of enjoying himself on this line, as I can testify. In case the consul at Liverpool cannot furnish him with the book, if he will publish his address, I will put him in the way of obtaining one.—U. S. A., Washington.

[12772.]—**Bee Keeping.**—Mr. Walton does not tell me the sizes of his hives, frames, or centre apartment inclosed by the movable partitions, consequently I am unable to give him other than general information. If his centre apartment contains sufficient for winter use I should certainly remove all the sealed combs from the collateral sides, leaving them quite empty; further I should overhaul the combs in the centre apartment, cut out all the sealed drone comb, and fill up the spaces with sealed worker comb cut from the collaterals, or from supers, although the former generally yield sufficient. The empty ends form comparatively dead air spaces, and may be made the means of drying, warming, or feeding during winter or spring. A hot dry brick or bottle of hot water will give a good deal of warmth, a lump of quick lime will dry the air in the hive, and a comb filled with syrup will form a ready means of spring feeding. I presume the hive is so made as to enable Mr. Walton to get at the collateral ends in winter without disturbing the bees, and if so they will form a capital means of ventilation; or the back of the hive may be raised, and the back of the cover or honey board raised also, or if the said cover be in pieces according to my own principle, the pieces should be set about one-sixteenth of an inch apart, after the bees have finished propolising, and a light sack or thin carpeting laid over it. I gave directions for transferring combs last week, and can give nothing more special on Mr. Walton's behalf, as he does not say anything of the relative sizes of his frames, to or from which he wishes to transfer the combs. The great feature to remember in transferring is not to undertake too much; get the upper part of the frames filled with comb, and fastened in by the bees, before attempting to fill up the lower part, then the lower part having firm bearing on the bottom bar cannot fall, and will require little attention except from the bees.—C. N. ABBOTT.

[12773.]—**Boot and Shoemaking.**—If "Harry" intends to go in for rivet work repairs the tools that he will require are a pair of lasts, a size or two sizes smaller than his boots, bottom iron plated, an iron foot, a shoemaker's hammer, ditto pincers, bradawls and sewing awls, and a closing awl and stabbing awl, a shoe rasp about 8in., knife, sole tacks, and hack knife. The thin edge of the worn leather is lifted by the hack knife after the nails are cut out, and the piece for repairs is thinned down to correspond and placed under, and all bradded down together.—JACK OF ALL TRADES.

[12774.]—**Harmonium Keys.** — "E. W. P." might purchase old piano keys for a mere trifle; these might be converted for the above purpose.—JOSEPH WILLIAM FENNELL.

[12776.]—**Gas.**—In our town (Macclesfield) we have formed a Gas Consumers' Association (membership free), and have held several public meetings to complain of the gradual increase of the gas bills during the last two years, since the introduction of collecting the bills quarterly, which now average double for the quarter what they were for the half-year, and to protest against the injustice of supplying poor gas for the high price fixed by our Act, 4s., which orders 18-candle gas. The increase in the bills is caused by the coal being exhausted too much, thereby making more vapour of a less illuminating power, leaving the coke unfit for household use, and the gas of so poor a quality as to need a larger consumption to get a light at all; in this way an immense amount of extra money is squeezed out of the consumers. The meters in most cases register perfectly correct, but we complain of being forced to burn more and to pay the same price per thousand for poor gas, when we need not consume so much if what we obtained was of good quality, which would be secured by taking the coal out of the retort sooner. It is a curious problem that some towns charge so little, and other towns are allowed by Government to charge so much—far in excess of the difference of the carriage or any rise in the cost of coals, and it is strange how few towns have a public photometer to show the quality of the gas supplied. Brighton is the only one I know of that has an official inspector and public photometer. Birmingham has a public photometer in its town-hall, and Leek is fixing one in the collector's office. Birmingham charges 2s. 9d. per 1,000, and allows 5 per cent. discount for cash Leek charges 4s. 2d., with 3d. discount for cash. Wolverhampton 2s. 9d., Plymouth 2s. 9d., Nottingham 3s., Manchester 3s. 2d., Warrington 3s. 6d., Derby 3s. 5d., Macclesfield 4s., London 3s. 9d., Diss 5s. 10d., Beccles 6s., Lowestoft 5s. 10d., Brighton 3s. 6d., Halesworth 5s. 10d.; Congleton lights its streets free. The above eastern counties towns look very much like a combination of gas companies, and much good would arise if each association will increase and diffuse what information they can gather. From the information we have so far gathered we find that wherever the gas is supplied by private companies much better satisfaction seems to be given, and wherever the gas works are corporate property every element of dissatisfaction appears to be introduced either from ignorance or from the illegal design of extorting extra money from the consumers for town improvements, &c., by supplying a poorer gas than the law allows, the gas committee knowing that the town possesses neither inspector or photometer to test the rubbish supplied. We desire to petition Parliament to appoint a public auditor of gas accounts qualified to test the gas at irregular times, and to allow the maker a certain margin (say 20-candle gas) and then give him a month's imprisonment whenever it is below 18-candle. The admission of the newspaper reporters to the weekly meetings of the gas committee would remedy much that is complained of, where the works belong to the ratepayers who are able to watch every other committee excepting this one, where there is the most danger of dishonesty and mismanagement. A correspondent made some capital remarks in a previous issue, regarding the different values of the different qualities of gas, but we ought to unite to obtain a really good quality, and then no one will object to pay a fair price.—R. A. HUNTLEY, Hon. Sec., Mac. Gas Cons. Assoc., Macclesfield.

[12776.]—**Gas.**—The illuminating power of gas is commonly ascertained by Bunsen's photometer, the result being expressed in "candles." Thus, if a sample of gas is said to be "16 candle gas," it means that when burning from an Argand burner of particular size, surmounted by a glass chimney of definite height, the rate of issue of the gas being five cubic feet an hour, the light given by the gas is equal to that produced by 16 sperm candles, each burning at the rate of 120 grains an hour. To perform the experiment, "H. J. W." would require a small dark room and some expensive apparatus. It is evident that unless the rate at which the gas burns is known, it is not possible to get comparative results. A very rough idea of the illuminating power of the gas may be obtained by a thin rod, such as a knitting-needle or pencil about a foot from a sheet of white paper placed against the wall; on adjusting the gas flame and a sperm or paraffin candle at such distances that the shadows produced on the sheet of paper shall be equally intense, the squares of the distances of the lights from the paper screen indicate the comparative intensities of the lights. Thus, if a gas-flame at 4ft throw as intense a shadow as a candle at 1ft., then $\frac{4 \times 4}{1 \times 1} = 16$; the number of times the light of the former is greater than the latter. There is much truth in "H. J. W.'s" remark that gas companies often produce bad gas and good dividends; but the transference of the concerns to Corporations or Boards of Health is usually attended with difficulty, and always with expense—two guineas a minute being a very common price for appearing before a Parliamentary Committee. The suggestions that the illuminating power of the gas should be a factor in estimating its value is a good one, but many people are guilty of wilful waste of gas and money by using bad or worn out burners. By paying attention to this subject, gas consumers may greatly improve their lights, and even reduce their gas bills.—ALFRED H. ALLEN.

[12778.]—**Printing Metal Leaf on Silk and Cotton.**—Let J. B. Sharpley try a varnish made of pint good methylated spirit and 1oz. shellac, about the same quantity of silver sand that has been washed clean and dried. Well shake it occasionally, and stand by to settle; when clear pour off the clear and add 1oz. of either gum sandarach or pale resin; when clear, fit for use, apply with a camel's-hair brush, and apply your metal leaf and heater. The cost will not exceed 1s. I prefer naphtha for the job.—JACK OF ALL TRADES.

[12779.]—**Lightning and Thunder.**—Question No. 1 is not clearly worded. Lightning is not necessarily forked because not sheet. We have zig-zag, sometimes nearly straight or curved, forked and sheet, also that very mysterious form called globular lightning. All these, even the last, I believe, have been imitated by the electrician. Real sheet lightning is, if it ever occurs, very rare; still it is possible. 2. The proper sound of the electric explosion is a crash more like the breaking of glass than anything else, *me judice*; the rolling is the effect of echo; however, the direction of the flash may prolong or modify the crash—still, as on lofty mountain peaks and in other favourable positions, the rolling sound is separated from that of the explosion by a wide interval, we hear the true sound. 3. Violent vibration of atoms or molecules, which is equal to saying we know nothing about it.—M. PARIS.

[12780.] — **Turning Spokes of Carriage Wheels.**—I believe that it is impossible to turn a single spoke at once in a common lathe, but two may be turned at once, over half the circumference of each, by fixing them side by side in a sort of metal chuck at each end, holding them firmly and having centres on the outsides, to be carried by point chuck and point of back centre in lathe; when both turned on the exposed sides take them out and reverse them in the fixings, and complete by turning the then exposed sides.—ZAX.

[12780.] — **Turning Spokes of Carriage Wheels.**—If "Amateur" looks over indices he will see that this thing has been treated upon and illustrated.—JACK OF ALL TRADES.

[12782.]—**Full Moon.**—The following are the dates of the full moons up to the end of next year:—

		h.	m.
1872.	September 16	17	5
	October 16	8	35
	November 14	17	8
	December 14	9	44
1873.	January 18	4	23
	February 11	23	33
	March 13	17	44
	April 12	9	51
	May 11	23	18
	June 10	10	1
	July 9	18	33
	August 8	1	52
	September 6	9	9
	October 5	17	31
	November 4	8	48
	December 3	16	20

—WILLIAM F. DENNING.

[12783.]—**Sash Planes.**—These are not exactly alike, and therein consists their value. The No. 1 must be used first, and should be set a little more "rank" than the other. When that has been worked quite down, take No. 2, which will take off about four fine shavings, and the moulding is finished. "Science and Art" might learn more about work and tools by working a few months in a shop than twenty years' reading. —OLD PLOUGHMAN.

[12783.]—**Sash Planes.**—If "Science and Art" planes down as far as he can with the No. 1 plane set rather coarse, he will find No. 2 will then take a shaving or two off, if set nice and fine; so No. 2 plane acts as a smoothing plane for No. 1, and leaves the work nice and clean.—PEACOCK.

[12783.]—**Sash Planes.**—The reason why they are numbered 1 and 2 is because No. 1 is used first, and takes off the greatest part of the wood to the shape required. No. 2 is then used, and is made to take two or three shavings more off, even after the other had worked quite down, so that it will keep sharp longer, and work finer.—JOHN WALTON.

["B. H." has also answered this query.]

[12784.]—**Libraries.**—I notice that some libraries have their names impressed on their books, &c., by a series of small perforations close together in the form of the letters, in the same way that bankers cancel their cheques with the date, &c., and Government is going to mark ballot papers, &c.—ZAX.

[12786.]—**Photography.**—1. Pack sensitised paper very tightly in an envelope that will exclude air as well as light. 2. A small quantity of carbonate of soda. 3. Place them face to face with a piece of millboard on each side of the pack, and wind a string tightly round. 4. Explained in replies to query 12656. 5. Use an ordinary copying camera.—J. W. N.

[12788.]—**Design for Marble Inlaid Table.**—If "M. and S." will have a really good and new design for a inlaid table let him only look on the numerous new church windows, and he will find all he requires. —MENZ.

[12788.]—**Design for Marble Inlaid Table.**—"Marble and Stonemason" has not said what sort of table, round or square, or probably I could furnish the design.—JOSEPH WILLIAM FENNELL.

[12789.]—**Staining Fanlight.**—The common or green glass is what is termed flushed glass, that is, the colour is flushed on one side of clear glass; if you eat the colour off by acid you will have the clear centre, or what part you please to operate on for your picture; you can paint or draft. Ample recipes you will find in back numbers.—MUTUAL TOM.

[12789.]—**Staining Fanlight.**—Perhaps "Kendal Saddler" means the glass done as follows:—A sheet of coloured glass is laid on a sheet of white glass, and melted together in a furnace. Then the surface of the coloured glass is covered with paraffin and wax, and smoked over a candle. The design is then drawn through the glass and eaten in right through the coloured glass by fluoric acid, which leaves the design in white glass.—C. B.

[12789.]—**Staining Fanlight.**—What "Saddler" speaks of are etched upon plated glass for the purpose by the action of hydrofluoric acid. The glass is to be got at the glass warehouses.—JACK OF ALL TRADES.

[12789.]—**Staining Fanlight.**—The glass alluded to is not stained (except the yellow), but is manufactured as coated glass, the chief part of its thickness colourless, but with a uniform coat on one side, of either the strongest red (miscalled "ruby") or the strongest blue. I have never seen it coated with green, or any colour but these two, nor with these in less than their fullest intensity, nor with both sides coated, though any such varieties would be more available. A third kind, however (yellow), is plain glass uniformly dyed over one side with the silver stain. Taking any of these, and covering its coloured side with Brunswick black, when this has dried you scrape it from the lines or forms that you desire to be white, and a "glass embosser" will then pour fluoric acid on it, which etches away the coloured coat where thus exposed. If a printed page or impression of a woodcut be applied with its face to the clean glass, and then the acid (either in gas or a weak solution), even the printing-ink will protect what is under it, while the paper will not, thus reproducing a *fac simile* with the colour for black. Gaseous acid leaves a perfectly dead surface, but the liquid a semi-polished one, less fit for a sunblind.—E. L. G.

[12792.]—**Tempering Needle.**—They are best as hard as they will go at each end, and can with care be easily soldered without softening.—JACK OF ALL TRADES.

[12792.]—**Tempering Needle.**—I think this extract from Brewster's "Magnetism" will answer the question:—"With regard to the best mode of hardening and tempering needles, Captain Kater found that when a needle is considerably hardened throughout, its capacity for magnetism is diminished. He found that the needle was susceptible of the greatest directive power when it was first hardened uniformly at a red heat, and then softened from the middle to within an inch of its extremities, by using a degree of heat which is just capable of making the blue colour, which is thus produced, to disappear." I should try coaguline as the means of attaching a weight to the needle, and not heat of any kind, which I think could not be applied with safety to a finished needle.—E. T. E.

[12792.]—**Tempering Needle.**—The harder steel is left for magnets the better it retains its magnetism, therefore leave your needle as hard as the circumstances will allow. The hot solder will, of course, draw the temper of the part it is applied to.—ZAX.

[12793.]—**Oil of Peppermint.**—Take your herb fresh gathered, when the bloom is just about to open, and place in a still with a quantity of water. Draw over one half, separate the oil from the water, and return the water to the still; take the old herb out, and replenish with more; put the still head on, and distil as before. You will need from five to six pounds of herb to get one ounce of oil.—JACK OF ALL TRADES.

[12794.]—**Ammoniacal Liquor.** — Twaddle's degrees of gravity are equal to 5 degrees on a hydrometer, in which water is 1,000. Thus, 1° T. = 1,005, 2° T. = 1,010, 5° T. = 1,025. In other words, to convert "Twaddle's" results into degrees of real gravity (with water = 1,000), multiply by 5, and add 1,000. If we divide the real gravity by 100, we obtain the weight in pounds of one gallon measure of the liquid. Thus, 1025 ÷ 100 = 10·25lb. for the weight of a gallon. "J. W." has now only a simple proportion sum before him. As 10·25 : 1 = 2240 : : 218·5; the number of gallons in 1 ton of the liquor at 5° "Twaddle."—ALFRED H. ALLEN.

[12796.]—**The Spanish Language.**—There is a Spanish "Ollendorf" published. I do not quite agree with "E. L. G." (reply 12348, p. 545) about the value of the four auxiliaries, and the Spaniards have well dropped the use of *tener*. The Portuguese, who, like the Spaniards, have *ser* and *estar*, still employ *ter* as an auxiliary. The correct use of *ser* and *estar* is a great nuisance to foreigners, and it appears to me very singular that *estar*, derived from the Latin *sto*, should be used to express a temporary condition. I do not believe there is any better way to learn a language than by grammar and dictionary, with a newspaper. Translate a part of it into English one day, and back into Spanish the next. *Experto crede.*—M. PARIS.

[12796.] — **The Spanish Language.** — I am acquainted with five or six Spanish grammars, and find the best to be Del Mar's, which I have successfully recommended to many.—PEDRO.

[12798.]—**Air Vessel on Suction Pipe.**—The pump barrel being so much as 20ft. above the water in the well one should know the speed of the pump-bucket in order to judge whether the air vessel is of use or not. At 20ft. above the water level the pressure of the atmosphere which forces the water up into the vacuum produced by the upward stroke of the pump-bucket, is reduced to about one-third of its normal pressure, or to about 5lb. per square inch. If the speed of the bucket be considerable this pressure may not be sufficient to cause the water to follow the bucket fast enough, and when is has arrived at the top of its stroke a void would be left underneath it, and before this could be filled by the rising water the bucket would have begun to descend again. This would both reduce the quantity of water lifted at each stroke and would cause a shock to the whole machinery when the bucket should come suddenly down and meet the water; but with an air vessel below the barrel the compressed air, expanding, assists to make the water follow the bucket more closely, and perhaps perfectly; the degree depends upon the relations which exist between the size of the suction pipe, the speed of the bucket, and the capacity of the air vessel. For these reasons it is best to place the working barrel of a pump as low down as possible; then the full or nearly full force of the atmospheric pressure causes the water to follow the bucket closely. But under some circumstances it may be well to place the working barrel, as in this case, considerably above the water level; but in that case an air vessel would be required to effect what I have pointed out. This is the way in which, it seems to me, the presence of the air vessel is to be accounted for.—C. S.

[12798.]—**Air Vessel on Suction Pipe.**—With a column of water of 20ft. by 6in. there would be a violent concussion consequent upon putting into motion and stopping suddenly at each stroke, which would probably burst the pipe but for this air vessel.—A., Liverpool.

[12799.]—**Speculum.**—The glass disc from which I worked my speculum was a piece of ordinary thick rough plate glass. After being smoothed it is now 1¼in. thick, so I suppose at first it was 1½in. It was chipped into a roughly circular form by the makers, and I finished the edge on a grindstone by hand.—A. WOOLSEY BLACKLOCK, M.D.

[12804.] —**Fixing Photographic Prints.** — "One in a Fix" either has his fixing bath too strong or keeps his prints in too long and not long enough in the toning bath. The strength of fixing bath ought to be—hyposulphite of soda, 1oz.; distilled water, 6oz.—NOTURB.

[12804.]—**Fixing Photographic Prints.**—All prints toned by chloride of gold change their purplish hue to a ruddy brown on immersion into the hyposulphite bath, but those which are sufficiently printed and toned in the first instance recover their proper hue between the fixing and washing operations. An acid condition of the toning bath, however, will produce pictures which are "flat, stale, and unprofitable."—S. BOTTONE.

[12812.]—**Water for Aquarium.**—The water must on no account be drawn from a well or pump, and, indeed, any kind of water that is used for drinking is unfit for the aquarium. The best water is that which is drawn from a river or pond. Ordinary rain-water will, however, answer all purposes, provided that it be clear, and that the butt from which it is taken has been provided with a cover. The water supplied by the water companies is filtered from nearly all animal and insect life, which constitutes the natural food of the fish, &c. Do not change or renew the water. A little may be added as evaporation takes place, but none must be taken away. Any further information required will be given with pleasure.—JAMES DICK.

[12817.]—**To Chemists.**—The blue colour is not due to any impurity, but is a peculiar action of the solution upon the light. If a quantity of quinine solution be viewed by the light which has already passed through a glass vessel filled with a similar liquid, no coloration is observed in the second quantity. The "fluorescence" is also destroyed by addition of an acid not containing oxygen—such as hydrochloric acid —while any oxygenised acid restores the blue coloration. The precise physical cause of the colour is that quinine (like turmeric, ivory, petroleum, &c.), has the power of changing the refrangibility of the ultra-violet rays of light, that is, lowering the number of vibrations per second, and so bringing these rays within the limits of our range of vision. The effect is made more visible by using light which has been deprived of the less refrangible rays by passage through purple-blue glass.—ALFRED H. ALLEN.

[12817.]—**To Chemists.**—The solution of sulphate of quinine is yellowish white by transmitted, and silvery blue by reflected, light. We can give no more satisfactory reason for this than we can for a rose being red, or grass green. The usually accepted explanation of the blue reflection from the surface of a solution of quinine sulphate, is the following:—"The highly refrangible actinic rays (usually invisible) become degraded into luminous rays of less refrangibility on striking the surface of such a liquid." Hence these rays, then, become visible. This peculiar property is termed "fluorescence," and is possessed by several liquids, among which the following are conspicuous:—Petroleum, aqueous infusion of horse chestnut bark (æsculine), tincture of Datura stramonium seeds, alcoholic solution of chlorophyll, and tincture of turmeric. Uranium glass is also highly fluorescent.—S. BOTTONE.

[12819.]—**Stains in Wood.**—Cyanide of potassium; very efficacious, but very poisonous; price, about 1s. per pound.—S. BOTTONE.

[12822.] — **Extracting Opium, &c, from Poppies.**—Opium is obtained from the white poppy, *Papaver somniferum*, by making incisions in the unripe capsule. A white milky juice exudes, which is carefully collected as soon as it acquires sufficient consistency to admit of its being scraped off. Poppy oil is also largely prepared from the seed of the above by the ordinary mode, viz., grinding, and pressing the meal thus produced between hot-plates in a hydraulic or other press. No use, that I am aware of, is made of the red colouring matter from the ordinary poppy, *P. Rhœas*. It may be extracted by alcohol.—S. BOTTONE.

[12823.]—**Cochineal Blué.**—It is a property possessed by colouring matters generally to form insoluble compounds with lead oxide; such compounds are technically known as *lakes*. The body in question has been studied by Preisser so long ago as 1851.—S. BOTTONE.

[12824.]—**Magnesium.**—Chloride of magnesium is prepared by dissolving magnesia or magnesium carbonate in hydrochloric acid, mixing the liquid with chloride of ammonium, evaporating to dryness, and igniting. Mix 900 grains of this product with 150 grains of fluor-spar, 150 grains fused common salt, and 150 grains of sodium cut into slices. The mixture is thrown into a red hot earthen or iron crucible, which is then covered and again heated. When the action has terminated, the fused mass is stirred with an iron rod to promote the union of the globules of magnesium. It is then poured upon an iron tray, allowed to cool, broken up, and the globules of magnesium separated from the slag; they may be collected into one globule by throwing them into a melted mixture of chlorides of magnesium and sodium with fluor spar. Do not heat too strongly.—ALFRED H. ALLEN.

[12846.]—**Rowing.**—Second kind of lever: the blade of the oar being the fulcrum, the power being exerted at the handle, and the boat being the weight acting at the point of contact of the oar and the boat. —LEWIS.

[12849.]—**Separating Lenses.**—Soak them for an hour or two in spirits of turpentine. Lenses are easily cemented together by pouring a few drops of the best Canada balsam into the concavity and gradually lowering the convex-lens into it, in such a manner as to avoid the formation of air bubbles. The lenses must be then clamped together until the balsam is dry. No difficulty attends this operation.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Jack of All Trades" has answered 12433, 12468; "L. C.," 12460.

12562 Tar Pavement, p. 521
12567 Brick and Tile Glazing, 522
12569 Consumption of Alcohol, 522
12575 Angles of Incidence and Reflection, 522
12580 Photo.-Lithography, 522
12583 Electro-plating and Coppering, 522
12585 Thermo-Electric Pile, 522
12587 Lamp for Blowpipe, 522

QUERIES.

[12873.]—**Overshot Water-wheel.**—An overshot wheel, 30ft. diameter and 11ft. wide, is now running 18in. deep in the tail water. What power would be gained, if any, by lifting this wheel entirely free from this tail water?—PERCIVAL NORTON.

[12874.]—**Decaying Wood.**—Will any fellow reader kindly advise what is best for the seats of a church (restored only five years ago) which are actually rotting? large patches of fungus appear indiscriminately on floors and seats, but always where there is a joint. It is almost confined to north side of church, where there is least sun.—CHURCHWARDEN.

[12875.]—**Sulphate of Manganese.**—Will some obliging reader give details of the manufacture of this salt as prepared for the calico printer, stating proportionate quantities of acid and oxide to be used, time occupied and heat employed? Also quantity obtainable from one ton black oxide of manganese?—TYRO.

[12876.]—**Electro-Plate.**—Could any of your subscribers inform me what is the composition of plate powder, and how does it act on the silver?—MECHANIC.

[12877.]—**Photography.**—Would some friend kindly tell me why the front portrait lenses are cemented together—mine having come apart? What cement could I put them together with? Are they cemented only round the edges of the glasses or all over, and does it matter if they are left apart?—PEACOCK.

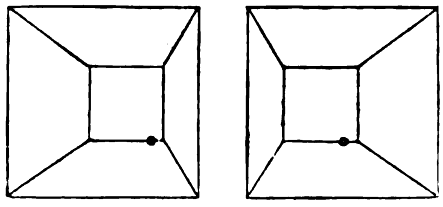
[12878.]—**Electric Bells.**—I am anxious to fit an electric bell in my bed-room to give notice if a window should be opened at night. Will any of "ours" learned in electricity, state what battery I should make, its strength, and how the bell is made? The distance between bed-room and window is about 10 yards.—H. MACKINTOSH.

[12879.]—**Curious Occurrence.**—A day or two ago, an ordinary tumbler that had contained water in which had been placed citrate of magnesia (but which at the time I speak of was quite empty), suddenly cracked with quite a sharp sound, and on my attempting to take it up, came in two. Could any one kindly give an explanation?—CARADOC.

[12880.]—**Oxygen Gas.—Substitute for Gas Bag.**—Would some fellow reader kindly give me an opinion as to the feasibility of the following idea to do away with gas-bags or gas-holders for the lime-light. Dentists carry their nitrous oxide in an iron retort about the size of a mercury bottle (1ft. long, 3in. diameter), into which (so a dentist has just told me) 100 gallons of gas is compressed by hydraulic or steam power. If 100 gallons of oxygen could be compressed in this way the gas could be used directly from the retort, and the pressure might, I imagine, be regulated by the stop-cock, and the supply would be sufficient for nearly four hours. The difficulty with me (in the absence of steam power and hydraulics) is how to compress. Could same be done in this way? Get a mercury bottle fitted with stop-cock, put in sufficient oxygen mixture to generate (say) 30 gallons of gas, turn off the cock so that no gas could escape, place over fire, leaving the heat to produce generation, and generation compression; the residuum of the mixture after generation occupies but a very small space. Would the experiment be a dangerous one; if so, how would be the best way to guard against such danger?—J. M.

[12881.]—**Condensing Engines.**—Would some obliging correspondent answer the following:—1. Why is the pump which withdraws the injection water, &c., called "air pump"? Is the name justified by the "small portion" of air (as engineers term it) mixed with the water, which, when meeting with the hot steam, is expanded, and thus requires a larger pump than would be required for withdrawing simply the injection water and condensed steam? 2. What is the quantity of air in water, is it about a 2,000th part? 3. In ordinary condensors, what would be about the average increase in the bulk of this air, through being heated by the steam? 4. Would the boiler, with steam up to 15lb. pressure be liable to burst, seeing there is 15lb. of air on outside; or is the steam indicated in excess of the atmosphere? Some common sense answers, without going into algebra, &c., would oblige an—ENGLISH MECHANIC.

[12882.]—**Vision.**—When I place a card between the accompanying figures, they do not at first unite so as to give a perspective view, but seem to move towards each



other till the proper effect is produced. What is the cause of the apparent motion of the figures towards each other?—PAUL GREGOR.

[12883.]—**Foul Air.**—Has an instrument, thermometer, indicator, or register of some sort ever been made to find out the state or quality of gases contaminating the atmosphere of a room? I mean gases besides the atmospheric air.—E. C.

[12884.]—**Evening Classes at University and King's Colleges.**—Will some brother reader inform me from his own experience or knowledge, whether the evening classes at King's College or those at University College are likely most to suit the purpose of an undergraduate reading for the degree of B. Sc. at the London University, with his reasons for such selection? Would the evening classes at either college be sufficient for this purpose, if supplemented by private study? I should also be glad to know what would be the advantage of entering as a matriculated, rather than as an occasional, student.—CERVUS.

[12885.]—**Seaside Telescope.**—I live by the seaside, and want a telescope for the hand. Up to what size of object-glass might I go, and should there be more than one draw? Is it not a fact that the more draws to a telescope the less perfect the instrument acts?—NOSILLOC.

[12886.]—**Smoky Boiler Furnace.**—I have a 2-horse vertical boiler with 10 tubes 2in. diameter, and find great difficulty in keeping steam up; the fire burns dead, apparently without draught, and fills the room with smoke. A 6in. elbow connects the boiler with chimney (which seems to have a good draught) but one day's use clogs boiler tubes nearly up with soot. Is it possible to produce a better draught without interfering with chimney, by means of a fan or some other appliance?—SMOKED OUT.

[12887.]—**Drum for Wire Rope.**—Will some one kindly tell me of a simple and accurate way to find the length of wire rope a drum will hold, single coil; a drum (say) 3ft. diameter, 5ft. between flanges, rope 1in. diameter?—TANTALUS.

[12888.]—**Screw Cutting.**—Would "Apprentice Turner" (let. 4762, p. 589) or any other reader kindly inform me the best way of compounding wheels for screw cutting—*i. e.*, to cut threads with over two wheels with leading screws from ⅝ pitch to 2, 4, 6, and 6½ threads per inch? I have Elliott and Greenwood's works, but I desire a more abridged method.—HIGH.

[12889.]—**Tempering Drills.**—I am a lead miner, and have hitherto sharpened my own tools with success. We have now come to a rock, composed, out of 100 parts, of 52½ per cent. of carbonate of lime, 41 per cent. of silica (or flint), 4½ per cent. of oxide of iron, and the remainder sulphate of iron and magnesia. We use the best cast steel drills, but I cannot temper a drill that will stand this stone. Can any reader help me out of this difficulty? Will any chemical added to the water effect my object, and what?—LEAD MINER.

[12890.]—**Faulty Negative Bath.**—Will some of our photographic readers kindly tell me how to rectify a negative bath (about a pint) which will not give enough intensity in the whites? I have just been copying a carte-de-visite portrait, and when I print from it I find the face is not dense enough, although the plate is fully intensified in other parts.—HYPO.

[12891.]—**Wheels for Lathe.**—Will some kind pattern-maker give instructions for marking and cutting the teeth in bevel and other cog-wheels? I have turned the patterns in the lathe.—A TURNER.

[12892.]—**Clutch.**—I should feel obliged if "Jack of All Trades," or some other correspondent, would give a description of the best form of clutch for expeditiously throwing drum barrel in and out of gear without stopping engine. Any information on the above subject would greatly oblige.—CUMRO BACH.

[12893.]—**Charcoal as a Fertiliser.**—I have heard it said that dressings of charcoal are very valuable to vegetables and flowers; will some reader who thoroughly understands the nature of charcoal tell me what kind of vegetables it is suitable for, and what kinds of flowers, as well as fruits, are benefited by it, and how it ought to be used, and what quantity?—WANTS TO KNOW.

[12894.]—**Bees.**—Can any correspondent inform me if our English bees have been introduced into New Zealand and Australia?—JOHN WALTON.

[12895.]—**British Museum.**—Can any one give the dimensions of the great reading-room of the museum, and the weight of iron used in constructing ribs, girders, &c.—JOHN WALTON.

[12896.]—**Electro-Metallurgy.**—Mr. Sprague states (No. 381, p. 423), writing about a single acid battery, "the silver is platinised after the cell is completed." Will he kindly explain how? and if it will not alter the action by putting in the platinising solution?—R. W. P.

[12897]—**Cleaning Stone Carving.**—I have a stone (carved) vase made of rather soft stone, which has got dirty. Will some one favour me with a recipe for cleaning it, as I cannot get into the recesses very well with a brush?—R. W. P.

[12898.]—**Light Wheels.**—I am about making a pair of light wheels, and would like to know how to get the bevel of the shoulders of the spokes where they fit against the nave, without first planing them up square, as I have never seen wheelwrights plane them. I should also like a description of the simplest form of chuck used for turning the spokes of wheels. Is there any kind of wooden chuck easy to make that would answer the purpose?—A NOVICE.

[12899.]—**Keeping Flowers in the Winter.**—Will some of your gardening correspondents be kind enough to tell me how to keep geraniums, fuchsias, verbenas, calceolarias, and such flowers in the winter? I have no frames or conservatory. Would it be sufficient to hang them in a dry room?—C. N. W.

[12900.]—**Acme Skates.**—I have heard such different opinions expressed about those skates that I should be glad if some one who has had experience in them would tell me what they think. Are they liable to tear off the heel of the boots, as I have heard they do; and are they good to learn figure-skating upon?—C. N. W.

[12901.]—**Split in Thumb Nail.**—Can any of the readers of the ENGLISH MECHANIC recommend a cure for a short split in the thumb nail. I have tried a permanent plaister; but this seemed to dry the nail, and make matters worse. The ailment is of a year's standing.—M. A.

[12902.]—**Whitworth Scholarships, &c.**—Can any reader give me the number of marks obtained by the successful candidates for the Whitworth Scholarships and Royal Exhibitions, 1871 and 1872.—S. W. HAYES.

[12903.]—**Dulcimer.**—Will some one tell me how to make a dulcimer?—C. M. B.

[12904.]—**Fixing Needle in Telegraph Coil.**—Can any kind reader inform me how I could fix a magnetic-needle in a telegraph coil so as that it would not oscillate after current being stopped?—C. M. B.

[12905.]—**Coil.**—I have made a coil according to the instructions given by "Glauphus" on p. 92 of Vol. XIII., but I fail to get the slightest current whatever. I made it as follows:—First, I made reel or bobbin 6in. overall, 3½ disc; and secondly, I wound on for the primary three layers of No. 16 cotton-covered wire; third, for secondary I wound on half a pound of 32 cotton-covered wire. Insulated secondary from primary with thick note paper. I soldered all the terminals with common solder and zinc dissolved in spirits of salts. I used a small Smee's cell, and tried a quart Bunsen cell, but to no use. I soldered one part of contact breaker to one end of primary and other end to handle of battery. I soldered one end of secondary to other part of contact breaker. If "Glauphus" will kindly come to my assistance I shall feel very much obliged to him.—D. STRATHERN.

[12906.]—**American Vermilion.**—What are the details of the process for manufacturing American vermilion—a pigment whose name sufficiently describes its colour; but which, on being ground, changes to orange? From examination I believe it to be a dichromate of lead; but it must, from the low price at which it is sold, and the circumstance that grinding would destroy the colour, be prepared otherwise than by projecting chromate of lead into melted nitre. This process, moreover, seems with commercial chrome yellow to yield an orange yellow, perhaps through some fault in manipulation.—CANADIAN.

[12907.]—**Painters' Colours.**—What is the best available work on the manufacture of painters' colours? Has the promised volume of Richardson and Watts' "Technology Relative to Pigments" yet appeared, and if so, is it procurable separately.—CANADIAN, S. Catherine's, Ontario.

[12908.]—**Brass Moulding.**—Will "Jack of All Trades," or some other practical reader, tell me how to make sand strip off a brass casting, one that has a deal of travel?—MOULDER.

[12909.]—**Economy of Coal.**—I should be obliged by replies to the subjoined queries. 1. The greatest weight of water evaporated by burning one pound of coal: state atmospheric pressure, and the kind of coal employed. 2. If when coal is burned in a furnace into which it is carried by a current of air in the form of dust, more heat is developed than when introduced by ordinary mechanical feeding or by a competent stoker. 3. What is the smallest recorded consumption of coal per hour for indicated horse-power? State kind of coal used; how supplied to furnace; steam pressure in boiler; ditto working pressure at commencement of stroke, amount of expansion, and vacuum. I lately saw a statement in the *Times* that a tug-boat working at 800lb. pressure consumed rather less than 2lb. per horse-power per hour. In Government steamers the average consumption was stated to be more than double, but Sir Spencer Robinson says the *Achilles* on one occasion only required 1·400lb. per horse-power per hour. See *Naval Science*. In a later statement the *Times*, it was asserted equally economical results to those in the lung were obtained at a pressure not exceeding four atmospheres.—THE HARMONIOUS BLACKSMITH.

[12910.]—**Welding Angle Iron.**—Could any of the numerous readers of the ENGLISH MECHANIC give me a few hints as to the best way to weld angle iron, 3in. × 3in. × ⅜in. turned to a hoop 4ft. diameter for end of boiler?—N. B.

[12911.]—**Variegated Maple.**—Will some reader oblige by informing me whether this shrub is grafted or budded, and on what description of stock, together with the time of year when the grafting or budding should be done?—S. E. C.

[12912.]—**Tooth Paste.**—There is one paste which passes under several names, one of which is cherry tooth-paste; the colour is red and the flavour that of cloves. Recipe will oblige—S. E. C.

[12913.]—**Cooking for Bachelors.**—Should I be asking too much if I appeal to some of "our" fair readers for assistance in this matter? There must be many of your readers who, like myself, are often at a loss to know what they can have for dinner by way of change, and for whom the cookery books do not condescend to give recipes. These books are written for families, and not for those in a state of single blessedness. I am obliged to gather hints on the subject from friends, but even then the number of dishes is not very varied. Will some one add to the number?—BACHELOR.

[12914.]—**Eminent Barbers.**—Will some kind correspondent give me some names of eminent men who were barbers in their earlier days?—RAZOR.

[12915.]—**Harmonium.**—I wish to build one with eight rows of reeds. I have had no difficulty in making the bellows, the size of which is 34in. × 17½in., and the fall 11in. The feeders are 19in. × 17½in. each. Is the bellows large enough? What kind of springs must I use for the inside of feeders? How must the pan or soundboard be arranged? I wish to use four pallets—one pallet to cover two sets of channels. How are the channels cut? are they cut with the grain or across? Instructions how to make the pan would be thankfully received. Also how to arrange the pallet bars, so that each bar shall be under the centre of key; the distance between each bar, &c. I should also like to know how the percussion system is applied to the harmonium, and what is its effect? I wish to have a small wheel on the end of the feeder levers. Can I do this, and would the friction be more or less than by the usual way of blowing?—IGNORAMUS.

[12916.]—**Grinding Edges of Watch-Glasses.**—Will some friend kindly tell me the best method of grinding down the edges of watch-glasses?—F. E.

[12917.]—**Coloured Tiles.**—Will any reader kindly inform me through your columns how red clay tiles are blacked in imitation of Staffordshire tiles, and, if by a composition, how to make and apply it?—K.

[12918.]—**Water Power.**—What is the most economical working apparatus for utilising a small stream of water, the fall not above 4ft.?—L. W. D.

[12919.]—**Pianoforte Hammers.**—I have lately covered the hammers of a "cottage" with taper felt (the old felt being entirely worn through) but I find the tone excessively weak since it was done. How is this? The felt was good and hard, and I compressed it as much as possible in putting it on. I found in stripping off the old felt, that just where the hammer strikes the string the felt came off easier, and of course I looked for the cause, and I found (or fancied so) that there was no glue applied just in that place—*i. e.*, the front of the hammer. Was I right or not, and has this anything to do with the weakness of tone? Can our practical friend "The Harmonious Blacksmith" throw a few sparks of light on the subject?—IGNORAMUS.

[12920.]—**Barlow Lens.**—Will "F.R.A.S." be kind enough to give the best distance for placing the Barlow lens from the eyepiece, in a 5ft. refractor, 3¼in. aperture? Length of tube carrying eyepiece, 4in.—J.

[12921.]—**Enormous Shell.**—I have been informed that there is a monster shell at the International Exhibition, weighing five tons. If there be such an enormous missile, I should feel obliged for dimensions and weight of shell and gun.—LOGAN.

[12922.]—**Sail for Canoe.**—I have a canoe for which I want to make a sprit sail. Will some brother subscriber give me instructions as to what size sail she will carry? The canoe is 10ft. 6in. long, beam 27in., weight between 40lb. and 50lb.—ROB ROY.

[12923.]—**Arithmetical.**—Can any one suggest any method shorter than that of indeterminate equations for solving the following problem? What number being divided by 47,474 will leave a remainder 4,747, being divided by 4,747 will leave a remainder of 474, being divided by 474 will leave a remainder of 47, being divided by 47 will leave a remainder 4?—H. H.

[12924.]—**Buying a Telescope.**—Will some one advise a novice how to spend five or six pounds in buying a telescope? Would a refractor or a reflector be best? If I could make the tube myself, and spend the above sum in mounted object-glass and eyepieces, would there be anything gained worth the trouble.—ORIEL.

[12925.]—**An Experiment.**—Given. A compartment (airtight) with a capacity of 20 cubic feet. Suspended from the top of this compartment there hang two pieces of platinum sponge, each one being 2ft. square and 1in. in thickness. The point of suspension being in connection with wires to carry off the heat of the combination of HO_2 in the form of electricity. The compartment to be filled with the gases HO_2 to the pressure of the atmosphere (15lb.) How long would it take to make the gases combine by this means.—VULCANITE.

[12926.]—**Weather Glass.**—Will any of your readers inform me how the loss of mercury will affect the registering of a barometer the old clock-face style, and if it is possible to make correct deductions from it?—DEMOSTHENES.

[12927.]—**Comets.**—Has the comet that so much has been said about lately been seen; if so, how, when, and where? Is it possible for a comet to appear and disappear in two days; if so, how? Replies will oblige.—DEMOSTHENES.

[12928.]—**Test for Phosphorus.** — Would some chemical reader kindly give me a test for the presence of phosphorus?—Q. Q.

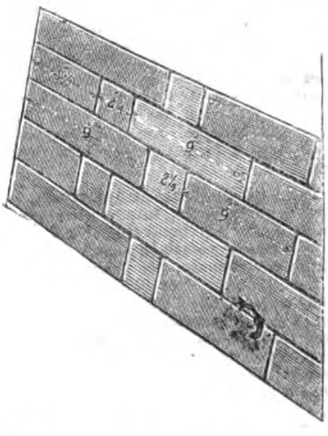
[12929.]—**Analysis.**—Would any of our chemical friends please state the *modus operandi* of detecting the presence of china clay, and also the quantitative analysis of the same in calicoes?—CALICO.

[12930.]—**Wheat Analysing.**—Can any of your readers give a simple plan of analysing, or ascertaining by other means, the percentage of starch contained in any given samples of wheat? Also, if there is any means of estimating the strength and purity of starch so obtained? Please be as plain as possible, as I am no adept at chemistry.—J. T. C.

[12931.]—**Brewing.**—Can any of your readers give a recipe for making drinkable good beer put into a musty barrel by mistake, and also how to more fully extract alcohol from malt? I cannot get the beer strong enough from mere malt and hops.—YOUNG BEGINNER.

[12932.]—**Strength of Hairspring.**—Will "West Cornwall" kindly inform me how the strength of a hairspring is determined upon by the size and weight of the balance? Also, how to tell the number of vibrations requisite per hour?—A YOUNG JOBBER.

[12933.] — **Skewbacks of Camber Arches.** — I should feel obliged if some of your readers would please to explain in your valuable paper the rule by which the skewbacks of camber arches are obtained. I find that many authors say that the skewbacks should



be inclined at an angle of 60°. If this is right it is not followed out in practice here, as I find that the inclination of the skewbacks of an arch over a 2ft. opening, is not the same as over a 7ft. opening. I have also seen an arch whose joints are tuck pointed, as per sketch. Is it right? If not, how should it be?—AN ANXIOUS BRICKLAYER.

[12934.]—**Organ.** — In planning a soundboard as directed by "J. D." (Vol. XIV., p. 483), he directs a certain number of the bass pipes to be placed at the treble end of the soundboard, and he directs separate slides for the stopped diapason—one for the bass and one for the treble—this, of course, taking up the space of two distinct rows of pipes; but this arrangement will admit of the bass or treble being shut off at pleasure. In the open diapason but one slide is used, therefore this row of pipes must be either wholly open or shut. Now, as the performer may wish to use the bass of this stop without the treble, how is the effect to be obtained? Would it be possible to divide the draw slide into three parts, the two ends working the bass, and connected by a tracker over the stock board, so as to act in unison, and the middle portion as a distinct treble stop, to be worked by a roller let down through the stockboard, having a small toothed brass pinion on its base, working in a toothed rack attached to the slide, the arm of the roller outside the stockboard being attached by a sticker or tracker to a square at the end of the board and continued on to the stop?—E. J. D.

[12935.]—**Water Power.**—I have a spring of water on the side of a sloping hill which will fill a 3in. pipe; after a course of near 200 yards, it has fallen vertically 125ft. Can any of your readers inform me what height is lost from friction in pipe, and what power could be got by turbine from this? A useful pond or head could be made.—JOHN.

[12936.]—**Hastings' Tricycle.**—In the ENGLISH MECHANIC for July 22, 1870, was described a tricycle by J. Hastings, possessing, in my judgment, considerable merit. If this should meet the eye of that gentleman, will he kindly say whether he is still of the same opinion about it, and whether he can recommend it as a vehicle easily driven, and satisfactory in respect of wear and tear?—J. C. H.

[12937.]—**Dumb-Bell Exercises.**—A better knowledge of the principles of dumb-bells, associated with a little understanding of the muscles of the human body, would, I think, add greatly to the zest of those who devote fifteen or twenty minutes of their mornings at home to the use of them. After a time they tire of the few too-evident exercises, occupying a brief page in the handbook to gymnastics, and long for some more substantial variations to bring out their other muscles. If some correspondent who has had experience would devote a paragraph—or the subject may be considered worthy of a chapter—treating of dumb-bell exercises, with a hint or two as to the muscles brought into play, I venture to say the subject would find interest with not a few, and probably benefit a great many. Let me caution him, however, that the class of which I speak is not composed of those crack gymnasts who despise the dumb-bells altogether, except when, may be, some showy and elegant, but useless, exercise questions their cleverness and sleight-of-hand. What we want are simple exercises calculated to bring out the different muscles of the chest and arms, to be regulated for the weight of the dumb-bells and the strength of the gymnast, simply by being repeated until the tiring point is arrived at, when a cessation ought to be made until the feeling of fatigue disperses itself. At least, this is my idea as regards the matter, and I call upon the more extended experience of others to present itself in the shape of an answer to this query.—INCHICORE.

[12938.]—**Dimensions of Mail Boats.**—To "Philanthropist."—I am very much obliged to "Philanthropist" for the information on the subject of the Irish mail boats, and should be very glad to have the "further information" which he offers (p. 623, reply 12599). Is the length, breadth, and depth of the vessel inside or outside measurement? Also, how many feet do the paddle-wheels dip into the water, and the number of float-boards, and their size on the wheels, and the consumption of coal per mile?—C. E. S.

[12939.]—**Bees and their Habits.**—Will some of our experienced bee-masters say if we are right in letting our bees enter the bottom of the hive? What are their objections to the entrance being near the top. As steam, hot air, &c., has a tendency to rise to the top of hive, would it not be more likely to flow off, carrying with it that damp which is fatal to bees, and also save the bees much labour in fanning the hot air down from the top? What are the habits of the Alps bees? Do they work up or down in their wild state? I have studied our forest bees, and find when they take possession of a tree, if there is the same room above as below the entrance, they in all cases go down. An answer to the above will much oblige.—MECHANICAL BEE-KEEPER.

[12940.]—**Concentrated Milk or Essence of Milk.**—Would any of your readers kindly inform me how to prepare the above.—ALECK.

[12941.]—**Pouncing Pattern on Printing Blocks.**—Many thanks to "Jack of All Trades" for answering my query (12842). As I work the block while damp the whiting rubs off. Will kind "Jack" tell me of some powder that will slightly stain a dark colour, and resist the damp on the block.—NEW SUBSCRIBER.

[12942.]—**Lightning.**—To "SIGMA."—I should like to know how electricians account for the fact of persons standing under trees being struck by lightning. It is well known that electricity will not leave a conductor to ignite gunpowder, even when the latter is close by; how, then, does it leave the tree to strike the person standing near its trunk? Surely, even supposing the sap of a tree to be a worse conductor than the fluids of the human body, the far greater sectional area of the tree than of the neck of the bystander ought to more than make up the difference in conductivity.—L. C. E.

[12943.]—**British Museum Library.**—I should be glad to know what course I must pursue to obtain a reader's ticket for the library of the British Museum, on what days and hours it can be used, and what privileges it will confer. Any further information on this subject will greatly oblige—CERVUS.

[12944.]—**New Watch-Works.**—A lady's gold watch has, for some time gone badly, and frequently stops. She shows it to a "watchmaker" in a country town, who reports that "the holes in the escapement are worn." He recommends her to purchase an English-made watch from him for sixteen guineas, or a Geneva one for eleven guineas, he agreeing to accept her old watch for £8 in part payment. It may, perhaps, be interesting to many readers of this journal if some instructed correspondent will say if this is the best resource. Would it not be better economy to send the watch to a London manufacturer of reputation to have the old escapement (and whatever else of the interior requires) replaced by new? Surely, the case, the gold dial-plate and hands, and the jewels being given, a watch can be completed for less than thirteen guineas, of first-rate workmanship. —HOROSCOPUS.

[12945.]—**Spectroscope Eyepiece for Microscope.**—A gentleman in Germany writes to me for information, having been informed that this is the latest thing out, that it will allow the minutest striæ of the solar spectrum to be examined, as well as the external and invisible rays both at the red and violet ends, and that by letting the latter pass through uranium glass they become visible. I shall be greatly indebted to any of your scientific readers who will say if this information is correct, and will explain how the spectroscope eyepiece can be so used, kindly adding any other useful information on the subject which may suggest itself.—KELBY.

[12946.]—**Original Gravities of Beers, &c.**—Can any of "our" chemical correspondents give me the true way to find the original gravities of beer, as I believe I must make some mistake somewhere, not being able to get within 1lb. gravity at any time. I try it by the distillation and also evaporation processes, which ought to prove each other, but they do not.—AROMA.

[12947.]—**Starch and New Collar.**—Why cannot our old collars be got up as new ones? What is used to obtain that smooth glossiness of new starched goods.—MUTUAL TOM.

[12948.]—**Colours of Birds.**—Can the colour of a bird be heightened through its stomach? For instance, will the new feathers of a canary be of a deeper colour if it is fed, during the moult, on saffron and marigold flowers?—TAI-KOONG-SOO.

[12949.]—**Cleaning Cricketing Boots.** — Could any brother reader inform me how to clean the brown leather on my cricket boots, as I have tried many plans this summer and have failed?—MIDDLE STUMP.

[12950.]—**Microscope.**—I have lately purchased a microscope, and can see nothing but transparencies through it. If I put a piece of paper or linen or any solid object under it, it shows all dark, instead of showing the surface of the object. Will any one enlighten me upon the subject, and how to see the surface of any solid object that is not transparent?—A CARPENTER.

[12951.]—**Dividing Wheel of Excentric Chuck.** —Will "J. K. P.," or some other correspondent, kindly give me a sketch or explanation as to how the dividing wheel of the excentric chuck is attached to the sliding-plate, so that it should move stiffly round; and also if the pulley and sliding-cone in the ornamental drilling instrument are let on square, or with a feather on the end of the spindle?—E. T. E.

[12952.]—**Preserving Salmon in Tins.**—Can any correspondent kindly inform me how this is done, also where any information can be obtained as regards the process?—SALMO.

[12953.]—**Chemistry of Tea and Concentrated Tea Fertiliser.**—I notice in the *Englishman* (an Indian newspaper) of the 18th July, 1872, an article by Dr. George King, on a tea fertiliser, prepared on a formula by Dr. Campbell Brown, an eminent English chemist, founded on a careful investigation and analysis of all parts of the tea plant. It further states that this chemist (Dr. Brown) has for some years been working at the chemistry of Indian tea. Would any kind correspondent render me information regarding the chemistry of Indian tea, and the component parts of this tea fertiliser by Dr. C. Brown, as also analysis of all parts of the tea plant, or if Dr. Brown has published any works or work on these, to me, important and useful subjects?—Melville Pike.

[12954.]—**Burner.**—Will "Tintub" kindly state to what use the "atmospheric burner" he has sketched (let. 4742, p. 567) could be applied? If we attempt to boil a kettle over it, shall we not be annoyed by the gassy fumes? Does "Tintub" mean us to apply it to the heating of bed-chambers, &c.? And can he (?) give an idea of the consumption of gas in this manner as compared with the ordinary manner?—H. O'B.

[12955.] — **Expansion Valve.** — Will some kind reader give us a description of a simple expansion valve for the steam-engine, to cut off at various parts of the stroke, worked by hand, or under the control of the governor?—Smalker.

CHESS.

All communications intended for this department to be addressed to J. W. Abbott, 88, Loughborough-road, Brixton, S.W.

The match between Steinitz and Zuckertort has terminated in favour of the former, who won seven games, losing one only, four being drawn.

ENIGMA IV.—By E. H. Courtenay, from the Dubuque *Chess Journal*.

White.

K on Q R sq; Rs on Q B sq and K Kt sq; Kts on Q Kt 2 and K B 5; B on Q B 7.

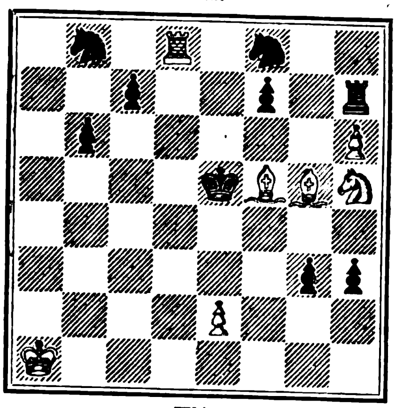
Black.

K on Q 7; Bs on Q B 7 and K 8; Ps on K 7; Q Kt 6 and K B 8.

White to play, and mate in *two* moves.

Problem XV.—By G. C. Heywood.

Black.



White.

White to play and mate in three moves.

Solution to Problem XIII.

White.	*Black.*
1. Q to K R sq. (ch).	1. Q to K 5.
2. B to Q R 6.	2. P takes B.
3. P takes P.	3. Anything.
4. P becomes a Q, mt.	

Solution to Enigma II.

White.	*Black.*
1. Kt takes P	1. Anything.
2. Kt B or P mates, acc.	

S. H. Thomas.—Kindly re-examine the problem in three moves, as it is wrong in the variation. The position in two moves is seemingly correct, and it shall shortly appear. The *Dundee Advertiser* publishes a draught column every week.

A. L.—Blank diagrams can be obtained through W. Morgan, Barbican. The other portion of your letter shall be attended to.

R. J. Pearce.—Your previous communication must have miscarried.

W. S. (Glasgow).—The mate is somewhat too obvious if you have copied the position correctly, as it can be done by (1) P takes P, discovering check, &c.

The following have sent correct solutions to Problem XIII.—H. Cherry; S. H. Thomas (Plymouth); W. Airey (Worsley); W. Nash (S. Neot's); A. W. Cooper; W. F. (Manchester); J. Beresford (Vauxhall); A. L. (Dulwich); R. J. Pearce; Argo (Yarmouth). All others are wrong.

Correct solutions to Enigma II. have been received from D. M. (Norwood); C. J. L. (Portsmouth); H. Cherry; J. C. U. (Leicester); R. Lines (Cinderford); W. F. (Manchester); A. W. Cooper; W. Airey; W. Nash; J. Bray (Langport); S. H. Thomas; R. J. Pearce; G & W. All others are wrong.

USEFUL AND SCIENTIFIC NOTES.

The Number of Eggs from a Hen.—A German naturalist answers the question how many eggs a hen can possibly lay as follows:—The ovary of a hen contains about six hundred embryo eggs, of which in the first year not more than twenty are matured; the second year produces one hundred and twenty; the third, one hundred and thirty-five; the fourth, one hundred and fourteen; and in the following four years the number decreases by twenty yearly. In the ninth year only ten eggs can be expected, and thus it appears that after the first four years hens cease to be profitable as layers.

Growth of Corals.—The *Honolulu Gazette* is responsible for the following:—An interesting fact has recently been observed respecting the growth of corals. Somewhat less than two years ago Captain McGregor, of the steamer *Kilauea*, moored a buoy in Kealakekua Bay. Last week he was ordered to hoist the anchor and examine the condition of the chain. The latter, which is a heavy two-inch cable, was found covered with corals and oyster shells, some of which are as large as a man's hand. The larger corals measure 4½in. in length, which represents their growth during the period of two years that the anchor and cable had been submerged. The specimen which we have seen shows the nature of its formation by the little coral insects more distinctly than any we have before examined. When taken out of the water, it had small crabs on it. A query arises whether these crabs live on the coral insects, or whether they simply seek the branches of the coral for protection. The popular supposition is that corals are of extremely slow growth. Here we have a formation equal to over 17ft. in a century.

Boring and Cutting Indiarubber.—To cut or bore indiarubber corks, says a correspondent of the *Chemical News*, dip the knife, or cork-borer, in a solution of caustic potash or soda. The strength is of very little consequence, but it should not be weaker than the ordinary reagent solution. Alcohol is generally recommended, and it works well until it evaporates, which is generally long before the cork is cut or bored through, and more has to be applied; water acts just as well as alcohol, and lasts longer. When, however, a tolerably sharp knife is moistened with soda-lye, it goes through indiarubber quite as easily as through common cork; and the same may be said of a cork-borer, of whatever size. I have frequently bored inch holes in large caoutchouc stoppers, perfectly smooth and cylindrical, by this method. In order to finish the hole without the usual contraction of its diameter, the stopper should be held firmly against a flat surface of common cork till the borer passes into the latter.

Odour of Flowers.—The delicate odour of pinks and other flowers may be obtained by a process devised by my son. He uses a glass funnel, with the narrow end drawn to a point. In this funnel he places lumps of ice, with salt, by which a very low temperature is produced. The funnel is supported on an ordinary retort stand, and placed near the flowering plants, when water and the ethereal odour of the blossom is deposited on the exterior of the glass funnel, and trickles down to the point, from which it drops at intervals into a glass vessel below. The scent thus obtained is very perfect and interesting, but is apt to become sour in a few days unless some pure alcohol is added. By this process many odours may be procured for comparison and study. To obtain the odour in perfection the blossom must be in its prime.—*Smee's "My Garden."*

Another Disabled Gun.—Whilst H.M.S. *Agincourt* was training her crew at target practice at sea, one of her six 12½-ton guns had its steel tube split through to the coils at the muzzle to a length of 24in. This gun had discharged seven empty shells at low elevations, and with sufficient intervals of time to keep the chamber cool, and prevent the too rapid consumption of the powder charges. None of the shells broke up. The supposition is that the front studs over-rode their grooves at the point where the increasing spiral brings them into bearing near the muzzle. This action would be facilitated by the compression of the walls of the shell due to the wedging of the rear studs over the lands. This makes the fifth heavy gun disabled within the last six months, and obliged to be returned to the Royal Arsenal for repair. The others are: two 12½-ton guns on board the *Bellerophon*, one 18-ton gun on board the *Hercules*, and one 18-ton gun at Shoeburyness.

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Subscriptions to be forwarded to the Editor, at the Office, ... Tavistock-street, Covent-garden, W.C.

Amount previously acknowledged .. ..

F. Weatherhogg .. ..

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustration on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Commercial letters, or queries, or replies, are not inserted. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Tuesday morning, September 10, and unacknowledged elsewhere:—

W. Newman.—M. C. Henley.—Richard Thomas.— ... Burton.—F. R. A. S.—J. E. F. Wilson.—R. A. Pearce.— ... C. B.—J. K. P.—Hadrian Harris.—W. H. Plummer.— Wm. Airey.—J. Earl Clare.—John Tippen.—W... Roberts.—W. S. Hollingsworth.—Jas. Malkin.—Rev. L. Arthur.—W. E. Hincklin.—F. S. M. W.—J. ... Livins.—J. F. H.—J. H. Crellen.—H. B.—Major Oakes. —W. O'Neil.—Eastbourniensis.—W. H. H. C.— Memnon and Friends.—O. S. Round.—Alfred ... Wallace.—Barnes Richards.—Francis Weatherko...— J. C. Snell.—T. H. Bartlett.—J. W. J. H.—Wm. Macdowell.—John Razor.—Samuel Deards.—Ding-Dong. —A Constant Subscriber.—Sinbat.—R. J. P.—Y. A.— One who has Proved it.—W. H. Cash.—Argentum.— Johan.—Robert Ackland.—Felix Notro.—Candidate.— An Old Sufferer.—Seabird.—Another Constant Reader. —Samuel Neil.—Thos. Moody.—J. W. Worsey.—D. J. —M.—A. H.—W. W.—An Amateur.—H. Moran.—C. R. —T. Hansard.—A. W. J.—C. E. S.—Atmospheric Burner.—B.—Thos. Fairhurst.—Indian Rubber.— ... R. N. Coles.—Safe and Sure.—A. S. Clara.—E. C. G.— H. H. Wood.—Samuel Hill.—C. W. Hodgson.—Manu... —Balcairn.—Turn Cutter.—France.—Excelsior.—Cornelius Varley.—H. O. P.—A. R. Watson.—Organist.— W. M. Grahame.—E. L. G.—W. G. B.—J. B. H.— William.—R. G. A.—Sting.—S. K.—A. N.—Islington.— W. R. Birt.—W. H. Hey.—Sigma.—C. N. Abbott.— Jack of All Trades.—L. S. A.—H. E.—Duffer.—Bo... gate.—Geo. Fox.—H. B.—Retort.—The Harmonious Blacksmith.—Philanthropist.—J. W. Fennell.—Pu... —R. Symington.—Gamma.—H. Childs.—Iriosol.— ... B. Knoble.—Old Ploughman.—F. R. A. S.—Mechanical Equivalent.—One in a Difficulty.—H. T. C.—S. G. C.— Emigrant.—Brancœ.—A Puddler.—Salt Water.—R. S. Deverell.—R. A. Proctor.—S. Bottone.—P. E. J.—John Dixon.—P. C. E.—W. Bright.—Mechanic.—Ferizo.— A. W. E.—John McKay.—E. T. W.—Pedestrian.— Eyewinker.—J. H. Colley.—E. B. Brown.—T. ... Stanley.—Rev. H. Rogers.—Elliptic.—Stargazer.—E. ... Mullens.—W. R. W.—Bookworm.—T. A. P.—J. Pell.— Equatorial.—Dr. Halley.—James Tresidder.—A. L. ... —James Mackintosh.—Zig Zag.—Mrs. Paine.—John... Hicks.—G. S. E.—W. Plowden.—T. S. Reeves.—Zo... Time-Keeper.—J. H.—W. H. H. C.

M. A.—What you say about the time consumed between the receipt and the appearance of letters is quite correct, and will soon be rectified, or partially so, at all events.

Veritas.—The cost of inserting the letter as an advertisement would be 30s.

J. H.—Work out the sum for yourself, or get ... intelligent schoolboy to do it for you.

J. Pell (Birmingham).—Your advertisement is ... and your money is returned. See our "Answers to Correspondents," p. 575.

Peacock.—You had better consult the indices of published volumes, and seek out the information you require on the organ.

Lewis.—Put your query in more intelligible lang...

Zax.—We should be glad of the letter or letters on "Steam on the Road."

E. T. S.—The query on constipation has been ... answered, and may be allowed to drop.

A Constant Reader.—We know nothing about the post-card, and if we did we should not forward it.

R. Dixon.—It is quite possible, of course, for a private student to pass the preliminary medical examination, if possessed of sufficient ability. As to the subjects to be got up, why not apply to one of the medical schools where examinations are held.

David Grundy.—Do you want a book on engraving or wheelwrighting? We know of none on the latter subject.

V. C.—Try the "Vine Manual," *Journal of Hor...* office.

A Poor Boy.—No book specially devoted to the subject. Why not ask how to do what you want through our columns.

J. Stewart.—If the height of the siphon from the ... to the bend is more than 34ft. it will not act. What has drawing water from behind a hill more than ... high, or the depth of fall at delivery end, to do with the principle? The atmosphere will only balance a column of liquid equal to its own weight, theoretically 33ft. or 34ft. of water, but practically a siphon ought not to have a greater length of inlet leg than 32ft., on account of friction, and this length would act only at the places but slightly elevated above sea-level: not on top of the Himalayas. See reply 12696, last week.

[..]NSON.—Yes; there are professors who would, if they thought you a fit and proper person, give you instruction in mesmerism on the usual terms. We do not know the titles of books "leading to a practical acquaintance with this interesting science." Apply to Mr. Burns, of Southampton-row, W.C., or Mr. Truelove, of High Holborn, for catalogues.

C. E. S.—Please furnish the proffered information on "Block System of Railways," and, as you say, compressed as much as possible.

C. H. FISHER.—If you are too young to hold property in your own right you cannot take out a patent in your own name, as a patent is property.

A THINKER, A. T. B., J. D. H., C. Buddett and Co., and A Welshman, are informed that we do not answer queries asking where certain things are sold. See "Hints to Correspondents."

C. J. RECORDON.—Too speculative for us.

N. B., AND JAS. MCGRATH.—Consult medical men.

M. J. W.—It is merely the name given it.

J. D. H.—They are two distinct journals. Your second query is an advertisement.

C. F. H. H.—Your query is an advertisement. You can obtain hackles at most tackle makers.

G. S. W.—Why not answer "Emigrant," re sundials, through our columns?

J. W. PEARSON.—Don't alarm yourself, but consult a medical man. The symptoms you mention are *not* those of heart disease. You could not expect to obtain a satisfactory reply to such a query.

JOHN LEE.—Write to the publishers, Messrs. Churchill, New Burlington-street.

APPRENDRE.—Where do you find the question? Your solution is correct; the remainder is 22. 12 is probably a typographical error.

AFFLICTED SUBSCRIBER.—See pp. 593, 610, 619, Vol. XIV.

ZETA.—Your communication arrived toe late.

ASTRONOMICAL NOTES FOR SEPTEMBER.—ERRATA.—P. 605, column 2, lines 9 and 12, for ι^1 and ι^2 Aquarii read τ^1 and τ^2 Aquarii.

COMPARING ELECTROMOTIVE FORCES.—"Pi" writes:—"*Humanum est errare.* This truth and an illness from which I have even now scarcely recovered are my only excuses for the errors into which I have fallen in attempting to correct 'O.,' to whom I beg to apologise. His equations are perfectly accurate; a mistake in a sign in my last letter vitiates the whole argument therein proposed."

O.—See note from "Pi" above.

JOSEPH BAKER.—"F.R.A.S." distinctly refuses to give information by post. Please, therefore, ask him any admissible question through our columns.

H. S. A., E. W. H., A Paper Maker, Rip Van, and W. J. Richards.—Your queries are advertisements.

W. H. H. C., Memnon, and Friends.—What you say with regard to the mathematical column will be borne in mind.

H. T. T.—We believe there is no such office.

SUBAQUEOUS RAILWAY FOR CANALS.—Impracticable.

THE INVENTOR.

APPLICATIONS FOR LETTERS PATENT TO THE WEEK ENDING AUGUST 30, 1872.

2472 J. Brodie, Fifeshire, N.B., for improvements in the construction of fastenings for gates and doors, drawers, lids, and desks.

2473 R. Stone, Liverpool, for an improved concrete for surfacing or laying roadways, footways, and other similar large surfaces.

2474 T. Palmer, A. Pickup, and S. Carter, Oldham, for improvements in sewing machines.

2475 O. Ingham, Lidgate, Yorkshire, for improvements in pickers for looms for weaving.

2476 A. Deiss, Plaistow, Essex, for a new or improved process of percolation.

2477 W. Truswell and R. W. Holden, Sheffield, for an improved apparatus for heating air, and for supplying hot air to furnaces, cupolas, smiths' hearths, and other fires, to bakers' and other ovens, to kilns for drying and burning bricks, and for utilising the fire in open fire grates for making hot air and supplying it to rooms in private houses or public buildings.

2478 A. M. Clark, Chancery-lane, for improvements in cotton gins. A communication.

2479 P. Lanranson, Hatton-garden, London, for improvements in methods of manufacture, and combinations therewith, for producing book-binding clasps or mechanical bookbinders. A communication.

2480 J. H. Johnson, Lincoln's Inn-fields, for improvements in supplying hot blast to blast and other furnaces, and in the apparatus or means employed therefor. A communication.

2481 M. Gally, Rochester, New York, for automatically arranging or constructing forms for printing communications or other kinds of printed matter at hand or at a distance.

2482 J. Dodd, Oldham, for improvements in mules for spinning and doubling cotton and other fibrous materials.

2483 B. Hunt, Serle-street, Lincoln's Inn, for an improved physiological or "button" battery. A communication.

2484 W. Ambler, Bradford, for improvements in machinery for the manufacture of paper tubes.

2485 A. C. Bamlett, Thirsk, Yorkshire, for improvements in reaping and mowing machines.

2486 W. Chaine, Portrush, Ireland, for improvements in saddle bags for carrying water.

2487 W. Young, P. Brash, and A. Scott, Midlothian, N.B., for improvements in the destructive distillation of coal, shale, and other bituminous substances for the production of illuminating gas and of oils.

2488 G. Haseltine, Southampton-buildings, for improvements in treadle mechanism. A communication.

2489 H. J. Griswold, Southwark-street, Surrey, for improvements in knitting machinery.

2490 E Rostron, Waterfoot, Manchester, for improvements in machinery employed in the manufacture of felt.

2491 C. F. Sebille, Paris, for improvements in the composition known as "schisto-asphaltic and bituminous-beton," and novel applications thereof, together with improved machinery or apparatus in connection therewith.

2492 G. Haseltine, Southampton-buildings, for improvements in railway carriage springs. A communication.

2493 G. Haseltine, Southampton-buildings, for improvements in electrical apparatus to be worn upon the head for the alleviation and cure of nervous affections. A communication.

2494 T. A. Weston, Ridgewood, U.S., for improvements in friction clutches and the arrangement and mode of operating frictional surfaces for transmitting, regulating, and arresting motion in machinery.

2495 J. Winskill, Settle, Yorkshire, for a new or improved construction of lime kiln.

2496 M. H. Synge, Pall Mall, for improvements in deodorising apparatus.

2497 J. R. Wright and A. Alexander, Sheffield, for improvement in the treatment of iron and manufacture of steel.

2498 W. Brookes, Chancery-lane, for improvements in means for stopping the working of apparatus on the breaking or failure of thread in the roving, spinning, or twisting of wool, cotton, or other fibres. A communication.

2499 J. Thornton, Cleckheaton, Yorkshire, for improvements in utilising borings, turnings, filings, planings, and other particles of iron.

2500 M. Henry, Fleet-street, City, or improvements in the mode of and machinery or apparatus for preparing fibrous materials for being spun. A communication.

2501 J. Edwards, Cassland-crescent, South Hackney, for improvements in signal alarums for railway trains.

2502 C. O'L. L. Prendergast, Wokingham, Berkshire, for an improved means and apparatus whereby passengers in a railway train can communicate a signal to the guard and driver.

2503 J. Morgan, Dublin, for an inhaler for medical purposes.

2504 W. Morris, Deptford, for improvements in making connections with water mains under pressure.

2505 C. Blackmore, Guildford-street, Middlesex, for improvements in ornamenting surfaces.

2506 E. A. Cook, Midlothian, N.B., for improvements in treating animal charcoal.

2507 J. Clay, Yardley, Worcestershire, for improvements in saddles.

2508 P. Varnaison, Paris, for an improved system of apparatus to allow of producing rapidly the vacuum in the night-carts.

2509 T. Henderson, Liverpool, for an improved apparatus for supplying fuel to furnaces, and for removing clinkers from the same.

2510 W. Vincent, for improvements in apparatus for manufacturing gas.

2511 W. Carwood, Queen-street, Finsbury, for improvements in presses for letter-press printing.

2512 W. H. Harfield, Mansion House-buildings, City, for improvements in apparatus for multiplying power, applicable to windlasses, cranes, hoists, and other machines.

2513 R. Warry, Devonport, for improvements in the construction of portable cooking stoves.

2514 H. Alder, Edinburgh, for improvements in the construction of dry meters.

2515 R. Goodall, Armley, Leeds, for an improved means or method of and apparatus for clarifying impure or waste water from fulling mills, scouring mills or scouring processes, dye houses, sewage, and other impure waters.

2516 T. D. McFarlane, Glasgow, for improvements in loading grain into or discharging it from ships and other places, and in apparatus employed therefor.

2517 H. A. Bonneville, Piccadilly, for improvements in machines for cutting textile and other materials. A communication.

2518 W. Lockhead, Glasgow, for improvements in treating and applying asbestos or amianthus.

2519 J. G. Tongue, Southampton-buildings, for the application of platinised glass or "glace platinée" to various articles, such as needle and perfumery boxes or cases, and other useful or fancy articles. A communication.

2520 C. W. Stones, Manchester, and A. Lowcock, Salford, for improvements in the arrangement and construction of movable weirs and sluices.

2521 C. Bartholomew, Doncaster, for improvements in machinery for cutting coal.

2522 P. M. J. Chambiant, Paris, for improvements in sewing machines.

2523 J. Field, Oldbury, Worcestershire, for improvements in field and garden hose and other like implements.

2524 K. Hoskins, Birmingham, for a new mode of constructing and adapting the frames of bedsteads for the reception of tensional or other spring mattresses, as also in the means of applying such tensional or other spring mattresses to iron bedsteads.

2525 J. M. Plessner, Golden-square, Middlesex, for improvements in obtaining and applying motive power and in apparatus to be employed for the same.

2526 R. H. Radcliffe, Cheshire, for an improvement in the arrangement for the screw propeller in steam ships.

2527 C. Frickinger, Berlin, for improvements in the manufacture of malleable iron and in the furnaces employed therein

2528 J. F. Parker and A. Wade, Birmingham, for improvements in the manufacture from coal and petroleum of hydrocarbon gas, or gas for illuminating and heating.

2529 H. A. Dufrene, South-street, Finsbury, for an improved mode of preserving fruit. A communication.

2530 T. S. Harrison, Albemarle-street, Middlesex, for an improved attachment for sewing machines. A communication.

2531 T. S. Harrison, Albemarle street, Middlesex, for an improved attachment for sewing machines.

2532 T. S. Harrison, Albemarle-street, Middlesex, for an improved apparatus for oxidising metals. A communication.

2533 Sir A. Fairbairn, T. S. Kennedy, and J. W. Naylor, Leeds, for a machine to draw out and straighten the fibres of silk, flax, hemp, jute, or other fibrous substances.

2534 A. S. Ellefson, Norway, for improvements in apparatus for generating steam.

2535 E. H. Buch, Finsbury-square, City, for improvements in apparatus for cooking and for making coffee and other infusions.

2536 J. G. Tongue, Southampton-buildings, for improvements in closing and securing packing cases or boxes. A communication.

2537 G. Haseltine, Southampton-buildings, for an improved machine for making screw taps. A communication.

2538 H. Y. D. Scott, Ealing, for improvements in the treatment of sewage, and in the preparation of manures therefrom.

2539 G. F. Newton, Northampton, for an improved machine for burnishing, rolling, and setting leather.

2540 A. Henry, Edinburgh, for improvements in breech-loading fire-arms.

2541 J. S. Stevens, Princes-street, Leicester-square, for improvements in window-sash fasteners.

2542 W. W. Box, Crayford, Kent, for improvements in apparatus used in the manufacture of gas.

2543 J. Stone, Drayton, Somerset, for a new or improved apparatus for warming bed and other rooms, also applicable for warming or heating churches, conservatories, greenhouses, or other buildings or rooms requiring warming or heating.

2544 A. N. Dubosq, Bordeaux, for a new system of landau carriage.

2545 C. Morfit, Southampton-buildings, for improvements in vats or vessels for the various chemical and manufacturing operations which involve the use of acids.

2546 A. M. Clark, Chancery-lane, for improvements in fire-arms. A communication.

2547 H. Highton, M.A., Putney, for improvements in submarine and other cables for the conveyance of electricity.

2548 A. Bryce, Alloa, N.B., for improvements in branding stoves.

2549 W. Millen and J. Muir, Glasgow, for improvements in holding punches and drills in punching and drilling machines, and in the means employed therefor.

2550 C. H Hall, New York, U.S., for an improved steam and water gauge for use with steam boilers and analogous apparatus.

2551 H. Foster, Boxmoor, Hertford, for improvements in apparatus for condensing steam and other vapours, and for refrigerating fluids.

PATENTS SEALED.

1008 C. Stevenson, for improvements in apparatus employed in converting esparto, straw, wood, and other similar substances into pulp.

1162 H. Warry, for improvements in various beverages.

1566 P. Michaelis, for an improved means or apparatus for stoppering bottles.

1567 P. Michaelis, for an internal capsule for bottles.

1646 W. R. Lake, for improvements in railway sleepers or cross ties.

1712 J. Hough, for improvements in apparatus for coupling or connecting and disconnecting railway waggons.

1816 A. McGregor, for improvements in the construction of horse rakes.

1846 W. B. Burrow and J. S. Burrow, for an improved "bin" or receptacle for wine or other bottles.

1868 G. Maxwell, for improvements in the construction of machinery or apparatus used for making bricks and tiles.

1891 J. Thomas, for improvements in furnaces for generating gas and melting metals.

1941 J. K. Cazier, for an improvement in the application of safety valves to steam boilers.

1957 W. R. Lake, for improvements in fastenings for uniting and securing the parts of bedsteads and for other like purposes.

536 W. H. le Mesurier, for an improved mode of roofing buildings.

567 J. Rust, for an improved composition specially applicable for use for sanitary, pictorial, decorative, and building purposes.

673 R. Elsdon, for improvements in the conversion of cast iron into steel or wrought iron, and in the apparatus employed therein.

515 G. A. Williams, for improvements in the manufacture of outside sun blinds.

583 S. Yeadon, sen., for improvements in "healds" or "heddles" for weaving purposes, in the parts connected therewith, and in the means or apparatus employed in the manufacture of the parts of such "healds" or "heddles."

585 B. J. B. Mills, for improvements in the construction of railway rails or bars.

590 E. T. Hughes, for improvements in machines for sewing boots and shoes.

594 A. G. Wallis and W. Bradshaw, for improvements in the manufacture of cocoa fibre mats.

596 H. R. Minns, for improvements in metal doors.

597 T. Pepper, for an improved washing machine.

598 F. Ayrton and S. S. Brown, for improvements in looms for weaving.

613 W. Walker, for an improved packing for stuffing boxes.

614 O. G. Abbott, for improvements in school desks which are applicable to other purposes.

615 J. Reilly, for improved arrangements for communicating between the passengers, guards, and engine-drivers of railway trains.

636 W. Morgan, for improvements in baskets specially applicable to coaling ships and vessels.

684 W. Dalgliesh, for improvements in the manufacture of Scotch bonnets, and in the machinery or apparatus employed therefor.

685 G. D. Abel, for improvements in the manufacture of Bessemer steel and iron, and in the production of iron castings, and in apparatus therefor.

706 W. R. Lake, for an improved type-setting machine.

727 J. F. C. Farquhar, for improvements in lighthouse and other lamps.

776 J. Somerville, for improvements in gas retort lids and mouthpieces, and machinery for luting the same.

793 F. S. Thomas, for improvements in the materials for making roads, ways, and floors.

815 F. Johnson and W. Hatchman, for an improvement in the manufacture of fabrics for umbrellas.

891 T. Giles, for improvements in safety valves.

914 J. H. Johnson, for improvements in ice-cream freezers.

1048 W. Walton and J. T. Fallows, for improvements in and machinery for rolling wire for making wire cards, and for other purposes.

1086 W. H. Maw, for the construction of floating stations or decks for floating fire-engines.

1105 W. Walton, for improvements in the manufacture of wire cards.

1115 R. Stone, for an improved system of casting or moulding applicable to ceilings, internal and external walls, roads, navigable vessels, and other large surface structures.

1205 W. Ferry, for improvements in cistern filters.

1215 J. W. Gray, for a new or improved lithoidal composition to be used as a paint and for other purposes.

1226 J. K. Collett, for improvements in the method of packing and preserving butter, and in apparatus for that purpose.

1460 E. H. C. Monckton, for improvements in the construction and arrangement of furnaces suited for smelting and fusing every description of ores and metals and glass, for heating gas and other retorts, and for other useful purposes, and in the means and appliances necessary thereto.

1506 J. Jeyes, for an improved fuel.

1600 F. J. Cheesbrough, for improvements in machinery and apparatus to be used in the process of manufacturing oil from seeds.

1637 C. Moseley, for a new method and means for condensing the vapours of coal-tar naphtha.

1657 D. Nicoll, for improved preparations applicable to woven and other fabrics for the purpose of rendering the same uninflammable.

1660 C. Raymond, for improvements in sewing machines.

1679 C. W. Harrison and A. H. Harrison, for improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein.

1892 G. A. Dorsett, for improvements in obtaining anthracene from heavy oils.

1895 J. F. Swinburn, for improvements in breech-loading small arms.

1919 C. W. Siemens, for improvements in the means of obtaining and applying magneto-electric currents and apparatus therefor.

1944 J. H. Johnson, for improvements in sifting or bolting machines.

1964 B. Russ, for improvements in the manufacture of gas, and in the treatment of the residues therefrom, in the means of purifying and rectifying the same; and in the combination or amalgamation of gases for the production of light and heat, and for other useful purposes, and in the machinery and apparatus to be employed therein.

1972 W. Walton, for improvements in window-sash fasteners, and in means of ventilation in connection with window sashes.

621 J. Thompson, for improvements in the lids or covers of vegetable dishes and other similar articles.

623 W. Roberts, for an improved machine for painting laths for venetian blinds and other purposes.

637 D. Hanna, for improvements in sewing machines.

638 J. Wilson and G. Landrum, for a new and improved method or means of finishing woollen cloth.

639 E. T. Hughes, for improved arrangements for rapidly and effectively destroying snow and ice in the streets, public places, courtyards, and other localities.

644 J. B. Saunders, for improvements in and connected with electrical instruments for signalling on railways.

645 W. Blackburn, for improvements in the construction of standards or supports for seats and desks or tables for school and other purposes.

656 J. P. R. Poch, for a new chemical compound for blasting purposes.

660 J. Tannett, J. Scott, jun., J. Craven, and S. Fox, for improvements in machinery for boring shaft couplings, and applicable for boring circular or other flanges.

692 B. Fitzpatrick, for improvements in apparatus for clipping horses and other animals.

755 S. Barton, for an improved rose and nozzle or jet to be used in connection with syringes and other apparatus for distributing water.

774 W. J. Lockyer, for improvements in the preparation of artificial manures.

813 S. Neville, for improvements in lears for annealing glass.

828 W. R. Lake, for improvements in printing telegraphs.

841 A. Pye-Smith and C. Ribbans, for improvements in non-conducting compositions for coating steam pipes and boilers, applicable also for preventing the passage of heat or cold to or from pipes, refrigerators, or other vessels.

890 R. M. Letchford and W. B. Nation, for improvements in the treatment of paraffin.

986 C. G. Hill, for improvements in machinery for goffering, fluting, and crimping fabrics.

1069 J. Worrall and J. Kershaw, for an improved apparatus for scouring pile fabrics.

1070 J. Worrall and J. Kershaw, for an improved mode of and apparatus for finishing cotton cords.

1117 G. Stavers, for improvements in apparatus for steering and manœuvring vessels.

1242 C. W. Vick and J. Cooke, for improved machinery for feeding, preparing, and carding engines.

1342 A. Clark, for improvements in corrugated metal revolving shutters.

1396 H. Turner, for improvements in the application of wire to building and other purposes.

1560 T. Cocks, for improved machinery or apparatus for planting potatoes.

1836 T. Lambert and E. J. White, for improvements in self-closing valves or cocks for drawing off water.

1851 V. van Baerle, for improvements in the manufacture of soap or compositions for washing purposes.

1883 J. Campbell, for improvements in the modes of decreasing the rolling of vessels.

1916 W. Macrone and W. McKenzie, for improvements in the production of stereotype plates and in apparatus employed therefor.

2017 W. Gorman, for improvements in manufacturing iron and steel and in apparatus connected therewith, part or parts of such improvements being applicable to various kinds of furnaces, and for the production of gases for heating and illuminating purposes, and for coking, carbonising, or calcining other substances.

2018 G. Westinghouse, jun., for improvements in brake apparatus for railway carriages.

2024 A. M. Clarke, for improvements in pads for stair and othe carpets.

651 L. Barnett, for improvements in reversible and seamless coats.

658 E. Powers, for improvements in the manufacture of iron steel, copper, and other metals.

664 E. M. Adams, for an improved galvanic apparatus to be used for curative purposes.

665 W. H. Carson and J. V. Toone, for an improved feed roller for chaff-cutting machines.

671 R. Blackburn, for improvements in apparatus and in means for treating sewage for agricultural purposes.

672 W. Exall, for improvements in tube expanders.

718 C. W. Lancaster, for improvements in shot, shell, and other similar missiles.

801 F. W. Gerhard and J. Light, jun., for improvements in the production of iron and steel.

1037 A. M. Clark, for improvements in the manufacture of illuminating gas and in apparatus for the same.

1077 J. H. Johnson, for improvements in rotatory steam-engines.

1345 J. H. Johnson, for improvements in carding engines.

1494 R. Porter and F. Porter, for improvements in distilling and in apparatus therefor.

1806 W. C. Sillar, R. G. Sillar, and C. Rawson, for improvements in treating animal matters in order to deoderise and decompose the same and to make a manure therefrom.

1889 W. R. Lake, for improved check tickets and methods of forming packages of the same, chiefly designdd for use on railways and steamboats.

1983 W. Matthews, for an improved movable cover or top for show cases or boxes.

2021 W. McLaren, for improvements in machinery for sewing or cutting wood.

2054 J. H. Johnson, for improvements in cooling air and gases and in the apparatus or means to be employed therein.

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